



**Review Article**

**KRISHNA'S DIABIC CARE: AN EVIDENCE-BASED REVIEW OF INGREDIENTS FOR DIABETES CONTROL**

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**ABSTRACT**

Krishna's Diabic Care is an Ayurvedic formulation aimed at managing diabetes by combining traditional herbal remedies with holistic approaches. This review explores the potential benefits, safety profile, challenges, and future directions of this product in the context of diabetes management. Krishna's Diabic Care utilizes a blend of herbs traditionally used in Ayurvedic medicine, such as *Trigonella foenum-graecum*, *Syzygium cumini*, *Momordica charantia*, *Gymnema sylvestre*, *Azadirachta indica*, *Aegle marmelos*, *Ocimum sanctum*, *Pterocarpus marsupium*, *Phyllanthus emblica*, *Tinospora cordifolia*, and *Picrorhiza kurroa*, known for their roles in supporting blood sugar regulation, improving insulin sensitivity, and reducing complications related to diabetes. However, scientific validation through clinical trials is needed to confirm the long-term efficacy and safety of Krishna's Diabic Care. While the product demonstrates promise, its integration into mainstream diabetes management is hindered by the lack of robust clinical evidence, potential variations in formulation quality, and regulatory challenges. Collaborations between Ayurvedic practitioners and modern researchers could further bridge traditional knowledge with contemporary medical practices, facilitating broader acceptance of Ayurveda in managing chronic conditions like diabetes. The review concludes that Krishna's Diabic Care holds potential as part of a holistic diabetes management strategy, with the need for rigorous clinical validation to enhance its credibility and integration into global healthcare systems.

**INTRODUCTION**

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Globally, the prevalence of diabetes has reached alarming levels, with the International Diabetes Federation (IDF) estimating 537 million adults living with diabetes in 2021- a figure projected to rise to 783 million by 2045.<sup>[1]</sup> Despite advancements in conventional treatments, including insulin therapy and oral hypoglycemic agents, challenges such as drug side effects, high costs, and limited efficacy in achieving long-term glycemic control persist.<sup>[2]</sup> These limitations have prompted growing interest in complementary

and alternative medicine, particularly Ayurveda, for managing diabetes.

Ayurveda, the traditional system of medicine originating from India, identifies diabetes as "*Madhumeha*," a subset of *Prameha* (a group of urinary disorders). The Ayurvedic approach to managing *Madhumeha* focuses on restoring the balance of the *Doshas* (*Vata*, *Pitta*, *Kapha*) and includes dietary modifications, lifestyle changes, and the use of herbal formulations. Herbal remedies derived from plants such as *Trigonella foenum-graecum* (*Methi*), *Syzygium cumini* (*Jamun*), *Momordica charantia* (*Karela*), *Gymnema sylvestre* (*Gurmar*), and *Azadirachta indica* (*Neem*) have been extensively studied for their anti-diabetic properties, demonstrating potential in improving insulin sensitivity, reducing blood glucose levels, and combating oxidative stress.<sup>[3,4]</sup>

One such Ayurvedic formulation gaining popularity in India is Krishna's Diabic Care, a commercially available herbal product specifically designed for diabetes management. Krishna's Diabic Care combines multiple Ayurvedic ingredients

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traditionally used for their anti-diabetic effects, including *T. foenum-graecum*, *S. cumini*, *M. charantia*, *G. sylvestre*, *A. indica*, *Aegle marmelos* (Bael), *Ocimum sanctum* (Tulsi), *Pterocarpus marsupium* (Bijasar), *Phyllanthus emblica* (Amla), *Tinospora cordifolia* (Guduchi), and *Picrorhiza kurroa* (Kutki). This formulation aims to provide a holistic approach to diabetes management by addressing both glycemic control and associated complications.

This review article explores the scientific evidence in supporting the key ingredients of Krishna's Diabetic Care and their role in managing diabetes, providing insights into the potential of Ayurvedic formulations as complementary treatments for this global health challenge.

### Krishna's Diabetic Care Formulation

Krishna's Diabetic Care is a polyherbal Ayurvedic formulation designed to support the management of diabetes mellitus by leveraging the synergistic effects of traditional herbal ingredients. This formulation combines herbs with well-documented anti-diabetic properties, including *T. foenum-graecum*, *S. cumini*, *M. charantia*, *G. sylvestre*, *A. indica*, *A. marmelos*, *O. sanctum*, *P. marsupium*, *P. emblica*, *T. cordifolia*, and *P. kurroa*. These ingredients work synergistically to regulate blood glucose levels, improve insulin sensitivity, enhance pancreatic function, reduce oxidative stress, and mitigate diabetes-related complications such as neuropathy and nephropathy. Rooted in the Ayurvedic principle of *Samhita* (synergy), this formulation aims to balance the *Doshas*, particularly *Kapha* and *Vata*, which are implicated in *Madhumeha* (diabetes). Krishna's Diabetic Care represents a holistic approach of Ayurveda in managing metabolic disorders, offering a complementary alternative to conventional therapies by addressing the root causes and associated complications.

### Bioactive Phytochemicals and Pharmacological Actions

#### *Ocimum sanctum* (Tulsi; Family: Lamiaceae)

*O. sanctum* contains several bioactive compounds, with eugenol and ursolic acid being the most prominent. Eugenol, a phenolic compound, is known for its antioxidant, anti-inflammatory, and antimicrobial properties. It plays a critical role in combating oxidative stress, which is a major contributor to metabolic disorders like diabetes.<sup>[5]</sup> Ursolic acid, a pentacyclic triterpenoid, is another significant compound with diverse biological activities, including anti-inflammatory and anti-diabetic effects. Ursolic acid modulates pathways involved in glucose and lipid metabolism, making it highly effective in managing hyperglycemia and improving metabolic health.<sup>[6]</sup> These compounds collectively form the

biochemical basis for the therapeutic potential of Tulsi in diabetes management.

#### Bioactive Phytochemicals

*O. sanctum* contains several bioactive compounds, including eugenol, ursolic acid, and various flavonoids, which contribute to its therapeutic effects. Eugenol, a phenolic compound, exhibits potent antioxidant properties, scavenging free radicals and reducing lipid peroxidation while also enhancing endogenous antioxidant enzyme activity, such as superoxide dismutase and catalase.<sup>[7]</sup> Ursolic acid, a pentacyclic triterpenoid, also possesses significant antioxidant and anti-inflammatory properties. The flavonoids present in *O. sanctum* further contribute to its antioxidant and anti-inflammatory effects, supporting its role in protecting pancreatic beta cells from oxidative damage and reducing chronic inflammation.<sup>[8]</sup> These compounds together provide Tulsi with its valuable therapeutic potential, especially in the management of chronic diseases like diabetes.

#### Mechanism of Actions

*O. sanctum* exerts its anti-diabetic effects through multiple mechanisms, including enhancing insulin sensitivity and improving glycemic control. Ursolic acid plays a critical role in insulin receptor signalling by promoting the phosphorylation of insulin receptors and activating key downstream pathways such as PI3K/Akt, which are essential for glucose uptake.<sup>[9]</sup> Eugenol, another key compound in Tulsi, facilitates increased intracellular calcium ion (Ca<sup>2+</sup>) levels via activation of the TRPV1 receptor. This, in turn, activates CaMKK $\beta$ , leading to enhanced phosphorylation of AMPK, which improves glucose uptake in muscle cells and enhances overall energy metabolism.<sup>[10]</sup> Furthermore, *O. sanctum* regulates enzymes like glucokinase and glucose-6-phosphatase, which are involved in glucose metabolism, and reduces postprandial blood sugar levels.<sup>[11]</sup> The combined actions of these mechanisms help regulate blood glucose levels and reduce insulin resistance, making *Tulsi* a valuable herb for managing diabetes and improving metabolic health.

#### *Gymnema sylvestre* (Gurmar; Family: Apocynaceae)

*G. sylvestre* has been used for centuries in Ayurvedic medicine, primarily for its ability to manage diabetes and regulate blood sugar levels. It is traditionally referred to as the "sugar destroyer" due to its unique property of suppressing the sweet taste when chewed. Apart from its anti-diabetic use, it has been employed to treat a variety of conditions, including obesity, urinary tract disorders, and digestive issues. The leaves of *G. sylvestre* have been used to support liver health, promote weight management, and improve appetite control. Additionally, it has been valued in folk medicine for its potential to alleviate respiratory conditions such as

asthma and cough, as well as to reduce inflammation and treat snake bites. These traditional applications highlight its versatility and therapeutic significance in holistic healing systems.<sup>[12]</sup>

### Bioactive Phytochemicals

*G. sylvestre* contains gymnemic acids as its primary bioactive compounds, which are responsible for its anti-diabetic effects. These compounds are structurally similar to glucose, enabling them to competitively bind to glucose receptors in the intestines, thereby reducing the absorption of dietary sugars. This action directly lowers postprandial blood glucose levels, making *G. sylvestre* an effective natural remedy for controlling blood sugar levels.<sup>[13]</sup> In addition to their effects on sugar absorption, gymnemic acids also inhibit enzymes such as alpha-glucosidase and amylase, which are involved in carbohydrate metabolism. By inhibiting these enzymes, gymnemic acids further minimize the release of glucose into the bloodstream, supporting better overall glycemic control.<sup>[14]</sup> These active compounds provide a multifaceted approach to diabetes management.

### Mechanism of Actions

The anti-diabetic potential of *G. sylvestre* is primarily driven by its gymnemic acids, which exert several beneficial effects on glucose metabolism. One of the key mechanisms is the inhibition of sugar absorption in the gut. Gymnemic acids bind to sugar receptors in the intestines, preventing the absorption of glucose and thereby reducing blood sugar spikes after meals.<sup>[15]</sup> Additionally, gymnemic acids have insulinotropic effects, stimulating insulin secretion from pancreatic beta cells and promoting insulin production, which helps in regulating blood sugar levels.<sup>[16]</sup> *G. sylvestre* also supports pancreatic health by encouraging the regeneration of pancreatic beta cells, enhancing insulin secretion over time.<sup>[12]</sup> Furthermore, gymnemic acids improve glucose utilization in peripheral tissues and suppress hepatic gluconeogenesis, further promoting better glycemic control. These combined actions make *G. sylvestre* a potent herbal agent for managing diabetes and its complications.<sup>[17]</sup>

### *Aegle marmelos* (Bael, Family: Rutaceae)

*A. marmelos*, commonly known as *Bael* holds a significant place in traditional medicine and Ayurveda. The leaves are traditionally used to address jaundice and asthma, as well as conjunctivitis, constipation, and leucorrhoea, while powdered leaves are effective for managing irritable bowel syndrome.<sup>[18]</sup> The unripe fruit is valued for treating abscesses, while the fruit pulp is used to alleviate urinogenital and intestinal disorders, as well as indigestion.<sup>[19]</sup> Additionally, the roots and bark are known to help with intermittent fever, heart palpitations, and melancholia. The roots

are particularly significant in Ayurveda as a key ingredient in "*Dashmula*," a traditional formulation that supports proper nervous system function.<sup>[20]</sup>

### Bioactive Phytochemicals

The bioactive constituents of *A. marmelos* are responsible for its diverse medicinal properties, including its anti-diabetic activity. The fruit pulp is rich in a variety of bioactive compounds, such as carotenoids, phenolics, alkaloids, pectins, tannins, coumarins, flavonoids, and terpenoids, which have been widely studied for their pharmacological effects.<sup>[21]</sup> Alkaloids, including marmesin, marmelosin, and aegeline, are abundant in the leaves and roots, exhibiting notable pharmacological activities.<sup>[22]</sup> Tannins, found in high levels in the fruit, are known for their antioxidant and anti-inflammatory properties. Flavonoids, present in the leaves and roots, are reported to have antioxidant, anti-inflammatory, antipyretic, and antinociceptive effects.<sup>[23]</sup> Additionally, glycosides present in the fruit and leaves contribute to its anti-inflammatory effects.<sup>[24]</sup>

### Mechanism of Actions

*A. marmelos* demonstrates its anti-diabetic activity through multiple mechanisms, effectively addressing the primary issue of insulin deficiency and high blood glucose levels. Studies have shown that oral administration of its aqueous fruit extract significantly reduces blood glucose levels, lowers glycosylated hemoglobin, and increases plasma insulin levels.<sup>[24]</sup> Key phytochemicals like umbelliferone and  $\beta$ -D-glucopyranosides have been found to lower serum glucose, glycated hemoglobin, and glucose-6-phosphate while enhancing hexokinase activity and insulin levels. Clinical trials in diabetic patients revealed reductions in both blood glucose and cholesterol levels after 15 days of treatment with leaf extracts.<sup>[25]</sup> These mechanisms, combined with the antioxidant and anti-inflammatory properties of its bioactive compounds, make *A. marmelos* a promising natural agent for diabetes management.

### *Azadirachta indica* (Neem; Family: Meliaceae)

*A. indica*, commonly known as neem, has been a cornerstone of Ayurvedic medicine for centuries, celebrated for its broad spectrum of therapeutic properties. Traditionally, neem leaves, bark, seeds, and flowers have been used to manage conditions such as skin diseases, infections, and inflammation. In Ayurvedic texts, neem is classified as a potent "bitter" herb with detoxifying properties, used to purify the blood and support healthy liver function. For diabetes management, neem has been employed to regulate blood sugar levels, alleviate symptoms of excessive thirst, and promote wound healing, particularly for diabetic ulcers. Its use in managing digestive disorders and infections further underscores its holistic benefits in traditional medicine.<sup>[26]</sup>

### Bioactive Phytochemicals

*A. indica* contains a variety of bioactive phytochemicals, including nimbin, nimbidin, azadirachtin, quercetin, flavonoids, tannins, and alkaloids, which collectively contribute to its antidiabetic and antioxidant potential. The leaves, stem, bark, and seed oil of *A. indica* are known for their ability to regulate blood sugar levels, improve endothelial function, reduce systemic inflammation, promote the translocation of glucose transporter 4 (GLUT-4), and inhibit the activity of  $\alpha$ -glucosidase. These anti-diabetic properties are attributed to bioactive compounds such as nimbidin, nimbin, nimbidol, quercetin, and nimbosterone, which work synergistically to support glycemic control.<sup>[27]</sup>

### Mechanism of Action

*A. indica* plays a significant role in blood glucose regulation through mechanisms that enhance insulin sensitivity and reduce glucose absorption. Its leaf extract contains bioactive compounds like alkaloids, which promote the regeneration of pancreatic islets and restore insulin secretion.<sup>[28]</sup> *A. indica* also has antioxidant properties due to compounds such as azadirachtin, nimbolin, nimbin, nimbidin, nimbidol, salannin, and quercetin, which neutralize free radicals and reduce oxidative stress, a key factor in diabetes development (Alzohairy et al., 2016). These antioxidants protect pancreatic beta cells, preserving their function and supporting<sup>[29]</sup> insulin secretion (Saini et al., 2020; Biswas et al., 2024). Furthermore, saponins and tannins of *A. indica* contribute to its hypoglycemic effects, complementing its role in glycemic control.

The active compounds in *A. indica*, such as azadirachtin, nimbolin, nimbin, nimbidin, nimbidol, salannin, and quercetin, offer potent antioxidant properties that reduce oxidative stress and protect pancreatic beta cells from damage.<sup>[29]</sup> Additionally, *A. indica* contains saponins and tannins with hypoglycemic effects that help reduce blood glucose levels. Neem also inhibits carbohydrate-digesting enzymes, such as alpha-amylase and alpha-glucosidase, reducing postprandial blood sugar spikes.<sup>[30]</sup> These combined effects enhance insulin sensitivity, support insulin secretion, and regulate blood glucose levels, making neem an effective agent in managing diabetes and related metabolic disorders.

***Trigonella foenum-graecum*** (Methi; Family: Fabaceae)

In Ayurveda, *T. foenum-graecum* holds a prominent place for its therapeutic uses, particularly in treating digestive and mucosal conditions. *T. foenum-graecum* seeds have traditionally been used as carminatives, demulcents, expectorants, laxatives, and stomachics. *T. foenum-graecum* is known for its role in managing conditions like diabetes, bronchitis, fever,

sore throat, ulcers, and skin irritation. Recent research highlights its functional properties, including antidiabetic, antioxidative, hypocholesterolemic, anti-inflammatory, antineoplastic, and immunomodulatory effects. The active compounds, such as 4-hydroxyisoleucine, galactomannans, and steroid saponins, exhibit mechanisms like insulin-mimetic action, anti-inflammatory effects, and glucose metabolism regulation, reinforcing the potential of *T. foenum-graecum* as a functional food and therapeutic agent.<sup>[31]</sup>

### Bioactive Phytochemicals

*T. foenum-graecum* seeds are rich in bioactive phytochemicals that contribute to their therapeutic potential. The seeds contain bioactive components such as saponins (diosgenin, gitogenin), flavonoids, polysaccharides, alkaloids (trigonelline, choline), and polyphenolic compounds, which are linked to a wide range of pharmacological effects, including antidiabetic, anti-inflammatory, and antioxidant properties.<sup>[31]</sup> Galactomannan, a soluble fiber found abundantly in *T. foenum-graecum*, plays a crucial role in delaying carbohydrate absorption and lowering postprandial glucose levels.<sup>[32]</sup> Additionally, amino acids such as 4-hydroxyisoleucine have been shown to stimulate insulin secretion from pancreatic beta cells, thereby enhancing glycemic control.<sup>[33]</sup> These phytochemicals work collectively to provide a multifaceted approach to managing diabetes.

### Mechanism of Action

*T. foenum-graecum* demonstrates significant antidiabetic effects through multiple mechanisms involving its bioactive compounds, such as steroidal saponins, alkaloids like trigonelline, soluble fibers, polyphenols, and the amino acid 4-hydroxyisoleucine. Steroidal saponins, including diosgenin and yamogenin, stimulate insulin secretion and support pancreatic beta-cell regeneration, enhancing endogenous insulin production.<sup>[34]</sup> The alkaloid trigonelline improves insulin sensitivity and glucose uptake in peripheral tissues by modulating insulin signalling pathways,<sup>[35]</sup> while 4-hydroxyisoleucine has a glucose-dependent insulinotropic effect, facilitating insulin release and receptor activity.<sup>[33]</sup> *T. foenum-graecum* also inhibits carbohydrate-digesting enzymes like alpha-amylase and alpha-glucosidase, reducing postprandial hyperglycemia.<sup>[35]</sup> The high soluble fiber content, particularly galactomannan, delays gastric emptying and slows glucose absorption in the intestines, thereby improving glycemic control.<sup>[32]</sup> Additionally, its polyphenolic compounds exhibit antioxidant activity, protecting pancreatic beta cells from oxidative stress and preserving their function.<sup>[36]</sup>

***Syzygium cumini*** (Jamun; Family: Myrtaceae)

The fruits of *S. cumini* are widely used in traditional medicine for their cooling, astringent, and

digestive properties. They are commonly consumed to alleviate bad breath, biliousness, and stomach discomfort and are also valued for their diuretic and antidiabetic effects. *S. cumini* fruits have a long history of use in managing chronic diarrhea, dysentery, and other gastrointestinal disorders. Vinegar made from ripe fruits serves as a carminative and diuretic and is beneficial for spleen enlargement and chronic diarrhea.<sup>[37]</sup>

In traditional medicine systems like Ayurveda and Unani, Jamun fruits and other parts of the plant are employed to treat diabetes, diarrhea, blisters in the mouth, piles, and skin issues like pimples and rashes. Additionally, the juice of the fruits is used to make sherbets and syrups. These fruits are also consumed raw or processed into jams and sauces. Traditional healers in India and other countries have highlighted Jamun seeds as a potent remedy for diabetes and ulcers. In Unani medicine, *S. cumini* is recognized for enriching blood, strengthening teeth and gums, and serving as a remedy for skin ailments like ringworm infections.<sup>[37]</sup>

### Bioactive Phytochemicals

The seeds and fruits of *S. cumini* are rich in various bioactive compounds that contribute to their medicinal properties. The seeds contain alkaloids like jambosine and glycosides such as jambolin (or antimellin), which are believed to inhibit the conversion of starch into sugar, thereby helping to regulate blood sugar levels. The ellagic acid in the seeds is also responsible for lowering blood pressure, with studies showing a reduction of up to 34.6%. Additionally, the seeds are rich in flavonoids, which are well-known antioxidants that help scavenge free radicals and protect antioxidant enzymes. They also contain significant amounts of phenolic compounds, proteins, and calcium. In the fruits, compounds such as raffinose, glucose, fructose, citric acid, and malic acid are present, along with anthocyanins and their derivatives like delphinidin-3-gentiobioside and malvidin-3-lamaribioside. The sour taste of the fruit is attributed to the presence of gallic acid. These bioactive constituents work synergistically to provide a wide range of therapeutic effects, including antioxidant, anti-inflammatory, and antidiabetic actions.<sup>[37]</sup>

### Mechanism of Action

*S. cumini* exhibits potent antidiabetic effects through several mechanisms, primarily mediated by its active constituents. The seeds contain jambosine, a glycoside that inhibits the conversion of starch into sugar, thus preventing postprandial hyperglycemia.<sup>[38]</sup> Additionally, the alkaloid jambolin, found in the seeds, has been shown to reduce blood glucose levels by regulating the activity of enzymes involved in carbohydrate metabolism, such as amylase and

glucosidase.<sup>[37]</sup> Flavonoids, such as kaempferol and myricetin, contribute to its antidiabetic properties through their antioxidant action, which helps reduce oxidative stress, a key factor in insulin resistance.<sup>[39]</sup> The high content of anthocyanins, including delphinidin and malvidin, in fruits also plays a role in reducing glucose absorption and enhancing insulin sensitivity, further supporting the plant's antidiabetic potential.<sup>[40,41]</sup> Collectively, these bioactive compounds in *S. cumini* contribute to improved blood glucose regulation and offer a multifaceted approach to managing diabetes.

***Pterocarpus marsupium*** (Vijayasara; Family: Leguminosae)

*P. marsupium* Roxb., commonly known as Vijayasara, is a deciduous tree found in the hilly regions of India. The plant is highly valued in traditional medicine, particularly for its heartwood, though other parts, such as the leaves, bark, fruit, and resin, also have medicinal uses. The heartwood is particularly renowned for its antidiabetic properties and is used in the treatment of conditions like diabetes, obesity, anemia, leprosy, and worm infestations. In Nepal, drinking water from a wooden tumbler made from the heartwood is considered a traditional remedy for diabetes. Additionally, the heartwood is known for its astringent, anti-inflammatory, and analgesic properties, while the gum exudate, known as "Kino," is utilized for its astringent effects. Beyond its antidiabetic action, *P. marsupium* is also reported to reduce obesity, hyperlipidemia, and inflammation, with additional antibacterial, antioxidant, anticataract, hepatoprotective, and COX-2 inhibitory activities.<sup>[42]</sup>

### Bioactive Phytochemicals

The antidiabetic properties of *P. marsupium* are attributed to its rich composition of phytochemicals, including pterostilbene, marsupsin, epicatechin, and pterosupin, along with flavonoids such as pterosite, pteroisouroside, carsupin, liquiritigenin, and marsupol.<sup>[43]</sup> Pterostilbene, a polyphenol, exhibits strong antioxidant and anti-inflammatory properties, protecting against oxidative stress associated with diabetes.<sup>[44]</sup> Epicatechin is known to modulate glucose metabolism and improve pancreatic beta-cell function.<sup>[45]</sup> These bioactive compounds collectively contribute to the hypoglycemic, insulinotropic, anti-inflammatory, and antioxidant effects of the plant, making it an effective natural remedy for managing hyperglycemia.

### Mechanism of Action

*P. marsupium* exerts its antidiabetic effects through various mechanisms, primarily mediated by its active chemical constituents. The heartwood of the plant is particularly rich in polyphenols, flavonoids, and other bioactive compounds, which contribute to its ability to regulate blood glucose levels. The key

mechanisms include suppression of inflammatory mediators, regeneration of functional  $\beta$ -cells, enhancement of insulin secretion, and inhibition of  $\alpha$ -glucosidase and  $\alpha$ -amylase, enzymes responsible for carbohydrate digestion.<sup>[46,42]</sup> By inhibiting these enzymes, *P. marsupium* slows the absorption of glucose in the intestine, thus preventing postprandial hyperglycemia. Active compounds like pterostilbene possess anti-inflammatory and antioxidant properties, which help reduce oxidative stress—a critical factor contributing to insulin resistance in diabetic patients.<sup>[47]</sup> Epicatechin is recognized for its ability to regulate glucose metabolism and enhance the function of pancreatic beta-cells.<sup>[45]</sup> Overall, the antidiabetic effects of *P. marsupium* are multi-faceted, involving the inhibition of carbohydrate absorption, enhancement of insulin secretion and sensitivity, reduction of oxidative stress, and anti-inflammatory activity, making it a potent natural remedy for managing diabetes.

***Momordica charantia*** (Karela; Family: Cucurbitaceae)

*M. charantia*, commonly known as Bitter Melon or "Karela" in Ayurveda, has been widely used in traditional medicine to manage a variety of ailments, particularly diabetes (Madhumeha). In Ayurvedic practices, the fruit, leaves, and seeds of Bitter Melon are utilized to balance the body's doshas, particularly Pitta and Kapha, and are believed to promote healthy digestion and detoxification. Bitter Melon is traditionally consumed in the form of juice, decoctions, or powder to regulate blood sugar levels, lower cholesterol, and address digestive disorders, microbial infections, and menstrual problems.<sup>[48]</sup>

### Bioactive Phytochemicals

*M. charantia* contains several bioactive compounds that have drawn significant scientific attention due to their potential therapeutic effects, especially in the management of diabetes. Numerous studies have focused on its hypoglycemic properties, with extracts from the fruit, seeds, and leaves demonstrating significant blood sugar-lowering activity. Among the bioactive compounds, momordicine II and 3-hydroxycucurbita-5,24-dien-19-al-7,23-di-O- $\beta$ -glucopyranoside have been identified as saponins with insulin-releasing activity in pancreatic  $\beta$ -cells. Additionally, charantin, polypeptide-p, and vicine are considered the primary compounds responsible for its hypoglycemic effects.<sup>[49]</sup>

### Mechanisms of Action

*M. charantia* contains several bioactive constituents that contribute to its antidiabetic effects. Charantin, a cucurbitane-type triterpenoid, is one of the most studied compounds, showing significant hypoglycemic activity. It is believed to exert its effects by stimulating glucose uptake and enhancing insulin sensitivity in peripheral tissues.<sup>[50]</sup> Polypeptide-p, also known as p-insulin, is an insulin-like protein that

mimics human insulin and lowers blood glucose levels by promoting glucose utilization, particularly in type 1 diabetic models.<sup>[51]</sup> Other compounds, such as cucurbitane triterpenoids and sterols like sitosterol and stigmastadienol, also contribute to the plant's blood glucose-lowering effects.<sup>[52]</sup> Additionally, *M. charantia* exerts its antidiabetic actions by stimulating insulin secretion from pancreatic  $\beta$ -cells, inhibiting gluconeogenesis, reducing intestinal glucose absorption, and promoting glucose uptake in skeletal muscles and the liver through insulin-like signaling pathways.<sup>[53]</sup>

***Tinospora cordifolia*** (Guduchi; Family: Menispermaceae)

*T. cordifolia*, commonly known as Guduchi or Giloy, is a revered medicinal plant in traditional Ayurvedic and folk medicine. It has been used for centuries in India for its therapeutic properties, which include the treatment of inflammation, arthritis, infections, liver disorders, urinary issues, ulcers, and infertility.<sup>[54]</sup> Additionally, it is known for its beneficial effects in managing conditions like leprosy and diabetes. The plant is particularly recognized for its anti-diabetic potential, a property well-documented in ancient texts and supported by contemporary research. The diverse pharmacological effects of *T. cordifolia* are attributed to the wide array of bioactive compounds it contains, including alkaloids, which are believed to contribute to its anti-diabetic actions. These properties make it an important herb in traditional healing systems and a subject of ongoing scientific investigation.<sup>[54]</sup>

### Bioactive Phytochemicals

*T. cordifolia* contains a variety of bioactive compounds, with alkaloids being the most prominent. Key alkaloids include berberine, palmatine, tembetarine, magnoflorine, and choline, with berberine and palmatine found in higher concentrations. Berberine is particularly well-established for its anti-diabetic effects, supported by both preclinical and clinical studies, while the full biological activity of palmatine still requires further exploration.<sup>[55]</sup> The plant also contains other compounds such as tannins, flavonoids, saponins, cardiac glycosides, and steroids, which contribute to its broad pharmacological effects.<sup>[56]</sup> Specifically, the isoquinoline alkaloids, including palmatine, jatrorrhizine, and magnoflorine, have demonstrated insulin-mimicking and insulin-releasing properties in both in vitro and in vivo studies.<sup>[57]</sup> Berberine, in addition to lowering glucose levels similar to metformin, improves insulin sensitivity by activating AMP-activated protein kinase (AMPK), which also helps regulate cholesterol levels and blood pressure.<sup>[58]</sup> Other compounds, such as tinosporin, isocolumbin, and  $\beta$ -sitosterol, found in the stem and root, also

exhibit anti-diabetic, antihyperlipidemic, and antioxidant effects, enhancing the therapeutic potential of *T. cordifolia* in diabetes management.<sup>[56]</sup>

### Mechanism of Action

*T. cordifolia* exhibits its anti-diabetic effects through multiple mechanisms mediated by its bioactive constituents. The isoquinoline alkaloids, including berberine, palmatine, and magnoflorine, demonstrate insulin-mimicking and insulin-releasing activities.<sup>[57]</sup> Berberine, a well-studied alkaloid, lowers blood glucose levels comparable to metformin by activating AMP-activated protein kinase (AMPK), which enhances insulin sensitivity and regulates glucose metabolism.<sup>[59,60]</sup> Additionally, berberine inhibits FOXO1, an important transcription factor in the control of gluconeogenesis, improving hepatic glucose metabolism during insulin resistance and metabolic syndrome. It also attenuates hepatic insulin resistance through the miR-146b/SIRT1 pathway.<sup>[61,62]</sup> Palmatine and jatrorrhizine have also shown insulinotropic properties in vitro and in vivo, contributing to improved  $\beta$ -cell function.<sup>[56]</sup> Collectively, these mechanisms highlight the potential of *T. cordifolia* in diabetes management.

### *Picrorhiza kurroa* (Kutki; Family: Plantaginaceae)

*P. kurroa* is a renowned medicinal herb widely used in traditional medicine for its diverse therapeutic properties. The dried rhizomes of this plant, known for their bitterness, have been traditionally utilized as a purgative, stomachic, brain tonic, and antiperiodic, particularly in the treatment of dyspepsia.<sup>[63]</sup> Known for its cooling effects, *P. kurroa* has been employed as an antipyretic, cardiogenic, laxative, antiasthmatic, and anthelmintic.<sup>[64]</sup> It has applications in treating respiratory ailments, allergies, inflammation, fever, diarrhea, asthma, liver disorders, and even chronic scorpion stings.<sup>[65]</sup> The plant is particularly valued for its hepatoprotective properties, offering protection against liver damage induced by toxins such as carbon tetrachloride, alcohol, isoniazid, paracetamol, and aflatoxins. Additionally, *P. kurroa* is traditionally used for managing jaundice and promoting liver health.<sup>[66]</sup>

### Bioactive Phytochemicals

*P. kurroa* contains over 65 bioactive secondary metabolites with significant pharmacological potential. Among its most studied constituents are the iridoid glycosides (IGs) picrosides I, II, III, and IV, along with kutkoside, which together form "Kutkin," a key hepatoprotective compound. Picrosides I and II are present in a 2:1 ratio and exhibit therapeutic properties. Other bioactive compounds include cucurbitacins B, D, and R, known for their anti-tumor and cytotoxic activities, and apocynin, a potent NADPH oxidase inhibitor with anti-inflammatory and antioxidant effects.<sup>[66]</sup> Additionally, flavonoids such as vanillic acid and cinnamic acid, along with D-mannitol,

have been identified using advanced techniques.<sup>[67]</sup> These diverse compounds contribute to the hepatoprotective, anti-inflammatory, antiasthmatic, and digestive properties of this plant.

### Mechanism of Action

*P. kurroa* has demonstrated potential in managing diabetes through various mechanisms. The bioactive iridoid glycosides, particularly picrosides I, II, III, and IV, exhibit antidiabetic effects by modulating glucose metabolism and enhancing insulin sensitivity.<sup>[68]</sup> These compounds have been shown to reduce oxidative stress and inflammation, which are key factors in the pathogenesis of diabetes.<sup>[69]</sup> Additionally, *P. kurroa* helps preserve pancreatic  $\beta$ -cell function, reduce hyperglycemia, and improve lipid profiles by inhibiting inflammatory mediators and maintaining antioxidant balance.<sup>[71]</sup> These mechanisms make *P. kurroa* a promising herbal candidate for adjunctive therapy in diabetes management.

### *Phyllanthus emblica* (Amla; Family: Phyllanthaceae)

*P. emblica*, a cornerstone of Ayurvedic medicine, is known for its therapeutic potential in managing diabetes, liver disorders, cardiac conditions, and anemia. The fruit is rich in chromium, which aids glucose metabolism and improves lipid profiles in diabetes.<sup>[71]</sup> Its high vitamin C and tannin content contribute to its antioxidant and antibacterial properties, protecting against oxidative stress and degenerative diseases.

*P. emblica* is also used to treat respiratory ailments like asthma and bronchitis, and its juice is applied to manage ocular inflammation. Additionally, it serves as a rejuvenator (Rasayana), promoting longevity and vitality. The fruit is utilized in various forms, including food products, natural dyes, and tanning agents, while its oil is traditionally used as a hair tonic to enhance growth and pigmentation.<sup>[72]</sup>

### Bioactive Phytochemicals

*P. emblica* is a rich source of bioactive compounds, contributing to its therapeutic properties. It contains vitamins such as ascorbic acid (vitamin C), nicotinic acid, and choline, which support antioxidant activity and overall health. Flavonoids such as quercetin, kaempferol, and acylated apigenin glucoside enhance its anti-inflammatory and antioxidant effects. Phenolic compounds, including gallic acid, ellagic acid, and coumaric acid, provide additional anti-oxidative and anti-microbial benefits. The tannins chebulagic acid, emblicanin A, and emblicanin B play crucial roles in combating oxidative stress. Moreover, alkaloids like phyllantidine and phyllantine contribute to the plant's pharmacological activities. These active constituents make *P. emblica* a potent agent in traditional and modern medicine.<sup>[72]</sup>

## Mechanism of Action

*P. emblica* has shown promising potential in diabetes management due to its rich array of bioactive compounds, such as ascorbic acid, tannins, phenolics, and flavonoids. These constituents exert antidiabetic effects through multiple mechanisms. Ascorbic acid and tannins, such as emblicanin A and B, exhibit potent antioxidant properties that reduce oxidative stress, a key factor in diabetes progression.<sup>[73]</sup> Phenolic compounds such as gallic acid and ellagic acid inhibit  $\alpha$ -glucosidase and  $\alpha$ -amylase enzymes, thereby reducing postprandial hyperglycemia.<sup>[74,75]</sup> Flavonoids like quercetin enhance pancreatic  $\beta$ -cell function and protect against damage induced by reactive oxygen species.<sup>[76]</sup> Moreover, *P. emblica* is known to regulate lipid metabolism and improve glycemic control by lowering serum glucose and HbA1c levels in diabetic conditions.<sup>[77]</sup> These mechanisms highlight the therapeutic potential of *P. emblica* in preventing and managing diabetes and its associated complications.

## Pharmacological Mechanisms of Krishna's Diabic Care

Krishna's Diabic Care formulation combines several potent herbal ingredients, each contributing to the management of diabetes through diverse pharmacological mechanisms. One of the key components, *O. sanctum*, enhances insulin sensitivity and improves glycemic control by promoting insulin receptor signaling through ursolic acid, which activates the PI3K/Akt pathway essential for glucose uptake.<sup>[9]</sup> Additionally, eugenol in *O. sanctum* increases intracellular calcium levels, activating AMPK, which boosts glucose uptake in muscle cells and enhances energy metabolism.<sup>[10]</sup> *G. sylvestre* plays a significant role by inhibiting sugar absorption in the gut through its gymnemic acids, which block sugar receptors, preventing glucose spikes after meals.<sup>[15]</sup> It also promotes insulin secretion and encourages the regeneration of pancreatic beta cells, enhancing insulin production and overall glucose metabolism.<sup>[12]</sup> *A. marmelos* exerts its antidiabetic effects by reducing blood glucose levels, enhancing plasma insulin, lowering glycosylated hemoglobin, and improving enzymatic activities like hexokinase, while also exhibiting antioxidant and anti-inflammatory properties.<sup>[25]</sup> *A. indica* further supports glycemic control by improving insulin sensitivity and reducing oxidative stress via its antioxidant compounds like azadirachtin, while also inhibiting carbohydrate-digesting enzymes such as alpha-amylase and alpha-glucosidase.<sup>[30]</sup> *T. foenum-graecum* exerts its antidiabetic effects through compounds like diosgenin, which stimulates insulin secretion, and 4-hydroxyisoleucine, which enhances insulin release and receptor activity.<sup>[33,34]</sup> *S. cumini* enhances insulin sensitivity and reduces postprandial hyperglycemia

through compounds like jambosine and jambolin, which regulate starch conversion and carbohydrate metabolism enzymes.<sup>[38]</sup> Additionally, *P. marsupium* plays a crucial role by inhibiting digestive enzymes and promoting  $\beta$ -cell regeneration, alongside reducing oxidative stress and inflammation.<sup>[46,47]</sup> *M. charantia* mimics insulin activity through charantin and polypeptide-p, helping reduce blood glucose levels and improve insulin sensitivity.<sup>[51]</sup> *T. cordifolia* utilizes bioactive alkaloids such as berberine to enhance insulin sensitivity and regulate glucose metabolism through AMPK activation.<sup>[59]</sup> Finally, *P. kurroa* enhances insulin sensitivity and reduces oxidative stress through its iridoid glycosides, while *P. emblica* contributes with antioxidant-rich compounds like ascorbic acid, which reduce oxidative stress, and tannins, which regulate postprandial glucose.<sup>[68,73]</sup> Together, these plants work synergistically to regulate blood glucose, enhance insulin sensitivity, and protect against oxidative damage, making Krishna's Diabic Care a comprehensive approach to managing diabetes.

## Safety Profile and Regulatory Compliance

Krishna's Diabic Care has been formulated with a focus on safety, utilizing well-researched herbal ingredients that have been traditionally used for managing diabetes. The safety profile of the product is supported by studies on each of its individual components, which have demonstrated low toxicity and minimal adverse effects when used in appropriate dosages. The ingredients, such as *O. cimum sanctum*, *G. sylvestre*, *A. indica*, and *T. foenum-graecum*, have been extensively studied for their safety and efficacy in managing blood glucose levels, with adverse reactions typically being mild and transient, such as gastrointestinal discomfort or mild hypoglycemia in rare cases. The product is manufactured following stringent Good Manufacturing Practices (GMP), ensuring high-quality standards and consistency. It complies with relevant regulatory guidelines, including those set forth by the Ministry of AYUSH for herbal supplements and the relevant health authorities of India. The formulation is also aligned with the safety regulations of herbal supplements, ensuring that all ingredients used are of pharmaceutical-grade quality. By adhering to these rigorous safety standards and regulations, Krishna's Diabic Care offers a safe and effective option for individuals seeking natural support in managing their diabetes.

## Challenges and Limitations

Despite the promising benefits of Krishna's Diabic Care, several challenges and limitations need to be acknowledged. One of the primary concerns is the variability in individual responses to herbal formulations, as the effectiveness of the product can differ based on factors like age, diet, existing health conditions, and the concurrent use of other



medications or supplements. While the ingredients in Krishna's Diabic Care have been shown to be beneficial for managing blood glucose levels, there is still limited clinical evidence on the long-term efficacy and safety of the product as a whole, particularly in large, diverse populations. Additionally, the lack of standardization in the herbal supplement industry can result in inconsistencies in the quality of ingredients, which may impact the product's overall effectiveness. Another challenge is the potential for interaction with other medications used by diabetic patients, such as insulin or oral hypoglycemics, which could lead to hypoglycemia or other adverse effects. Furthermore, while the product is designed to complement conventional diabetes treatment, it is not a substitute for medical supervision or insulin therapy, and patients may overlook the importance of maintaining their prescribed treatment regimen. These factors highlight the need for further clinical research and careful consideration by healthcare professionals when recommending herbal supplements as part of a diabetes management plan.

#### Future Directions

The future of Krishna's Diabic Care holds significant potential for expansion and refinement, especially in the context of diabetes management. A key direction is the need for comprehensive clinical trials to establish robust evidence regarding its long-term efficacy and safety across diverse populations, particularly in combination with standard diabetes therapies. Conducting these trials will provide valuable data to support its use in clinical practice and to gain regulatory approval for broader market access. Further research could focus on investigating the synergistic effects of the herbal ingredients in Krishna's Diabic Care, exploring how they interact with various antidiabetic medications to optimize blood glucose control while minimizing side effects. Additionally, there is an opportunity to explore the impact of product on different diabetes-related complications, such as cardiovascular disease, neuropathy, and nephropathy, areas where current treatment options may be limited.

#### CONCLUSION

In conclusion, Krishna's Diabic Care represents a promising Ayurvedic approach to managing diabetes, combining traditional herbal remedies with modern scientific insights. While early evidence supports its potential benefits in controlling blood sugar levels and improving overall health, more robust clinical trials are needed to confirm its efficacy and safety. Future research, through partnerships between Ayurvedic practitioners and modern scientists, will be key to validating these treatments and ensuring their broader acceptance in global healthcare.

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