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Review Article

Harnessing Nature's Power: Antidiabetic Medicinal Plants

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ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia due to inadequate insulin production or ineffective insulin use. Despite the availability of pharmacological treatments, managing diabetes without adverse effects remains challenging. Current therapies, including insulin and oral antidiabetic agents, are often associated with significant side effects, necessitating the exploration of alternative approaches. In recent years, medicinal plants have garnered increasing attention as potential therapeutic agents for diabetes management. Traditional systems of medicine, such as Ayurveda, continue to play a crucial role in healthcare, particularly in developing countries, where plant-based treatments are culturally accepted and widely used. This review explores various plant species with documented antidiabetic properties, focusing on their ability to regulate glucose levels, enhance insulin secretion, or inhibit carbohydrate metabolism. Compounds such as glycosides, alkaloids, flavonoids, and terpenoids have demonstrated potential in reducing hyperglycemia and associated complications. By investigating plant-based remedies, we aim to provide an alternative, complementary approach to diabetes management, emphasizing the importance of ethnobotanical research in discovering new, safer treatments for this global health challenge.

INTRODUCTION

Diabetes mellitus is a group of metabolic disorders with one common manifestation -hyperglycemia (1, 2). Diabetes mellitus, being a multifactorial disease, demands multiple therapeutic approaches. Global studies on diabetes mellitus have reiterated that primary prevention is necessary and drastic steps must be taken to diagnose the disease early on, provide effective management and also take steps to prevent the onset of disease in high-risk subjects. According to WHO, plant-based traditional system of medicine is still the mainstay of about 75– 80% of the world population, mainly in the developing countries, for primary healthcare because of better cultural acceptability, better compatibility with the human body and lesser side

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effects (3) . According to the fifth edition of the World Diabetes Atlas released by the International Diabetes Federation (IDF), as of 2011, the total adult population in the age group of 20-79 years stands at 4.3 billion, out of which 366 million live with diabetes, which is set to increase to 552 million by 2030 (4). Ayurveda is an ancient system of medicine originating in India, and is an extension of yoga. Its two most famous treatises, Charak Samhita and Sushruta provide evidence of a rich tradition of herbal medicine in India. Historical and anthropological studies have repeatedly demonstrated the importance of yoga's 'upanishadic' roots and philosophical basis. In India, there is a high degree of reliance on and cultural acceptability of Ayurveda medicine in favour of traditional systems of medicine. The rural population in India is heavily dependent on traditional medical systems (5). In an earlier study, we found that 67.7% of patients with diabetes attending our outpatient department used CAM, in particular naturopathy (6).Currently available therapies for diabetes include insulin and various oral antidiabetic agents such as sulfonylureas, biguanides, a-glucosidase inhibitors, and glinides, which are used as monotherapy or in combination to achieve better glycemic regulation. Many of these oral antidiabetic agents have a number of serious adverse effects; thus, managing diabetes without any side effects is still a challenge (7). An estimated 143 million people suffer from diabetes worldwide and the number is growing rapidly (8). Recently, some medicinal plants have been reported to be useful in diabetes worldwide and have been used empirically in antidiabetic and antihyperlipidemic remedies. Antihyperglycemic activity of the plants is mainly due to their ability to restore the function of pancreatic tissues by causing an increase in insulin output or inhibit the intestinal absorption of glucose or to the facilitation of metabolites in insulin dependent processes. More than 400 plant species having hypoglycemic activity have been available in literature, however, searching for new antidiabetic drugs from natural plants is still attractive because they contain substances which demonstrate alternative and safe effects on diabetes mellitus. Most of plants contain glycosides, alkaloids, terpenoids, flavonoids, carotenoids, etc., that are frequently implicated as having antidiabetic effect (9). The severity of damage triggered by hyperglycemia on the respective organ systems may be related to how long the disease has been present and how well it has been controlled. Several symptoms such as thirst, polyuria, blurring of vision, and weight loss also accompany diabetes (10).

Classification of Diabetes Mellitus

Type 1: Associated with absolute insulin deficiency

A. Immune-mediated

B. Idiopathic

Type 2: Adult-onset, Associated with insulin resistance

Type 3:

A. Genetic defects of -cell function

B. Genetic defects in insulin action

C. Diseases of exocrine pancreas

D. Endocrinopathies

E. Drug-or chemical-induced

F. Infections

G. Uncommon forms of immune-mediated diabetes

H. Other genetic syndromes sometimes associated with diabetes

Type 4: Gestational diabetes mellitus (11)

Management of diabetics :

Effectively managed through lifestyle modifications such as

1. Weight loss,
2. Balanced diet,
3. Regular exercise.

When these interventions are insufficient to control blood sugar levels, medications or insulin therapy may be recommended (12).

Medicinal Plants as an Alternative Source of Antidiabetic Agents

Natural products, particularly of plant origin, are the main quarry for discovering promising lead candidates and play an imperative role in the upcoming drug development programs [13-15]. Ease of availability, low cost, and least side e_ects make plant-based preparations the main key player of all available therapies, especially in rural areas. For centuries, many plants have been considered a fundamental source of potent antidiabetic drugs. In developing countries, particularly, medicinal plants are used to treat diabetes to overcome the burden of the cost of conventional medicines to the population [16]. Nowadays, treatments of diseases including diabetes using medicinal plants are recommended [17] because these plants contain various phytoconstituents such as flavonoids, terpenoids, saponins, carotenoids, alkaloids, and glycosides, which may possess antidiabetic activities [18]. The antihyperglycemic e_ects resulting from treatment with plants are usually attributed to their ability to improve the performance of pancreatic tissue, which is done by increasing insulin secretions or by reducing the intestinal absorption of glucose [16]. Herbal medicines and plant components with insignificant toxicity and no side effects are notable therapeutic options for the treatment of diabetes around the world [19].

Herb–Drug interactions in diabetes:

The co-administration of antidiabetic herbs and pharmaceutical agents may result in HDIs leading to enhanced effects (which may be desirable clinically), decreased pharmacological effects, or adverse drug events, such as hypoglycaemia [20].

Conventional antidiabetic drugs

Low levels (or absence) of insulin leads to type 1 diabetes, and administration of insulin is indicated for treatment of this condition. Type 2 diabetes, the most common type of diabetes, is caused by insulin resistance; conventional pharmaceutical medications against type 2 diabetes include: i) sensitizers that increase the sensitivity of target organs to insulin, ii) secretagogues that increase the level of insulin secreted from the pancreas, and iii) α-glycosidase inhibitors (e.g., acarbose) that reduce the gastrointestinal absorption of glucose. The sensitizers include biguanides (e.g., metformin) and thiazolidinediones (e.g., pioglitazone), while the secretagogues include sulfonylureas (e.g., glibenclamide, glimepiride, gliclazide, tolbutamide) and meglitinides (e.g., repaglinide). [21].

Genus	Species	Geographic Zone	Activity	Reference
Acacia	*Acacia catechu*	Nepal, India	antihyperglycemic	[22]
	Acacia modesta	India and Pakistan	antihyperglycemic	[23]
	Acacia arabica	India	hypoglycemic and antihyperglycemic	[24]
Acalypha	*Acalypha indica*	India	antidiabetic	[25]
	Acalypha langiana		antidiabetic	[26]
Achillea	*Achillea millefolium*	India	antidiabetic	[27]
	Allium sativum	India (Ayurveda), Indonesia, Iran, Cuba, Mauritius, Togo, China (TCM)	α-amylase inhibitor, hypoglycemic, α-glucosidase inhibitor, antihyperglycemic	[28,29]
Aloe	*Aloe ferox*	India (Ayurveda)	antidiabetic	[30]

	Aloe vera	India (Ayurveda), Ghana, Mauritius, Uganda, Tanzania, Traditional Chinese medicines, Trinidad and Tobago, Iran, Pakistan, Philippines, Saudi Arabia	α-amylase inhibitor, hypoglycemic	[31-33]
Alpinia	*Alpinia calcarata*	India, Sri Lanka	antidiabetic	[34,35]
	Alpinia galanga	India	antidiabetic	[36]
	Artemisia parviflora	India	antidiabetic	[37]
	Artocarpus heterophyllus	India (Ayurveda), Mauritius	hypoglycemic, α-amylase inhibitor	[38-40]
Berberis	*Berberis aristata*	India (Ayurveda)	antidiabetic	[41]
	Berberis asiatica	India	antidiabetic	[42]
Brassica	*Brassica juncea*	India (Ayurveda)	antidiabetic	[43]
	Brassica oleracea		antihyperglycemic	[44]
	Brassica rapa	India	antidiabetic	[45]
Buddleja	*Buddleja asiatica*	India	antidiabetic	[46]
Butea	*Butea monosperma*	India	antidiabetic	[27]
	Butea frondosa	India	antidiabetic	[47]
Caesalpinia	*Caesalpinia bonducella*	India	α-amylase inhibitor	[48]
Calamus	*Calamus tenuis*	India	antidiabetic	[49]
	Calamus erectus	India	Antidiabetic	[50]
	Calotropis procera		Antidiabetic	[51]
Capparis	*Capparis aphylla*		antihyperglycemic	[52]
	Capparis decidua	India, Pakistan	Antidiabetic	[53]
	Capparis sepiaria	India	Antidiabetic	[54]
	Capparis spinosa	India (Ayurveda and Unani)	Antidiabetic	[55]
Caralluma	*Carallumaadscendens*	India	Antidiabetic	[56]
	Carallumaumbellata	India	antihyperglycemic	[57]
Carissa	*Carissa carandas*	India (Ayurveda, Unani, and Homoeopathy)	Antidiabetic	[58]
Cassia	*Cassia auriculata*	India, Tanzania	Antidiabetic	[59]
	Cassia fistula	India	Antidiabetic	[60]

	Cinnamomum cassia	India (Unani, Ayurveda) Japan, China, South Africa	antidiabetic	[61]
	Cinnamomum impressinervium	India	antidiabetic	[62]
	Cinnamomum tamala	India (Ayurveda)	hypoglycemic	[63]
	Cinnamomum verum	India (Ayurveda)	α-amylase inhibitor	[28]
	Cinnamomum zeylanicum		α-glucosidase	[64]
	Citrus sinensis	India	antidiabetic	[65]
Clerodendrum	*Clerodendrum glandulosum*	India	antidiabetic	[66]
	Clerodendrum colebrookianum	India	antidiabetic	[46]
	Clerodendrum infortunatum	India	antidiabetic	[67]
	Clerodendrum phlomidis	India (Ayurveda)	antidiabetic	[68]
Coccinia	*Coccinia cordifolia*	India	antidiabetic	[69]
	Coccinia grandis	India (Ayurveda), Sri Lanka	antihyperglycemic, α-glucosidase inhibitor, α-amylase inhibitor	[28,70-72]
	Coccinia indica	India (Ayurveda)	antidiabetic	[43,63]
Costus	*Costusigneus*	India	antidiabetic	[73]
	Costus pictus	India	antidiabetic	[74]
	Croton klozchianus	India (Ayurveda)	antidiabetic	[75]
	Croton zambesicus		antidiabetic	[76]
Cucumis	*Cucumis callosus*	India	antidiabetic	[77]
	Curculigoorchioides	India (Ayurveda)	antidiabetic	[78]
Curcuma	*Curcuma angustifolia*	India	antidiabetic	[79]
	Curcuma domestica	India	antidiabetic	[27]
	Curcuma longa	China, Bangladesh, India (Ayurveda), Indonesia, Laos	antidiabetic	[33,80]
Cuscuta	*Cuscutareflexa*	India, Bangladesh	antidiabetic	[49,81]
	Cuscuta chinensis	China	antidiabetic	[82]
	Cuscuta americana	Trinidad and Tobago	antidiabetic	[83]
Cyperus	*Cyperus kyllinga*	India (Ayurveda)	antidiabetic	[84]
	Cyperus laevigatus	India (Ayurveda)	antidiabetic	[85]

	Cyperus rotundus	India (Ayurveda)	antidiabetic	[86]
	Delonixelata		antidiabetic	[87]
Desmodium	*Desmodiumgangeticum*	India (Ayurveda), Sri Lanka	antidiabetic	[70,88]
	Dioscorea opposita	China, India (Ayurveda), China (TCM)	antidiabetic	[33,80,89]
	Diospyros melanoxylon	India, Sri Lanka	antidiabetic	[90]
	Diospyros peregrina	India	antidiabetic	[91]
Elephantopus	*Elephantopusscaber*	India	antidiabetic	[92]
	Elephantopusmollis		antidiabetic	[93]
Embelia	*Embelia madagascariensis*		hypoglycemic	[94]
	Embeliaribes	India (Ayurveda)	antidiabetic	[95]
Enicostema	*Enicostemaaxillare*	India (Ayurveda)	antidiabetic	[96]
	Enicostemalittorae		antidiabetic	[97]
Erythrina	*Erythrina indica*	India	antidiabetic	[98]
	Erythrina variegeta	India	antidiabetic	[87]
Eugenia	*Eugenia jambolana*	India (Ayurveda)	α-amylase inhibitor	[83,99]
	Eugenia polyantha	India, Indonesia	antidiabetic	[100,101]
Euphorbia	*Euphorbia caducifolia*	India	antidiabetic	[102]
	Euphorbia dioeca		α-glucosidase inhibitor	[103]
	Euphorbia drumondii	India (Ayurveda)	hyperglycemic	[104]
	Euphorbia hirta	India, Bangladesh, Nepal	α-glucosidase	[105-107]
	Euphorbia ligularia	India	antidiabetic	[62]
	Euphorbia neriifolia	India (Ayurveda)	antidiabetic	[108]
	Euphorbia prostrata		antihyperglycemic	[109]
Ferula	*Ferulaassa-foetida*	India (Ayurveda), Iran, Afghanistan	antidiabetic	[110,111]
Ficus	*Ficus amplissima*	India (Ayurveda, Siddha, Unani)	antidiabetic	[112]
	Ficus benghalensis	India (Ayurveda, Siddha, Unani,	antidiabetic	[101, 113]

		homoeopathy), Southeast Asia		
	Ficus carica	India (Ayurveda, Siddha, Unani, homoeopathy)	antidiabetic	[114, 115]
	Ficus cunia	India	α-glucosidase inhibitor	[116]
	Ficus glomerata	India (Ayurveda, Siddha, Unani, homoeopathy)	antidiabetic	[63,117]
	Ficus palmata		antidiabetic	[118]
	Ficus racemosa	India (Ayurveda, Siddha, Unani, homoeopathy), Bangladesh, Southeast Asia	antihyperglycemic, hypoglycemic, α-glucosidase and α-amylase inhibitor	[119,120]
	Ficus religiosa	India (Ayurveda)	antidiabetic	[113]
	Ficus virens	India (Ayurveda)	antidiabetic	[121]
Glycyrrhiza	*Glycyrrhiza glabra*	China, India	antidiabetic	[33,122]
	Glycyrrhiza uralensis	India	antidiabetic	[123]
Grewia	*Grewia asiatica*	India (Ayurveda)	antidiabetic	[124]
	Grewia hirsuta	India	antidiabetic	[125]
	Grewia nervosa		antidiabetic	[126]
Helicteres	*Helicteresisora*	India (Ayurveda)	antidiabetic	[127]
Holarrhena	*Holarrhenaantidysenterica*	India (Ayurveda)	antidiabetic	[128]
Hydnocarpus	*Hydnocarpusalpina*		hypoglycemic	[129]
	Hydnocarpuswightiana	India (Ayurveda)	antidiabetic	[130]
Leucas	*Leucas aspera*	India, Bangladesh	antidiabetic	[36,131]
	Leucas cephalotes	India (Ayurveda), Nepal, Pakistan	antidiabetic	[132]
	Luffa echinata	India	Antidiabetic	[64]
Mangifera	*Mangifera indica*	India (Ayurveda), Nigeria	α-amylase inhibitor, antihyperglycemic	[28,133]
	Melia dubia	India	antidiabetic	[134]
	Melia orientalis	India (Ayurveda)	antidiabetic	[135]
Mentha	*Mentha arvensis*	India	antidiabetic	[136]
	Mentha longifolia	India	antidiabetic	[27]

Mimusops	*Mimusopselengi*	India (Ayurveda)	antidiabetic	[137]
	Momordica charantia	Philippines, Vietnam, Mauritius, Trinidad and Tobago, India (Ayurveda), Nigeria, Bangladesh, Taiwan, central America	α-amylase inhibitor, hypoglycemic, antihyperglycemic	[138-141]
Moringa	*Moringa oleifera*	South Africa, Kenya, Mexico, India (Ayurveda), Nigeria, Mauritius, Senegal	hypoglycemic	[63,142-45]
Morus	*Morus alba*	Iran, Philippines, Trinidad and Tobago, India (Ayurveda), China (TCM), Pakistan, Korea, Chile	antidiabetic, hypoglycemic, α-glucosidase and α-amylase inhibition	[146-154]
Mucuna	*Mucuna gigantea*	India	antidiabetic	[155]
	Mucuna pruriens	India (Ayurveda)	Antidiabetic	[43]
Murraya	*Murrayakoenigii*	India (Ayurveda)	α amylase inhibitor, hypoglycemic effects, antihyperglycemic	[156]
	Musa Sapientum	India	antihyperglycemic	[109,157]
Nymphaea	*Nymphaea nouchali*	Bangladesh, India (Ayurveda)	Antidiabetic	[106]
	Nymphaea stellata	India (Ayurveda)	α-glucosidase inhibitor, hypoglycemic, antihyperglycemic	[158, 159]
Ocimum	*Ocimum sanctum*	India (Ayurveda), China, Bangladesh	hypoglycemic	[160,161]
	Ocimumtenuiflorum	India (Ayurveda)	α-amylase inhibitor, hypoglycemic, antihyperglycemic	[28,162]
Oxalis	*Oxalis corniculata*	India	Antidiabetic	[27]
	Oxalis griffithii	India	Antidiabetic	[49]
Paederia	*Paederiafoetida*	China, Vietnam, India Japan	Antidiabetic	[162]
	Paederia scandens	China, Vietnam, India, Japan	Antidiabetic	[162]
pandanus	*Pandanus fascicularis*	India (Ayurveda)	antihyperglycemic	[163]
	Pandanus tectorius		Antidiabetic	[164]
Phyllanthus	*Phyllanthus amarus*	Vietnam, India (Ayurveda, Siddha,	α-glucosidase inhibitor,	[114,165]

		Unani and homeopathy), Nigeria, Malaysia	hypoglycemic, α-amylase inhibitor	
	Phyllanthus emblica	Thailand, Southeast Asia, India (Ayurveda)	Antidiabetic	[117,166,167]
	Phyllanthus gardnerianus	India	Antidiabetic	[168]
	phyllanthusvirgatus		α-amylase inhibitor	[169]
	Phyllanthus watsonii		Antidiabetic	[170]
Physalis	*Physalis angulata*	India	Antidiabetic	[171]
	Physalis minima	India	Antidiabetic	[36]
	Physalis peruviana	India	Antidiabetic	[172]
Piper	*Piper longum*	Bangladesh, India (Ayurveda)	antihyperglycemic	[173-175]
	Piper nigrum		α-amylase inhibitor, hypoglycemic	[28,176]
Plantago	*Plantago ovata*	India	Antidiabetic	[99]
Plumeria	*Plumeria rubra*	India	α-amylase and α-glucosidase inhibitor	[177]
Polygonum	*Polygonum hydropiper*	India	antidiabetic	[46]
Pterocarpus	*Pterocarpus santalinus*	India (Ayurveda)	antidiabetic	[178]
	Pterocarpus marsupium	India	antidiabetic	[179]
	Pterocarpus soyauxii		antidiabetic	[180]
Prunus	*Prunus persica*	India	antidiabetic	[181]
Rheum	*Rheum emodi*	India (Ayurveda), China	antidiabetic	[182]
	Rhus hirta		antidiabetic	[183]
	Rhus mysorensis		antidiabetic	[184]
Salacia	*Salacia chinensis*	India (Ayurveda, Unani), Japan, Korea	hypoglycemic, antihyperglycaemic	[185, 186]
	Salacia oblonga	India (Ayurveda, Unani), Japan, Korea	hypoglycemic	[186,187]
	Salacia prinoides	India (Ayurveda), Sri Lanka, Southeast Asia	antidiabetic	[186]
	Salacia reticulata	India (Ayurveda, Unani), Japan, Korea, Sri Lanka	hypoglycemic, α-glucosidase inhibitor	[185,187,188,189]

Sida	*Sida acuta*	India	antidiabetic	[190]
	Sida cordifolia	Bangladesh, India (Ayurveda)	antidiabetic	[191,192]
	Sidarhombifolia		antidiabetic	[193]
Solanum	*Solanum indicum*	Uganda, India	antidiabetic	[62,194]
	Solanum trilobatum	India (Ayurveda, Siddha)	antidiabetic	[195]
	Solanum tuberosum		antidiabetic	[196]
	Solanum viarum	India	antidiabetic	[49]
Stereospermum	*Stereospermumsuaveolens*	India	Antidiabetic	[197]
Swertia	*Swertia chirayita*	India (Ayurveda)	Hypoglycemic	[63,198]
	Swertia cordata		Antidiabetic	[199]
	Swertia longifolia		α-amylase inhibitor	[200]
Syzygium	*Syzygiumdensiflorum*	India	Antidiabetic	[201]
	Syzygiumcumini	Bangladesh, India (Ayurveda), Brazil	α-glucosidase and α-amylase inhibitor, antihyperglycemic	[30,49,120,202,203]
	Syzygiumdensiflorum	India	antidiabetic	[201]
	Syzygiumjambolanum	India (Ayurveda)	hypoglycemic	[204,205]
	Tabernaemontanadivaricata	India	antidiabetic	[62]
	Tabernaemontanaheyneana		antidiabetic	[206]
Taxus	*Taxus baccata*	India	antidiabetic	[27]
	Terminalia arjuna	Bangladesh, India (Ayurveda)	α-amylase inhibitor, antihyperglycemic	[87,207]
	Terminalia bellirica	Bangladesh, Vietnam, India (Ayurveda, Siddha, Unani), Sri Lanka, Southeast Asia	antidiabetic	[106,208,209]
	Terminalia catappa		antidiabetic	[210]
	Terminalia chebula	Thailand, India (Ayurveda),	α-amylase inhibitor	[28,166,211,212]

		Bangladesh, Iran		
Trichosanthes	*Trichosanthescucumerina*	India (Ayurveda)	hypoglycemic	[62]
	Trichosanthes dioica	India (Ayurveda)	antidiabetic	[213]
	Vaccinium vitis		antidiabetic	[214]
Withania	*Withania coagulans*	India (Ayurveda), Pakistan	antihyperglycemic	[215,216]
z	*Withania somnifera*	India (Ayurveda)	hypoglycemic	[100,217]
Zanthoxylum	*Zanthoxylum alatum*		antidiabetic	[218]
	Zanthoxylum armatum	India (Ayurveda)	antidiabetic	[60]
	Zanthoxylum humile	India (Ayurveda)	antidiabetic	[219]
Zingiber	*Zingiber officinale*	India (Ayurveda), Latin America Africa	α-amylase inhibitor, hypoglycemic	[28,63,220,221]
	Ziziphus nummularia	India	antidiabetic	[102]
	Ziziphus xylopyrus	India (Ayurveda), Pakistan, China	antidiabetic	[222]

Plant Name	**Country/Region**	**Activity**	**Reference**
Abrus precatorius	India (Ayurveda, Unani, Siddha)	antidiabetic	[223]
Acorus calamus	India, Indonesia, America	α-glucosidase inhibitor	[105,224]
Adansonia digitata	India (Ayurveda)	α-amylase inhibitor	[28]
Adiantum capillus-veneris	India	antidiabetic	[27]
Ailanthus excelsa	India	antidiabetic	[225]
Alangiumsalvifolium	India (Ayurveda)	hypoglycemic	[226,227]
Alstoniascholaris	India, Thailand	α-glucosidase inhibitor	[227]
Andrographis paniculata	India (Ayurveda), Bangladesh, Nepal, Malaysia, Southeast Asia	antihyperglycemic	[81,107,116,228,229]
Anthocephalus cadamba	India (Ayurveda), Australia, China, Indonesia, Malaysia, Papua New Guinea, Philippines, Singapore, Vietnam	antidiabetic	[230]

Aphanamixispolystachya	India (Ayurveda)	antidiabetic	[231]
Argyreia nervosa	India (Ayurveda)	Antidiabetic	[232]
Asanadigana	India (Ayurveda)	Antidiabetic	[233]
Barringtonia acutangula	India (Ayurveda)	antidiabetic	[234]
Basella rubra	India	α-amylase inhibitor	[235]
Begonia roxburghii	India	antidiabetic	[49]
Blepharismolluginifolia	India	antidiabetic	[236]
Boerhaviadiffusa	India (Ayurveda)	antidiabetic	[80]
Boswellia ovalifoliolata	India	antidiabetic	[237]
Cajanus cajan	India (Ayurveda)	antidiabetic	[43]
Callicarpa arborea	India	antidiabetic	[49]
Canna indica		antidiabetic	[238]
Casia fistula	India (Ayurveda)	α-amylase inhibitor	[28]
Cayratiatrifolia	India	antidiabetic	[239]
Ceiba pentandra	India, Nigeria	α-amylase inhibition, hypoglycemic, antihyperglycemic	[240-242]
Centella asiatica	India (Ayurveda), Bangladesh, Malaysia, Laos, Southeast Asia	antidiabetic	[106,117,243-245]
Centratherumanthelminticum	India (Ayurveda)	hypoglycemic	[191,246]
Chlorophytum borivilianum	India (Ayurveda)	antidiabetic	[247]
Clitoriaternatea	India (Ayurveda)	α-glucosidase, α-amylase inhibitor hypoglycemic	[164,248,249]
Cocculus hirsutus	India	α-amylase inhibitor	[235]
Coldenia procumbens	India	antidiabetic	[250]
Commiphorawightii	India (Ayurveda)	antidiabetic	[80]
Cosciniumfenestratum	India, Sri Lanka	antidiabetic	[251,252]
Cuminum cyminum	India	antidiabetic	[253]
Cyamopsis tetragonoloba	India (Ayurveda)	antidiabetic	[254]
Dendrocalamushamiltonii	India (Ayurveda)	hypoglycemic	[63]

Desmostachyabipinnata	India (Ayurveda)	antidiabetic	[255]
Dillenia indica	India	antidiabetic	[49]
Diplazium esculentum	India	antidiabetic	[49]
Elaeocarpus ganitrus	India (Ayurveda), Nepal	antidiabetic	[256]
Emblica officinalis	India (Ayurveda), Bangladesh	antidiabetic	[132,257,258]
Enhydra fluctuans	India	antidiabetic	[259]
Feronia limonia	India	antidiabetic	[260]
Gloriosa superba	India (Ayurveda)	antidiabetic	[261]
Glycosmis pentaphylla	Siddha, India (Ayurveda)	antidiabetic	[262]
Gmelina arborea	India, Sri Lanka	antidiabetic	[263,264]
Gymnemasylvestre	Ayurveda, Pakistan, Southeast Asia	hypoglycemic and antihyperglycemic	[117,265,266]
Hemidesmus indicus	India (Ayurveda)	antidiabetic	[267]
Heritiera fomes	India	antidiabetic	[268]
Ichnocarpus frutescens	India (Ayurveda)	antidiabetic	[269]
Imperata cylindrica	India (Ayurveda)	antidiabetic	[270]
Lagenaria sicereria	Mauritius, India (Ayurveda)	antihyperglycemic	[38,271,272]
Lactuca gracilis	India	antidiabetic	[49]
Linum usitatisumum	India (Ayurveda)	α-amylase inhibitor	[28]
Meynalaxiflora	India	antidiabetic	[273]
Millingtonia hortensis	India	antidiabetic	[49]
Mukiamaderaspatana	India (Ayurveda, Siddha)	antidiabetic	[274]
Nelumbo nucifera	India (Ayurveda), China (TCM), Southeast Asia	α-glucosidase, α-amylase inhibitor, hypoglycemic	[117,275-277]
Nicotiana plumbaginifolia	India	antidiabetic	[27]
Nigella sativa	Algeria, India (Ayurveda, Siddha, Unani), Pakistan, Morocco, Middle East, Mediterranean, North Africa	antidiabetic	[278-281]

Nycantus arbor-tristis	India (Ayurveda), Sri Lanka	hypoglycemic	[282]
Odina wodier	India	antidiabetic	[283]
Oreocnide integrifolia	India	antidiabetic	[284]
Oroxylum indicum	Bangladesh, India (Ayurveda)	antidiabetic	[106,285]
Pavonia zeylanica	India (Ayurveda)	antidiabetic	[227]
Pergulariadaemia	India (Ayurveda)	antidiabetic	[286]
Peucedanumpraerup torum	India (Ayurveda), China	antidiabetic	[287]
Phoenix dactylifera	Jordan, India (Ayurveda), Pakistan, Egypt	antidiabetic	[288-290]
Pisonia grandis	India	antidiabetic	[291]
Plumbago zeylanica	India	antidiabetic	[27]
Polyalthia longifolia	India	antidiabetic	[292]
Pongamia pinnata	India (Ayurveda)	antihyperglycemic	[293,294]
Portulaca oleracea	Trinidad and Tobago, India (Ayurveda), Algeria, Iran, China (TCM), Mexico	hypoglycemic	[295-298]
Premna integrifolia	India (Ayurveda)	hypoglycemic	[74]
Psoralea corylifolia	India (Ayurveda)	antidiabetic	[299]
Punica granatum	India (Ayurveda, unani)	antidiabetic	[300-303]
Roylea cinerea	India	antidiabetic	[304]
Rubia cordifolia	India	antidiabetic	[305]
Saccharum spontaneum	India	antidiabetic	[49]
Sesbeniaaegyptiaca	India (Ayurveda)	hypoglycemic	[63]
Sphaeranthus indicus	India	antidiabetic	[306]
Stevia rebaudiana	India, Paraguay, Brazil, south America	antidiabetic	[307,308]
Tamarindus indica	India (Ayurveda), Trinidad and Tobago, Africa	α amylase inhibitor	[37,309, 310]
Tephrosia purpurea	India (Ayurveda)	antihyperglycemic	[311, 312]
Thespesia populnea	India (Ayurveda)	antihyperglycemic and hypoglycemic	[313]
Tragiainvolucrata	India (Ayurveda)	antidiabetic	[314]
Viola odorata	India	antidiabetic	[27]
Wedeliatrilobata	South America, China, Japan, India	antidiabetic	[315]

Centhratherum	India	Antidiabetic	[316]
Casalpinia bonduc	India	Antidiabetic	[316]

Marketed herbal Antidiabetic products:

Sr. NO.	Product	Manufacturer	Mechanism	Ref.
1	Sharang Dyab-Tea	Plant Med. Lab Pvt. Ltd	Stimulate insulin production	[317]
2	Herbal hill jambu	Isha Agro Devlopers	Reduce blood and urine sugar level	[318]
3	Stevia-33	Vitalize herbs	Maintain proper blood sugar level	[319]
4	Diab-FIT	Herbal FIT	Maintain proper blood sugar level	[320]
5	Madhumar capsule	Kangrd Hills Care and Cure Products	Control chronic diabetes mellitus	[321]
6	Daya Stone Powder	Jignesh and co.	Lowers the blood sugar level	[322]
7	Diabetone Tablet	Shelter Pharma Ltd.	Reduce blood sugar level by neutralize the level of pituitary secretion	[323]
8	Kumari-SAAR	Krishna herbal company	Maintain diabetic complication	[324]
9	Spenai	Shriji Herbal Products	Antidiabetic	[325]
10	Blue berry	A1-Hikma FZCO	Antidiabetic	[326]
11	Episulin	Varuna biocell Pvt.Ltd	Antidiabetic	[327]

CONCLUSION:

The global rise in diabetes prevalence has highlighted the need for innovative and holistic approaches to its management. While conventional antidiabetic medications are effective, their side effects often lead patients to seek alternative therapies. This review underscores the therapeutic potential of medicinal plants in diabetes management, with over 400 species demonstrating hypoglycemic properties. Many of these plants offer mechanisms that address key aspects of diabetes, such as enhancing insulin activity, inhibiting glucose absorption, and protecting pancreatic function. Importantly, traditional medicine systems like Ayurveda and Unani have long recognized the benefits of these plants, especially in rural populations that rely heavily on herbal remedies. As research into these botanical treatments continues, there is significant promise in integrating them with conventional medical approaches to provide a more comprehensive, side-effect-free management of diabetes. However, more clinical studies are needed to validate their efficacy and safety. The future of diabetes treatment may well lie in the synergy between modern pharmacology and traditional plant-based medicine

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