



Ayurvedic plants used in diabetes mellitus: a systematic review

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ABSTRACT

Diabetes is a common illness, according to the unique assessments of ayurvedic concepts diabetes is the disease which occurs when toxins get accumulated in the tissue and result in circulation blockage. The various root causes of diabetes that ayurveda enlists are poor nutrition and poor digestion, inequity of nervous system, physical and mental stress, and disturbance in natural biological cycle. Many traditional medical systems have developed strategies to treat this condition. The alternative therapy most commonly used to treat diabetes is herbal therapy, which therefore become the primary focus of this review. The objective of this article is to conduct a search of the published literature on the use of Ayurvedic medicines for the treatment of diabetes mellitus. A broad search of Ayurvedic medicines showed that there was sufficient literature to support a systematic review of the use of Ayurvedic plants for the treatment of diabetes.

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Introduction

Diabetes mellitus is the chronic metabolic disease and growing health problem in most countries. In 2006, according to the World Health Organization, at least 171 million people worldwide suffer from diabetes. Its incidence is increasing rapidly, and it is estimated that by the year 2030, this number will be doubled. Diabetes is predicted to increase by 27% in developed countries and 48% in developing countries from 1995 to 2025. In U.S., the trends may already be outpacing the predictions. Diabetes increased by 61% from 1991 to 2001. [1]

Facts about the diabetes:

- In new millennium, 1 out of 20 persons will be diabetic.
- Diabetic personas are more prone to Heart attacks.
- Diabetic patients are more prone to develop Gangrene.
- Diabetic patients are 17 times more prone to kidney damage as compared to non diabetics.
- Diabetic patients are 25 times more prone to blindness.
- Diabetes is number one cause of blindness.
- Diabetic patients are 2 to 6 times more prone to strokes.
- Incidence of cataract high in Diabetics.

Ayurvedic concept of diabetes mellitus:

The polyuric states, clinically resembling diabetes mellitus, were described as early as 1550 BC by George Ebers, the sweet taste of diabetic urine associated with polyuria were noted and clinically described first in 5th– 6th century AD in Sanskrit literature by Indian physicians Susruta and Charaka. Susruta and Charaka described urine of certain polyuric

Patients tasting like honey (madhu). The Indian description of that period distinguished two forms of diabetes, one affecting the older and obese, and the other affecting thin people who did not survive long; the fortuitous parallel with the present-day subdivisions of diabetes into insulin-dependent and non-insulin-dependent types [1, 2].

Classification of diabetes:

According to Ayurveda due to simultaneous vitiation of all the three doshas twenty types of prameha (diabetes) are

manifested. According to origin prameha, they are classified in major three classes.

- 1) Kaphaja prameha (Diabetes of kapha origin)
- 2) Pittaja prameha (Diabetes of pitta origin)
- 3) Vattaja prameha (Diabetes of vatta origin)

Diabetes mellitus is one of the types of vattaja prameha and known as madhumeha (diabetes mellitus). The word madhumeha, "madhu" meaning sweet/sweetness and "meha" excessive urination. [3, 4].

Etiology of diabetes mellitus

The etiology of madhumeha is multifactorial in the Ayurvedic system. Two types of causes may be inherited at birth or acquired afterwards. Specifically, when three doshas become imbalanced, it may lead to madhumeha. Disorder may also arise directly from abnormalities in the tissues of the body, such as fat (medas), muscle (mansa), and muscle fat (vasa). Other causes are excessive sleep, excessive appetite (especially for sweet food), lack of physical exercise, excess sexual intercourse, suppression of natural urges, uneven body postures, and other behaviors [5-7].

Pathogenesis of diabetes mellitus:

Diabetes mellitus is the type of vattaj prameha. Susruta described two types of vattaja prameha. The first, called sahaja that is due to a defect in genetic substance and other is apathyanimittaja that is believed to be acquired later in the life. This corresponds to adult-onset diabetes, and the patients are described as obese [5].

Charaka wrote that all prameha (urinary disorders) start with a derangement of the bodily humor kapha. The vitiated kapha spreads throughout the body and mixes with fat (medas) because fat has properties similar to those of kapha. The affected body fluids are passed in the urine, but they block the openings of the urinary tubules coming out of the bladder. This is believed to be the cause of the frequent urination observed in madhumeha [5-7].

Symptoms, Diagnosis and Prognosis of diabetes mellitus:

Symptoms: Vagbhata and Susruta describe the symptoms of diabetes as a honey-like sweetness of urine as well as polydipsia, polyphagia, lassitude, tiredness, obesity, looseness of limbs, non-relishing of food, burning sensation of the skin, epileptic fits, insomnia, numbness of body, and constipation. Charaka wrote that chronic prameha, of which madhumeha is one type, give rise to the following symptoms: oppressive feeling of the heart, anger, desire for foods of all different tastes, insomnia, and boils and abscesses, thus anticipating many of the sequelae of diabetes mellitus observed today [6].

Diagnosis: In Ayurveda, diagnosis is based more on symptoms than on any laboratory results. The sweetness of urine and urine being assailed by a swarm of flies or ants is enough to make the diagnosis of madhumeha according to some authorities. Specifically, disease is diagnosed through a clinical examination called the Eight-Point Diagnosis or *astha sthana pariksha*. It includes an assessment of the state of a patient's doshas as well as various physical signs. This Eight-Point Diagnosis applied to diabetes is shown in Table 1. [6].

Prognosis: Ayurveda holds that, if there is *ulvanata* (predominance) of pitta or kapha in persons suffering from madhumeha, their prognosis is better. If there is an excess of vatta relative to kapha and pitta, then madhumeha is said to be incurable [6].

Principle of Treatment

Classical Ayurvedic therapy for madhumeha (diabetes mellitus) is based on the principles of Ayurvedic treatment. First an assessment of the dosha imbalance is made. Generally, in all types of prameha (urinary disorders), kapha is vitiated, but in madhumeha, vatta is aggravated. Therefore, the aim of therapy is to restore both the doshas [4].

Therapy is started with purification therapy (*sodhana*) in which oil is applied to the body of patient. This is followed by emetic therapy, to treat excess kapha, and then by purgation therapy to balance excess pitta. Next, desaturation therapies, such as fasting, physical exercise, and herbs, are used to reduce the excess doshas. Some early Ayurvedic experts, such as Susruta and Vagbhata, even advised administering enemas containing decoctions of medicinal herbs as a cleaning process to reduce the excess doshas.

Herbal therapies for diabetes:

Traditional herbal remedies used for treatment of diabetes around the world. More than 1,200 species of plants with hypoglycemic activity are identified. Ayurvedic herbal drugs for diabetes are selected on the principles of *rasa* (taste), *guna* (physicochemical properties), *veerya* (potency), *vipaka* (post-digestive effect), and *prabhava* (unique action). Each of these principles is felt to have specific effects on the doshas and functions of the body, which is how they exert their therapeutic effects [8].

There are numbers of plant drugs that has antidiabetic activity. Their antidiabetic activity is proven preclinically as well as clinically. Various drugs that have antidiabetic activities are described in following table.

Benefits of ayurvedic therapy in diabetes mellitus

Ayurvedic treatment is very fundamental and best way to treat diabetes mellitus. The non-insulin type can be very effectively controlled & sugar level can be brought to normal within three weeks by ayurvedic treatment. It can be maintained at normal level by the continuous use of ayurvedic medicines. Classical medications as well as special medicines are safe in the

management because these medicines will not lead to hypoglycemic episodes or other complications [116,117].

Herbal medicines have been in use from traditionally. Because of its less toxicity and easy availability the herbal medicines are widely used now days. The use of self-prescribed herbal medicines in USA increased from 2.5 to 12.1% between 1990 and 1997. A similar increase has been reported in Europe. The evidence in favor of efficacy of these remedies is based on traditional use rather than clinical trials. Many herbal preparations are used in the treatment of diabetes mellitus in Sri Lanka and in India traditionally [118].

Future Direction

In Ayurveda the great scientists of India described very specific and curable treatment for diabetes and its complications. There is need to understand those principle and apply the ideas of Ayurveda in the treatment of diabetes like chronic disorder. Modern scientists and pharmacologists should work on the ayurvedic principle of treatment and find the best and most safe way to treat diabetes mellitus. Indian people used numbers of herbal drugs in treatment diabetes mellitus, today there is need to find out their action in scientific way. Numbers of institution and scientists work on the herbal drugs those used in diabetes.

This article is just one tried to focus some of the herbal drugs and their activities as well as some of ayurvedic principle involved in the treatment of diabetes mellitus. Now time comes to understand the ayurvedic phenomena for treatment of some of chronic disorders like diabetes, cardiovascular disorders and others.

Conclusion

It is very costly to discover a new drug it takes cost about 800 million US\$. Hence, discovery of affordable, effective, safe and innovative new drugs is becoming a global crisis.

The research for alternate remedies (from the plant kingdom and other) for diabetes mellitus is going on throughout the world as the disease possesses many challenges not only to the physicians but also to the researchers. Ayurveda was discovered, nurtured and perfected in India; this science can provide a framework for new research. In its golden days, Ayurveda was practiced by *vaidyas* (physicians) who had knowledge about nature and medicines, by taking their help a total scientific research can carried out in new fashion that helps to discover new, safe and effective anti-diabetic drugs. It is no longer an option to ignore ayurvedic drugs or treatment from regular medical practices.

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Table 1. Eight-point diagnosis for diabetes mellitus

Ayurvedic term	Diagnostic technique	Characteristic in diabetes
Nadi pariksha	Pulse diagnosis	Depends on dominant dosha
Mutra pariksha	Urine examination	Sweet
Vata	Nervous system assessment	Vata usually depleted. If in excess, poor prognostic sign
Pitta	Assessment of digestive fire and metabolic secretions	May be elevated
Kapha	Mucous and mucoid secretions assessment	Generally increased; may be highly exaggerated
Mala pariksha	Stool examination	Depends on dominant dosha
Jihva pariksha	Tongue examination	Depends on dominant dosha
Shabda pariksha	Examination of body sounds	Depends on dominant dosha

Table 2. List of plants having hypoglycemic activity

Sr. no.	Name of plant	Part used	Extract/active principle	Animal model	References
1	<i>Acacia Arabica</i>	Seeds		Rats	[9,10]
2	<i>Acacia. benthami</i>	Seeds		Rats	[9]
3	<i>Acacia. catechu</i>	Wood	(flavonoid)	Rats	[11]
4	<i>Acacia melanoxyton</i>	Seeds		Rats	[12]
5	<i>Acacia. modesta</i>	Seeds		Rats	[13]
6	<i>Acosmium panamense</i>	Bark	Water and butanolic extract	Rat	[14]
7	<i>Acourrtia thurberi</i>	Root		Mice, Rabbit	[15]
8	<i>Adhatoda vasica</i>	Leaves		Rats	[16]
9	<i>Adiantum cappilus-veneris</i>	Whole plant		Rabbits	[17]
10	<i>Aegle Marmelos</i>	Leaves	Water extract	Rat	[18,19]

1.	<i>Agarista mexicana</i>	Stem	Chloroform extract	Mice	[20]
2.	<i>Allium cepa</i>	Bulb	Allyl propyl disulphide	Rabbits	[21]
3.	<i>Allium Sativum</i>	Bulbs	Allicin or diallyldisulphide oxide	Rabbits	[22,23]
4.	<i>American ginseng</i>	Root	Polysaccharide fraction	Mice	[24]
5.	<i>Anacardium occidentale</i>		Aqueous extract	Rat	[25]
6.	<i>Anemarrhena asphodeloides</i>	Rhizome	Isolated xanthone compound	Mice	[26]
7.	<i>Arachis hypogaea</i>		Aqueous extract	Rat	[27]
8.	<i>Artemisia Herba-Alba</i>			Rat	[122]
9.	<i>Artemisia pallens</i>	Aerial part	Methanolic extract	Rat	[28]
10.	<i>Artemisia santonicum</i>	Panicles	Aqueous extract	Rabbit	[29]
11.	<i>Azadirachta indica</i>	Seed oil	Nimbidin	Rabbits	[30]
12.	<i>Barleria lupulina</i>	Aerial part	Methanolic extract	Rat	[31]
13.	<i>Bauhinia forficata</i>	Leaf	n-butanol fraction	Rat	[32]
14.	<i>Brassica juncea</i>	Leaf, seed		Mice	[33]
15.	<i>Caesalpinia bonducella fleming</i>	Seed	Aqueous extract, 50% ethanolic Extract	Rat	[34]
16.	<i>Caesaria esculanta</i>	Roots		Rats	[35]
17.	<i>Camellia sinensis</i>	Leaves		Rat	[36]
18.	<i>Capparis sepiaria</i>	Leaves	ethanol extract	Rat	[128]
19.	<i>Carissa edulis</i>	Leaf	Aqueous extract	Rat	[37]
20.	<i>Cassia auriculata</i>	Seeds		Rabbits and Dogs	[38]
21.	<i>C. fistula</i>	Seeds		Rats	[9]
22.	<i>Cassia kleini</i>	Leaf	Ethanol extract	Rat, Mice	[39]
23.	<i>Catharanthus roseus</i>	Leaf, Twings	Dichloromethane:Methanol (1:1) extract	Rat	[40]
24.	<i>Cecropia Obtusifolia</i>	Leaf	Water and butanolic extract	Rat	[41]
25.	<i>Citrullus colocynthis</i>	Rind	Aqueous, glycosidic saponin extract	Rabbit	[42]
26.	<i>Citrus grandis Osbeck</i>	Fruit		Rat	[126]
27.	<i>Clausena anisata</i>	Root	Methanolic extract	Rat	[43]
28.	<i>Coccinia indica</i>	Fruits Leaves, whole plant		Rats	[44]
29.	<i>Cryptostegia grandiflora</i>	Aerial parts		Rabbits	[45]
30.	<i>Cucurbita ficifolia</i>		Raw extract		[46]
31.	<i>Cuminum nigrum</i>	Seed		Rabbits	[47]
32.	<i>Cyamopsis *eiragonolobus</i>	Fruits, Seeds		Rabbits	[48]
33.	<i>Dolichos biflorus</i>	Seeds		Rats	[49]
34.	<i>Emblica Officinalis</i>		Methanolic extract	Rat	[50]
35.	<i>Encostemma littorale</i>	Whole plant		Rats	[51,52]
36.	<i>Ensete superbum</i>	Seeds		Rats	[52]
37.	<i>Equistum myriochaetuna</i>	Aerial part	Water extract	Rat	[54]
38.	<i>Eucalyptus citriodora Hook</i>	Leaf	Aqueous extract	Rat	[127]
39.	<i>Eugenia jambolana</i>		Alcoholic and aqueous extract	Rat	[55]
40.	<i>Euphorbia prostrata</i>	Whole plant		Rabbits	[56]
41.	<i>Ficus bengalensis</i>	Root bark	Phytosterolin	Rabbits	[57]
42.	<i>Ficus glomerata</i>	Bark		Rabbits	[58]
43.	<i>Ficus hispida</i>	Bark	Double distilled ethanol and water soluble fraction	Rat	[59]
44.	<i>Ficus Racemosa</i>	Bark	Ethanolic extract	Rat	[60]
45.	<i>Fumaria parviflora</i>	Whole plant		Normal rabbits	[56]
46.	<i>Globularia alypum</i>	Leaf	Aqueous extract	Rat	[61]
47.	<i>Glycine max</i>	Seeds		Rats	[49]
48.	<i>Grape</i>	Seeds		Rats	[121]
49.	<i>Gymnema sylvestre</i>	Leaves	Glycosaminoglycan and protein bound polysac- Charides	Rats	[63]
50.	<i>Hamiltonia suaveloens</i>	Roots		Rats, dogs and monkeys	[63]
51.	<i>Helicteres isora</i>	Root	Ethanolic extract	Mice	[64]
52.	<i>Ichnocarpus frutescens</i>	Root	Aqueous extract	Rat	[119]
53.	<i>Inula Britannica</i>	Flower	Aqueous extract	Mice	[65]
54.	<i>Ipomoea aquatica</i>	Leaf		Rat	[66]
55.	<i>Launaea nudicaulis</i>		(glycoside)	Rats	[67]
56.	<i>Leucaena leucocephala</i>	Seed		Rats	[68]
57.	<i>Leucas lavandulaefolia</i>		Methanolic extract	Rat	[69]
58.	<i>Luffa aegyptiaca</i>	Seed	Ethanolic extract	Rat	[31]

59.	<i>Mongifera indica</i>	Leaf	Aqueous extract	Rat	[70]
60.	<i>Memecylone umbellatum</i>	Leaf	Alcoholic extract	Mice	[71]
61.	<i>Momordica charantia</i>	Fruits		Rabbits	[56]
62.	<i>Moringa stenopetala</i>			Rabbit	[72]
63.	<i>Mucuna pruriens</i>	Seed		Rats	[49]
64.	<i>Murraya koenigii</i>	Leaves		Dogs	[73]
65.	<i>Musa paradisiaca</i>	Flower		Rabbits	[17]
66.	<i>Musa sapientum</i>	Flower	Chloroform extract	Rat	[74]
67.	<i>Npmphaea nouchali</i>	Root		Rabbits	[17]
68.	<i>Ocimum sanctum</i>	Leaf	70% ethyl alcoholic extract	Rat	[75]
69.	<i>Opuntia lindheimeri</i>			Pig	[76]
70.	<i>Panax ginseng</i>	Root		Mice	[77]
71.	<i>Pandanus odoros</i>	Root	Aqueous extract	Rat	[78]
72.	<i>Parmetiera edulis</i>	Fruit	Chloroform extract	Mice	[79]
73.	<i>Petroselinum crispum</i>			Rat	[80]
74.	<i>Phyllanthus fraternus</i>	Leaves		Rabbits	[81]
75.	<i>Phyllanthus sallowianus</i>	Bark	Aqueous dichloromethane butanol fraction	Mice	[82]
76.	<i>Pinus roxberghii</i>	Bark & root		Rabbits	[17]
77.	<i>Piper sarmentosum</i>	Whole	Aqueous extract	Rat	[83]
78.	<i>Pisum sativum</i>			Rat	[84]
79.	<i>Pongamia pinnata</i>	Bark		Rabbits	[85]
80.	<i>Potentialla fulgens</i>	Root	Methanolic extract	Mice	[86]
81.	<i>Prunus persica</i>	Leaves		Dogs and rabbits	[87]
82.	<i>Psacallium decopositum</i>	Root		Mice, rabbit	[15]
83.	<i>Psacallium peltatum</i>	Root		Mice, rabbit	[15]
84.	<i>Pterocarpus marsupium</i>	Heart-wood		Rabbits	[15]
85.	<i>Rauwolfia serpentina</i>	Stem	Total alkaloid	Cats	[88]
86.	<i>Rehmannia glutinosa</i>			Rat	[89]
87.	<i>Rhizome polygonati</i>		Water soluble extract	Mice, Rat	[90]
88.	<i>Rubus fruticosus</i>	Leaf	Aqueous extract	Rat	[61]
89.	<i>Salacia oblonga</i>	Root bark	Petroleum ether extract	Rat	[91]
90.	<i>Salacia reticulata</i>	Leaf extract	Aqueous extract	Mice	[123]
91.	<i>Sclerocarya birrea</i>	Stem bark	Aqueous extract	Rat	[92]
92.	<i>Scoparia dulcis</i>		Aqueous extract	Rat	[93]
93.	<i>Sida cordifolia</i>	Arial part	Ethyl acetate extract		[94]
94.	<i>Spondias mombin</i>	Leaf extract	Methanolic extract	Rat	[124]
95.	<i>Stevia rebaudiana</i>	Leaf		Rat	[95]
96.	<i>Terminalia belerica</i>		Methanolic extract	Rat	[50]
97.	<i>Terminalia chebula</i>	Fruit Fruit	Methanolic extract Water extract	Rat Rat	[50 ,120]
98.	<i>Terminalia pallida</i>	Fruit	Ethanol extract	Rat	[96]
99.	<i>Tinospora cardifolia</i>	Root	Aqueous extract	Rat	[97]
100.	<i>Tridax procumbens</i>	Leaf	Alcoholic and petroleum ether extract	Rat	[125]
101.	<i>Trigonella foenum</i>	Leaf	Aqueous extract	Rat	[98]

Table 3. List of medicinal plants subjected to clinical trials:

Sr. no.	Name of the plants	Nature of clinical trials	RESULT	REF.
1	Allium cepa			
	(i) Juice (100 g) orally	20 diabetic patients and 20 normal healthy controls	Reduction of blood sugar in diabetics. No alteration in blood sugar in controls.	[58]
	(ii) Allylpropyl disulphide (0.125 g/50 kg body wt)	6 Normal volunteers	Significant fall in blood sugar levels	[99]
2	Clerodendron phlomoides			
	(i) Alcoholic extract of plant.	33 diabetic patients + 10 Normal volunteer	Reduction in fasting blood sugar	[100]
	(ii) Decoction of the Plant (4 ml).	13 Diabetic patients	Reduction in blood sugar	[101]
3	Cinnamomum tamala			
	(i) Leaves powder 2 teaspoon four times a day for month	32 diabetic patients	Fall in fasting blood sugar level but not in a postprandial level.	[102]
	(ii) Leaves powder 3 Teaspoons four times a day for 15 days.	5 diabetic patients	Reduction on blood glucose	[103]
4	Coccinia indica			
	Powder (3 gm twice daily) and juice (30 ml twice daily)	41 diabetic patients	Reduction in blood sugar.	[104]
5	Enicostemma littorale			
	Fresh juice (1-5 ounces) 3 times and a day.	17 Diabetic patients	Fall in fasting blood sugar not in postprandial blood sugar.	[105]
6	Ficus bengalensis			
	Aqueous extract of bark (100 ml of 10 percent extract)	The 12 normal volunteers 6 diabetic patients 6 control patients	No effect in normal human, mild activity in diabetic patients	[106]
7	Gymnema Sylvester			
	(i) Leaves and stem	Diabetic patients	Lowering of blood sugar.	[107]
	(ii) Aqueous decoction	20 diabetic patients	Lowering of blood sugar	[108]
	(iii) Leaves	10 normal and 6 diabetic patients	Reduction in blood sugar.	[109]
8	Momordica charantia			
	(i) P-insulin	9 patients on primary diabetes mellitus sugar	Reduction in blood	[110]
	(ii) Fruit powder (100 g daily for 2 weeks)	Normal control 25 patients of diabetes mellitus	No significant effect in either cases (But gave a false negative test for sugar in urine)	[111]
	(iii) Fresh juice of fruits	Diabetic patients	Lowering of blood sugar.	[112,113]
9	Pterocarpus marsupium			
	Decoction	22 diabetic patients	Improvement in glucose tolerance in 12 patients	[114]
10	Syzygium cumini			
	Seed powder	28 Diabetics	In 20 cases significant fall in fasting and postprandial blood sugar.	[115]