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Antidiabetic Plants

Properties and Applications

Arpita Roy, PhD
Editor

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Preface

Diabetics is one of the chronic diseases of metabolism that account for approximately 2.8% of the world's demography. It is up surging across every continent in the world. Treatment to prevent this disease is an important challenge for researchers. Conventional drugs for the treatment of this disease improve insulin sensitivity. Increased insulin production results in a decrease blood glucose level. However, they have additional side effects and do not always provide satisfactory results. The WHO estimates that approximately 80% of the world's population rely on traditional medicine for primary health care and many plants have ethnomedical claims of usefulness in the treatment of diabetes and other chronic diseases worldwide, and have been employed empirically in antidiabetic, antihyperlipidemic, antihypertensive, ant inflammatory, and antiparasitic remedies. Plants are a key source for potential lead candidates' discovery, which can play an essential role in drug discovery and drug development projects. Plants are an alternative source to overcome this problem, as they contain various phytocompounds that show protective effects against diabetics.

This book provides systematic information about different plants and their active compounds, as well as their mode of action in the prevention and treatment of diabetes.

Chapters 1 and 2 discuss the antidiabetic plant-derived compounds of Indian origin. It reported that approximately 288 plant species recognised for their hypoglycaemic effects. As per their botanical name, family, and type of active substances, the plants are described in the chapter.

Chapter 3 discusses the antidiabetic plants from African region. It reported that the plants most researched are those in the Asteraceae and Lamiaceae families, and West Africa has a greatest number of these species that act as antidiabetic agents.

Chapters 4 and 5 discuss plant-based compounds for diabetic management and reported studies of different compounds that were isolated from a wide

range of plants which exhibit α-amylase and α-glucosidase inhibitory activities.

Chapters 6-10 discuss the role of Aloe Vera, Momordica charantia, Zanthoxylum armatum, Ocimum sanctum, and Azadirachta indica in diabetes management. The potential benefits of all plants have been reported.

Chapters 11 and 12 discuss the conservation strategies for antidiabetic plants. There are several challenges to the conservation of antidiabetic plants, including threats from habitat degradation, overexploitation, and climate change. The potential of using legal and policy instruments to protect these plants and the need for more research and data collection to understand their ecology and use. It proposes some recommendations for improving conservation strategies for antidiabetic plants. In general, these chapters provide a comprehensive overview of the conservation strategies for antidiabetic plants and identify gaps in current efforts.

Chapter 1

Antidiabetic Plant-Derived Compounds with an Indian Origin

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Abstract

India is known as the world's largest botanical garden because it produces the most therapeutic herbs. With the expansion of traditional medicine over the past few decades, green, biofriendly, affordable, and generally safe plant-based medications have transitioned from the peripheral to the main drug development. The most informative survey of the literature on antidiabetic herbal remedies comes from information from the collective literature on more than 288 plant species recognised for their hypoglycemic effects. In this plant chapter, antidiabetic plants of Indian origin have been discussed.

Keywords: medicinal plant, bioactive compound, diabetes phytocompounds

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Introduction

Traditional remedies have been used for a long time and play an essential role in alternative therapies. Traditional medicines have less adverse effects than modern remedies. Around 75-80% of the world's population still relies on traditional remedies. Various medicinal plants are beneficial in the treatment of diabetes around the world and have been used experimentally as antidiabetic and antihyperlipidemic treatments. However, research on novel anti-diabetic drugs derived from natural plants remains appealing, including phytoconstituents with alternative and safe effects in the treatment of diabetes mellitus (Tran et al., 2020).

In ancient times, Vyas and Purohit estimated that around 70,000 plant species have been used as herbal medicine throughout history. Ayurveda originated in India and is the oldest (almost 5000 years old), serving as an alternative to the medical system. Furthermore, Susruta Samhita and Charaka Samhita contain enormous information about traditional medicine (Jain et al., 2019). For 1000 years, the traditional Indian health system has used a variety of therapeutic plants in herbal remedies. Traditional remedies are heavily on medicinal plants, minerals, and organic compounds. Most Indian traditional medicine practitioners create and administer their formulations. The WHO lists 21,000 plants that are used for medical reasons across the world. There are 2500 different species in India, among which 150 are used economically. India is the world's largest producer of medicinal plants known as the botanical garden. Ethnobotanical data indicate that 800 plants have antidiabetic properties (Kayarohanam, 2015).

Although synthetic antidiabetic drugs used with insulin are the primary method of regulating diabetes, they do not completely reverse the course of its problems and aggravate it by exhibiting significant adverse effects (Alam et al., 2022). This is the driving factor behind the search for alternative sources of antidiabetic drugs. Despite the substantial improvement in the treatment of diabetes with oral hypoglycemic medications over the past three decades, the result of treatment does not completely cure the patient (Patil et al., 2011). Numerous drawbacks to existing medications are found, such as toxicity, drug resistance (reduced effectiveness), and other side effects.

Due to the numerous restrictions associated with the use of existing synthetic antidiabetic medications, the search for additional antidiabetic therapies from natural sources is reported. Presently, focussing on all the obstacles, the main alternative found that the shift from synthetic to herbal treatment, which can best be described as "return to nature" is the call of the

day (Kumar et al., 2019). In this chapter, a detailed description of Indian medicinal plant species with their phytocompounds is reported for their antidiabetic effects.

Diabetes and Therapeutic Strategies

Diabetes mellitus is an anomalous endocrine disease characterized by abnormal carbohydrate, lipid, and proteins. These abnormalities lead to abnormal insulin production, secretion, and action (Kayarohanam, 2015). Globally, around 422 million people are affected by diabetes. Its prevalence has increased from 6.4% to 9.3% in 2019 (Saeedi et al., 2019). The frequency is expected to increase to 10.2% by 2030 and 10.9% by 2045. Diabetes is expected to be the seventh leading cause of death by 2030, according to the World Health Organisation. Type 1 and Type II are the two main types of diabetes disease. Type 1 diabetes is caused by a near-total insulin deficiency or lack of insulin. Type 2 diabetes is a diverse set of diseases defined by varying degrees of insulin resistance, decreased insulin secretion, and increased glucose production. Prediabetes and gestational diabetes are two more types of diabetes. Gestational diabetes refers to glucose intolerance during pregnancy. Most women regain normal glucose tolerance after giving birth, but there is a significant risk of developing type 2 diabetes later in life.

Uncontrolled hyperglycemia and hyperlipidemia cause acute and long-term problems in both type 1 and type 2 diabetes. (Subramoniam, 2016). Acute complications of diabetics cause ketoacidosis and hyperglycemic hyperosmolar state (HHS). Ketosis is caused by increased fatty acid release from adipocytes, as well as a shift toward the production of ketone bodies in the liver. In the liver, these fatty acids are normally metabolised to triglycerides or VLDL. However, hyperglucagonemia affects liver metabolism and favours the synthesis of ketone bodies. Diabetic ketoacidosis is typically caused by both insulin deficiency and excess glucagon production. It is also triggered by high levels of catecholamines, cortisol, and/or growth hormone. People with type 2 diabetes with polyuria and weight loss are at risk of HHS. Chronic diabetes complications are classified as vascular or nonvascular. Microvascular problems include neuropathy, retinopathy, and nephropathy, while macrovascular complications cause peripheral arterial disease, coronary artery disease, and cerebrovascular disease (Subramoniam, 2016).

Table 1. Indian medicinal plant and its antidiabetic activities

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
1.	*Abrus precatorius*	Jequirity bean or Rosary pea	Fabaceae	Alkaloids, Cyclitols, Saponins, Fluoroacetate, Terpenes, Flavonoids	Modulation of insulin
2.	*Acacia arabica*	Babool	Fabaceae	Alkaloids, Cyclitols, Saponins, Fluoroacetate, Terpenes	Decreasing serum glucose level
3.	*Acacia catechu*	Catechu	Fabaceae	Epicatechin	Antidiabetic action
4.	*Acacia modesta*	Phulai	Fabaceae	Flavonoids and phenolic acids	Glucose uptake employing α-amylase inhibition
5.	*Acalypha indica*	Indian Copperleaf	Euphorbiaceae	Alkaloids, Cyclitols, Saponins, Fluoroacetate, Terpenes, Flavonoids	*Lower increased blood glucose*
6.	*Acanthopanax senticosus*	Siberian Ginseng	Araliaceae	Phenolic compounds such as syringin and eleutheroside E	*Suppressed glucide absorption by inhibition of intestinal α-glucosidase activity*
7.	*Achillea millefolium*	Common yarrow	Asteraceae	Flavonoid	Reduces blood glucose
8.	*Achyranthes rubrofusca*	Devil's horsewhip	Amaranthaceae	triterpenoid saponins, ketosteroids, and ketosteroids and polysaccharides	*Improvement in beta cell function, insulin resistance, glucose (re)absorption, and glucagon-like peptide-1 homeostasis*
9.	*Acorus calamus*	Sweet flag	Acoraceae	Asarones, β-Asarone	The expression and secretion of glucagon-like peptide-1 (GLP-1) is related to its hypoglycemic effects
10.	*Adansonia digitata*	Baobab tree	Malvaceae	Vitamin-C, Steroids, Flavonoids	α-amylase inhibitor

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
11.	*Adiantum capillus-veneris*	Maidenhair fern	Pteridaceae	Flavonoids	*Reduces blood glucose*
12.	*Adina cordifolia*	Haldina	Rubiaceae	Flavonoids, alkaloids, terpenoids, tannins, gums and carbohydrates	Control glucose level
13.	*Afzelia africana*	Lengue	Fabaceae	Flavonoids, proanthocyanidins, tannins, phenols and alkaloid, terpenoids	Potentiation of insulin from β cells
14.	*Ailanthus excelsa*	Tree of heaven	Simaroubaceae	Phenolic components, ailantic acid, sitosterol, and Quassinoids	reduced blood glucose level
15.	*Alangium salvifolium*	Sage-leaved alangium	Cornaceae	Alangine, ankorine, tubulosine, alangicine, salsoline	Hypoglycemic
16.	*Albizzia lebbeck*	Woman's tongue	Fabaceae	Alkaloids, anthraquinones, essential oils, flavonoids	Decreasing blood glucose
17.	*Allium cepa*	Onion	Liliaceae	Quercetin and allicin	Stimulate the production of insulin
18.	*Allium sativum*	Garlic	Amaryllidaceae	Flavonoids	Enhance glucose tolerance
19.	*Aloe ferox*	Bitter aloe	Asphodelaceae		Lower fasting blood glucose levels.
20.	*Aloe vera*	Aloe vera	Asphodelaceae	Alkaloids and aromatic compounds	Decrease the blood glucose
21.	*Alpinia galanga*	Thai ginger	Zingiberaceae	α-fenchyl, β-pinene	Inhibits enzymes in carbohydrate metabolism, that is α-amylase and α-glucosidase
22.	*Alstonia scholaris*	White cheesewood	Apocynaceae	Picrinine	α-glucosidase inhibitor
23.	*Amaranthus tricolor*	Elephant-Head Amaranth	Amaranthaceae	Ascorbic acid and flavonoids	Antihyperglycemic activity

Table 1. (Continued)

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
24.	*Anacardium occidentale*	Cashew	Anacardiaceae	beta-carotene, lutein, zeaxanthin, alpha-tocopherol, gamma-tocopherol, thiamin	Lower blood glucose level
25.	*Andrographis paniculata*	Bitterweed	Acanthaceae	Diterpenoids, flavonoids, and polyphenols.	Decreasing hepatic glucose production
26.	*Anthocephalus cadamba*	Kadam	Rubiaceae	Linalool	*Glucose lowering efficacy*
27.	*Aphanamixis polystachya*	Pithraj Tree	Meliaceae	Terpene and alkaloid	Lower glucose level
28.	*Argyreia nervosa*	Woodrose	Convolvulaceae	Ergoline alkaloids such as ergine	Increasing insulin secretion
29.	*Artemisia parviflora*	Himalayan wormwood	Asteraceae	β-caryophyllene, camphor, germacrene D, artemisia ketone, 1,8-cineole	Reduce blood glucose
30.	*Artocarpus heterophyllus*	Jackfruit	Moraceae	Prenylflavonoids, hydroxycinnamic acids and glycosides	Hypoglycemic, α-amylase inhibitor
31.	*Azadirachta indica*	Neem	Meliaceae	Nimbolide, azarirachtin, and gedunin	α-glucosidase and α-amylase inhibitor, hypoglycemic
32.	*Barleria prionitis*	Vajradanti	Acanthaceae	Alkaloids, flavonoids, glycosides, phenolics, and saponins	Decreased blood glucose
33.	*Barringtonia acutangula*	Mango-pine	Lecythidaceae	Triterpenoids,	Suppression of transfer of glucose
34.	*Basella rubra*	Red Ceylon Spinach	Basellaceae	Phenolic compounds	Possess insulin mimetic action
35.	*Bauhinia thoningii*	Camel’s foot tree	Fabaceae	Flavonoids and tannins	Reduction in blood glucose

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
36.	*Begonia roxburghii*	East Himalayan Begonia	Begoniaceae	Alkaloids and carbohydrates	Alteration of glucose metabolism;
37.	*Berberis aristata*	Dāruhaldhi	Berberidaceae	Triterpenes	Lower blood glucose
38.	*Blepharis molluginifolia*		Acanthaceae	Apigenin, Flavonoid, alkaloids, phenolic	Antidiabetic activity
39.	*Boerhavia diffusa*	Punarnava	Nyctaginaceae	Alkaloids, flavonoids, tannins and anthraquinones	Modulates abdominal glucose
40.	*Boswellia ovalifoliolata*	Indian frankincense	Burseraceae	Monoterpenes, diterpenes, triterpenes, and tetracyclic triterpenic acids	Protective effects on diabetic complications
41.	*Brassica juncea*	Indian Mustard	Brassicaceae	Esters, alcohols, ketones, acids, nitriles, aldehydes, phenols, hydrocarbons	Decreasing hepatic glucose production
42.	*Brassica rapa*	Field mustard	Brassicaceae	Polyphenols	Antidiabetic efficacy
43.	*Buddleja asiatica*	Dog tail	Scrophulariaceae	6-O-(3”,4”-dimethoxycinnamoyl) catalpol	Production and intestinal absorption of glucose
44.	*Butea frondosa*	Flame of the forest	Fabaceae	Alkaloids, flavonoids, phenolic compounds, steroids	Significant reductions in blood glucose
45.	*Caesalpinia bonducella*	Gray Nicker	Fabaceae	Alkaloids, flavonoids, phenolic compounds, amino acids, glycosides, steroids	α-amylase inhibitor
46.	*Caesalpinia ferrea*	Leopard Tree	Fabaceae	Butanedioic acid	Reduction of blood glucose levels
47.	*Cajanus cajan*	Pigeon pea	Fabaceae	Flavonoids and stilbenes	Maintain blood glucose and cholesterol
48.	*Calamus erectus*	Viagra palm	Arecaceae	α-asarone, α-cedrene, (E)-methylisoeugenol	α-glucosidase and α-amylase enzyme inhibition

Table 1. (Continued)

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
49.	*Calamus tenuis*		Arecaceae		Anti diabetic property
49.	*Callicarpa arborea*	Beautyberry Tree	Lamiaceae	β-selinene, ar-turmerone and α-copaene	Regulate glycaemic metabolism, increase insulin, and improving microcirculation
50.	*Camellia sinensis*	green tea	Theaceae	Catechins	Antihyperglycemic
51.	*Capparis decidua*	Karira	Capparaceae	β-sitosterol	Inhibited acute elevation of blood glucose level
52.	*Capparis sepiaria*	Wild caper bush	Capparaceae	Alkaloids, glycosides, tannins, phenolics, flavonoids	Conventional hypoglycemic drugs
53.	*Capparis spinosa*	Alpine Caper Bush	Capparaceae	Docosane, nonacosane and hexadecanoic acid	*Glucose levels significantly decreases*
54.	*Caralluma adscendens*	Aak	Apocynaceae	Triterpenoids	Inhibitory activity against alpha-amylase and alpha- glucosidase.
55.	*Caralluma umbellata*	Pussur	Apocynaceae		Antihyperglycemic
56.	*Casearia esculenta*	Bairi	Flacourtiaceae		Restores glucose level
57.	*Casia fistula*	Golden Shower Tree	Fabaceae		α-amylase inhibitor
58.	*Cassia auriculata*	Avartaki or Mature Tea Tree	Caesalpiniaceae		
59.	*Cassia grandis*	Pink Shower Tree	Fabaceae		Antidiabetic potential
60.	*Catharanthus roseus*	graveyard plant	Apocynaceae		α amylase inhibitor, Reduced blood glucose levels
61.	*Cayratia trifolia*	Fox grape			
62.	*Cecropia pachystachya*	Ambay pumpwood	Urticaceae		Hypoglycemic effect
63.	*Ceiba pentandra*	Kapok Tree			α-amylase inhibition, hypoglycemic,antihyperglycemic
64.	*Centella asiatica*	gotu kola	Apiaceae		

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
65.	*Centratherum anthelminticum*	black/bitter cumin or kalijiri	Asteraceae		Hypoglycemic
66.	*Ceriops decandra*	Flat-leaved Spurred Mangrove	Rhizophoraceae		Controls blood glucose
67.	*Chiliadenus iphionoides*		Asteraceae		Increased insulin secretion
68.	*Chlorophytum borivilianum*	safed musli	Asparagaceae		Antidiabetic
69.	*Cinnamomum cassia and Cinnamomum japonica*	Japanese cinnamon	Lauraceae		Decreased blood glucose
70.	*Cinnamomum impressinervium*		Lauraceae		Controls Blood sugar
71.	*Cinnamomum tamala*	Indian Cassia or Indian Bay Leaf or Tej pat	Lauraceae		Hypoglycemic effect
72.	*Cinnamomum verum*	Cinnamon	Lauraceae		α-amylase inhibitor
73.	*Citrullus colocynthis*	bitter apple	Cucurbitaceae		Cucurbitaceae
74.	*Citrus sinensis*	sweet orange	Rutaceae		
75.	*Clerodendrum glandulosum* or *Clerodendrum colebrookianum*	East Indian glory bower	Lamiaceae		Inhibitors of glycemic enzyme
76.	*Clerodendrum infortunatum*	hill glory bower	Lamiaceae		Controls Blood sugar
77.	*Clerodendrum phlomidis*	Arni	Lamiaceae		Inhibitors of glycemic enzyme
78.	*Clitoria ternatea*	butterfly pea	Fabaceae		α-glucosidase, α-amylase inhibitor
79.	*Coccinia cordifolia*		Cucurbitaceae		Antidiabetic activity

Table 1. (Continued)

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
80.	*Coccinia grandis*	Ivy Gourd	Cucurbitaceae		Antihyperglycemic, α-glucosidase inhibitor, α-amylase inhibitor
81.	*Coccinia indica*	the ivy gourd			Inhibitors of glycemic enzyme
82.	*Cocculus hirsutus*	broom creeper	Menispermaceae		α-amylase inhibitor
83.	*Cocos nucifera*	Coconut	Arecaceae	Flavonoid, tannin, and saponin.	Potentiating the insulin effect of plasma
84.	*Coldenia procumbens*	Riceweeds	Boraginaceae		Inhibitors of glycemic enzyme
85.	*Commiphora wightii*	Indian bdellium-tree or gugal	Burseraceae		Inhibitors of glycemic enzyme
86.	*Coscinium fenestratum*	Tree turmeric or Daru Haridra	Menispermaceae		Inhibitors of glycemic enzyme
87.	*Costus igneus*	insulin plant	Costaceae		Insulin like activity
88.	*Costus pictus*	Spiral flag	Costaceae		Inhibitors of glycemic enzyme
89.	*Croton klozchianus*				Lower glucose level
90.	*Cucumis callosus*	Muskmelon	Cucurbitaceae		Controls Blood sugar
91.	*Cuminum cyminum*	spice Cumin	Apiaceae		
92.	*Curculigo orchioides*	golden eye-grass or Black Musli	Hypoxidaceae		
93.		turmeric	Zingiberaceae		
94.	*Curcuma longa* and *Curcuma domestica*	Turmeric	Zingiberaceae	Curcuminoids	Inhibition of α-glucosidase and α-amylase enzyme
95.	*Cuscuta reflexa*	Giant dodder	Convolvulaceae		
96.	*Cyamopsis tetragonoloba*	Cluster bean	Fabaceae		
97.	*Cyamopsis tetragonoloba*	Cluster bean	Fabaceae		

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
98.	*Cyperus kyllinga*	Whitehead spikesedge	Cyperaceae		Controls Blood sugar
99.	*Cyperus laevigatus*	Smooth flatsedge	Cyperaceae		Controls Blood sugar
100.	*Cyperus rotundus*	Papyrus sedges,	Cyperaceae		
101.	*Dendrocalamus hamiltonii*	Hamilton's bamboo	Poaceae		
102.	*Desmodium gangeticum*	salparni	Fabaceae		
103.	*Desmostachya bipinnata*	halfa grass	Poaceae		Controls Blood sugar
104.	*Dillenia indica*	Elephant Apple	Dilleniaceae		Inhibitors of glycemic enzyme
105.	*Dioscorea opposita*	Chinese yam	Dioscoreaceae		Inhibitors of glycemic enzyme
106.	*Diospyros melanoxylon*	Coromandel ebony	Ebenaceae		Inhibitors of glycemic enzyme
107.	*Diospyros peregrina*	Indian persimon,	Ebenaceae.		Inhibitors of glycemic enzyme
108.	*Diplazium esculentum*	Fiddlehead fern	Athyriaceae		
109.	*Eclipta alba*	False daisy	Asteraceae		α-glucosidase inhibitor
110.	*Elaeocarpus ganitrus*	Blueberry beads"	Elaeocarpaceae		
111.	*Elephantopus scaber*	Elephant's Foot	Asteraceae		
112.	*Embelia ribes*	False black pepper	Primulaceae		
113.	*Emblica officinalis*	Indian gooseberry	Phyllanthaceae		
114.	*Enhydra fluctuans*	Helencha or harkuch	Asteraceae		
115.	*Enicostema axillare*	Indian Whitehead	Gentianaceae		Controls Blood sugar
116.	*Erythrina indica*	Indian coral tree	Fabaceae		Inhibitors of glycemic enzyme
117.	*Erythrina variegeta*	Indian coral tree	Fabaceae		Inhibitors of glycemic enzyme
118.	*Eucalyptus citriodora*	Lemon - scented Gum	Myrtaceae		Inhibitors of glycemic enzyme
119.	*Eugenia jambolana*	Jamun	Myrtaceae		α-amylase inhibitor
120.	*Eugenia polyantha*	Indian bay-leaf	Myrtaceae		
121.	*Euphorbia caducifolia*	Leafless milk hedge	Euphorbiaceae		

Table 1. (Continued)

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
122.	*Euphorbia drumondii*	Caustic weed	Euphorbiaceae		Hyperglycemic
123.	*Euphorbia hirta*	Asthma Weed	Euphorbiaceae	quercetin, quercitrin, quercitol, Triterpenoid,	Decrease in blood glucose level, α-glucosidase activity
124.	*Euphorbia ligularia*	Indian spurge	Euphorbiaceae		Inhibitors of glycemic enzyme
125.	*Feronia limonia*	wood-apple	Rutaceae		Inhibitors of glycemic enzyme
126.	*Ferula assa-foetida*	Asafoetida	Apiaceae		
127.	*Ficus amplissima*	Indian Bat tree	Moraceae		Controls Blood sugar
128.	*Ficus benghalensis*	Banyan	Moraceae		Controls Blood sugar
129.	*Ficus carica*	Common fig	Moraceae		
130.	*Ficus cunia*	Drooping fig	Moraceae		α-glucosidase inhibitor
131.	*Ficus glomerata*	Cluster fig tree	Moraceae		
132.	*Ficus racemosa*	Cluster fig	Moraceae		Antihyperglycemic, hypoglycemic, α-glucosidase and α-amylase inhibitor
133.	*Ficus religiosa*	peepal tree	Moraceae		
134.	*Ficus virens*	white fig	Moraceae		
135.	*Gloriosa superba*	Gloriosa lily	Colchicaceae		Controls Blood sugar
136.	*Glycosmis pentaphylla*	Gin berry	Rutaceae		Controls Blood sugar
137.	*Glycyrrhiza glabra*	Liquorice	Fabaceae		Controls Blood sugar
138.	*Glycyrrhiza uralensis*	Chinese liquorice	Fabaceae		Controls Blood sugar
139.	*Gmelina arborea*	Beechwood	Lamiaceae		Controls Blood sugar
140.	*Grewia asiatica*	Phalsa	Malvaceae		Controls Blood sugar
141.	*Grewia hirsuta*	Nagabala	Malvaceae		Controls Blood sugar
142.	*Gymnema sylvestre*	Australian cowplant	Apocynaceae	Triterpene saponins	Stimulation in insulin secretion from the pancreas
143.	*Heinsia crinata*	Bush apple	Rubiaceae		Stimulate in insulin secretion
144.	*Helicteres isora*	Marodphali	Malvaceae		Stimulate in insulin secretion

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
145.	*Hemidesmus indicus*	Indian sarsaparilla	Apocynaceae		Stimulate in insulin secretion
146.	*Heritiera fomes*	Sunder	Malvaceae		Stimulate in insulin secretion
147.	*Holarrhena antidysenterica*	Kutaja	Apocynaceae		Inhibitors of glycemic enzyme
148.	*Hydnocarpus wightiana*	Chaulmoogra	Achariaceae		Inhibitors of glycemic enzyme
149.	*Ichnocarpus frutescens*	Black creeper	Apocynaceae		Inhibitors of glycemic enzyme
150.	*Imperata cylindrica*	Cogongrass	Poaceae		Stimulate in insulin secretion
151.	*Lactuca gracilis*	Lettuce	Asteraceae		Stimulate in insulin secretion
152.	*Lagenaria sicereria*	Calabash gourd	Cucurbitaceae		Stimulate in insulin secretion
153.	*Leucas aspera*	Thumbai	Lamiaceae		Controls Blood sugar
154.	*Leucas cephalotes*	Goma	Lamiaceae		Stimulate in insulin secretion
155.	*Linum usitatisumum*	Flax	Linaceae		Stimulate in insulin secretion
156.	*Luffa echinata*	Ghagarabela	Cucurbitaceae		Stimulate in insulin secretion
157.	*Mangifera indica*	Mango	Anacardiaceae		Antidiabetic, α-amylase inhibitor, antihyperlipidemic effect, hypoglycemic
158.	*Melia dubia*	Malabar Neem	Meliaceae		
159.	*Melothria maderaspatana*	Mukia Maderaspatana	Cucurbitaceae		
160.	*Mentha longifolia*	Horsemint	Lamiaceae		Inhibitors of glycemic enzyme
161.	*Mentha arvensis*	Corn Mint	Lamiaceae		Inhibitors of glycemic enzyme
162.	*Meyna laxiflora*	Muyna	Rubiaceae		Inhibitors of glycemic enzyme
163.	*Millingtonia hortensis*	Indian Cork-Tree	Bignoniaceae		Inhibitors of glycemic enzyme
164.	*Mimusops elengi*	Spanish Cherry	Sapotaceae		
165.	*Momordica charantia*	Bitter Melon	Cucurbitaceae	Charantine, charine, momordicin, momordin, cucurbitins, cucurbitacins momorcharins	Insulin secretion and glycogen synthesis
166.	*Moringa oleifera*	Drumstick tree	Moringaceae		Hypoglycemic

Table 1. (Continued)

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
167.	*Morus alba*	White mulberry	Moraceae		inhibition of antidiabetic, hypoglycemic, α-glucosidase and α-amylase inhibition
168.	*Mucuna gigantea*	Burny bean	Fabaceae		Stimulate in insulin secretion
169.	*Mucuna pruriens*	Velvet bean	Fabaceae		Stimulate in insulin secretion
170.	*Mukia maderaspatana*	Madras pea pumpkin	Cucurbitaceae		Stimulate in insulin secretion
171.	*Murraya koenigii*	Cucumis maderaspatanus	Rutaceae		
172.	*Murraya koenigii*	Curry Leaf Tree	Rutaceae		α amylase inhibitor, hypoglycemic effects, antihyperglycemic
173.	*Musa Sapientum*	Common banana	Musaceae		Antihyperglycemic
174.	*Musa Sapientum*				Antihyperglycemic
175.	*Nelumbo nucifera*	Sacred lotus	Nelumbonaceae		α-glucosidase, α-amylase inhibitor
176.	*Nicotiana plumbaginifolia*	Tex-mex tobacco	Solanaceae		
177.	*Nigella sativa*	black cumin	Ranunculaceae		
178.	*Nycantus arbor-tristis*	Night Blooming Jasmine	Oleaceae		Hypoglycemic
179.	*Nymphaea nouchali*	Blue lotus	Nymphaeaceae		
180.	*Nymphaea stellata*	Indian blue water lily	Nymphaeaceae		α-glucosidase inhibitor, hypoglycemic, antihyperglycemic
181.	*Ocimum sanctum*	Tulsi	Lamiaceae	Triterpenoid, eugenol, methyleugenol, and p-caryophylen	Hypoglycemic

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
182.	*Ocimum tenuiflorum*	holy basil	Lamiaceae		α-amylase inhibitor, hypoglycemic, antihyperglycemic
183.	*Odina wodier*	Oodi mara	Anacardiaceae		
184.	*Opuntia ficus-indica*	Prickly pear	Cactaceae		Controls Blood sugar
185.	*Oreocnide integrifolia*	Wild Rhea	Urticaceae		
186.	*Origanum vulgare*	Oregano	Lamiaceae		
187.	*Oroxylum indicum*	Indian trumpet flower	Bignoniaceae		
188.	*Oxalis corniculata*	creeping woodsorrel	Oxalidaceae		Inhibitors of glycemic enzyme
189.	*Oxalis griffithii*	Wood sorrel	Oxalidaceae		Inhibitors of glycemic enzyme
190.	*Paederia scandens*	Gandheli	Rubiaceae		
191.	*Panax ginseng*	Korean ginseng	Araliaceae	Ginsenosides-terpene glycosides, saponins, naxans, vanillic acid, and salicylates.	Improving insulin resistance, improving glucose uptake, decreasing blood glucose concentration, and protecting/regeneratingβ-cell from pancreatic islets
192.	*Pandanus fascicularis*	Fragrant screw-pine	Pandanaceae		Antihyperglycemic
193.	*Paspalum scrobiculatum*	Kodo millet	Poaceae		
194.	*Passiflora nitida*	Bell apple	Passifloraceae		
195.	*Pavonia zeylanica*	Ceylon leadwort	Plumbaginaceae		
196.	*Pergularia daemia*	Trellis-vine	Apocynaceae		Controls Blood sugar
197.	*Persea americana*	Avocado	Lauraceae		
198.	*Persea americana*				
199.	*Peucedanum praeruptorum*	Qian Hu	Apiaceae		
200.	*Phaseolus vulgaris*	Wild bean	Leguminosae		
201.	*Phoenix dactylifera*	date palm	Arecaceae		Inhibitors of glycemic enzyme

Table 1. (Continued)

Sl No.	Plant Species	Common name	Family	Phytochemical properties	Activity
202.	*Phyllanthus amarus*	Carry Me Seed	Phyllanthaceae		α-glucosidase inhibitor, hypoglycemic, α-amylase inhibitor
203.	*Phyllanthus emblica*	Indian gooseberry	Phyllanthaceae		Controls Blood sugar
204.	*Phyllanthus niruri*	gale of the wind	Euphorbiaceae		Controls Blood sugar
205.	*Phyllanthus niruri*				Controls Blood sugar
206.	*Physalis angulata*	Cutleaf groundcherry	Solanaceae		Controls Blood sugar
207.	*Physalis minima*	Bladder Cherry	Solanaceae		Controls Blood sugar
208.	*Physalis peruviana*	Cape gooseberry	Solanaceae		
209.	*Picralima nitida*	Akuamma	Apocynaceae		
210.	*Pimpinella tirupatiensis*	Saunf	Apiaceae		
211.	*Piper longum*	Indian Long Pepper	Piperaceae		
212.	*Piper longum*				Antihyperglycemic
213.	*Pisonia grandis*	Lettuce Tree	Nyctaginaceae		
214.	*Plantago ovata*	Psyllium	Plantaginaceae		
215.	*Plumbago zeylanica*	Ceylon leadwort	Plumbaginaceae		
216.	*Plumeria rubra*	Frangipani	Apocynaceae		α-amylase and α-glucosidase inhibitor
217.	*Polyalthia longifolia*	The false ashoka	Annonaceae		Antidiabetic
218.	*Polygonum hydropiper*	Marshpepper knotweed	Polygonaceae		Stimulate in insulin secretion
219.	*Pongamia pinnata*	Malapari or Karanja tree	Fabaceae		Stimulate in insulin secretion
220.	*Portulaca oleracea*	Common purslane	Portulacaceae		Stimulate in insulin secretion
221.	*Premna integrifolia*	Wind killer	Lamiaceae		Hypoglycemic
222.	*Prunus persica*	Peach	Rosaceae		