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THERAPEUTIC POTENTIAL OF *JASMINUM SAMBAC* IN DIABETES: A REVIEW

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Abstract:
Diabetes mellitus (DM) is a complex metabolic disorder characterized by consistently high blood glucose levels due to issues with insulin production or function. This condition disrupts the metabolism of carbohydrates, fats, and proteins and is primarily classified into Type 1 and Type 2 diabetes. Type 1 diabetes is an autoimmune disorder where the immune system destroys insulin-producing pancreatic cells, requiring lifelong insulin treatment and lifestyle changes. Type 2 diabetes involves insulin resistance and inadequate insulin production, often linked to obesity and lack of physical activity. Effective management includes lifestyle modifications, medications, and regular monitoring to avoid serious complications such as cardiovascular issues, nerve damage, and vision problems.
The document also explores the botanical features of jasmine and stevia. Jasmine (*Jasminum Sambac*) is prized for its fragrant flowers used in perfumes and cosmetics and thrives in warm, humid environments. It contains aromatic compounds like linalool and jasmones. Stevia (*Stevia rebaudiana*) is known for its sweet-tasting leaves, used as a natural sweetener due to compounds like stevioside and rebaudioside, which are significantly sweeter than sugar. Stevia is cultivated worldwide and valued for its sweetness without added calories and potential health benefits.

Keywords: Diabetes, Blood Glucose Level, Jasmine, Stevia

Introduction:

Diabetes mellitus (DM), commonly referred to as diabetes, is a complex metabolic disorder marked by hyperglycemia, which is a condition of persistently high blood glucose levels. This elevated glucose occurs due to irregularities in insulin production, insulin action, or both and leads to chronic and varied disruptions in carbohydrate, fat, and protein metabolism. (1) Diabetes typically progresses over time and has a complex pathogenesis with diverse manifestations. The prevalence of both type 1 and type 2 diabetes is on the rise, with 463 million adults affected globally in 2019. (1) Diabetes insipidus is a condition where excessive amounts of dilute urine are produced, caused by either a lack of vasopressin (central diabetes insipidus), resistance to vasopressin (nephrogenic diabetes insipidus), or drinking too much water (primary polydipsia). (2) There are primarily two types of diabetes:
A. Type 1 diabetes
B. Type 2 diabetes

A. Type 1 diabetes

Type 1 diabetes is an autoimmune disorder in which the immune system mistakenly attacks and destroys the insulin-producing beta cells in the pancreas. Before the disease fully manifests, there is often a prolonged phase where the person has islet autoimmunity (IA). This condition leads to insufficient insulin production. Previously, Type 1 diabetes was known as "insulindependent diabetes mellitus" (IDDM) or "juvenile diabetes." (3,4,5)

Type 1 diabetes mellitus (T1DM) makes up about 10% of diabetes cases worldwide but usually starts at a younger age. This form of diabetes is caused by the autoimmune destruction of βcells in the pancreas. In some cases (<10%), referred to as type 1B, there is no indication of autoimmunity, and the cause remains unknown. (6,7)

Rare forms of T1DM with monogenic and oligogenic origins have been documented, and genetic studies in affected families have pinpointed the associated genes. (8) While T1DM often appears in adulthood, there is limited data on this trend. When T1DM develops later in life, the progression of the disease is usually less severe, and β-cell destruction occurs more gradually compared to childhood-onset T1DM, complicating the distinction between T1DM and type 2 diabetes mellitus (T2DM). (9,10)

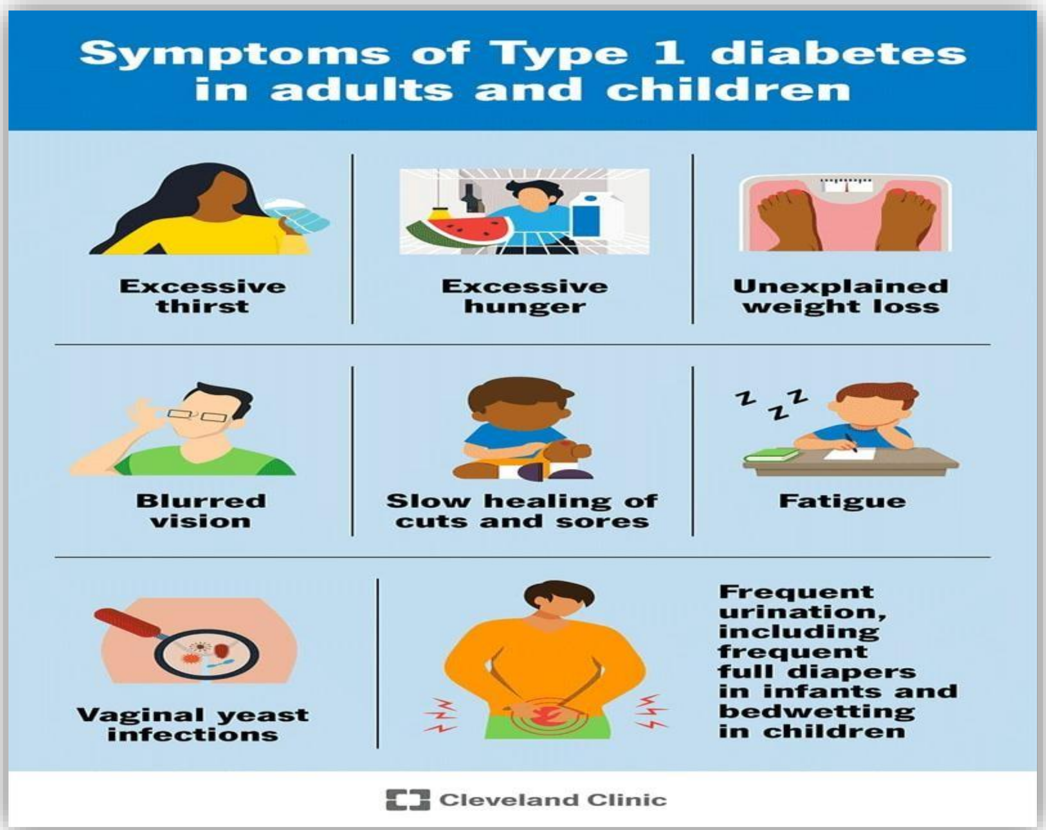

Figure 1 : Symptoms of type 1 Diabetes

B. Type 2 diabetes

Type 2 diabetes mellitus (T2DM) is defined by disruptions in carbohydrate, lipid, and protein metabolism, resulting from either diminished insulin secretion, insulin resistance, or both. (11) Among the three main types of diabetes, T2DM is the most prevalent, accounting for over 90% of all cases, compared to type 1 diabetes mellitus (T1DM) and gestational diabetes. (12,13)

In recent decades, our comprehension of the development and progression of T2DM has advanced significantly. The primary cause is a gradual decline in insulin secretion by pancreatic β-cells, typically occurring against a backdrop of pre-existing insulin resistance in skeletal muscle, liver, and adipose tissue. (12,15)

The World Health Organization (WHO) defines diabetes mellitus as a chronic metabolic disorder marked by high blood glucose levels, which gradually causes damage to the heart, blood vessels, eyes, kidneys, and nerves. [16] More than 90% of diabetes mellitus cases are type 2 diabetes mellitus (T2DM), a condition characterized by insufficient insulin secretion from pancreatic islet β-cells, insulin resistance in tissues, and an inadequate compensatory response in insulin secretion. [17,20]

Figure 2 : Symptoms of type 2 Diabetes

Pathophysiology of diabetes

Diabetes mellitus encompasses a range of chronic metabolic disorders, all defined by elevated blood glucose levels resulting from either an inability to produce insulin, insulin resistance, or both. These disorders are categorized into two separate types according to their clinical characteristics.: [21,22]

1. Type 1 diabetes results from an autoimmune attack on the pancreas's beta cells, leading to a total absence of insulin production. [22] The incidence of type 1 diabetes varies greatly worldwide, shaped by genetic factors and environmental influences. Recent research indicates that individuals with type 1 diabetes mellitus (T1DM) who have lower socioeconomic status experience higher rates of morbidity and mortality. [23,24]
2. Type 2 diabetes develops when the body becomes highly resistant to insulin's effects and is unable to produce sufficient insulin to overcome this resistance. [22] It is widely recognized that obesity significantly contributes to insulin resistance and the development of type 2 diabetes mellitus (T2DM). [25]

Mechanism: (26,27)

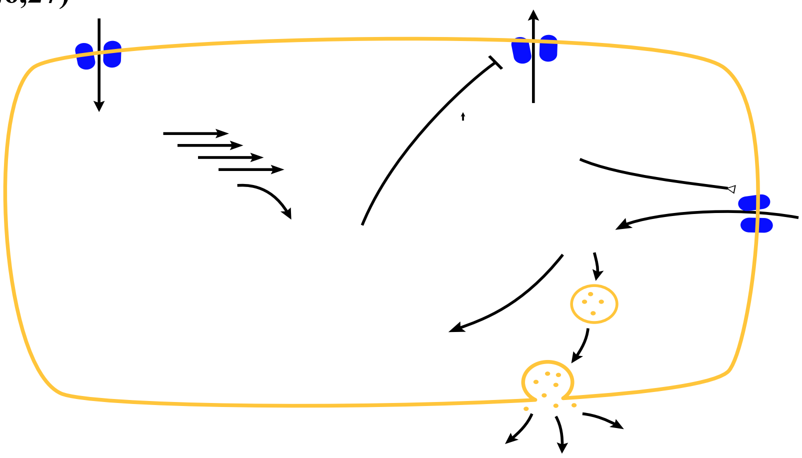

Figure 3: Mechanism of insulin release in normal pancreatic beta cells. Insulin production is constant within the beta cells. Its release is triggered by food, chiefly food containing absorbable glucose.

Insulin is released into the blood by beta cells (β-cells), found in the islets of Langerhans in the pancreas, in response to rising levels of blood glucose, typically after eating.
Lower glucose levels result in decreased insulin release from the beta cells and in the breakdown of glycogen to glucose. This process is mainly controlled by the hormone glucagon, which acts in the opposite manner to insulin.
If the amount of insulin available is insufficient, or if cells respond poorly to the effects of insulin (insulin resistance), or if the insulin itself is defective, then glucose is not absorbed properly by the body cells that require it, and is not stored appropriately in the liver and muscles. The net effect is persistently high levels of blood glucose, poor protein synthesis, and other metabolic derangements, such as metabolic acidosis in cases of complete insulin deficiency.
When there is too much glucose in the blood for a long time, the kidneys cannot absorb it all (reach a threshold of reabsorption) and the extra glucose gets passed out of the body through urine (glycosuria).

Complications:

Long-term complications of diabetes develop gradually. The longer you have diabetes and the less controlled your blood sugar the higher the risk of complications. Eventually, diabetes complications may be disabling or even life-threatening. Possible complications include:
Cardiovascular disease: Diabetes dramatically increases the risk of various cardiovascular problems, including coronary artery disease with chest pain (angina), heart attack, stroke and narrowing of arteries (atherosclerosis). If you have diabetes, you're more likely to have heart disease or stroke.
Nerve damage (neuropathy): Chronic HG may lead to either sensory or motor neuropathic problems or autonomic nervous system dysfunction, including arrhythmias, gastroparesis, incontinence, and sexual dysfunction. [(28)]
Kidney damage (nephropathy): Diabetic nephropathy is a condition that individuals may be genetically predisposed to, but it can also be triggered by specific environmental factors. About one-third of patients with poorly controlled diabetes will develop diabetic nephropathy, which can progress to the need for renal dialysis. This outcome may result from genetic factors, interactions between cytokines and reactive oxygen species, or advanced glycation end products. [(30)]
Eye damage (retinopathy): Diabetes can damage the blood vessels in the retina, causing diabetic retinopathy, which can ultimately lead to blindness. Furthermore, diabetes increases the likelihood of developing other serious eye conditions, such as cataracts and glaucoma. Untreated diabetes can result

in vision loss, with the risk of blindness linked to the duration and severity of retinopathy. In many cases, retinopathy has been present for years before it is detected, and the risk of vision loss grows over time. [31]

Foot damage: Nerve damage or poor blood flow to the feet raises the risk of foot complications. Diabetic foot issues are linked to a higher rate of foot injuries due to reduced proprioception. Underlying ischemia hampers wound healing, and subsequent infections can cause ulceration. [32]
Skin conditions: Diabetes can make you more prone to skin conditions, including bacterial and fungal infections. High blood glucose levels contribute to chronic skin infections, which increase the frequency of these infections and cause symptoms like itching and other skin issues. (33,34)

Causes: (27)

Feature	Type 1 diabetes	Type 2 diabetes
Onset	Sudden	Gradual
Age at onset	Any age; average age at diagnosis being 24.	Mostly in adults
Body size	Thin or normal	Often obese
Ketoacidosis	Common	Rare
Autoantibodies	Usually, present	Absent
Endogenous insulin	Low or absent	Normal, decreased or increased
Heritability	0.69 to 0.88	0.47 to 0.77
Prevalence (age standardized)	<2 per 1,000	~6% (men), ~5% (women)

Table: 1 Comparison of type 1 and 2 Diabetes

Type 1 diabetes has a genetic component, with multiple genes, including specific HLA types, affecting the likelihood of developing the condition. In individuals who are genetically predisposed, environmental factors like viral infections or diet may trigger the onset of diabetes. Although various viruses have been suggested as potential triggers, there is currently no definitive evidence to confirm this connection in humans.

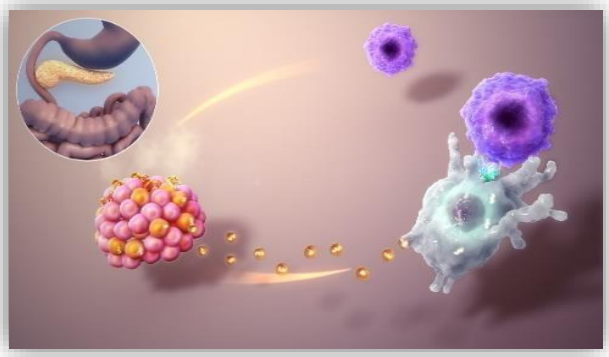

Figure 4: Autoimmune attack in type 1 diabetes.

Autoimmune disease: Type 1 diabetes and Latent Autoimmune Diabetes in Adults (LADA) occur when the immune system targets and destroys the insulin-producing cells in the pancreas.
Type 1 diabetes can be diagnosed at any age, with a notable number of cases identified in adults. When Type 1 diabetes presents in adults, it is specifically referred to as LADA and tends to progress more gradually compared to its onset in children.

Type 2 diabetes is marked by insulin resistance, which may also involve a decrease in insulin production. It is the most prevalent form of diabetes mellitus, making up 95% of all cases.
Many individuals with type 2 diabetes show signs of prediabetes, such as impaired fasting glucose or impaired glucose tolerance, before they fully develop the condition. Making lifestyle changes or using medication to enhance insulin sensitivity or decrease glucose production by the liver can help slow or even reverse the progression from prediabetes to full-blown type 2 diabetes.

Insulin resistance: Insulin resistance is the primary cause of Type 2 diabetes. It occurs when the cells in your muscles, fat, and liver fail to respond effectively to insulin. Various factors contribute to different levels of insulin resistance, including obesity, physical inactivity, diet, hormonal imbalances, genetic predispositions, and certain medications.

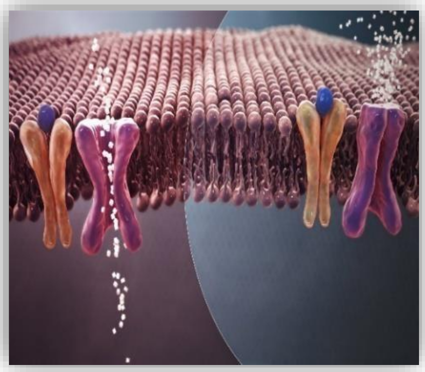

Figure 5: Reduced insulin secretion or weaker effect of insulin on its receptor leads to high glucose content in the blood.

Dietary factors like consumption of sugar-sweetened beverages are linked to a higher risk of developing Type 2 diabetes. The types of fats consumed also play a role, with saturated and trans fats raising the risk, while polyunsaturated and monounsaturated fats help lower it.

Literature Review

1. Jasmine

Figure 6 : *Jasminum sambac*

Taxonomy (35)
Jasmines belong to the genus *Jasminum*, which is part of the Oleaceae family.

Kingdom: Plantae
Clade: Angiosperms (flowering plants)
Clade: Eudicots (a major group of dicotyledonous plants)
Family: Oleaceae (olive family) **Genus:** Jasminum L.

Biological source
Jasminum Sambac, commonly known as Arabian jasmine, belongs to the Oleaceae family. It is called sampaguita in the Philippines, where it is the national flower; Gunda mallige in India; moli in China; pikake in Hawaii; and Arabian jasmine in the mainland USA. This plant is commercially cultivated in India, Thailand, China, and the Philippines. It is an evergreen vine or shrub that can grow up to 1-3 meters tall. The leaves are ovate, and they are arranged oppositely or in whorls of three. The flowers bloom year-round in clusters of 3-12 and are highly fragrant, opening at night and closing in the morning. This plant is commercially cultivated in Thailand, the Philippines, and India. (36,37)
Jasmine plants thrive in hot and humid conditions during the day but need cooler temperatures at night. They are well-suited for indoor environments, where they can avoid frost damage. When grown in full sunlight, they develop into bushy shrubs, whereas in shaded areas, they tend to grow as vines with larger and darker leaves. (37,38)

Geographical Source
Jasmine is celebrated as the "queen of flowers" and often referred to as the "Belle of India" or the "Queen of Fragrance" due to its delightful and refreshing scent. In various regions of India, it goes by different names, including Mogra, Motia, Chameli, Malli puvvu, Jaati, Mulla, Mallige, Juhi, and Moonlight in the Grove. The plant is also noted for its journey from Asia to Europe, initially arriving along the Mediterranean, spreading through Greece and Turkey, moving into Western Europe via Spain, France, and Italy, and finally reaching England in the late 17th century.
Over 200 species of jasmine are currently grown in subtropical regions around the world, primarily for their fragrant blooms used in the perfume industry. The leading producers of jasmine absolute or concrete are Egypt and India, while Morocco, Algeria, France, and Italy also contribute to production. Egypt alone is responsible for about 70–80% of the global jasmine absolute supply. Additionally, jasmine is commonly used as an ornamental plant in
gardens. (38,39)

Morphology
Leaves**:** Jasmine plants usually have glossy, dark green leaves that are either pinnate or trifoliate, meaning they are divided into several leaflets arranged along a central stem. The leaflets are typically oval or lance-shaped.
Flowers: Jasmine flowers are perhaps the plant's most defining feature. They are small, typically white, or yellow, and frequently fragrant. These flowers are usually star-shaped, with five or more petals, and can appear in clusters or individually, depending on the species.
Stems: Jasmine plants can grow as either shrubs or vines. Some species are climbers with long, flexible stems that can wrap around supports, while others are more compact, with an upright growth habit.
Fruit: Following flowering, some jasmine species produce small, berry-like fruits. However, these fruits are generally not the plant's main ornamental feature.
Root: Jasmine plants have fibrous root systems that spread out rather than developing deep taproots. This type of root structure allows them to efficiently absorb nutrients from the soil.

Chemical Constituents
Jasmine, especially *Jasminum Sambac* and *Jasminum grandiflorum*, is celebrated for its aromatic flowers, which contain a range of chemical compounds that contribute to its distinctive fragrance. Notable constituents include:
- Linalool: A terpene alcohol with a floral and mildly spicy scent, enhancing the sweet and soothing qualities of jasmine's aroma.

• Jasmones: A category of compounds derived from jasmonic acid, including various esters and lactones, which are essential to the unique fragrance of jasmine.
• Benzyl Acetate: This compound imparts a sweet, fruity scent and is frequently found in floral fragrances.
• Geraniol: A monoterpenoid alcohol with a rose-like fragrance that complements the floral notes of jasmine.
• Quercetin: has been examined for its potential to reduce blood sugar levels and boost insulin sensitivity. Additionally, it may aid in decreasing oxidative stress and inflammation associated with diabetes-related complications.
• Kaempferol: Kaempferol, like quercetin, might assist in controlling blood sugar levels and improving insulin sensitivity. Some research also links it to a lower risk of developing type 2 diabetes.
• Indole: A compound that adds a rich, woody, and floral depth to jasmine's scent, providing complexity.
• Eugenol: Though present in smaller amounts, this compound introduces a spicy, clovelike note to the fragrance.
• α-Farnesene: A sesquiterpene with a sweet, green, and subtly fruity scent, contributing to the overall aroma in minor quantities.

Uses

1. Perfumery and Fragrance

• **Essential Oils**: Jasmine flowers are a primary source of jasmine essential oil, used in high-end perfumes and colognes for their rich, floral scent.
• **Scented Products**: Jasmine is used in candles, room sprays, and potpourri to provide a pleasant and relaxing aroma.

2. Cosmetics and Personal Care

• **Skin Care**: Jasmine extracts and essential oils are incorporated into lotions, creams, and serums for their hydrating and soothing properties. They are also known for their fragrant and luxurious qualities.
• **Hair Care**: Jasmine is featured in shampoos and conditioners for its aromatic benefits and its potential to improve scalp and hair health.

3. Culinary Uses

• **Jasmine Tea**: The flowers are used to flavor green tea, resulting in jasmine tea, which is prized for its delicate aroma and flavor. It is also believed to have antioxidant properties.
• **Flavouring**: The flowers can flavor syrups, liqueurs, and desserts, imparting a floral essence to various dishes.

4. Traditional Medicine

• **Herbal Remedies**: In traditional medicine, jasmine flowers are used for their potential anti-inflammatory, pain-relieving, and calming effects. They may help address digestive issues, respiratory problems, and stress.
• **Infusions**: Jasmine tea and infusions are consumed for their relaxing effects and to promote a sense of calm.

5. Ornamental Uses

• **Gardening**: Jasmine flowers are popular in gardens and landscapes for their beauty and fragrance. They are often used as ground cover, climbing plants, or in decorative garden designs.
• **Flower Arrangements**: Jasmine flowers are used in bouquets and floral arrangements, adding elegance and a pleasant scent.

6. Cultural and Ritualistic Uses

• **Religious Ceremonies**: In many cultures, jasmine flowers are used in spiritual and religious ceremonies, symbolizing purity, love, and devotion.

• **Festivals and Celebrations**: Jasmine flowers are incorporated into traditional festivals and celebrations, especially in regions where they hold cultural significance.

2.Stevia

Figure 7 : Stevia

Taxonomy [40]
Stevia rebaudiana is particularly noted for its sweet-tasting leaves, which contain steviol glycosides used as a natural sweetener.
Kingdom: Plantae
Clade: Angiosperms -> Eudicots -> Asterids
Order: Asterales
Family: Asteraceae
Genus: Stevia
Species: Stevia rebaudiana
Biological source
Stevia rebaudiana, part of the Stevia genus in the Asteraceae family, is commonly known as candyleaf, sweetleaf, or sugarleaf. Its leaves are extensively used to produce sweeteners known as stevia, which are marketed under various brands. The intense sweetness of stevia comes from compounds called steviol glycosides, particularly stevioside and rebaudioside, which are 200 to 300 times sweeter than conventional sugar. [40]

Geographical Source
Stevia is widely grown around the world, particularly in Paraguay and Brazil, thanks to their favorable climate. Countries such as Thailand, China, Indonesia, Malaysia, and Brazil cultivate stevia commercially for sugar production, with products available under various brand names like Rebiana, Previa, and Truvia. [41]
Various Stevia species have different sweetening compounds, with S. rebaudiana being the sweetest. This semi-humid subtropical plant can be grown effortlessly, like other vegetable crops, even in a kitchen garden. Recently, Stevia has been successfully cultivated in several Indian states, including Rajasthan, Maharashtra, Kerala, and Orissa. The rising demand for natural sweeteners has led Indian farmers to expand Stevia cultivation on a larger scale. [42] **Morphology** (43)
Size and Growth: Stevia is a small, perennial herbaceous plant typically growing between 6580 cm (25-31 inches) tall.
Leaves: The leaves are simple, opposite, and sessile (without a petiole). They are usually elliptical to ovate in shape, with a smooth margin. The leaves are dark green and can be up to 5-10 cm (2-4 inches) long. paraphrase it.
Stem: Stevia features a branching, herbaceous stem that gradually turns semi-woody as it matures. The stem is generally green and may have a subtle hairy texture.

Flowers: The plant bears small, discreet flowers that are either white or pale pink, arranged in clusters or panicles at the stem tips.
Roots: Stevia has a fibrous root system and lacks a deep taproot.
Overall Appearance: The plant has a bushy form with dense foliage and is primarily cultivated for its sweet-tasting leaves.

Chemical Constituents
The active compounds in stevia are steviol glycosides (mainly stevioside and rebaudioside).

- Stevioside: A glycoside that delivers a strong sweetness and constitutes a significant part of Stevia's sweet compounds, with a sweetness level approximately 50-300 times that of sucrose.
- Rebaudioside A: A major sweetener in Stevia, notable for its reduced bitterness and greater stability, offering about 50-450 times the sweetness of sucrose.
- Rebaudioside C: Found in smaller quantities, it enhances the overall sweetness and helps to balance the flavor.
- Dulcoside A: Though found in trace amounts, it adds a subtle sweetness.
- Steviol: The aglycone form of Stevia's sweet compounds, produced during the metabolic breakdown of stevioside and rebaudiosides in the body.
- Steviol Glycosides: Includes other minor glycosides like Rebaudioside B, D, and E, which also contribute to the sweetness but in lesser amounts.

These compounds are responsible for Stevia's intense sweetness and low-calorie content. [44,45] **Uses**
Sweetener: Stevia is employed to sweeten numerous products such as soft drinks, juices, teas, and flavoured waters. It is also utilized in baked goods, candies, and sauces.
Dietary Products: Its low-calorie count makes Stevia a popular choice for sugar-free or reduced-calorie items, including desserts, yogurts, and snack bars.
Medicinal Uses: Stevia extracts are incorporated into certain over-the-counter medications and dietary supplements. They are frequently found in products designed to help manage diabetes and high blood pressure, owing to their potential impact on blood glucose and blood pressure levels.
Natural Sweetener: Stevia is included in weight management products and dietary supplements as it offers sweetness without the extra calories found in sugar.
Herbal Remedies: Traditionally, Stevia has been used to address digestive problems and is noted for its possible anti-inflammatory and antioxidant properties.
Skincare Products: Some skincare items feature Stevia extracts for their potential moisturizing and calming effects.
Fertilizer: Stevia leaves are occasionally used as natural compost or mulch because of their rich nutrient profile. [41,45]

Conclusion
In conclusion, the review underscores the potential of *Jasminum sambac* as a therapeutic option for diabetes management. Research indicates that this plant contains bioactive compounds with antioxidant, anti-inflammatory, and glucose-lowering effects, which could improve glycemic control and metabolic health. Its ability to influence key metabolic pathways and enhance insulin sensitivity highlights its value as a supplementary treatment for diabetes. Nevertheless, additional clinical studies are needed to confirm these benefits, determine effective dosages, and assess safety. Overall, Natural remedies such as *Jasminum Sambac* and *Stevia rebaudiana* show promising benefits; jasmine is used in perfumes, cosmetics, and traditional medicine, while stevia is a natural, low-calorie sweetener that may help regulate blood glucose and blood pressure. Both plants demonstrate the varied ways natural products can contribute to health and wellness, whether through direct medicinal uses or as dietary alternatives, and ongoing research into these and other natural remedies could further improve their effectiveness in managing diabetes and overall metabolic health.

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