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Medicinal plants with hypoglycemic effect: A review

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Abstract

Diabetes mellitus is one of the most common endocrine diseases. Due to its complications, it caused significant mortality. Insulin and oral antidiabetic drugs were associated with many side effects. The search for more effective and safer hypoglycemic agents is one of the important areas of investigation. The pharmacological investigations revealed that several medicinal plants showed hypoglycemic effects by many mechanisms. The current review highlighted the medicinal plants with antidiabetic effect.

Keywords: Diabetes; Insulin; Phytoconstituents; Pancrease; Blood glucose; Beta cell; Antidiabetic; Hypoglycaemic; Medicinal plant

1. Introduction

Diabetes mellitus is one of the most common endocrine diseases. It affected around 2.8% of the world's population and is anticipated to cross 5.4% by the year 2025. Medicinal plants were used for the treatment of diabetic mellitus in traditional medicine systems of many cultures throughout the world. The hypoglycemic activity of many medicinal plant products were evaluated and confirmed in animal models as well as clinical trials⁽¹⁻³⁾. Some studies also investigated the biologically active ingredients and identified the mechanism of antidiabetic effects of the crude extracts or the isolated active ingredients. There are several mechanisms of the hypoglycemic effect of the medicinal plants, including enhancing regeneration or revitalization of damaged pancreatic beta cells, and protecting against further damage, enhancing insulin synthesis and secretion from the beta-cells, decreasing glucose absorption from gastro-intestinal system, increasing insulin sensitivity of the tissues, possessing of insulin mimicking effects, and changing the activity of some enzymes involved in glucose metabolism⁽⁴⁾. This review discuss blood glucose-lowering effects of medicinal plants.

Table 1 Medicinal plants possessed antidiabetic activity

Plants	Active extract or component	Model	Experimental animal	Ref.
<i>Achillea santolina</i>	aqueous extract	streptozotocin induced diabetes	rats	4-5
<i>Adiantum capillus-veneris</i>	alcoholic extract	oral glucose tolerance test	rabbits	6-8
<i>Agrimony eupatoria</i>	aqueous extract	streptozotocin induced diabetes	mice	9-10

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<i>Agropyron repens</i>	aqueous extract	streptozotocin - induced diabetes	mice	11-12
<i>Allium cepa</i>	ethanol, chloroform and petroleum ether extracts	alloxan, glucose and epinephrine induced diabetes	Several experimental animals	13-21
	aqueous extract	alloxan induced diabetes	rabbits	22
	ingestion of crude <i>Allium cepa</i>	clinical	type1 and 2 diabetic patients	23
<i>Allium sativum</i>	aqueous, ethanol, petroleum ether, or chloroform extract, or the essential oil	Normal, alloxan and streptozotocin - induced diabetes	rabbits, rats and mice	24-26
	aqueous extract and S-allyl cysteine sulphoxide, (allicin)	alloxan induced diabetes	rats	27-28
	garlic oil and diallyl trisulphide	streptozotocin - induced diabetes	rats	29
	Garlic juice	alloxan induced diabetes	rabbits	30
	garlic powder	Clinical	Diabetic patients	31
<i>Aloe vera</i>	Aloe gel	diabetic and normal	mice	32-36
	Aloe gel	clinical	type 2 diabetic patients	37-38
<i>Alpinia galanga</i>	powdered rhizome	normoglycemic rabbits	rabbits	39-40
	Ethanol extract	Glucose uptake model in diabetic rats	rats	41
<i>Althaea officinalis</i>	Polysaccharide from the root	normoglycemic	mice	42-43
	Scopoletin	hyperglycemia in levo-thyroxine-induced hyperthyroid rats	rats	44
<i>Anchusa strigosa</i>	aqueous extract	streptozotocin - induced diabetes	rats	45-46
<i>Anthemis nobelis</i>	aqueous extract and flavonoid extract	streptozotocin - induced diabetes	rats	47-49
<i>Arctium lappa</i>	ethanolic extract	streptozotocin - induced diabetes	rats	50-51
	Root extract	clinical	normal and diabetic patients	52
<i>Artemisia campestris</i>	aqueous leaf extracts	alloxan-induced diabetes	rats	53-55
<i>Asparagus officinalis</i>	methanolic seed extract and aqueous extract of asparagus by-product	streptozotocin - induced diabetes	rats	56-58

<i>Avena sativa</i>	ethanolic extract	induced diabetes (not specified)	mice	59-60
	oat-buckwheat bread, buckwheat porridge and β -glucan	glycaemic response clinically	Normoglycemic subjects	61-62
<i>Ballota nigra</i>	aqueous extract	alloxan-induced diabetes	rats	63-64
<i>Benincasa hispida</i>	stem chloroform extract	normoglycemic	rats	65-66
	Salad contained 100gm of ash gourd	clinical	hyperlipidemic diabetic patients	67-68
	crude extract	normoglycemic	mice	69
<i>Brassica nigra</i>	extracts of the seeds	streptozotocin induced diabetes	rats	70-72
<i>Brassica rapa</i>	roots ethanol extract	Type 2 induced diabetes	mice	73
<i>Bryophyllum calycinum</i>	aqueous extract	streptozotocin induced diabetes	rats	74-77
<i>Caesalpinia crista</i>	seed powder	alloxan-induced diabetes	rabbits	78-79
	seed extract	alloxan-induced diabetes	rats	80-81
	ethanolic and aqueous seed extracts	streptozotocin induced diabetes	pup's models	82
	aqueous and 50% ethanolic seed extracts	normal and streptozotocin induced diabetes	rats	83
	hydromethanolic extract	streptozotocin induced diabetes	rats	84
<i>Calotropis procera</i>	root extracts	streptozotocin induced diabetes	rats	85-86
	dried latex	alloxan-induced diabetes	rats	87-88
	root methanol, stem methanol and leaf ethyl-acetate extracts	streptozotocin induced diabetes	rats	89
<i>Canna indica</i>	polyphenolic of root	<i>In vitro</i>	glucose transport in cultured muscle cells	90-91
<i>Capparis spinosa</i>	fruit extract	streptozotocin induced diabetes	rats	92-95
<i>Capsicum annuum</i> and <i>Capsicum frutescens</i>	capsaicin	normoglycemic	dogs	96
<i>Carum carvi</i>	aqueous and ethanolic extract	streptozotocin induced diabetes	rats	97-101
<i>Carthamus tinctorius</i>	crude extract	alloxan induced diabetes	rabbits	102-103

	N-p-coumaroyl serotonin and N-feruloyl serotonin	<i>In vitro</i>	α -glucosidase inhibition	104
<i>Casuarina equisetifolia</i>	crude aqueous and methanolic leaf extracts	alloxan induced diabetes	rats and mice	105-109
<i>Casuarina equisetifolia</i>	leaves ethanolic extract	streptozotocin induced diabetes	rats	110-111
<i>Cicer arietinum</i>	petroleum ether extract	alloxan induced diabetes	mice	112
<i>Cichorium intybus</i>	crude extract alloxan induced diabetes	alloxan induced diabetes	rats	113-114
	ethanolic extract	streptozotocin induced diabetes	rats	115
	crude extract	radiolabelled glucose uptake assay	<i>in vitro</i>	116
	crude extract	intestinal absorption of glucose	<i>in vitro</i>	117
	crude extracts	hyperglycemic model	mice	118
<i>Cistanche tubulosa</i>	crude extract (equivalent to 120.9, 72.6 or 24.2 mg verbascoside/kg)	type 2 diabetes model	mice	119-120
	acylated phenylethanoid glycosides (echinacoside and acteoside)	starch-loaded model	mice	121
<i>Citrullus colocynthis</i>	fruits	clinical	type II diabetic patients	122-123
	seed extracts	glucose-stimulated insulin release from pancreatic islets	in vitro rat pancreatic	124
Citrus species	hexane extract of <i>Citrus limon</i> peel	alloxan induced diabetes	rats	125-126
	petroleum ether extract of <i>Citrus medica</i> seeds	streptozotocin induced diabetes	Rats	127
	methanol extract of <i>Citrus limetta</i> fruit peel	streptozotocin induced diabetes	Rats	128
	four different concentrations of peel extract from <i>Citrus sinensis</i>	alloxan induced diabetes	mice	129
<i>Clerodendrum inerme</i>	crude extract	streptozotocin-induced diabetes	mice	130-131
<i>Clitoria ternatea</i>	methanol and ethanol leaves extract	streptozotocin induced diabetes	Rats	132-133

	methanol extract of leaves	alloxan-induced diabetes	Rats	134
	aqueous extract of leaves and flowers	alloxan-induced diabetes	Rats	135-136
	crude leaf extracts	streptozotocin induced diabetes	Rats	137-139
<i>Coriandrum sativum</i>	seeds	clinical	type 2 diabetic patients	140-141
	aqueous and alcoholic extracts	clinical	type 2 diabetic patients	142-143
	aqueous extract	streptozotocin-induced diabetes	mice	144
	ethanol extract	streptozotocin-induced diabetes	Rats	145
<i>Cressa cretica</i>	ethanolic extract	alloxan-induced diabetes	Rats	146-147
	methanolic extract	streptozotocin-induced diabetes	Rats	148
<i>Crocus sativus</i>	aqueous extract	streptozotocin-induced diabetes	Rats	149-152
<i>Cuminum cyminum</i>	seeds	streptozotocin induced diabetes	rats	153-154
	methanolic extract of seeds	streptozotocin induced diabetes	rats	155
	Diet supplemented with <i>Cuminum cyminum</i>	alloxan induced diabetes	rats	156-157
<i>Cydonia oblonga</i>	hydro-ethanolic extract	streptozotocin induced diabetes	rats	158-159
<i>Cynodon dactylon</i>	ethyl acetate (70%) extract of root and stem	hyperglycemia induced by a combination of ketamine and xylazine	mice	160-161
	aqueous extract	normoglycemic rats	rats	162-163
	ethanolic extract of root stalks	streptozotocin induced diabetes	rats	164
	crude extract	alloxan-induced diabetes	rats	165
<i>Cyperus rotundus</i>	crude extract	alloxan induced hyperglycemia	rats	166-167
	aqueous decoction of tuber parts	alloxan induced diabetic and normoglycemic rabbits	rabbits	168

<i>Dactyloctenium aegyptium</i>	different solvent extracts	streptozotocin induced diabetes	rats	169-170
	<i>n</i> -hexane, chloroform, ethyl acetate and methanolic fractions from ethanolic extract	streptozotocin induced diabetes	rats	171
<i>Dalbergia sissoo</i>	pet.ether and ethanolic extracts	alloxan induced diabetes	rats	172-174
	aqueous stem bark extract	streptozotocin-nicotinamide induced type 2 diabetes	rats	175
	ethanolic extract of bark	alloxan induced diabetes	rats	176
<i>Datura fastuosa</i>	seed powder	alloxan-induced diabetes	rats	177-178
<i>Daucus carota</i>	dichloromethane extract of carrot roots	stimulated insulin-dependent glucose uptake assay	<i>in vitro</i> adipocytes	179-180
	methanol extract of seeds	streptozocin-induced diabetes (type I)	rats	181
<i>Desmostachia bipinnata</i>	hydroalcoholic extract	non- diabetic	rats	182-183
	ethanolic extract alloxan induced diabetes	alloxan induced diabetes	rats	184
<i>Digitalis species</i>	Digitonin, a saponin from the seeds	glucose tolerance test	rats	185-186
<i>Dodonaea viscosa</i>	methanolic leaves extracts	alloxan-induced diabetes	rabbits	187-188
	ethyl acetate and methanolic extracts	streptozocin-induced diabetes and normoglycemic	rats	189
	methanol and chloroform	alloxan-induced diabetes	rats	190
<i>Dolichos lablab</i>	methanolic extract	streptozotocin-nicotinamide induced diabetes	rats	191-193
	ethanolic extract of leaves	alloxan induced diabetes	rats	194
<i>Echinochloa crusgalli</i>	70% hydroalcoholic extract	alloxan induced diabetes	Rats	195-196
<i>Ephedra species</i>	alcoholic extract	alloxan induced diabetes	Rats	197-198
<i>Equisetum arvense</i>	methanolic extract	streptozotocin-nicotinamide induced diabetes	Rats	199-202

<i>Eryngium creticum</i>	aqueous decoction of arial parts	normoglycemic streptozocin-hyperglycemic	Rats	203-204
	aqueous extracts	alloxan induced diabetes	Rats	205-207
<i>Eucalyptus species</i>	ethanolic extract	oral glucose tolerance test	rats	208-209
<i>Euphorbia hirta</i>	ethanol extract	alloxan induced diabetes	rats	210-211
	ethanolic extract of leaf, flower and stem	streptozotocin induced diabetes	mice	212
	ethanol extract and ethylacetate fractions	α -glucosidase inhibition activity	<i>in vitro</i>	213
<i>Foeniculum vulgare</i>	methanolic extracts	anti-glycative activity assay	<i>in vitro</i>	214-215
<i>Fumaria officinalis</i>	crude aqueous extracts	diabetes induced by feeding 21% fructose in drinking water	rats	216-217
<i>Fumaria parviflora</i>	methanolic extract	streptozotocin-induced diabetes	rats	218
	consumption of the plant	streptozocin induced diabetes	rats	219
	powdered plant	normal and alloxan-induced diabetes	rabbits	220-221
<i>Glossostemon bruguieri</i>	root mucilages	streptozotocin-induced diabetes diabetic	rats	222
<i>Glycyrrhiza glabra</i>	glycyrrhizin	in genetically diabetic model	mice	223
	glycyrrhizin	streptozotocin-induced diabetes	rats	224
<i>Gossypium species</i>	aqueous extract of different parts (bark, leaf, and flower)	α -amylase and α -glucosidase inhibition	<i>in vitro</i>	225-226
	seed	alloxan-induced diabetic	rabbits	227
	ethyl ether and ethanol extracts	alloxan induced diabetes	rats	228
<i>Helianthus annuus</i>	ethanol seed extract	streptozotocin induced type 2 diabetes	rats	229-230
	crude methanol extract	alloxan-induced diabetes	rats	231
	methanol extract	alloxan-induced diabetes	rats	232

<i>Helianthus tuberosus</i>	ethanol extracts	streptozotocin induced diabetes	rats	233-234
<i>Hibiscus cannabinus</i>	methanolic extract	streptozotocin induced diabetes	rats	235-236
<i>Hibiscus rosa-sinensis</i>	aqueous ethanolic and ethanol extracts	streptozotocin-induced diabetes	rats	237-239
	flowers extract	alloxan induced diabetes	rats	240-241
	ethanolic extract	alloxan-induced diabetes	rats	242-243
	flower powder	clinical	type II diabetic patients	244
<i>Hibiscus sabdariffa</i>	aqueous extracts	α -amylase and α -glucosidase inhibition	<i>in vitro</i>	245-246
	crude extract, ethanolic extract and polyphenol extract	streptozotocin-induced diabetes	rats	247-249
	calyxes aqueous extract	streptozotocin-induced diabetes	rats	250
	hydroalcoholic extract of flower	alloxan induced diabetes	rats	251
<i>Hyoscyamus Species</i>	methanolic leaves extract of	streptozotocin-induced diabetes	rats	252-253
	calystegines, polyhydroxylated alkaloids extracted from seeds	streptozotocine induced diabetes	mice	254
<i>Jasminum sambac</i>	flower extract	streptozotocin induced diabetes	rats	255
	ethyl acetate and water extracts of leaves	alloxan induced diabetes	rats	256-257
<i>Juglans regia</i>	crude extracts	streptozotocin induced diabetes	rats	258-259
	aqueous extract of leaf	normal and diabetic rats	rats	260
	ethanolic leaf extract	alloxan-induced diabetes	rats	261
	methanolic extracts of leaf and fruit peel	alloxan induced diabetes	rats	262
	crude leaf extract	streptozotocin-nicotinamide induced diabetes	rats	263
	leaf extract	clinical	type II diabetic patients	264-265
	walnut hydrosol	clinical	patients with type 1 diabetes	266

<i>Juniperus communis</i>	decoction	streptozotocin-induced diabetes	rats	267-269
<i>Juniperus oxycedrus</i>	water leaves extracts	streptozotocin-induced diabetes	rats	270-271
	oils	inhibition of α -amylase	<i>in vitro</i>	272
	ethanol and water leaves extracts	streptozotocin-induced diabetes	rats	273
<i>Jussiaea repens</i>	ethyl acetate extract	alloxan-induced diabetes	rats	274-275
<i>Kochia scoparia</i> (<i>Bassia scoparia</i>)	methanolic extract	glucose-loaded test	rats	276-277
<i>Lagerstroemia speciosa</i>	leaves extract [standardized to 1% corosolic acid (Glucosol)]	clinical	type 2 diabetic patients	278
	aqueous leaf extract	streptozotocin-induced diabetes	mice	279
	crude leaves extract	streptozotocin-induced diabetes	Rats	280
	dried powder and decoction	alloxan induced diabetes	mice	281
	diet containing 5% of the hot-water leaves extract	type 2 diabetes	mice	282-283
<i>Lathyrus sativus</i>	methanolic extract of non-boiled and boiled seeds extract	glucose-loaded test	mice	284-285
<i>Lawsonia inermis</i>	Hydroalcoholic and ethanol leaf extract	alloxan induced diabetes	Rats	286-287
	70% ethanolic leaf extract	alloxan induced diabetes	mice	288-289
<i>Leontice leontopetalum</i>	crude extract	<i>in vitro</i>	human pancreatic beta cell-treated with streptozotocin	290-292
<i>Lippia nodiflora</i>	methanol extract	streptozotocin induced diabetes	rats	293
	γ -sitosterol isolated from <i>Lippia nodiflora</i>	streptozotocin induced diabetes	rats	294-296
<i>Luffa acutangula</i>	seeds ethanolic extract	streptozotocin induced diabetes	rats	297
	methanolic leaves extract	oral glucose tolerance test	mice	298
	petroleum ether, chloroform and ethanol extracts of fruits	alloxan induced diabetes	rats	299

	methanolic and aqueous extracts of fruits	streptozotocin and nicotinamide induce type 2 diabetes	rats	300-301
<i>Mangifera indica</i>	crude leaf extracts	normal and alloxan-induced diabetes	rats	302
	seed kernels ethanol extract	streptozotocin induced diabetes	rats	303
	50% ethanol extract of leaves	streptozotocin induced diabetes	rats	304-305
	ethanol and water extracts of leaves and stem-barks	nondiabetic and type 2 induced diabetes	rats	306
<i>Marrubium vulgare</i>	ethanolic extracts (root, leaf and stem)	normoglycemic	rats	307
	infusion	alloxan induced diabetes	rats	308
	aqueous extract	clinical	type 2 non-controlled diabetic patients	309-311
<i>Matricaria chamomilla</i>	leave extract	streptozotocin-induced diabetes	rats	312
	<i>Matricaria chamomilla</i> and <i>Origanum vulgare</i> extracts combination	alloxan-induced diabetes	rats	313
	aerial part ethanolic extract	streptozotocin-induced diabetes	rats	314
	The effects of chamomile tea in hot water	clinical	patients with type 2 diabetes	315-316
<i>Medicago sativa</i>	aqueous and aqueous ethanolic extracts	streptozotocin induced diabetes	rats	317-318
	aqueous extract	alloxan-induced diabetes	rats	319-320
<i>Melilotus officinalis</i>	extract formulated under the by trade name of Semilil (Angipars)	streptozotocin induced diabetes	rats	321-322
<i>Mirabilis jalapa</i>	ethanolic extract of root	streptozotocin induced diabetes	Mice	323
	hydroethanolic leaf extract	streptozotocin induced diabetes	Rats	324-325
<i>Morus alba</i>	leaf crude extracts	type II diabetic model	Rats	326
	flavonoids rich fraction of 70% alcohol extract of root bark	streptozotocin-induced diabetes	Rats	327
	aqueous and alcoholic extract of leaves	streptozotocin induced diabetes	Rats	328-329
	fruit extract	type 2 diabetes model	Mice	330

	stem bark extract	streptozotocin-induced diabetes	Rats	331-332
<i>Nasturtium officinale</i>	ethyl acetate, methanol and aqueous extracts	streptozotocin induced- diabetes	Rats	333
	aqueous, acetonic, and alcoholic extracts	alloxan and streptozotocin induced diabetes	Rats	334-337
<i>Nerium oleander</i>	standardized hydromethanolic leaf extract	alloxan induced diabetes	Mice	338
	crude extract	streptozotocin-induced diabetes	Rats	339-340
<i>Nicotiana tabacum</i>	hydroethanolic leaf extract	oral glucose tolerance test	normoglycemic rats	341-342
<i>Ocimum basilicum</i>	methanol-dichloromethane, methanol and n-hexane leaf extracts	alloxan induced diabetes	Rats	343-344
	crude extracts of the aerial parts	<i>in vitro</i> , and in alloxan induced diabetes	<i>in vitro</i> α -amylase and α -glucosidase inhibition and oral glucose tolerance in diabetic rats	345
	aqueous extract	streptozotocin induced diabetes	Rats	346-347

2. Conclusion

Diabetes mellitus is one of the most common endocrine metabolic disorders. It caused significant mortality due to its complications. Medicinal plants possessed hypoglycemic effects by many mechanisms. The current review discussed the medicinal plants with antidiabetic effect with special focus on their mechanism of action.

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