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Review on Antidiabetic Potential on Some Medicinal Plants

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ABSTRACT

Plants are used traditionally throughout the globe to treat various diseases. Traditionally used medicinal plants are an essential part of the health sector in Bangladesh due to their abundance of a vast source of ethnomedicine. Diabetes mellitus is one of the major health problems in the world, the incidence, and associated mortality are increasing. Inadequate regulation of blood sugar imposes serious consequences for health. Conventional antidiabetic drugs are effective, however, they also with unavoidable side effects. On the other hand, medicinal plants may act as an alternative source of antidiabetic agents. There is an increasing demand to use natural antidiabetic agents. The literature about antidiabetic herbs is scattered. The present article is a conglomeration of available indigenous literature. It also presents some common plants used in diabetes and the future of hypoglycaemic herbal drugs.

INTRODUCTION:

Ethnobotanical research has been increased recently at greater diversity not only at the national level but also at the international level. A number of the literature revealed that there is a significant gap exists between scientific validation of ethnomedicine and its uses. Herbal medicines with nutritional value are now away also used for their pharmacological properties to improve health status [1,2]. Thus plants are used as both food and medicine simultaneously [2,3].

Etymologically, the term diabetes can be defined as "pass-through". The word diabetes has been derived from the Greek Word ('dial means through; 'bites means pass). More appropriately it has been defined as the secretion of an inordinate quantity of sweet-tasting, urine with a peculiar smell, accompanied with great thirst, dryness of skin, extreme debility, and general emaciation. In diabetes, the deficiency of insulin leads to a complex series of reactions which are clinically manifested as hyperglycemia [4]. Metabolic changes caused by hyperglycemia are called diabetes mellitus and the hyperglycemia may cause defects in insulin action or secretion or both cases. The available hypoglycemic agents used worldwide such as metformin, sulfonylureas, and glucosidase inhibitors have serious adverse effects such as diabetic ketoacidosis, diarrhea, and various diabetes complications [5].

TYPES OF DIABETES, PREVALENCE, AND MANAGEMENT

There are various types of diabetes of which type 1 DM (T1DM) and type 2 DM (T2DM) were the most usually discussed. T1DM is also known as insulin-dependent diabetes. It is primarily due to pancreatic islet beta-cell destruction and is characterized by deficient insulin production in the body [6]. Patients with T1DM are prone to ketoacidosis and need daily administration of insulin to control the amount of glucose in their blood. The majority of T1DM occurs in children and adolescents [7].

On the other hand, T2DM, also known as non-insulin-dependent diabetes, results from the body's effective use of insulin and hyperglycemia [8,9] and accounts for the vast majority of people with diabetes around the world. Insulin resistance is due to the reduced responsiveness of target tissues to normal circulating levels of insulin [9]. Ethnicity, family history of diabetes, and previous gestational diabetes, older age, overweight and obesity, unhealthy diet, physical inactivity, and smoking increase diabetes risk. Most people with diabetes are erected

by T2DM diabetes (90%), which usually occurs nearly entirely among adults but, these days is increasing in children [7].

The universal prevalence of diabetes has nearly doubled since 1980, rising from 4.7% to 8.5% in the adult population. Moreover, the prevalence of diabetes has also been found to steadily increase for the past 3 decades and has risen faster in low- and middle-income countries compared to high-income countries. The increase in the prevalence of diabetes is parallel with an increase in associated risk factors such as being overweight or obese. If not properly treated or controlled, diabetes may cause blindness, kidney failure, lower limb amputation, and other long-term consequences that impact significantly on the quality of life [10].

Interestingly, the WHO also projects that diabetes will be the seventh leading cause of death in 2030 [11]. The incidence and prevalence of diabetes have continued to increase globally, despite a great deal of research with the resulting burden resting more heavily on tropical developing countries [12,13]. Based on demographic studies, by 2030, the number of people older than 64 years with diabetes will be greater in developing countries (82 million) in comparison to that in developed countries (48 million). The greatest relative increases are projected to occur in the Middle East Crescent, sub-Saharan Africa, and India [14,15]. Amongst all people with diabetes, T2DM accounts for the majority (90%) of cases, and these can be prevented as well as treated easily, while T1DM cannot be prevented with current knowledge.

Since management of diabetes is complex and multidisciplinary, it should include primary prevention through the promotion of a healthy diet and lifestyle (such as exercise). Dietary management and exercise represent important pillars of care and are crucial in the treatment of T2DM, and both may be adequate to attain and retain the therapeutic goals to normolipidemic and normoglycemia.

PLANTS ON DIABETES MELLITUS

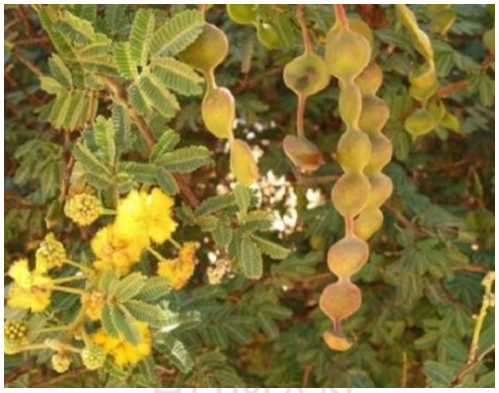
Natural products are the major mine for discovering promising lead candidates, which play an important role in future drug development programs. Ease of availability, least side effects, and low cost make the herbal preparations are the main key player of all available therapies, especially in rural areas. The aim of this review is not to mention all the anti-diabetic plants previously discussed in detail in the textbook “Traditional Medicines for Modern Times

Antidiabetic Plants", but we will shed light on the most relevant data related to these popular plants [16, 17].

Aloe vera (*Aloe barbadensis*-Asphodelaceae): Aloe vera extract was evaluated in streptozotocin-induced diabetic mice and mouse embryonic NIH/3T3 cells [896]. Administration of an extract at a dosage of 130 mg/kg per day for four weeks resulted in a significant decrease in blood glucose, TG, LDL, and TC, an effect comparable to that of metformin. Moreover, this study showed that a lyophilized aqueous aloe extract (1 mg/mL) upregulated GLUT-4 mRNA synthesis in NIH/3T3 cells. In a more recent study, Aloe vera extract (300 mg/kg) exerted antidiabetic effects by improving insulin secretion and pancreatic cell function by restoring pancreatic islet mass in streptozotocin-induced diabetic rats [18].

Avocado (*Persea americana*-Lauraceae): The hydroalcoholic extract of the leaves of Persea americana (0.15 and 0.3 g/kg, p.o. daily for 4 weeks) reduced blood glucose levels in streptozotocin-induced diabetic rats [19]. The extract did not affect the plasma insulin level, suggesting that the hypoglycemic effect was due to extrapancreatic activity, independent of insulin secretion. Additionally, the extract improved the metabolic state of diabetic animals and increased body weight. In another study, the aqueous extract of Persea americana seeds significantly decreased glucose levels and reversed the histopathological damage that occurred in alloxan-induced diabetic rats, comparable to the effects of glibenclamide [20].

Babul (*Acacia arabica*-Fabaceae): Two doses of chloroform extracts of Acacia arabica (250 and 500 mg/kg, p.o. (orally) for two weeks) were evaluated in alloxan-induced diabetic albino rats [21]. The results of this study showed an antidiabetic effect in the two doses tested, decreasing serum glucose level and restoring TC, TG, and high-density lipoprotein (HDL) and low-density lipoprotein (LDL) levels. Additionally, in this study chloroform extracts of Benincasa hispida fruit, Tinospora cordifolia stem, Ocimum sanctum aerial parts, and Jatropha curcus leaves were evaluated, showing similar effects. In another study performed in streptozotocin-induced diabetic rats, the extract of Acacia arabica (100 and 200 mg/kg, p.o. for 21 days) provoked a significant decrease in serum glucose, TC, TG, LDL, and malonyl dialdehyde (MDA) levels and a significant increase in HDL and coenzyme Q10 in a dose-dependent manner [22].



Bitter-Melon (*Momordica charantia*-Cucurbitaceae): One study evaluated the antihyperglycemic and antioxidative potential of aqueous extracts of Momordiccharantia pulp and Trigonella foenum-graecum seed in alloxan-induced diabetic rats [23]. The Momordica charantia extract treatment for 30 days significantly decreased the blood glucose levels and showed antioxidant potential to protect vital organs such as the heart and kidney against damage caused by diabetes-induced oxidative stress. Furthermore, a similar activity was found with the Trigonella foenum-graecum extract treatment.

Chaff-flower (*Achyranthes rubrofusca*-Amaranthaceae): Hypoglycemic activity of the aqueous and ethanolic extracts of Achyranthes rubrofusca leaves was studied in alloxan-induced diabetic rats [24]. The two extracts (200 mg/kg, p.o. for 28 days) significantly decreased the blood glucose level and increased pancreatic enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione levels. Better results were obtained with the aqueous extract but were not statistically significant.

Camel's foot tree(*Bauhinia thoningii*-Fabaceae): A study conducted on alloxan-induced diabetic rats showed the antidiabetic effect of an aqueous leaf extract from Bauhinia thoningii [25]. The extract administered orally at a dose of 500 mg/kg for seven days provoked a significant reduction in blood glucose, LDL, and coronary risk index.

Cashew (*Anacardium occidentale*-Anacardiaceae): Hypoglycemic role of Anacardium occidentale was reported in streptozotocin-induced diabetic rats [26]. The rats were treated with 175 mg/kg of the aqueous extract, twice daily, beginning 2 days before streptozotocin injection. Three days after streptozotocin administration, there was a significantly lower blood glucose level in pretreated rats compared to control diabetic rats. Moreover, the treatment prevented glycosuria, bodyweight loss, polyphagia, and polydipsia. A more recent study performed with 100 mg/kg of methanol extract for 30 days showed a decrease of blood glucose levels of streptozotocin-induced diabetic rats and comparable effects to the standard drug Pioglitazone [27].

Caucasian whortleberry (*Vaccinium Arctostaphylos*-Ericaceae): The effects of ethanolic extract of Vaccinium Arctostaphylos fruit was investigated in alloxan-diabetic rats for three weeks [28]. The treatment significantly decreased the blood glucose and TG levels and increased the erythrocyte SOD, glutathione peroxidase, CAT activities, and expression of GLUT-4 and insulin genes.

Date Palm (*Phoenix dactylifera*-Arecaceae): Antidiabetic effects of leaf extract of Phoenix dactylifera at 100, 200, and 400 mg/kg, p.o. and its fractions at 50, 100, and 200 mg/kg, p.o. for 14 days treatment were evaluated in alloxan-induced diabetic rats [29]. The treatment showed a significant reduction of blood glucose, TC, and TG levels and water intake and a significant increase in plasma insulin levels compared to the control group.

Drumstick Tree (*Moringa oleifera*-Moringaceae): One study investigated the antidiabetic and antioxidant effects of methanol extracts of Moringa oleifera pods (150 and 300 mg/kg, p.o. for 21 days) in streptozotocin-induced diabetic rats [30].

Fenugreek (*Trigonella foenum-graecum*-Fabaceae): The antidiabetic effects of ethanol extract of Trigonella foenum-graecum seeds in alloxan-induced diabetic rats at different doses (0.1, 0.5, 1, and 2 g/kg) were evidenced, showing significant blood glucose-lowering capacity. Moreover, the hydroalcoholic extract of Trigonella foenum-graecum seed attenuates markers of inflammation and oxidative stress while improving exocrine function in alloxan-induced diabetic rats [31].

Gale Of Wind (Phyllanthus niruri-Euphorbiaceae): The methanol extract of aerial parts of Phyllanthus niruri was evaluated in alloxan-induced diabetic rats [32]. The results of this study showed a significant reduction of blood glucose, TC, and TG levels in a dose-related manner. Moreover, histological analyses showed that that extract had imparted cell regenerative power. In another study was observed that a Phyllanthus niruri leaf aqueous extract improves kidney functions; ameliorates kidney oxidative stress, inflammation, fibrosis, and apoptosis; and enhances kidney cell proliferation in adult male rats with diabetes [33].

Golden Shower Tree (*Cassia fistula*-Fabaceae): Alcoholic extracts of stem bark of Cassia fistula administered to alloxan-induced diabetic rats at 250 or 500 mg/kg for 21 days significantly decreased blood glucose levels [34]. The extract also recovered normal levels of serum cholesterol, TG, creatinine, albumin, total proteins, and body weight. Moreover, the alcoholic extract showed significant antioxidant activity by reducing 2,2-diphenyl-1-picrylhydrazyl (DPPH), nitric oxide, and hydroxyl radical-induced in vitro.

Gurmarbooti (*Gymnemasylvestre*-Apocynaceae): An ethanolic extract of Gymnemasylvestre leaf (100 mg/kg, p.o. for 4 weeks) was examined in vitro and in vivo to investigate the role of antioxidants in streptozotocin-induced diabetic rats [35]. The ethanol extract showed antihyperglycemic activity and improved the antioxidant status in diabetic rats. Moreover, the extract showed in vitro antioxidant activity in thiobarbituric acid (TBA), SOD, and 2,2-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid assays.

Harra (*Terminalia chebula*-Combretaceae): Chloroform extract of Terminalia chebula seed powder in streptozotocin-induced diabetic rats (100, 200, and 300 mg/kg) significantly reduced the blood glucose level in a dose-dependent manner and presented a potent renoprotective action [36].

Indian jujube (*Zizyphusmauritiana* -Rhamnaceae): Petroleum ether and aqueous extract of Zizyphusmauritiana (200 and 400 mg/kg, p.o. for seven days) in alloxan-induced diabetic rats significantly restored elevated biochemical parameters such as glucose, urea, creatinine, TC, TG, HDL, LDL, hemoglobin, and glycosylated hemoglobin [37].

Indian Screw Tree (*Helicteresisora*-Sterculiaceae): Butanol and aqueous ethanol extracts of Helicteresisora root (250 mg/kg, p.o. for 10 days) were investigated in alloxan-induced diabetic rats [38]. The two treatments reduced blood glucose, TC, TG, and urea levels. Further histological examination showed the restoration of pancreatic islets, kidney glomeruli, and liver to their normal sizes.

Lemon-Scented Gum (*Eucalyptus citriodora*-Myrtaceae): Aqueous extract of Eucalyptus citriodora leaf in alloxan-induced diabetic rats (250 and 500 mg/kg, p.o. for 21 days) significantly reduced blood glucose levels [39].

Java plum (*Syzygium jambolana*-Myrtaceae): As we have commented, a combination of Syzygium jambolana extract obtained from the seeds, fruits of Momordica charantia, and leaves of Azadirachta indica (200 mg/kg) showed a hypoglycemic effect in rabbits [40]. Treatment of diabetes with plant extracts was started at 8 days after alloxan injection. The antidiabetic effect was produced after 72 h in many of the rabbit's groups. This effect may be due to enhanced endogenous insulin production, possibly through pancreatic cell regeneration or repair caused by higher insulin levels in the serum.

Joseph's-coat (*Amaranthus tricolor*-Amaranthaceae): Methanolic extract of Amaranthus tricolor whole plant at different doses (50, 100, 200, or 400 mg/kg) was administered one hour before glucose administration in the oral glucose tolerance test (GTT) [41]. The results of this study showed significant antihyperglycemic activity in glucose-loaded mice at all doses of the extract tested, with the maximum effect observed at the maximum dose tested and with an effect comparable to glibenclamide (10 mg/kg).

Long Pepper (Piper longum-Piperaceae): In a study with an aqueous extract from Piper longum root was administered a dose of 200 mg/kg in male albino rats, with diabetes induced by intraperitoneal administration of streptozotocin; these rats presented significant antidiabetic activity after 6 h of treatment, with better effectiveness than glibenclamide [42].

Many Stamen Horse Purslane (Zaleyadecandra-Aizoaceae): Oral administration of an ethanolic extract from Zaleyadecandra roots (200 mg/kg, for 15 days) significantly restored the levels of glucose, TC, TG, total proteins, urea, creatinine, lipid peroxidation, and antioxidant enzymes in alloxan-induced diabetic rats [43]. Moreover, the histopathological analysis showed significant regenerative power in the extract-treated group compared to the control group, including effects in necrosis and degeneration in the liver and pancreas.

Neem (Azadirachta indica-Meliaceae): One study was designed to evaluate the hypoglycemic effects of different plant extracts (Azadirachtaindica leaves, Momordica charantia fruits, and Syzygium jambolana seeds) in single and in the combined formulation in alloxan-induced diabetic rabbits [40]. Treatment of diabetes with plant extracts started at 8 days after alloxan injection. A dose of 200 mg/kg of an ethanol extract from the leaves of Azadirachtaindica caused a hypoglycemic effect 72 h after administration in diabetic rabbits, with the persistence of up to 24 h.

Oregano (Origanum vulgare-Lamiaceae): The phytochemical analysis of a methanolic extract from Origanum vulgare showed an enriched composition in bisphenols, and it has demonstrated in vitro antioxidant activity in DPPH assays [44]. An in vivo study performed in streptozotocin-induced diabetic mice with methanolic and aqueous extract showed that aqueous extract had no impact on diabetes induction, while methanolic extract reduced diabetes incidence and preserved normal insulin secretion. Moreover, methanolic extract upregulated antioxidant enzymes (SOD, CAT, glutathione reductase, and peroxidase), attenuated pro-inflammatory activity, and showed cytoprotective activity.

Prickly Pear (Opuntia ficus-indica-Cactaceae): Various extracts from edible Opuntia ficus-indica (petroleum ether, ethyl acetate, butanoic, aqueous, and water parts) and a standard drug as a positive control (dimethyl biguanide, 100 mg/kg) were tested in streptozotocin-induced diabetic mice [45]. The results of this study showed that all extracts tested significantly decreased blood glucose levels and maintained body weight, except the aqueous extract. Mainly, the petroleum ether extract showed a remarkable decrease in blood glucose levels.

Sthulatvak (Cinnamomum cassia-Lauraceae): Cinnamon bark extracts were administered at doses of 200 and 300 mg/kg for 14 days in high-fat, diet-fed, and low-dose streptozotocin-induced diabetic mice [46]. The results of this study showed that Cinnamomum cassia and Cinnamomum japonica bark extract significantly decreased blood glucose concentration. Also, cinnamon extracts significantly increased the consumption of extracellular glucose in insulin-resistant HepG2 cells and normal HepG2 cells compared with controls, suggesting an insulin sensitivity improvement.

Tea (Camellia sinensis-Theaceae): The hypoglycemic activity of the crude tea leaves extract of Camellia sinensis was investigated on streptozotocin-induced diabetic mice [47]. The tea (0.5 mL/day) was administered for15 and 30 days and caused antihyperglycemic and hypolipidemic (TG and TC) activities in diabetic rats. Moreover, protective effects such as the recovery of certainly altered hematobiochemicalparameters—creatinine, urea, uric acid, aspartate aminotransferase (AST), and alanine aminotransferase(ALT)—and reduced body weight were observed.

Thalaak Sonchus oleraceus (Asteraceae): The antidiabetic activity of Sonchus oleraceus was tested in streptozotocin-induced diabetic mice [48]. In vitro examination of a hydroethanolic extract from the whole plant showed antioxidant activity using DPPH and showed an IC50 = 0.19 mg/mL. The extract showed significant antidiabetic activity, and measurement of stress markers in plasma, liver, and kidneys showed high antioxidant potential. The effects may be attributed to the significant free radical-scavenging capacity, hypoglycemic activity, and the ability to prevent oxidative stress in diabetic rats, which was determined by the decrease of MDA and H_2O_2 and the increase in CAT activity.

Tamarind (Tamarindus indica-Fabaceae): In vitro assays of an alcoholic extract made from Tamarindus indica stem bark showed significant antioxidant activity in DPPH, nitric oxide, and hydroxyl radical [34]. Alloxan-induced diabetic rats were treated orally with the alcoholic extract from Tamarindus indica at 250 and 500 mg/kg doses for 21 days, and a significant decrease in blood glucose levels was observed. In another study, hydroethanolic seed coat extract of Tamarindus indica significantly reduced blood glucose levels in normoglycaemic, glucose-loaded, and alloxan-induced diabetic rats.

Witheringiasolanacea (Solanaceae): Normal rats were treated with an aqueous extract from Witheringiasolanacea leaves at 250, 500, and 1000 mg/kg doses, and only the last two doses significantly decreased blood glucose levels after 1 h of a GTT [49]. Moreover, the 500 mg/kg dose significantly reduced blood glucose levels in alloxan-induced hyperglycemic rats at 4 h and 5 h of treatment.

Vinca (*Catharanthus roseus*-Apocynaceae): Dichloromethane-methanol extracts of Catharanthus roseus leaves and twigs in streptozotocin-induced diabetic rats significantly reduced blood glucose levels and hepatic enzyme activities of glycogen synthase, glucose 6-phosphate-dehydrogenase, succinate dehydrogenase, and malate dehydrogenase. In another study performed in streptozotocin-induced diabetic rats, the ethanolic extracts of Catharanthus roseus (100 and 200 mg/kg) detrained the glucose transport system in the liver for 4 weeks and significantly amplified the expression of the GLUT gene [50].

***Ziziphus xylopyrus*(Rhamnaceae):** This research was undertaken to test the effect of Ziziphus xylopyrus fruits extract on the diabetes of Rat. Ziziphus xylopyrus fruits extract (100 mg/kg, 200 mg/kg) was administered orally to Rat with the help of an oral feeding needle. Fruits extract was significantly ($P < 0.001$) reduce total cholesterol level it also decrease ($P < 0.001$) triglyceride level. This drug also increased ($P < 0.001$) total protein level.

Table No 1: List of Antidiabetic Plant

S. No.	Common Name	Scientific name	Plant parts	Extract	Activity	Reference
1	Aloe vera	Aloe barbadensis-Asphodelaceae	Stem	Aqueous	Antidiabetic	18
2	Avocado	Persea americana-Lauraceae	Leaf	hydroalcoholic	hypoglycaemic	21
3	Babul	Acacia arabica-Fabaceae	-	Chloroform	Antidiabetic	22
4	Bitter-Melon	Momordica charantia-Cucurbitaceae	Pulp	aqueous	hyperglycaemic	23
5	Chaff-flower	Achyranthes rubrofusca-Amaranthaceae	Leaf	Aqueous and ethanolic	Hypoglycemic	24
6.	Camel's foot tree	Bauhinia thoningii-Fabaceae	Leaf	Aqueous	Antidiabetic	25
7	Cashew	Anacardium occidentale-Anacardiaceae	-	Aqueous	Hypoglycaemic	26, 27
8	Caucasian whortleberry	Vaccinium arctostaphylos-Ericaceae	Fruit	Ethanolic	Antidiabetic	28
9	Date Palm	Phoenix dactylifera-Arecaceae	leaf	Aqueous	Antidiabetic	29
10	Drumstick Tree	Moringa oleifera-Moringaceae	Pods	Methanolic	Antidiabetic	30
11	Fenugreek	Trigonella foenum-graecum-Fabaceae	seed	Ethanolic	Antidiabetic	31
12	Gale Of	Phyllanthus niruri-	Aeria	methanolic	Antidiabetic	32, 33

	Wind	Euphorbiaceae	l part			
13	Golden Shower Tree	Cassia fistula-Fabaceae	Stem bark	Alcoholic	Antidiabetic	34
14	Gurmarbooti	Gymnemasylvestre-Apocynaceae	leaf	ethanolic	Antidiabetic	35
15	Harra	Terminalia chebula-Combretaceae	seed	chloroform	antidiabetic	36
16	Indian jujube	Zizyphusmauritiana-Rhamnaceae	-	Petroleum ether and aqueous	Antidiabetic	37
17	Indian Screw Tree	Helicteresisora-Sterculiaceae	root	Butanol and aqueous ethanol	Antidiabetic	38
18	Lemon-Scented Gum	Eucalyptus citriodora-Myrtaceae	leaf	Aqueous	Antidiabetic	39
19	Java plum	Syzygium jambolana-Myrtaceae	seed	-	Hypoglycaemic	40
20	Joseph's-coat	Amaranthus tricolor-Amaranthaceae	Whole plant	methanolic	hyperglycaemic	41
21	Long Pepper	Piper longum-Piperaceae	Root	Aqueous	antidiabetic	42
22	Many Stamen Horse Purslane	Zaleyadecandra-Aizoaceae	Root	Ethanolic	antidiabetic	43
23	Neem	Azadirachta indica-Meliaceae	leaf	-	hypoglycemic	40
24	Oregano	Origanum vulgare-	-	Methanolic and	antidiabetic	44

		Lamiaceae		aqueous		
25	Prickly Pear	Opuntia ficus-indica-Cactaceae	-	petroleum ether, ethyl acetate, butanoic, aqueous, and water parts	antidiabetic	45
26	Sthulatvak	Cinnamomum cassia-Lauraceae	Bark	-	antidiabetic	46
27	Tea	Camellia sinensis-Theaceae	leaf	-	hypoglycemic	47
28	Thalaak	Sonchus oleraceus-Asteraceae	leaf	hydroethanolic	antidiabetic	48
29	Tamarind	Tamarindus indica-Fabaceae	Stem bark	alcoholic	antidiabetic	34
30	-	Witheringiasolanacea Solanaceae	Leaf	aqueous	antidiabetic	49
31	Vinca	Catharanthus roseus-Apocynaceae	Leaf	Dichloromethane-methanol	antidiabetic	50
32	Ber	Ziziphus xylopyrusRhamnaceae	Fruit	-	antidiabetic	51

SUMMARY:

The present review attempts to be useful to scholars, scientists, and health professionals working in the field of pharmacology and therapeutics to develop antidiabetic drugs. In this work, we discussed traditional medicinal plants for the treatment of DM. But, there is promising potential from alternate sources like herbal medicines/traditional knowledge-based drugs which have multiple targets and potentially can be evolved as new drugs/complementary which needs serious attention. There is an important need to renew scientific research based on traditional knowledge of indigenous communities to be included

in drug discovery programs. Moreover, as future perspectives, the medicinal plants described may be useful in the design of new functional foods with antidiabetic properties or for avoiding hyperglycemic effects of some foods like those rich in simple carbohydrates.

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