



DIABETES AND MEDICINAL PLANTS: A PROMISE FOR TODAY AND TOMORROW

Botany

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ABSTRACT

Even from early civilization, plants have been considered to be powerful tool in treating illness. The present article is an attempt to highlight the list of the traditional plants used to cure diabetes. Active constituents of any medicinal plant define the efficacy and safety of treatment to control diabetes. The WHO has defined herbal medicines as finished labelled medicinal products that contain as active ingredients aerial or underground parts of plants or other plant material or combination thereof, whether in crude state or as plant preparations. Diabetes mellitus is one of the most common non-communicable diseases globally. Herbal medicines have been the highly esteemed source of medicine throughout human history. They are widely used today indicating that herbs are a growing part of modern, high-tech medicine. The medicinal plants, besides having natural therapeutic values against various diseases and considerable works have been done on these plants to treat diabetes mellitus, describes that the antidiabetic activity of flavonoids, terpenoids, coumarins and other medicinal plants is due to the presence of phenolic compounds, constituents which show reduction in blood glucose levels. This article provides a brief review of different plants using in the traditional system for the treatment of diabetes since ancient times, and attempt has been made to compile the reported hypoglycaemic plants available in different scientific journals.

KEYWORDS

Medicinal plants, antidiabetic, hypoglycaemic, therapeutic, pharmacology,

Introduction:

Diabetes mellitus is spreading in an alarming way throughout the world and three fourth of the world populations and considered as a major cause of high economic loss which can in turn impede the development of nations. Moreover, uncontrolled diabetes leads to many chronic complications such as blindness, heart disease, and renal failure, etc. For this, therapies developed along the principles of western medicine (allopathic) are often limited in efficacy, carry the risk of adverse effects, and are often too costly, especially for the developing world. Therefore, treating diabetes mellitus with plant derived compounds which are accessible and do not require laborious pharmaceutical synthesis seems highly attractive. Diabetes mellitus is a group of metabolic alterations characterized by hyperglycaemia resulting from defects in insulin secretion, action or both.¹ Without enough insulin, the cells of body cannot absorb sufficient glucose from the blood; hence blood glucose levels increase, which is termed as hyperglycemia. If the glucose level in the blood remains high over a long period of time, this can result in long term damage to organs such as kidneys, liver, eyes, nerves, heart and blood vessels. Complications in some of these organs can lead to death.² Progress in understanding the metabolic staging of diabetes over the past few years has led to significant advances in regimen for treatment of this devastating disease.^{3,4} In conventional therapy, Type 1 diabetes is treated with exogenous insulin and Type 2 with oral hypoglycaemic agents.⁵ Terrestrial plants have been used as medicines in Egypt, China, India and Greece. Now, an impressive number of modern drugs have

been developed from the plants. Plant secondary metabolites have proved to be an excellent reservoir of new medical compounds.⁶ World Health Organization, over 80% of the world's populations rely upon such traditional plant-based systems of medicine to provide them primary healthcare.⁷

Symptoms are nearly the same in the two major types of diabetes, but they differ in their intensity. The initial symptoms of untreated diabetic patients are attributed to elevated blood-glucose levels. Consequently, a loss of glucose in urine occurs, which increases urine output, leading to dehydration accompanied by thirst and raised water consumption. Insulin deficiency eventually results in weight loss in spite of an increase in appetite and food consumption. Untreated diabetic patients also suffer from fatigue, nausea and vomiting. They are susceptible to develop bladder, skin, and vaginal infections. Fluctuations in blood sugar levels can cause blurred vision. Moreover, very high sugar-levels can result in coma and even death.¹⁰ In the last few years, there has been a growing interest in the herbal medicine in care and management of diabetes both in developing and developed countries, due to their natural origin and less side effects.¹⁶

This review shows the importance and the interest placed on medicinal plants in the drive to demonstrate their anti-diabetic effects and the responsible bioactive agents and covers the common name of a plant, family, and other parts that commonly used as a remedy sources, active chemical constituents etc.¹

Table 1. Traditional anti-diabetic potential herbal plants and their active principles^{1,3,8,9,11,12,13,14,15,17,18,20,21,22,23,25,26,27}

S.no.	Botanical name	Family	Common name	Part used	Active chemical constituents
1.	<i>Acacia meansii</i>	Mimosaceae	Kikar	Bark	Robinetinidol and fisetinidol
2.	<i>Acacia arabica</i>	Mimosaceae	Kikar	Bark	Polyphenol, Tannin
3.	<i>Abelmoschus esculentus</i>	Malvaceae	Bhindi	fruit	Carbohydrate, Gum, Mucilage, Protein, Phytosterol, Flavonoid, Tannin, Phenolics, Volatile oil
4.	<i>Abutilon indicum</i>	Malvaceae	Kangi	Leaves	-
5.	<i>Allium cepa</i>	Alliaceae	onion	bulb	Allyl propyl disulphide, S- methyl cysteine sulphoxide
6.	<i>Allium sativum</i>	Alliaceae	Garlic	bulblets	Diallyl disulphide oxide, Ajoene, Allyl propyl disulfide, S-allyl cysteine, S-allyl mercaptocysteine
7.	<i>Acacia catechu</i>	Mimosaceae	-	-	-
8.	<i>Achyranthes aspera</i>	Amaranthaceae	Apamarg	Plant	-
9.	<i>Adhatoda zeylanica</i>	Acanthaceae	Arusa	Leaves	-
10.	<i>Aloe vera</i>	Liliaceae	Barbados aloe	Leaf	Pseudoprotinosaponin, Prototinosaponin
11.	<i>Aloe barbadensis</i>		Barbados aloe	Leaf	Lophenol, 24-methyl-lophenol, 24- ethyllophenol
12.	<i>Aegle marmelose</i>	Rutaceae	Bael	Leaves	Aegeline, Coumarin, Flavonoid, Alkaloid
13.	<i>Amomum aromaticum</i>	Zingiberaceae	Hari Elachi	Rhizome	-
14.	<i>Amomum subulatum</i>	Zingiberaceae	Bari elachi	fruit	-

15.	<i>Anacardium occidentale</i>	Anacardiaceae	Kaju	Leaves	-
16.	<i>Andrographis paniculata</i>	Acanthaceae	Kiryat	Leaves	-
17.	<i>Anethum sowa</i>	Apiaceae	Soya	Fruit	-
18.	<i>Annona squamosa</i>	Annonaceae	Seethaphal	fruit	Liriodenine, moupinamide
19.	<i>Arachis hypogaea</i>	Papilionaceae	Mungfali	Nut	-
20.	<i>Artemisia pallens</i>	Asteraceae		Leaves and flowers	Germacranolide
21.	<i>Areca catechu</i>	Arecaceae	Supari	Nut	Arecaine and arecoline
22.	<i>Asparagus racemosus</i>	Asparagaceae	Satavari	Root	-
23.	<i>Atropa belladonna</i>	Solanaceae	Sagangur	Leaves	-
24.	<i>Azadirachta indica</i>	Meliaceae	Nimb	Leaves	-
25.	<i>Bauhinia forficata</i>	Leguminosae		Leaf	Astragalins, kaempferitrin
26.	<i>Beta vulgaris</i>	Amaranthaceae	-	Root	Phenolics, betacyanins
27.	<i>Boerhavia diffusa</i>	Nyctaginaceae		Whole plant	Punarnavine and ursolic acid
28.	<i>Butea monosperma</i>	Fabaceae	Palash	seeds	Butein, Palasonin, Stigmasterol-3 β- D glucopyranoside
29.	<i>Brassica oleracea</i>	Brassicaceae	Cabbage	Cabbage oil	-
30.	<i>Bryophyllum pinnatum</i>	Crassulaceae	Patthar chat	Leaf	-
31.	<i>Bougainvillea spectabilis</i>	Nyctaginaceae		Leaves	-
32.	<i>Bacopa monnieri</i>	Scrophulariaceae	Maduka parni	Whole plant	-
33.	<i>Bambusa bambos</i>	Poaceae	Kanta bans	Leaves	-
34.	<i>Bambusa arundinaria</i>	Poaceae		Leaves	b-Sitosterol glucoside and stigmasterol
35.	<i>Bambusa nutans</i>	Poaceae	Malabans	Whole plant	-
36.	<i>Brassica juncea</i>	Brassicaceae	Mustard	Seeds, leaf	Isorhamnetin diglucoside
37.	<i>Bridelia ndellensis</i> Beille.	Euphorbiaceae	-	stem bark	
38.	<i>Bridelia ferruginea</i>	Euphorbiaceae	-	leaf	
39.	<i>Boswellia carterii</i> , <i>Boswellia serrata</i>	Burseraceae	-	Oleo-gum resin	Boswellic acid
40.	<i>Capparis decidua</i>	Capparidaceae	-	Fruit	Spermidine Isocodonocarpine
41.	<i>Cassia auriculata</i>	Fabaceae	Tanner's cassia	Flower	Sterol, Triterpenoid, Flavonoid, Tannin
42.	<i>Camellia sinensis</i>	Theaceae	-	Leaves	caffeine and catechins
43.	<i>Canarium schweinfurthii</i>	Burseraceae	-	Stem bark,	-
44.	<i>Chamaemelum nobile</i>	Asteraceae	-	Leaf	-
45.	<i>Citrus reticulata</i>	Rutaceae	Mandarin	Fruit	1 Essential oil
46.	<i>Cajanus cajan</i>	Leguminosae	Pigeon pea	Seeds	7-phenyloctahydroquinolizin- 2-one
47.	<i>Capsicum frutescens</i>	Solanaceae	Chilli	fruit	Capsaicin
48.	<i>Catharanthus roseus</i>	Apocynaceae	sadabahar	Whole Plant	Vinculin, Alkaloid
49.	<i>Cinnamomum zeylanicum</i>	Lauraceae	dalchini	Leaf, Bark	Cinnamaldehyde, eugenol
50.	<i>Combretum micranthum</i>	Combretaceae		Leaves	Polyphenols
51.	<i>Coriandrum sativum</i>	Apiaceae	Coriander	Leaf	Alanin
52.	<i>Cuminum cyminum</i>	Apiaceae	cumin	Seed	Aldehyde
53.	<i>Curcuma longa</i>	Zingiberaceae	turmeric	Rhizome	Curcuminoid
54.	<i>Cedrus deodra</i>	pinaceae	Devadaru	Heartwood	-
55.	<i>Cocos nucifera</i>	Arecaceae	Nariyal	Oil	-
56.	<i>Conium maculatum</i>	Umbelliferae	-	-	-
57.	<i>Cucumis meluliferus</i>	Cucurbitaceae	Jelly melon	Fruit	B-carotene, Fatty acid
58.	<i>Carica papaya</i>	Caricaceae	papaya	Fruit	Saponin, Tannin, Alkaloid,
59.	<i>Datura metel</i>	Solanaceae	Datura	seeds	-
60.	<i>Diospyros lotus</i>	Ebenaceae	Date plum	Fruit	Phenolics
61.	<i>Diospyros peregrina</i>	Ebenaceae	Gaub persimmon	Fruit	Lupeol, Betulin, Gallic acid, Betulinic acid, Hexacosane, Hexacosanol, Sitosterol
62.	<i>Elephantopus scaber</i>	Asteraceae		Whole plant	Terpenoid and 2,6,23 - trienolide
63.	<i>Emblica officinalis</i>	Euphorbiaceae	Amla	Fruit	Tannoid
64.	<i>Eugenia jambolana</i>	Myrtaceae	Jaman	Seeds	Anthocyanin, Citric, Malic, Gallic acid
65.	<i>Ephedra distachya</i>	Ephedraceae	Jointed fir	plant	Ephedrine
66.	<i>Eucalyptus globulus</i> Labill	Myrtaceae	-	-	-
67.	<i>Ficus carica</i>	Moraceae	Anjir	Leaf, Fruit	-
68.	<i>Ficus racemosa</i>	Moraceae	Gular	fruit	-
69.	<i>Ficus bengalensis</i> Linn.	Moraceae	Bargad	bark	Leucodelphinidin and Leucopelargonin
70.	<i>Ficus religiosa</i>	Moraceae	Peepal	Leaf	
71.	<i>Gynandropsis gynandra</i>	Capparidaceae		Root	N,N-diethyltoluamide
72.	<i>Gymnema sylvestre</i>	Asclepiadaceae	Gurmar buti	leaf	Gymnemic acid, Gymnema, Saponin
73.	<i>Grifola frondosa</i>	Meripilaceae	Maitake	Fruit	Disaccharide
74.	<i>Glycine max</i>	Fabaceae	soya	seeds	3-O-methyl-D-chiro-inositol
75.	<i>Hibiscus rosa sinensis</i>	Malvaceae	gurhal	flower	-
76.	<i>Helicteres isora</i>	Sterculiaceae	East Indian screw tree	Fruit	Steroid, Terpenoid, Alkaloid, Carbohydrate, Phenolics
77.	<i>Hordeum vulgare</i>	Poaceae	Barley	seeds	Beta-glucan
78.	<i>Ipomea batata</i>	Convolvulaceae	Mithalu	Tuberous root	-
79.	<i>Ibervillea sonora</i>	Cucurbitaceae	Huereque	root	Monoglyceride (MG), Fatty acid
80.	<i>Jatropha curcas</i>	Euphorbiaceae	Barbados	Whole plant	Diterpene

81.	<i>Kickxia linaria</i>	Scrophulariaceae	Kanodi	Whole plant	-
82.	<i>Lithocarpus polystachyus</i>	Fagaceae	-	Leaves	-
83.	<i>Lycium barbarum</i>	Solanaceae	Chirchita	Fruit	Polysaccharid
84.	<i>Lactuca sativa</i>	Asteraceae	-	Seed	
85.	<i>Lantana camara</i>	Verbenaceae	-	Leaves	Lantoside, lantanone
86.	<i>Liriope spicata</i>	Liliaceae	-	Root	Beta-sitosterol, stigmasterol
87.	<i>Murraya koenigii</i>	Rutaceae	Chari leaf tree	Leaf, Fruit	Carbazole, Alkaloid
88.	<i>Melia dubia</i>	Meliaceae	African mahogany	Whole plant	Liminoid
89.	<i>Mentha piperita</i>	Lamiaceae	Pudina	Leaf	Essential oil, Terpen, Flavonoid, Vanadium, Zinc, Chromium, Copper, Iron, Potassium, Sodium, Nickel
90.	<i>Momordica charantia</i>	Cucurbitaceae		leaves	Charantin, sterol
91.	<i>Morinda citrifolia</i>	Rubiaceae	Fruit Fruit juice	Indian mulberry	Saponin, Triterpene, Steroid, Flavonoid
92.	<i>Moringa oleifera</i>	Moringaceae	Moringa	Whole Plant	-
93.	<i>Myrtus communis</i>	Myrtaceae	-	Fruit	Myrtucommulone D, myrtucommulone E, myrtucommulone C & myrtucommulone B
94.	<i>Musa paradisiaca</i>	Musaceae	Banana	Fruit	Dietary fibre, Pectin
95.	<i>Nigella sativa</i>	Ranunculaceae	Kalongi	Whole plant	Thymoquinon
96.	<i>Nelumbo nucifera</i>	Nymphaeaceae	Sacred lotus	Flower	Tolbutamide
97.	<i>Ocimum sanctum</i>	Lamiaceae	Holy basil	Leaf	Eugenol (1-hydroxy-2-methoxy-4- 26] allylbenzene)
98.	<i>Olea europea L.</i>	Oleaceae	olive	Leaf	Oleuropeoside
99.	<i>Oryza sativa</i>	Graminae	Dhan	-	
100.	<i>Oxalis species</i>	Oxalidaceae	Khatti buti	Fruit	
101.	<i>Panax quinquefolius</i>	Araliaceae		root	Ginsenosides, protopanaxadiol
102.	<i>Parinari excelsa</i>	Chrysobalanaceae		Bark	Myricetin, quercetin
103.	<i>Punica granatum</i>	Punicaceae	Pomegranate	fruit	Tannin, Gallic acid
104.	<i>Pterocarpus marsupium</i>	Leguminosae	-	Whole plant	Kenotannic acid, pyrocatechin
105.	<i>Psidium guajava</i>	Myrtaceae	guava	Fruits	-
106.	<i>Phoenix dactylifera</i>	Arecaceae	Khajur	Leaves	-
107.	<i>Piper longum</i>	Piperaceae	Pipli	Fruit	-
108.	<i>Piper betle</i>	Piperaceae	Pan	Leaf	
109.	<i>Phyllanthus amarus</i>	Phyllanthaceae	-	whole plant	Phyllanthin
110.	<i>Prunus amygdalus</i>	Rosaceae	-	Seed	amygdalin
111.	<i>Portulaca oleracea</i>	Portulacaceae	-	Seed	
112.	<i>Punica granatum</i>	Punicaceae	-	Flower	Punicalagin, punicalin
113.	<i>Quercus infectoria</i>	Fagaceae	Majuphal	Leaves	-
114.	<i>Rhus coriaria</i>	Anacardiaceae	Sicilian Sumac	Fruit	Limonene, Nonanal, Dec-2 (Z)-enal
115.	<i>Rotula minor</i>	Boraginaceae	Kalavidhana	Root	-
116.	<i>Ricinus communis</i>	Euphorbiaceae	-	Root	Ricinolic acid
117.	<i>Saraca asoca</i>	Caesalpinaceae	Asok	Flower	-
118.	<i>Silybum marianum</i>	Compositae	Gidea	Flower	-
119.	<i>Sorghum bicolor</i>	Graminae	Jawar	Stem	-
120.	<i>Stevea rebaudiana</i>	Asteraceae	-	Plant	-
121.	<i>Salacia oblonga wall.</i>	Celastraceae	-	Root bark	salacinol
122.	<i>Smallanthus sonchifolius</i>	Asteraceae	-	Leaves	Sonchifolin, uvedalin, uctuaninenhydrin,
123.	<i>Swertia punicea</i>	Gentianaceae	-	Whole plant	Methyl swertianin and bellidifolin
124.	<i>Solanum nigrum</i>	Solanaceae	Makoy	Whole plant	-
125.	<i>Trigonella foenum graecum</i>	Fabaceae	-	Leaves and seeds	4-hydroxy isoleucine
126.	<i>Terminalia chebula</i>	Combretaceae	Chebolic myrobalan	Seed, Fruit	Shikimic, Gallic, Triacotanoic, Palmitic acid, β -sitosterol, Daucoesterol
127.	<i>Terminalia catappa</i>	Combretaceae	Indian almond	Fruit	Phenolics
128.	<i>Tamarindus indica</i>	Caesalpinaceae	Imli	seeds	Flavonoid, Polysaccharide
129.	<i>Tectona grandis</i>	Verbenaceae	Sagwan	Heart wood	-
130.	<i>Thespesia populnea</i>	Malvaceae	Portia tree	Fruit, stem, bark	Populnetin, Herbacetin, Populneol, Quercetin
131.	<i>Terminalia arjuna</i>	Combretaceae	Arjun	Root	-
132.	<i>Tinospora cordifolia</i>	Menispermaceae	Giloy	Whole plant	-
133.	<i>Urtia dioica</i>	Urticaceae	Bichhu booti	Leaves	-
134.	<i>Viburnum opulus</i>	Caprifoliaceae	Cranberry	Fruit	Tannin
135.	<i>Vernonia anthelmintica</i>	Asteraceae	-	Seed	Epoxy acid or vernolic acid
136.	<i>Vitex negundo</i>	Lamiaceae	Nirgundi	Leaves	-
137.	<i>Vigna angularis</i>	Fabaceae	-	Plant	-
138.	<i>Vitis vinifera</i>	Vitaceae	-	Unripe fruit	Procyanidins
139.	<i>Widhania somnifera</i>	Solanaceae	ashwagandh	Leaves, root	-
140.	<i>Withania coagulans</i>	Solanaceae	Vegetable rennet	Fruit	Milk-coagulating enzyme, Esterase, Fatty oil, Essential oil, Alkaloid
141.	<i>Xanthocercis zambesiaca</i>	Fabaceae	Nyala tree	Leaf	Fagomine, 4-O-beta-Dglucopyranosylfagomine, Castanospermine
142.	<i>Ziziphus xylopyrus</i>	Rhamnaceae	Ghonta	Fruit	-
143.	<i>Zingiber officinale</i>	Zingiberaceae	Ginger	Rhizome	Gingerol, Ethanol
144.	<i>Ziziphus spinachristi</i>	Rhamnaceae	Christ thorn	Leaf	Christinin-A, Fatty acid
145.	<i>Zygophyllum album</i>	Zygophyllaceae	-	Whole plant	-
146.	<i>Zygophyllum gaetulum</i>	Zygophyllaceae	-	Aerial parts	-

Discussion:

This review shows the importance and the interest placed on medicinal plants in the drive to demonstrate their antidiabetic effects and the responsible bioactive agents. This review also covers the common name of a plant, the parts that are commonly used as a remedy sources. This paper has presented a list of 146 anti-diabetic plants which shows anti-diabetic activity and traditionally used in the treatment of diabetes mellitus. The majority of the experiments confirmed the benefits of medicinal plants with hypoglycaemic effects in the management of diabetes mellitus. The detailed natural plants not only used for the treatment of diabetes, but also treated for other ailments also. The fruits were most commonly used plant parts and other parts (leaf, root, stem, bark, flower, and whole plant) were also useful for curing. The most commonly involved active constituents are Flavonoid, Tannin, Phenolics, and Alkaloid.

Conclusion:

In the present review an attempt has been made to compile some anti-diabetic medicinal plants, may be useful to the health professionals, scientists and scholars working in the field of pharmacology and therapeutics to develop anti-diabetic drugs. Diabetes mellitus is a most common endocrine disorder, affecting more than 300million people worldwide. For this, therapies developed along the principles of western medicine (allopathic) are often limited in efficacy, carry the risk of adverse effects, and are often too costly, especially for the developing world. Therefore, treating diabetes mellitus with plant derived compounds which are accessible and do not require laborious pharmaceutical synthesis seems highly attractive. Traditional plants or herbal formulations might offer a natural key to unlock diabetic complications. Now a time traditional plants or herbal products had been recommended for treatment of diabetes.

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