International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Ethnobotanical Plants in management of Diabetes Mellitus (Type-II): A Global Perspective

Dr. Abul Fazal Mazumder

Assistant Professor, Department of Botany, Moinul Hoque Choudhury Memorial Science College, Algapur, Hailakandi, Assam

Abstract

Diabetes mellitus (DM) is a very critical metabolic disorder characterized by constant hyperglycemia resulting from pancreatic irregularities in insulin secretion, its action, or a combination of both. There is a critical shift toward exploring ethnobotanical interventions due to the side effects and costs associated with conventional pharmaceuticals. This review analyzes the findings from 50 ethnobotanical and clinical studies to evaluate the phytochemistry, traditional preparation, clinical efficacy and biological mechanisms of several prominent medicinal plants, including *Aloe vera, Brassica juncea , Catharanthus roseus, , Moringa oleifera, Momordica charantia, Ocimum sanctum, Syzygium cumini, Trigonella foenum-graecum,* etc. Findings from clinical trials and meta-analyses suggest that these plants target multiple pathological pathways, including the stimulation of insulin secretion, enhancement of insulin sensitivity, and inhibition of carbohydrate-digesting enzymes. While many studies show significant potential as adjunct therapies, challenges remain regarding chemical standardization and the potential for narrow-therapeutic-index herb-drug interactions.

Keywords: Ethnobotany, Medicinal plants, Diabetes mellitus, Hypoglycemic.

1. Introduction

Diabetes mellitus is a very common and prevalent disease affecting both developed and developing countries (Arumugam *et al.*, 2013). It has become a global health crisis that substantially reduces both quality and expectancy of life (Gajbhiye *et al.* 2018). Type-1 diabetes is characterized by deficiency of insulin production, whereas Type-2 Diabetes Mellitus (T2DM) involves progressive insulin resistance and a decrease in β-cell function (Morey, 1997; Srinivasan and Ramarao, 2007; Kazemi *et al.*, 2010). As the global prevalence continues to increase it is projected to reach 552 million by 2030 (Whiting *et al.*, 2011). As per the data of the International Diabetes Federation (IDF), the diabetic population of the world will reach to 629 million by 2045, which was recorded as 425 million in 2017 (Dixit and Tewari, 2020). Moreover, Nagarathna *et al.* (2020) reported that the diabetic population in India will reach to 79.4 million by 2030. Chronic hyperglycemia leads to severe other complications, such as retinopathy, nephropathy, neuropathy, cardiovascular diseases and cerebrovascular disease (Mehta *et al.*, 2009; Amod *et al.*, 2012; Gajbhiye *et al.* 2018; Bahmani *et al.*, 2014). While conventional treatments like metformin are standard, many patients in developing regions depend on indigenous knowledge and medicinal plants for management of diabetes (Abu-Odeh *et al.*, 2021). Traditional systems such as

Ayurveda, Unani, and various African traditional systems have documented hundreds of species with antidiabetic potential (Kamau *et al.*, 2017, Kasole *et al.*, 2019, Keter *et al.*, 2012). There are about 21,000 medicinal plants species available throughout the globe out of which about 2500 plant species have been found to be present in India (Yatoo *et. al.*, 2017). Among these, about 800 plants have been reported having antidiabetic potential (Patil *et al.*, 2011). One of the advantages of medicinal plants is that these are easily available and have very low side effects. Plants have always been a good source of drugs and many of the drugs currently available have been derived directly or indirectly from plants (Arumugam *et al.*, 2013).

This review article enumerates some medicinal plants having antidiabetic activity and explaining their mechanisms of action such as *Aloe vera, Brassica juncea , Catharanthus roseus, , Moringa oleifera, Momordica charantia, Ocimum sanctum, Syzygium cumini, Trigonella foenum-graecum,* etc. and also the method of experiment on various animals and the therapeutic efficiency of the plant extracts were also exploited. Some of the important plants having anti-diabetic potential are given in the Table 1.

2. Methodology

In this review study, articles were searched using keywords such as "medicinal plants used in diabetes" "ethnobotany in treatment of diabetes" in reputable databases such as Google Scholar, PubMed, and Scopus. The selection criteria included the language of the article, which was English. Ethnobotanical articles were then content-analyzed for their impact on the treatment of diabetes (Dixit, *et al.*, 2020; Hooshmand Gharebagh L., 2025).

3. Antidiabetic effect of ethnobotanical plants:

3.1. *Allium cepa* L.

Allium cepa is a very important antidiabetic plant generally cultivated as a culinary agent. The potential of *A. cepa* as antidiabetic has been studied in both human and animal model. The bulb aqueous extract (0.4g/100g body weight) significantly decreased blood glucose level by (70%), urea by (16%), creatinine (32%) and bilirubin by (28%) in alloxan induced rats (El-Demerdash, Yousef, and El- Naga 2005). In another study on rabbit the aqueous extract at a dose 100 and 300 mg/kg of body weight showed significant reduction in blood glucose level and established the decreased levels of antioxidant enzymes (Ogunmodede *et al*. 2012). Moreover, in human model, the fresh bulb slices at a dose (100 g) were given to type 1 and type 2 diabetic persons. The dose decreased blood glucose level by (50%) in the person affected by type 1 at 4 hours after administration in comparison to insulin-treated (70.8%) diabetic person. In type 2 diabetic person, the reduction was 20% compared to 37.5% in insulin-treated person (Eldin *et al.* 2010). In another study, a diet supplemented with 3% freeze-dried onion powder was fed to Streptozotocin (STZ) induced rats for 8 weeks which showed significantly lowered blood glucose and strong anti-oxidant potential (Babu and Srinivasan, 1997). The isolated sulphur amino acid S-methyl cysteine sulphoxide at a dose of (200 mg/kg body weight) for 45 days showed very significant hypoglycaemic activity, controlled lipids in serum and tissues and also restored the potential of liver hexokinase, glucose 6-phosphatase and 3-Hydroxy- 3-Methyl-Glutaryl-CoA (HMG CoA) reductase (Kumari *et al.* 1995).

3.2. *Aloe vera* (L.) Burm.f.

Aloe vera is a well-known traditional medicinal plant. The aerial parts ethanolic extract (100 and 500 mg/kg body weight) was administered in normal and hyperglycaemic rats (Afaf *et al.* 2008). The extract

at dose 100 mg/kg showed similar effect to the standard drug glibenclamide in lowering plasma glucose level while highly significant reduction (P< 0.01) in plasma glucose level was reported in the group which received 500 mg/kg of the extract. Similarly, dried exudate of leaves at a dose of 150 mg/kg body weight showed reduced fasting blood glucose level and improved the levels of the antioxidant enzymes in STZ induced rats (Nwajo, 2006). The gelatinous leaf extract (350 mg/kg body weight) containing aloin (181.7 mg/g) and aloe-emodin (3.6 mg/g) has been investigated in experimentally insulin resistant mice administered for 4 weeks, which improved insulin tolerance and fasting blood glucose level (Pérez *et al*., 2007). In a long term experiment with fresh leaf ethanolic extract (300, 500 mg/kg body weight) in alloxan and STZ induced diabetic rats have potentially reduced fasting blood glucose level at 42 day as (44%) and (73%), respectively (Shinde *et al.* 2014). Rajendran, *et al.*, 2007 reported that the leaf gel of *A. vera* showed a significant increase in liver glycogen and body weight whereas, it decreases normalized serum lipids and urine and blood glucose level. In another study, an administration of ethanolic extract of *A. vera* gel (300 mg/kg) for 21 days showed remarkable antihyperlipidaemic activity in streptozotocin induced diabetic rats (Rajendran *et al.*, 2007). Misawa *et al.* (2008) isolated phytosterols, cycloartanol and lophenol from *A. vera* leaf gel that reduces sugar level for 44 days in type II diabetic.

3.3. *Azadirachta indica* Juss.

Atangwho *et al.* (2010) reported that leaf extract of *Azadirachta indica* in combination with *Vernonia amygdalina* increases insulin level thus possesses antihyperglycemic property in diabetic rats. Administration of leaf extract of *A. indica* normalizes the lipid parameters and blood glucose and hence, elicits antidyslipidemic and antihyperglycemic property in streptozotocin induced diabetic rats (Bisht and Sisodia, 2010; Chattopadhyay and Bandyopadhyay, 2005). Moreover, mixed herbal formulation of *A. indica* and *Momordica charantia* leaf (400 mg/kg) shows remarkable antihyperlipidemic and antidiabetic effect (Ebong *et al.*, 2008). A study in Pakistan on *A. indica* reported its antidiabetic effect as was evident as the leaves ethanolic extract in normal and STZ (25 mg/ml) induced diabetes rats increase release of insulin from the pancreas (Chattopadhyay and Bandyopadhyay 2005) while the leaves ethanolic extract (500 mg/kg) in STZ induced diabetes rats lowered the blood sugar level and improved pancreatic lesions (Akinola *et al.*, 2010).

3.4. *Brassica juncea* (L.) Czern

Brassica juncea is a commonly used as spice in various parts of India and is also a traditional medicinal plant which belongs to family Cruciferae. *B. juncea* aqueous seed extract has a potential hypoglycemic activity which was studied in STZ induced diabetic male albino rat when applied with doses as 250, 350, 450 mg/kg (Thirumalai *et al.*, 2011). Anand *et al.* (2007) in his study reported that administration of 200 mg/ kg aqueous extract of *B. juncea* seeds daily for one month in streptozotocin induced diabetic rats showed remarkable antihyperlipidaemic and antidiabetic effect. Administration of *B. juncea* extract for 21 days in combination with metformin treated diabetes mellitus by controlling cholesterol and triglyceride level in body. The study was performed in four groups namely, normal, normal+streptozotocin, streptozotocin+metformin and streptozotocin+*B. juncea* extract where, the dose of metformin and plant extract was 75 and 450 mg/kg respectively (Kumar *et al.*, 2019).

3.5. *Berberis vulgaris* L.

Berberis vulgaris (common barberry) is a traditional medicinal plant which belongs to family Berberidaceae. The hypoglycaemic effect of *B. vulgaris* L. in streptozotocin-induced diabetic rats. The results showed that water extract and saponins showed significant hypoglycemic effect (Meliani *et al.*,

2011). *B. vulgaris* was also reported to help lower blood sugar and improve insulin resistance mainly due to its active compound, berberine (Dulić *et al.*, 2019). *B. vulgaris* and its active component, berberine (BBR) has antidiabetic, antiobesity, hypotensive and hypolipidemic properties (Tabeshpour *et al.*, 2017). Amanlikova, *et al.*, 2026, observed the antidiabetic and hypoglycemic activity of a protein isolate obtained from Berberis vulgaris fruits (BPI). The hypoglycemic effect was reported to be associated with the presence of bioactive peptides capable of inhibiting carbohydrate-digesting enzymes, improving insulin sensitivity, and reducing oxidative stress.

3.6. *Catharanthus roseus* (L.) G. Don

The hypoglycemic effect of the methanolic leaf extract of *Catharanthus roseus* (*C. roseus*) in alloxan induced diabetic rats decreased the levels of blood glucose when compared with Control rat. The blood glucose lowering effect of *C. roseus* methanolic extract was found to be more pronounced than Glibenclamide and Metformin (Ohadoma and Michael, 2011). Tiong *et al.* (2013) in his study isolated four alkaloids from *C. roseus* leaf extract using dichloromethane solvent that possess improved glucose ingestion in pancreatic beta-TC6 cells of mouse. Similar reports were made by Aruljothi *et al.*, 2016. Moreover, extract of *C. roseus* showed antidiabetic potential by reducing serum protein and blood glucose in alloxan induced rats (Tolambiya and Mathur, 2016; Singh *et al.*, 2001).

3.7. *Syzygium cumini* (L.) Skeels

Syzygium cumini is an important antidiabetic plant with fruit, leaves and seeds used for treatment of diabetes. The ripe fruits and dried seeds show antidiabetic effects and reduce the blood sugar level. The ripe fruits are also used to lower the diabetes (Mishra *et al.*, 2019). The seeds contain glycosides like jamboline and jambosin, which sieze the conversion of starch into sugar. The seed powder (up to 10g/day) is used as a traditional remedy in India and Nepal. Clinical supplementation with jamun seed powder has showed significant improvements in fasting blood glucose and postprandial glucose over 90-day periods. (Mishra *et al.*, 2019; Zain-ul-Abidin *et al.*, 2018). The leaves aqueous extract (25, 50, 75 and 100 mg/ml) inhibit α-amylase activity by (60.52%), (66.23%), (69.33%) and (71.71%) (Sathiavelu *et al*. 2013). In another experiment barks, leaves, root and seeds significantly ($P< 0.001$) reversed hyperglycaemic activity (Deb *et al*. 2013). Four active compounds isolated from leaves n-hexane fraction have hyperglycaemic activity (Alam *et al*. 2012).

3.8. *Moringa oleifera* Lam.

Known as the "miracle tree," (Villegas-Vazquez *et al.*, 2025) *Moringa oleifera* is valued for its high nutritional density and antioxidant polyphenols, such as quercetin and chlorogenic acid. While preclinical models show robust glucose-lowering effects, human trials have produced more variable results. Mechanistically, its leaves act primarily in the gastrointestinal tract to delay gastric emptying and slow carbohydrate digestion (Arshad *et al.*, 2025). The bark, sap, root, leaves, flowers, and fruits are used in traditional medicine. The fruits and leaves showed antidiabetic properties. Fruit juice (15–20 ml) along with little old jaggery is used once in day to cure diabetes. Patients are also advised to take fruits, flowers, and leaves as vegetables in the daily diet (Mishra *et al.*, 2019)

3.9. *Lantana camara* L.

The administration of methanolic leaf extract (200 and 400 mg/kg) of *L. camara* shows significant antihyperlipidemic and antidiabetic activities by controlling the parameters such as low density lipoprotein, high density lipoprotein, total cholesterol and triglycerides (Ganesh *et al.*, 2010). Kumar *et al.* (2010) studied the antidiabetic effect of ethanolic extract of *L. aculeate* root in rats injected with alloxan. Moreover, Venkatachalam *et al.* (2011) studied potential antihyperglycemic property of

methanolic extract of *L. camara* fruit on the basis of HbA1c profile, body weight and histopathological studies of normal and streptozotocin induced diabetic rats.

3.10. *Hibiscus rosa-sinesis* L.

Rehana *et al.* (2017) in their investigation synthesized a nanoparticle of zinc oxide (ZnO) by using various plant extracts viz. *Hibiscus rosa-sinesis*, *Moringa oleifera*, *Azadirachta indica*, *Tamarindus indica* and *Murraya koenigii*. The study revealed the α-glucosidase and α-amylase action of ZnO nanoparticles that lowered the side effects and toxicity of the drugs used for the treatment of diabetes. In another study, five fractions isolated from the leaf extract of *H. rosa-sinensis* using ethanol solvent reveals antihyperlipidemic and antidiabetic action in non-obese diabetic mouse (Moqbel *et al.*, 2008). In addition, acute and sub acute treatment of diabetes was studied in alloxan induced diabetic rats, through two doses (250 and 500 mg/kg) of ethanol extract of *H. rosa-sinensis* flowers which showed remarkable reduction in blood glucose (Venkatesh and Thilagavathi, 2008).

3.11. *Momordica charantia* L.

Momordica charantia is commonly used in Asia and Africa. This plant contains charantin, polypeptide-p, and vicine, which possess insulin-mimetic properties. In Pakistan and India, fresh fruit juice (10 ml/kg) or cooked slices are used as standard remedies to lower glucose level and enhance the secretion of insulin (Ullah, *et al.*, 2019, Mishra *et al.*, 2019). The fresh fruit juice at 10 ml/kg body weight in oral administration test in type 1 diabetic rats lowered blood glucose level significantly after 30 and 90 minutes by about (30%) and (10%) (Matheka *et al.* 2012). Sathishsekar and Subramanian (2005) investigated the role of seed extract of *M. charantia* in reducing (150 mg/kg) renal and hepatic thiobarbituric acid reactive substances, hydroperoxides and fasting blood glucose. The study also reported a significant reduction in superoxide dismutase, glutathione-s-transferase, catalase, reduced glutathione and glutathione peroxidase in the kidney and liver of diabetic rats (Sathishsekar and Subramanian, 2005). A phytoconstituent from *M. charantia*, alcalase hydrolysate, possessed higher hypoglycaemic property in comparision to pancreatin hydrolysate (Yuan *et al.*, 2008). Wang *et al.* (2019) made a comparable study between Indian and Chinese *M. charantia* by measuring various parameters such as total triterpene, totat phenol, antidiabetic activity and antioxidant property using reducing power, free radical scavenging, α-glucosidase inhibition and α-amylase inhibition assays. Furthermore, subcutaneous administration of alcoholic extract and fresh juice of *M. charantia* fruit was found to cause hypolipidemic, hepato-renal protective and antidiabetic effect in experimentally induced (alloxan) diabetic rats (El Batran *et al.*, 2006).

3.12. *Ocimum sanctum* L.

The leaves and seeds of the *Ocimum sanctum* plant are medicinally very important and are used all over the globe. The leaf juice is also used as an antidiabetic herbal remedy. Seven tender young leaves or leaf juice when given to patients 2 times in a day, showed a lowered glucose level in blood (Mishra *et al.*, 2019). Three new phytoconstituents namely, ocimarin, ocimumosides A and ocimumoside, isolated from leaves of *O. sanctum* revealed anti-stress activity. Out of which, ocimumosides A shows anti-stress property by controlling plasma corticosterone, adrenal hypertrophy, plasma creatine kinase and hyperglycemia (Gupta *et al.*, 2007). Aerial part extract of *O. sanctum* using two solvents (chloroform and hydro-alcohol) showed antidiabetic effect in alloxan induced diabetic rats at two doses of 250 and 500 mg/kg (Patil *et al.*, 2010; Patil *et al.*, 2011). Moreover, triterpenoid, isolated from aerial part extract (Hydro alcoholic) of *O. sanctum* at 20 mg/kg dose showed antidiabetic effect in alloxan induced diabetic rats. The hydroalcoholic extract of *O. tenuiflorum* showed significant anti-diabetic and anti-

hyperlipidemic activity at 250 and 500 mg/kg was studied against streptozotocin (STZ) induced mice, and this effect was comparable with that of glibenclamide (Parasuraman *et al.*, 2015).

3.13. *Trigonella foenum-graecum* L.

The seeds of *Trigonella foenum-graecum* contain 4-hydroxyisoleucine and high soluble fiber content, which stimulate insulin secretion and delay carbohydrate digestion (Mowl *et al.* 2009; Ullah *et al.*, 2019). The administration of ethanolic extract of *T. foenum-graecum* seeds (2g/kg, 1g/kg, 0.5g/kg and 0.1g/kg) in alloxan induced rats diabetic rats significantly ($p<0.05$) reduced blood glucose by (33.92 %) comparable to that of standard drug, glimepiride (4mg/kg) (35.26%) (Mowl *et al*. 2009).

Table:1. Ethnobotanical Plants in Diabetes Management

Sl. No.	Scientific Name	Common Name	Family	Parts Used	Method of Application	Associated Disease	Mode of Application	Uses Reported / Action	Author (s) & Year
1	*Abelmoschus esculentus*	Okra / Mloukhia/Lady's finger	Malvaceae	Fruits	Maceration of 3 fruits in water overnight	Diabetes	Oral	Taken fasting or 1-2x daily	Skalli et al. (2019); Mrabti et al. (2021)
2	*Abelmoschus moschatus*	Bhandi	Malvaceae	Fruit	Raw or cooked as vegetable	Diabetes	Oral	Direct consumption for glucose regulation	Ullah et al. (2019)
3	*Abrus precatorius*	Raati gedi	Leguminosae	Leaves	Ground into powder mixed with milk	Diabetes	Oral	50 ml of mixture taken twice daily	Joshi (2011)
4	*Acacia modesta*	Palosa	Fabaceae	Leaves	0.5 kg boiled in water	Diabetes	Oral	1 tbsp of decoction 2x daily; gum also used	Ullah et al. (2019)
5	*Acacia nilotica*	Kiker / Ghered	Fabaceae	Leaves, seeds, bark	Decoction or maceration	Diabetes	Oral	Taken before meals or at night	Demoz et al. (2015); Ullah et al.

									(2019)
6	*Achillea odorata*	El-qorte	Asteraceae	Leaves	Infusion	Type 1 Diabetes (TD1)	Oral	Glycemic support via spontaneous plant extract	Belhaj et al. (2021)
7	*Adiantum caudatum*	Seto sinki	Adiantaceae	Whole plant	Crushed and boiled	Diabetes	Oral	Infusion on empty stomach for 10 days	Joshi (2011)
8	*Allium cepa*	Onion / Shiguerti-keyih	Amaryllidaceae	Bulb, seed	Maceration or fresh	Diabetes	Oral	Hypoglycemic agent (allyl propyl disulphide)	Demoz et al. (2015); Ocvirk et al. (2013)
9	*Allium sativum*	Garlic / Rôsun	Amaryllidaceae	Bulb, root	Maceration or fresh	Diabetes	Oral	Glycemic regulation via oral consumption	Demoz et al. (2015); Ocvirk et al. (2013)
10	*Aloe vera*	Aloe / Siber	Liliaceae	Leaf, AP	Fresh juice, powder, or capsules	Hyperglycemia; T2DM	Oral	Acemannan-rich for FBS and HbA1c reduction	Fallah Huseini et al. (2012); Demoz et al. (2015)
11	*Argania spinosa*	Argane	Sapotaceae	Almond fruits, leaf	Crushed seeds or infusion	Diabetes	Oral	1 tsp of crushed seeds taken orally	Skalli et al. (2019); Mrabti et al. (2021)
12	*Artemisia absinthium*	Chiba	Asteraceae	AP, leaves	Decoction or	Diabetes; Colds	Oral	Lowering blood	Eddouks et al.

					infusion			sugar and warming the body	(2002); Mrabti et al. (2021)
13	*Azadirachta indica*	Neem	Meliaceae	Leaf, bark, seed	Boiled in water (1kg/5L)	Diabetes	Oral	Decoction taken before meals 2x daily	Demoz et al. (2015); Ocvirk et al. (2013)
14	*Balanites aegyptiaca*	Hlilaje	Zygophyllaceae	Leaf, fruit, root	Infusion or decoction	Diabetes; Hepatitis	Oral	Purgative and metabolic support	Demoz et al. (2015); Mrabti et al. (2021)
15	*Berberis vulgaris*	Barberry	Berberidaceae	Root	administration of saponins and aqueous extracts	Hypoglycaemic	Oral	significant reduction in blood glucose level and lipid profile	Meliani et al. (2011)
16	*Brassssica juncea*	Indian Mustard	Cruciferae	Seed	aqueous extracts	Hypoglycaemic	Oral	dosage dependent augmenting effect of the seed extract on the serum insulin	Thirumalai et al. (2011)
17	*Citrullus colocynthis*	Colocynth / Hdej	Cucurbitaceae	Fruit, endocarp	Powder (1g/day) or maceration	Diabetes	Oral; Cutaneous	Lowering glucose; cutaneous application for 3 days	Ullah et al. (2019); Skalli et al. (2019)

18	*Cymbopogon citratus*	Lemon grass / Sinda	Poaceae	Entire plant, leaf	Decoction or infusion	Diabetes	Oral	Liquid tonic for metabolic regulation	Mrabti et al. (2021); Demoz et al. (2015)
19	*Catharanthus roseus* (L.) G. Don	Sadabahar	Apocynaceae	Flower	2-3 flowers taken with aloe juice	Diabetes	Oral	Reducing serum protein and blood glucose	Dixit & Tiwari (2020)
20	*Dillenia indica*	Elephant Apple	Dilleniaceae	Leaves	Leaf extract	Diabetes	Oral	Enhanced serum insulin level	Kumar et al. (2011)
21	*Embelia ribes*	False black pepper	Myrsinaceae	Berries	Plant extract	Diabetes	Oral	Reduced blood sugar	Durg et al. (2017)
22	*Gymnema sylvestre*	Gurmar / Medhasingi	Asclepiadaceae	Whole plant, leaf	Decoction or extract	T2DM; Prediabetes	Oral	Beta-cell regeneration and intestinal sugar blocking	Ocvirk et al. (2013); Martinez et al. (2021)
23	*Hybanthus enneaspermus*	Ratanpurush/Spade Flower	Violaceae	Whole plant	Plant extract	Diabetes	Oral	Reduction in blood sugar	Patel et al. (2011)
24	*Hibiscus rosa-sinensis L.*	China rose	Malvaceae	Leaf	Tender fresh leaf juice	Diabetes	Oral	Reduction in blood sugar	Dixit & Tiwari (2020)
25	*Justicia adhatoda*	Asuro / Vashak	Acanthaceae	Leaves	10 ml extract with honey	Diabetes	Oral	Administered 3 times daily	Joshi (2011); Nazar et al. (2024)
26	Lantana camara L.	Wild sage	Verbenaceae	Leaf, Fruit	Consumed raw	Diabetes	Oral	Reduction in blood sugar	Dixit & Tiwari (2020)

27	*Mangifera indica*	Mango / Aam	Anacardiaceae	Seed, leaf, bark	Infusion or powder	Diabetes	Oral	Metabolic support via flavonoid-rich kernels	Ocvirk et al. (2013); Mrabti et al. (2021)
28	*Momordica charantia*	Bitter Melon / Karela	Cucurbitaceae	Unripe fruit	Slices with salt or juice	Diabetes; Prediabetes	Oral	Charantin for insulin-mimetic glucose uptake	Ullah et al. (2019); Joshi (2011); Saqulain et al. (2025)
29	*Moringa oleifera*	Drumstick Tree	Moringaceae	Leaves	Fresh juice or powder	Diabetes	Oral	Nutritional density to slow gastric emptying	Demoz et al. (2015); Mrabti et al. (2021)
30	*Nigella sativa*	Black Seed	Ranunculaceae	Seeds	Powder (1-2 tsp) or oil	T2DM; Prediabetes	Oral	Thymoquinone-mediated antioxidant protection	Kaatabi et al. (2015); Eddouks et al. (2002); Demoz et al. (2015)
31	*Ocimum sanctum*	Holy Basil	Lamiaceae	Aerial part	Leaf powder with honey	Diabetes	Oral	Reduction in blood sugar	Patil et al. (2011)
32	*Phoenix dactylifera*	Date Palm / Nkhl	Arecaceae	Fruits, seed	Decoction or raw	GDM; Diabetes	Oral	Hypoglycemic agent and metabolic tonic	Belhaj et al. (2021); Mrabti et al. (2021)
33	*Psidium guajava*	Guava	Myrtaceae	Leaves	Decoction	Diabetes; Diarrhea	Oral	Standard remedy for glycemic	Demoz et al. (2015); Hoosh

								control and GI issues	mand Ghareb agh (2025)
34	*Sclerocarya birrea*	N'goun an	Anacardi aceae	Bark, roots, leaf	Decocti on or macerat ion	Diabetes ; Hyperten sion	Oral	1 cup of tea taken every night	Dembél é et al. (2026)
35	*Syzygium cumini*	Jamun / Neredu	Myrtace ae	Seeds, fruit	Seed powder (10g/da y)	Diabetes	Oral	Jambolin for halting starch-to-sugar conversi on	Goswa mi et al. (2026); Bailey & Day (1989)
36	*Solanum xanthocarpu m*	Indian nightsha de/ Wild egg plant	Solanace ae	Leave s	Leaf extract	Diabetes	Oral	Antidiab etic	Poongo thai et al. (2011)
37	*Trigonella foenum-graecum*	Fenugre ek / Methi	Fabaceae	Seeds, AP	Decocti on or powder	Diabetes	Oral	Soluble fiber for insulin secretion	Ullah et al. (2019); Demoz et al. (2015)
38	*Vitex negundo*	Chaste tree	Lamiace ae	Leave s	Leaf extract	Diabetes	Oral	Antihype rglycemi c	Sundara m et al. (2012)
39	*Withania somnifera*	Ashwag andha	Solanace ae	Leaf, root	Infusio n or raw	Diabetes	Oral	Manage ment of metaboli c disturban ces	Ocvirk et al. (2013); Demoz et al. (2015)
40	*Zingiber officinale*	Ginger / Zingible	Zingiber aceae	Rhizo me, root	Fresh juice or powder	Diabetes ; Tiredne ss	Oral	Tonic for glycemic regulatio n and stamina	Mrabti et al. (2021); Demoz et al. (2015)

4. Conclusion

In this review traditional medicinal plants used for the treatment of Diabetes mellitus were studied. The traditional medicinal plants are mostly used in rural areas because of the availability of a good amount of medicinal plants in those areas. Therefore, treating Type-II Diabetes with plant derived compounds which are accessible and do not require much laborious pharmaceutical synthesis seems highly attractive. Many of such plants have been explored and scientifically validated. However, still a number of plant species need pharmacological studies to validate their efficacy and potential. In the present study an attempt has been made to investigate the antidiabetic medicinal plants which might be useful to the health professionals, scientists and scholars working in the field of pharmacology and therapeutics to develop antidiabetic drugs.

References

1. Afaf IA, Osman MKM, Elmahdi B. 2008. Effect of *Aloe vera* (Elsabar) Ethanolic Extract on Blood Glucose Level in Wistar Albino Rats. *Journal of Applied Sciences Research*. 4:1841-1845.
2. Akinola OB, Caxton-Martins EA, Dini L. 2010. Chronic Treatment with Ethanolic Extract of the Leaves of *Azadirachta indica* Ameliorates Lesions of Pancreatic Islets in Streptozotocin Diabetes. *International Journal of Morphology*. 28 (1).
3. Alam MR, Rahman A Bin, Moniruzzaman M, Kadir MF, Haque MA, Alvi MR-U-H, Ratan MD. 2012. Evaluation of antidiabetic phytochemicals in *Syzygium cumini* (L.) Skeels (Family: Myrtaceae). *Journal of Applied Pharmaceutical Science*. 2:94.
4. Amod, A., Ascott-Evans, B.H., Berg, G.I., Blom, D.J., Brown, S.L., Carrihill, M.M., Dave, J.A., Distiller, L.A., Ganie, Y.N., Grobler, N., Heilbrunn, A.G., Huddle, K.R.L., Janse van Rensburg, G., Jivan, D., Joshi, P., Khutsoane, D.T., Levitt, N.S., May, W.M., Mollentze, W.F., Motala, A.A., Paruk, I.M., Pirie, F.J., Raal, F.J., Rauff, S., Raubenheimer, P.J., Randeree, H.A.R., Rheeder, P., Tudhope, L., Van Zyl, D.J., Young, M., 2012. The 2012 SEMDSA guideline for the management of Type 2 diabetes (Revised). *J. Endocrinol. Metabol. Diabetes South Africa* 17, S1–S95.
5. Anand P, Murali KY, Tandon V, Chandra R, Murthy PS. Preliminary studies on antihyperglycemic effect of aqueous extract of *Brassica nigra* (L.) Koch in streptozotocin induced diabetic rats. *Indian J Exp Biol*. 2007 Aug;45(8):696-701. PMID: 17877146.
6. Arshad MT, Maqsood S, Ikram A, Gnedeka KT. Recent Perspectives on the Pharmacological, Nutraceutical, Functional, and Therapeutic Properties of *Moringa oleifera* Plant, 2025. *Food Sci Nutr*.;13(4):e70134. doi: 10.1002/fsn3.70134. PMID: 40248126; PMCID: PMC12003216.
7. Aruljothi B, Samipillai SS. Antidiabetic activity of *Catharanthus roseus* in alloxan induced diabetic rats. *Int J Modn Res Revs.* 2016 Jan;4(3):1121-1124.
8. Arumugam, G., Manjula, P., Paari, N., 2013, A review: Anti diabetic medicinal plants used for diabetes mellitus, *Journal of Acute Disease* (2013)196-200.
9. Atangwho IJ, Ebong PE, Eyong EU, Egbung GE. 2010. Combined extracts of *Vernonia amygdalina* and *Azadirachta indica* may substitute insulin requirement in the management of type I diabetes. *Research Journal of Medicine and Medical Sciences*. 5(1):35-9.
10. Babu PS, Srinivasan K. 1997. Hypolipidemic action of curcumin, the active principle of turmeric (*Curcuma longa*) in streptozotocin induced diabetic rats. *Molecular and Cellular Biochemistry*. 166:169-175.

11. Bahmani, M., Zargaran A., Rafieian-Kopaei, M., Saki, K., 2014, Ethnobotanical study of medicinal plants used in the management of diabetes mellitus in the Urmia, Northwest Iran, *Asian Pac J Trop Med*; 7 (Suppl 1): S348-S354.
12. Belhaj, S., Noureddine Chaachouay N., Zidane, L. 2021. Ethnobotanical and toxicology study of medicinal plants used for the treatment of diabetes in the High Atlas Central of Morocco. *Journal of Pharmacy & Pharmacognosy Research*. 9 (5), 619-662.
13. Bisht S, Sisodia SS. 2010. Anti-hyperglycemic and antidyslipidemic potential of *Azadirachta indica* leaf extract in STZ-induced diabetes mellitus. *Journal of Pharmaceutical Sciences and Research*. 2(10):622.
14. Chattopadhyay RR, Bandyopadhyay M. 2005. Effect of *Azadirachta indica* leaf extract on serum lipid profile changes in normal and streptozotocin induced diabetic rats. African Journal of biomedical Research. 8(2):101-104.
15. D.A. Amanlikova, M.J. Oripova, D.G. Abdugafurova, G.G. Rakhmonova. 2026. Antidiabetic and Hypoglycemic Activity of Protein Isolate from *Berberis vulgaris* Fruits. *Science and Innovation*, 5(5), 75-79. https://doi.org/10.5281/zenodo.20303041
16. Deb, L., Bhattacharjee, C., Shetty, S.R. and Dutta, A.,2013. Evaluation of Anti-Diabetic Potential of The *Syzygium cuminii* (Linn) Skeels By Reverse Pharmacological Approaches, *Bulletin of Pharmaceutical Research*, 3(3):135-45
17. Dembélé, A.A, Togola, I., Konaré,M.A., Samaké, S. and Diarra, N. 2026. Ethnobotanical knowledge of medicinal plants used in the management of hypertension and diabetes in the district of Bamako, Mali. *Scientific Research and Essays*, 21(1), 1-13
18. Demoz, M. S., Gachoki, K. P., Mungai, K. J., & Negusse, B. G. 2015. Ethnobotanical survey and preliminary phytochemical studies of plants traditionally used for diabetes in Eritrea. *European Journal of Medicinal Plants*, *9*(2), 1–11.
19. Demoz, S.M., Kareru, P.G., Kericko, J.M., and Negusse, B. G. 2015. Evaluation of the Anti-diabetic Potential of the Methanol Extracts of *Aloe camperi*, *Meriandra dianthera* and a Polyherb. *Journal of Diabetes Mellitus*, 05(04):267-276
20. Dixit S, Tiwari S. Investigation of anti-diabetic plants used among the ethnic communities of Kanpur division, India. *Journal of Ethnopharmacology*. 2020 May 10;253:112639.
21. Dixit S, Tiwari S. 2020. Review on Plants for Management of Diabetes in India: An Ethno-Botanical and Pharmacological Perspective. *Pharmacogn J*. 12(6)Suppl:1801-10.
22. Dulić, M., Ciganović, P., Vujić, L., & Zovko Končić, M. 2019. Antidiabetic and Cosmeceutical Potential of Common Barbery (*Berberis vulgaris* L.) Root Bark Extracts Obtained by Optimization of 'Green' Ultrasound-Assisted Extraction. *Molecules*, *24*(19), 3613. https://doi.org/10.3390/molecules24193613
23. Durg S, Veerapur VP, Neelima S, Dhadde SB. 2017. Antidiabetic activity of *Embelia ribes*, embelin and its derivatives: A systematic review and meta-analysis. *Biomed Pharmacother*.; 86:195-204. doi: 10.1016/j.biopha.2016.12.001. Epub 2016 Dec 13. PMID: 27984799.
24. Ebong PE, Atangwho IJ, Eyong EU, Egbung GE. 2008. The antidiabetic efficacy of combined extracts from two continental plants: *Azadirachta indica* (A. Juss) (Neem) and *Vernonia amygdalina* (Del.)(African bitter leaf). *American journal of Biochemistry and Biotechnology*. 4(3):239-44.
25. Eddouks, M., Maghrani, M., Lemhadri, A., Ouahidi, M. L., & Jouad, H. 2002. Ethnopharmacological survey of medicinal plants used for the treatment of diabetes mellitus,

hypertension and cardiac diseases in the south-east region of Morocco (Tafilalet). *Journal of Ethnopharmacology*, *82*(2-3), 97–103.

26. El Batran SA, El-Gengaihi SE, El Shabrawy OA. 2006. Some toxicological studies of *Momordica charantia* L. on albino rats in normal and alloxan diabetic rats. *Journal of ethnopharmacology*.108(2):236-42.
27. El-Demerdash FM, Yousef MI, El-Naga NIA. 2005. Biochemical study on the hypoglycemic effects of onion and garlic in alloxan-induced diabetic rats. *Food and Chemical Toxicology*. 43:57-63.
28. Eldin IMT, Ahmed EM, Abd EHM. 2010. Preliminary study of the clinical hypoglycemic effects of *Allium cepa* (red onion) in type 1 and type 2 diabetic patients. *Environmental Health Insights*. 4:EHIS5540.
29. Fallah Huseini, H., Kianbakht, S., Hajiaghaee, R., Afkhami-Ardekani, M., Bonakdaran, A., & Hashem Dabaghian, F. (2012). *Aloe vera* leaf gel in treatment of advanced type 2 diabetes mellitus needing insulin therapy: A randomized double-blind placebo-controlled clinical trial. *Journal of Medicinal Plants*, *11*(43), 19–27.
30. Gajbhiye, R.L., Ganapathy, A., Jaisankar, P., 2018. A review of alpha-glucosidase and alpha-amylase inhibitors for Type 2 diabetes isolated from some important Indian medicinal plants. *Ann. Clin. Pharmacol. Therapeutics* 1, 1003.
31. Ganesh T, Sen S, Thilagam E, Thamotharan G, Loganathan T, Chakraborty R. 2010. Pharmacognostic and anti-hyperglycemic evaluation of *Lantana camara* (L.) var. aculeate leaves in alloxan-induced hyperglycemic rats. International Journal of Research in Pharmaceutical Sciences.1(3):247-52.
32. Gaytán Martínez, L. A., Sánchez-Ruiz, L. A., Zuñiga, L. Y., González-Ortiz, M., & Martínez-Abundis, E. 2021. Effect of *Gymnema sylvestre* administration on glycemic control, insulin secretion, and insulin sensitivity in patients with impaired glucose tolerance. *Journal of Medicinal Food*, *24*(1), 28–32.
33. Goswami, K., Wadhawan, N., Saini, A. K., & Barala, S. 2026. Effect of Jamun (*Syzygium cumini*) seed powder on glycaemic index and insulin sensitivity in type 2 diabetes. *International Journal of Advanced Biochemistry Research*, *SP-10*(6), 1094–1100.
34. Gupta P, Yadav DK, Siripurapu KB, Palit G, Maurya R. 2007. Constituents of *Ocimum sanctum* with antistress activity. *Journal of natural products*. 70(9):1410-6.
35. Hooshmand Gharebagh, L. 2025. An ethnobotanical review of medicinal plants traditionally used for diabetes management in southern Iran. *Journal of Biochemicals and Phytomedicine*, *4*(1), 23–30. https://doi.org/10.34172/jbp.2025.4
36. Joshi, K. 2011. Ethnobotanical study of plants used for the treatment of diabetes mellitus in the mountainous regions of Nepal. *Journal of Non-timber Forest Products*, *18*(1), 19–26.
37. Kaatabi, H., Bamosa, A. O., Badar, A., Al-Elq, A., Abou-Hozaifa, B., Lebda, F., Al-Khadra, A., & Al-Almaie, S. 2015. *Nigella sativa* improves glycemic control and ameliorates oxidative stress in patients with type 2 diabetes mellitus: Placebo controlled participant blinded clinical trial. *PLoS ONE*, *10*(2), e0113486.
38. Kamau, L.N., Mbaabu, P.M., Karuri, P.G., Mbaria, J.M., Kiama, S.G., 2017. Medicinal plants used in the management of diabetes by traditional healers of Narok County, Kenya. *Tang Medicine* 7, e10.

39. Kasole, R., Martin, H.D., Kimiywe, J., 2019. Traditional medicine and its role in the management of diabetes mellitus: "patients' and herbalists' perspectives". Evidence-Based Complement. *Alternat. Med.* 2835691.
40. Kazemi S, Asgary S, Moshtaghian J, Rafieian M, Adelnia A, Shamsi F. 2010. Liver-protective effects of hydroalcoholic extract of *Allium hirtifolium* Boiss. In rats with alloxan-induced diabetes mellitus. *ARYA Atheroscler* 6(1): 11-15.
41. Keter, L.K., Mutiso, P.C., 2012. Ethnobotanical studies of medicinal plants used by traditional health practitioners in the management of diabetes in Lower Eastern Prov-ince, Kenya. *J. Ethnopharmacol*. 139, 74–80.
42. Kumar A, Rana AK, Singh A, Singh A. 2019. Bioactivity of methanolic extract of *Brassica juncea* in animal model of diabetes mellitus. *Chinese Herbal Medicines*. 11(4):434-7.
43. Kumar KV, Sharief SD, Rajkumar R, Ilango B, Sukumar E. 2010. Antidiabetic potential of *Lantana aculeata* root extract in alloxan-induced diabetic rats. *International Journal of Phytomedicine.* 2(3).
44. Kumar S, Kumar V, Om Prakash. 2011. Antidiabetic, hypolipidemic and histopathological analysis of *Dillenia indica* (L.) leaves extract on alloxan induced diabetic rats. *Asian Pac J Trop Med.* 347-352.
45. Kumari K, Mathew BC, Augusti KT. 1995. Antidiabetic and hypolipidemic effects of S-methyl cysteine sulfoxide isolated from *Allium cepa* Linn. *Indian Journal of Biochemistry and Biophysics.* 32:49-54.
46. Matheka DM, Alkizim FO, Kiama TN, Bukachi F. 2012. Glucose-lowering effects of *Momordica charantia* (Karela) extract in diabetic rats. African Journal of Pharmacology and Therapeutics. 1(2): 62-66.
47. Mehta SR, Kashyap AS, Das S. 2009. Diabetes mellitus in India: The modern scourge. Medical journal armed forces India. 65(1):50-4.
48. Meliani N, Amine Dib ME, Allali H, Tabti B. 2011. Hypoglycaemic effect of *Berberis vulgaris* L. in normal and streptozotocin induced diabetic rats. *Asian Pac J Trop Biomed.* 6:468-471.
49. Misawa E, Tanaka M, Nomaguchi K, Yamada M, Toida T, Takase M, Iwatsuki K, Kawada T. 2008. Administration of phytosterols isolated from *Aloe vera* gel reduce visceral fat mass and improve hyperglycemia in Zucker diabetic fatty (ZDF) rats. *Obesity research & clinical practice*. 2(4):239-45.
50. Mishra, J., Mahalik, G., Parida. S., 2019. Ethnobotanical Study of Traditional Medicinal Plants Used In The Management of Diabetes In The Urban Areas of Khurda, Odisha, India, *Asian J Pharm Clin Res, Vol 12, Issue 9, 73-78*
51. Moqbel FS, Naik PR, Najma HM, Selvaraj S. 2011. Antidiabetic properties of *Hibiscus rosa sinensis* L. leaf extract fractions on non-obese diabetic (NOD) mouse. Indian J Exp Biol. 49(1):24-9.
52. Morey SC. 1997. ADA recommends a lower fasting glucose value in the diagnosis of diabetes mellitus. *Am Fam Physician*. 56(8): 2128, 2130.
53. Mowl A, Alauddin M, Rahman M, Ahmed K. 2009. Antihyperglycemic effect of Trigonella foenumgraecum (Fenugreek) seed extract in alloxaninducedbdiabetic rats and its use in diabetes mellitus: a brief qualitative phytochemical and acute toxicity test on the extract. *African Journal of Traditional Complement and Alternative Medicines*. 6(3):255-61.

54. Naceiri Mrabti, H.; Bouyahya, A.; Naceiri Mrabti, N.; Jaradat, N.; Doudach, L.; Faouzi, M.E.A. 2021. Ethnobotanical survey of medicinal plants used by traditional healers to treat diabetes in the Taza region of Morocco. *Evid. Based Complement. Altern. Med.* 2021:5515634.
55. Nagarathna R, Tyagi R, Battu P, Singh A, Anand A, Nagendra HR. 2020. Assessment of risk of diabetes by using Indian Diabetic risk score (IDRS) in Indian population. *Diabetes Research and Clinical Practice*. 162:108088.
56. Nazar, A., Adnan, M., Shah, S. M., Bari, A., Ullah, R., Tariq, A., & Ahmad, N. 2024. Ethnobotanical assessment of antidiabetic medicinal plants in District Karak, Pakistan. *BMC Complementary Medicine and Therapies*, *24*(1), 173. https://doi.org/10.1186/s12906-024-04462-w
57. Nwajo HU. 2006. Antioxidant activity of the exudates from Aloe barbadensis leaves in diabetic rats. Biokemistri. 18.
58. Ocvirk, S., Kistler, M., Khan, S., Talukder, S. H., & Hauner, H. (2013). Traditional medicinal plants used for the treatment of diabetes in rural and urban areas of Dhaka, Bangladesh – an ethnobotanical survey. *Journal of Ethnobiology and Ethnomedicine*, *9*(1), Article 43. https://doi.org/10.1186/1746-4269-9-43
59. Ogunmodede OS, Saalu LC, Ogunlade B, Akunna GG, Oyewopo AO. 2012. An evaluation of the hypoglycemic, antioxidant and hepatoprotective potentials of onion (Allium cepa L.) on alloxaninduced diabetic rabbits. International Journal of Pharmacology. 8:21-29.
60. Ohadoma SC, Michael HU. Effects of co-administration of methanol leaf extract of Catharanthus roseus on the hypoglycemic activity of metformin and glibenclamide in rats. Asian Pac J Trop Med 2011; 475-477.
61. Parasuraman S, Balamurugan S, Christapher PV, Petchi RR, Yeng WY, Sujithra J, Vijaya C. Evaluation of Antidiabetic and Antihyperlipidemic Effects of Hydroalcoholic Extract of Leaves of Ocimum tenuiflorum (Lamiaceae) and Prediction of Biological Activity of its Phytoconstituents. Pharmacognosy Res. 2015 Apr-Jun;7(2):156-65. doi: 10.4103/0974-8490.151457. PMID: 25829789; PMCID: PMC4357966.
62. Patel DK, Kumar R, Prasad SK, Sairam K, Hemalatha S. Antidiabetic and in vitro antioxidant potential of Hybanthus enneaspermus (Linn) F. Muell in streptozotocin-induced diabetic rats. Asian Pac J Trop Med 2011; 4: 316-322.
63. Patil R, Patil R, Ahirwar B, Ahirwar D. Current status of Indian medicinal plants with antidiabetic potential: a review. Asian Pacific Journal of Tropical Biomedicine. 2011 Oct 1;1(2):S291-8.
64. Patil R, Patil R, Ahirwar B, Ahirwar D. Isolation and characterization of anti-diabetic component (bioactivity guided fractionation) from Ocimum sanctum L. (Lamiaceae) aerial part. Asian Pac J Trop Med 2011; 278-282.
65. Patil RN, Patil RY, Ahirwar B, Ahirwar D. Evaluation of antidiabetic and related actions of some Indian medicinal plants in diabetic rats. Asian Pacific Journal of Tropical Medicine. 2011 Jan 1;4(1):20-3.
66. Patil RN, Patil RY, Ahirwar D. Study of some medicinal plants for antidiabetic activity in alloxan induced diabetes. Pharmacologyonline. 2010;1(1):53-60.
67. Pérez YY, Jiménez-Ferrer E, Zamilpa A, Hern.ndez-Valencia M, Alarc.n-Aguilar FJ, Tortoriello J, Rom.n-Ramos R. 2007. Effect of a polyphenol-rich extract from Aloe vera gel on experimentally induced insulin resistance in mice. American Journal of Chinese Medicines. 35:1037-1046.

68. Poongothai K, Ponmurugan P, Syed Zameer Ahmed K, Senthil Kumar B, Sheriff SA. Antihyperglycemic and antioxidant effects of Solanum xanthocarpum leaves (field grown & in vitro raised) extracts on alloxan induced diabetic rats. Asian Pac J Trop Med 2011; 778-785.
69. Rajasekaran S, Ravi K, Sivagnanam K, Subramanian S. Beneficial effects of Aloe vera leaf gel extract on lipid profile status in rats with streptozotocin diabetes. Clinical and Experimental Pharmacology and Physiology. 2006 Mar;33(3):232-7.
70. Rajendran A, Narayanan V, Gnananvel I. Evaluation of therapeutic efficacy of Aloe vera sap in diabetes and treating wounds and inflammation in animals. J Appl Sci Res. 2007;3(11):1434-6.
71. Rehana D, Mahendiran D, Kumar RS, Rahiman AK. In vitro antioxidant and antidiabetic activities of zinc oxide nanoparticles synthesized using different plant extracts. Bioprocess and biosystems engineering. 2017 Jun 1;40(6):943- 57.
72. Saqulain, S., Verma, M., Singh, H., Dharmalingam, S., M. J., E., Srivastav, Y., Krishna, K. V. V. S., Ghadge, T., & Kumar, A. (2025). Therapeutic role of *Gymnema sylvestre* and *Momordica charantia* in diabetes management: A detailed review of their mechanisms in insulin resistance, glucose metabolism regulation, and clinical efficacy in type 2 diabetes mellitus. *International Journal of Pharmaceutical Sciences*, *3*(2), 1769–1783.
73. Sathiavelu A, Sangeetha S, Archit R, Mythili S. 2013. In vitro anti-diabetic activity of aqueous extract of the medicinal plants Nigella sativa, Eugenia jambolana, Andrographis paniculata and Gymnema sylvestre.International Journal of Drug Development and Research. 5:323-328.
74. Sathishsekar D, Subramanian S. Antioxidant properties of Momordica Charantia (bitter gourd) seeds on Streptozotocin induced diabetic rats. Asia Pacific journal of clinical nutrition. 2005 Jun 1;14(2):153.
75. Shinde VS, Borkar AS, Badwaik RT. 2014. Evaluation and comparative study of hypoglycemic activity of aloe Barbadensis Miller with oral hypoglycemic drugs (glibenclamide and metformin) in rats. International Journal of Medical Research and Pharmaceutical Sciences. 4:31-36.
76. Singh SN, Vats P, Suri S, Shyam R, Kumria MM, Ranganathan S, Sridharan K. Effect of an antidiabetic extract of Catharanthus roseus on enzymic activities in streptozotocin induced diabetic rats. Journal of Ethnopharmacology. 2001 Aug 1;76(3):269-77.
77. Skalli, S., Hassikou, R., & Arahou, M. (2019). An ethnobotanical survey of medicinal plants used for diabetes treatment in Rabat, Morocco. *Heliyon*, *5*(3), e01421.
78. Srinivasan K, Ramarao P. Animal models in type 2 diabetes research: an overview. Indian J Medical Res 2007; 125(3): 451-472.
79. Sundaram R, Naresh R, Shanthi P, Sachdanandam P. Antihyperglycemic effect of iridoid glucoside, isolated from the leaves of Vitex negundo in streptozotocininduced diabetic rats with special reference to glycoprotein components. Phytomedicine 2012; 19(3-4): 211-216.
80. Tabeshpour J, Imenshahidi M, Hosseinzadeh H. A review of the effects of *Berberis vulgaris* and its major component, berberine, in metabolic syndrome. Iran J Basic Med Sci. 2017 May;20(5):557-568. doi: 10.22038/IJBMS.2017.8682. PMID: 28656091; PMCID: PMC5478784.
81. Thirumalai T, Therasa VS, Elumalai EK, David E. Hypoglycemic effect of Brassica juncea (seeds) on streptozotocin induced diabetic male albino rat. Asian Pac J Trop Biomed 2011; 4: 323-325.
82. Tiong SH, Looi CY, Hazni H, Arya A, Paydar M, Wong WF, Cheah SC, Mustafa MR, Awang K. Antidiabetic and antioxidant properties of alkaloids from Catharanthus roseus (L.) G. Don. Molecules. 2013 Aug;18(8):9770-84.

83. Tolambiya P, Mathur S. A study on potential phytopharmaceuticals assets in Catharanthus roseus L.(Alba). Int J Life Sci Biotechnol Pharm Res. 2016 Jun;5(1):1-6.
84. Ullah, M., Mehmood, S., Ali, M., Bussmann, R. W., Aldosari, A., Khan, R.A., Ullah, R., Hussain, W., Shah, M.A.R., 2019, An ethnopharmacological study of plants used for treatment of diabetes in the Southern and Tribal regions of Khyber Pakhtunkhwa province, Pakistan Ethnobotany Research and Applications, http://dx.doi.org/10.32859/era.18(8)1-20
85. Venkatachalam T, Kumar VK, Selvi PK, Maske AO, Anbarasan V, Kumar PS. Antidiabetic activity of Lantana camara Linn fruits in normal and streptozotocin induced diabetic rats. J Pharm Res. 2011 May;4(5):1550-2.
86. Venkatesh S, Thilagavathi J. Anti-diabetic activity of flowers of Hibiscus rosasinensis. Fitoterapia. 2008 Feb 1;79(2):79-81.
87. Villegas-Vazquez EY, Gómez-Cansino R, Marcelino-Pérez G, Jiménez-López D, Quintas-Granados LI. Unveiling the Miracle Tree: Therapeutic Potential of *Moringa oleifera* in Chronic Disease Management and Beyond. Biomedicines. 2025 Mar 5;13(3):634. doi: 10.3390/biomedicines13030634. PMID: 40149610; PMCID: PMC11939887.
88. Wang L, Clardy A, Hui D, Gao A, Wu Y. Antioxidant and antidiabetic properties of Chinese and Indian bitter melons (Momordica charantia L.). Food Bioscience. 2019 Jun 1;29:73-80.
89. WHO (2015). World Health Organization: Diabetes, Fact sheet N°312, Updated January 2015.
90. Yatoo MI, Saxena A, Gopalakrishnan A, Alagawany M, Dhama K. Promising antidiabetic drugs, medicinal plants and herbs: An update. International Journal of Pharmacology. 2017 Jan 1;13(7):732-45.
91. Yuan X, Gu X, Tang J. Optimization of the production of Momordica charantia L. Var. abbreviata Ser. protein hydrolysates with hypoglycemic effect using Alcalase. Food chemistry. 2008 Nov 15;111(2):340-4.
92. Zain-ul-Abidin, S., Khan, R., Ahmad, M., Bhatti, M.S., Zafar, M., Saeed, A. & Khan, N., 2018, Ethnobotanical survey of highly effective medicinal plants and phytotherapies to treat diabetes mellitus II in South-West Pakistan, *Indian Journal of Traditional Knowledge*, Vol. 17(4), pp. 682-690