INTERNATIONAL RESEARCH JOURNAL OF PHARMACY
www.irjponline.com ISSN 2230 – 8407
Review Article

PLANTS WITH ANTIDIABETIC ACTIVITIES AND THEIR MEDICINAL VALUES

B. V. Raman[1], A. Naga Vamsi Krishna[2]*, B. Narasimha Rao[1], M. Pardha Saradhi[1], M. V. Basaveswara Rao[3]

[1]Centre for biomedical Research, Department of Biotechnology, K. L University, Green fields, Vaddeswaram, Guntur, A.P, India

[2]Department of Biochemistry, Acharya Nagarjuna University, Guntur, A.P, India

[3]Department of Chemistry, Krishna University, Machilipatnam-521001, A. P, India

Article Received on: 16/01/12 Revised on: 25/02/12 Approved for publication: 17/03/12

*E-mail: drbvraman@gmail.com

ABSTRACT

The anti-diabetic drugs from plants in current clinical use and their similar mechanism of action of herbal components are preferred mainly due to lesser side effects and low cost. So many medicinal plants with anti-diabetic activity related beneficial effects and of herbal drugs used in diabetes is pressurized. The present review focused on the some of the herbal plants and their medicinal uses have shown experimental or clinical anti-diabetic activity. The essential values of some plants have long been published, but a large number of them have remained unexplored to date. Therefore, there is a necessity to explore their uses and to ascertain their therapeutic properties. These are mainly *Allium cepa, Anacardium occidentale, Andrographic paniculata, Momordica charantia, Azadirakta indica, Brassica oleraccia, Cinnamomum tamala* and *Withania sominifera* mainly etiological factor implicated in the development of diabetes and it's complications.

Keywords: Anti-diabetic activity, medicinal plants, medicinal uses.

INTRODUCTION

Diabetes mellitus is a multifactorial disorder characterized by hyperglycemia resulting from increased hepatic glucose production, diminished insulin secretion, and impaired insulin action. It is a disease of worldwide significance and increasing their prevalence without any plateau. There are lots of chemical components available to control and treat diabetic patients, but total recovery from diabetes may not possible. Conventional drugs treat diabetes by improving insulin sensitivity, increasing insulin production and/or decreasing the amount of glucose in blood. In addition to adverse effects, drug treatments are not always satisfactory in maintaining normal level of blood glucose and avoiding late stage diabetic consequences[1]. However, many medicinal plants have been provided a potential source of anti-diabetic principles and are widely used for the treatment of diabetes mellitus in various traditional systems of medicine worldwide and many of them are known to be effective against diabetes. Several scientists are reporting the hypoglycemic effects of pharmacologically active components of plants in diabetes patients by assessing the lowering affects on alpha amylase (both salivary and pancreatic) by plant components and various direct and indirect effects of different blood parameters responsible for development of diabetes[2]. These assessments make diabetes patients to move from usage of chemical drugs to naturopathic treatments and the use of neutraceuticals as therapeutic drugs. A large number of clinical trials were carried out to test the hypoglycemic activity of plants and pure chemical compounds isolated from the crude extracts of the plants. The anti-diabetic drugs in current clinical use and their similar mechanism of action herbal components are preferred mainly due to lesser side effects and low cost. Of course, there is a great need of scientific and multi-centric clinical trials for direct use of plants as therapeutic agents to treat different diseases including diabetes[3]. This paper provides a brief review of different plants using in the traditional system for the treatment of diabetes since ancient times. Experimental reports on different plants states that the *Allium cepa, Anacardium occidentale, Andrographic paniculata, Momordica charantia, Azadirakta indica, Brassica oleraccia, Cinnamomum tamala,* and *Withania sominifera* are commonly using as remedy for diabetes. The main etiological factor implicated in the down regulation of diabetes and its complications i.e., retinopathy, neuropathy, nephropathy and microangiopathy is free radicals mainly antioxidant properties with antidiabetic compounds would be more useful in treatment of diabetes (Table-1). In Ayurveda the sweet, vigorous taste of diabetic urine associated with polyuria and clinically mentioned in sixth century A.D in sanskrit literature susrutha[17]. Medicinal plants using in traditional system found to contain steroids, alkaloids and terpenoids in herbal preparations.

Since long back plants are being using for the treatment of different ailments including diabetes and other cardiovascular diseases under traditional healing systems. Very few of these traditional anti-diabetic plants have received proper scientific or medical scrutiny despite recommendations by World Health Organization (WHO). Ayurveda and other Indian traditional approaches have described more than 800 plants in the Indian subcontinent, known to possess anti-diabetic potential. These require to be effectively studied and in fact only few of them have been characterized for their mechanistic actions. Most of them have been tested on porcine pancreatic α-amylase (PPA) and salivary amylase while reports on their effect on human pancreatic amylase (HPA), if any, are scarce. As a part of this we also started screening medicinal plants with anti-diabetic activity through not only HPA but also salivary amylase inhibitors[2]. It has been shown that activity of Human Pancreatic α-amylase (HPA) in the small intestine correlates to an increase in post-prandial glucose levels, the control of which is therefore an important aspect in treatment of diabetes. Pancreatic α-amylase inhibitors offer an effective strategy to lower the levels of post prandial hyperglycemia via control of starch breakdown. Eleven Ayurvedic Indian medicinal plants with

known hypoglycemic properties were tested for α-amylase inhibition, in order to assess and evaluate their inhibitory potential on pancreatic α-amylase. Analysis of 91 extracts showed that 10 exhibited strong Human Pancreatic Amylase (HPA) inhibitory potential. Phytochemical analysis revealed the presence of alkaloids, proteins, tannins, cardiac glycosides, flavonoids, saponins and steroids as probable inhibitory compounds[5,6]. Diabetes mellitus is characterised by hyperglycaemia, lipidaemia and oxidative stress and predisposes affected individuals to long-term complications afflicting the eyes, skin, kidneys, nerves and blood vessels. Increased protein glycation and the subsequent build-up of tissue advanced glycation endproducts (AGEs) contribute towards the pathogenesis of diabetic complications. Protein glycation is accompanied by generation of free radicals through autoxidation of glucose and glycated proteins and via interaction of AGEs with their cell surface receptors (referred to as RAGE). Glycation derived free radicals can damage proteins, lipids and nucleic acids and contribute towards oxidative stress in diabetes. There is interest in compounds with anti-glycation activity as they may offer therapeutic potential in delaying or preventing the onset of diabetic complications. Although many different compounds are under study, only a few have successfully entered clinical trials but none have yet been approved for clinical use[7].

It is estimated that more than 200 species of plants exhibit anti-diabetic properties, including many common plants, such as pumpkin, wheat, celery, wax guard, lotus root and bitter melon. To date, hundreds of herbs and traditional Chinese medicine formulas have been reported to have been used for the treatment of diabetes mellitus. Jai et al[8]., revealed that polysaccharide containing herbs restore the functions of pancreatic tissues and cause an increase in insulin output by the functional beta cells, while other ingredients enhance the microcirculation, increase the availability of insulin and facilitate the metabolism in insulin-dependent processes. Pharmacological and clinical evaluations indicated that these drugs had a mild, but significant, blood glucose lowering effect and that the long-term use of these agents may be advantageous over chemical drugs in alleviating some of the chronic diseases and complications caused by diabetes[8]. Saxena et al[9]., reported that *Momordica charantia, Pterocarpus marsupium,* and *Trigonella foenum greacum*, have been shown beneficial effects for treating type 2 diabetes by stimulating or regenerating effect on beta cells or extra-pancreatic effects. Hyponidd is a herbo-mineral formulation composed of the extracts of ten medicinal plants i.e., *Momordica charantia, Melia azadirachta, Pterocarpus marsupium, Tinospora cordifolia, Gymnema sylvestre, Enicostemma littorale, Emblica officinalis, Eugenia jambolana, Cassia auriculata* and *Curcuma longa*. Administration of Hyponidd not only controls the diabetes but also decreased levels of glycosylated haemoglobin, plasma thiobarbituric acid reactive substances, hydroperoxides, ceruloplasmin and alpha-tocopherol in diabetics. Plasma reduced glutathione and vitamin C were significantly elevated by oral administration of hyponidd. The results showed that hyponidd exhibits antihyperglycaemic and antioxidant activity in STZ-induced diabetic rats[10]. Die-Huang-Wan is an herbal formulation, contains dioscorea (*Dioscoreae rhizoma*), cornus (*Corni fructus*), alisma (*Rhizoma alismatis*), holelen (Poria), rehmannia (*Rehmanniae radix*) and tree peony bark (*Moutan radicis* cortex), used to lower plasma glucose by increasing insulin secretion. These results suggest that cornus is the major contributor to the plasma glucose-lowering action in Die-Huang-Wan[11]. In past there have been many medicinal plants, which have been used in traditional medicines for their anti-diabetic properties without any scientific support and pharmacological evidence. The aqueous extract of Murraya koenigii leaves has been taken to evaluate the hypoglycemic activity in normal and alloxan induced diabetic rabbits. This plant is promising as it is widely and regularly used as a spice for food flavoring and as such it appears to be without any side effects and toxicity. The results reporting that the aqueous extract of these leaves may be prescribed as adjunct to dietary therapy and drug treatment for controlling diabetes mellitus[12]. A similar result was observed with *T. laurifolia* leaf and found an insulin like substance(s) which directly act as hypoglycemic agents and also revealed that compounds present in the leaf extract induces the regenerative process of beta-cells as an added advantage with this plant[13]. *Hydnocarpus wightiana* is advocated in traditional Indian medicine to possess strong anti-diabetic activity. This study suggests that presence of amphiphilic antioxidant molecules along with enzyme inhibitory activities in the acetone extract of H. wightiana seed hulls may be responsible for the anti-diabetic properties as advocated in traditional medicine[14]. This review mainly focuses on plant drug preparations and herbal combinations used in the treatment of diabetes and the development of other complications especially abnormalities in lipids, proteins and carbohydrates metabolism. However the fact is significant achievement have been made in the past to treat and controlling the diabetes[15,16]. Experimental reports published by several authors reveals that anti-diabetic activity can be offered by medicinal plants/ herbs through increasing insulin secretion, enhancing glucose uptake by adipose and skeletal muscle tissues, inhibiting intestinal glucose absorption and inhibiting hepatic glucose production. Even though several authors regularly publishing the anti-diabetic activities of several medicinal plants, animal based studies and multicenter large scale clinical trials are scanty to evaluate the safety and efficacy of these proposed phytomedicines and neutraceuticals. In fact, the people of different countries are attracting more towards naturopathy and phytomedicines in the recent times and several therapists are also recommending most of these plants as remedies for various diseases including diabetes in the form of extracts, decoctions and juices. Therefore, it is high time to analyze these plant/ herbal medicines and their interactions with conventional drugs when administered simultaneously in different forms.

Phytonutrients play a vital role in diabetes mellitus

Mainly these are having health protecting properties macro and micro nutrients for the growth. And these are having alkaloids, flavonoids, indoles, phenolic compounds and terpenes minerals in plants mainly needed for body is very small amounts. Phytonutrients may serve as antioxidant properties and enhances the metabolisms (Table-1).

CONCLUSION

Mainly scientific evidence reveals that antioxidants reduce the risk of chronic diseases include in heart disease. Oxidative stress is mainly complicating in diabetes efforts to find suitable antidiabetic and antioxidant therapy. Naturally occurring antioxidants like vitamin C, Phenolic compounds have been recognized to reduce disease risk. Different types of assay methods were used to divide the plants for hypoglycemic activity in vivo and in vitro.

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Table – 1: List of medicinal plants with Anti-diabetic and other related beneficial activities

S.No.	Name of the plant	Medical used	Reference
		A	
1.	*Abrus precatorius*	Anti - Diabetic , Purgative, Aphrodisiac, Emetic, Sore throat	17
2.	*Acacia arabica*	Anti - Diabetic , Cough, Chronic diarrhea, Dysentery, Passive hemorrhages	18
		B	
3.	*Balanites roxburghii* Planch	Anti - Diabetic, Purgative, Anthelmintic, Coughs, Burns, Useful in snake bites	19
4.	*Barleria lupulina*	Anti - Diabetic, Kidney disorders, CNS activity	20
		C	
5.	*Catharanthus roseus* Linn	Anti - Diabetic, Anti cancer, Diarrhea, Vermifuge, Toothache	21
6.	*Capparis sepiaria*	Anti - Diabetic, Hepato protective	22
		D	
7.	*Datura quercifolia*	Anti - Diabetic, Anodyne, Hypnotic, Norcotic, Anti spasmodic, Hallucinogenic	17
8.	*Datura metel*	Anti - Diabetic, Anti septic, Anti spasmodic, Counter irritant, Narcotic	23
		E	
9.	*Eleutherococcus senticosus*	Anti - Diabetic, Anti stress, Fatigue, Adaptogenetic	24
10.	*Eragrostis bipinnata schum*	Anti - Diabetic, Hepato protective	17
11.	*Euphorbia prostrata*	Anti - Diabetic, Anti inflammatory, Anti microbial	25
12.	*Eupatorium odoratum*	Anti-diabetic, antioxidant, antiviral, antiinflammatory and anticancer	26
		F	
13.	*Ferula assa-foetida*	Anti - Diabetic, Anti periodic, Expectorant, Cardio tonic, Anti spasmodic, Alterative, Deobstruent	17
		G	
14.	*Galega officinalis*	Anti - Diabetic, Galactagogic, Diuretic, Diaphoretic	27
15.	*Gymnema yannaense*	Anti - Diabetic, Laxative, Stimulant, Stomachic, Diuretic	28
		H	
16.	*Hedyotis biflora*	Anti - Diabetic, Anti tumor, Fever, Gastric irritation, Nervous depression	29
17.	*Hoodia currorii*	Anti - Diabetic, Anti oxidant, Hypertension, Stomaches	30
		I	
18.	*Ichnocarpus frutescens*	Anti - Diabetic, Anti tumor, Anti oxidant, Hepato protective	31
19.	*Indigofera arrecta Hochst*	Anti - Diabetic , Anti bacterial	32
		J	
20.	*Jacobinia suberecta*	Anti - Diabetic, Effective in HIV	17
21.	*Juglans mandshurica*	Anti - Diabetic, Cough, Allergy, Acute gastritis, lithangiuria	33
		K	
22.	*Kalanchoe crenata*	Anti - Diabetic, Protects from cardio vascular complications	34
23.	*Konjac mannan*	Anti - Diabetic, Obesity disorders, Promotes intestinal motility	35
		L	
24.	*Laportea ovalifolia*	Anti - Diabetic, Hypolipidaemic, Analgesic effect	36
25.	*Larrea tridentata*	Anti - Diabetic, Rheumatic disease, Venereal infections, Urinary infections, Cancer	37
		M	
26.	*Mollotus roxburghianum*	Anti - Diabetic, Anti inflammatory	38
27.	*Mangifera indica*	Anti - Diabetic, Immunomodulatory, Anti oxidant, Diaphoretic, Astringent	39
		N	
28.	*Nelumbo nucifera gaertn*	Anti - Diabetic, Diuretic, Piles, Leprosy, Vomiting, Dysentery	40
29.	*Nepeta ciliaris*	Anti - Diabetic, Insect repellents	41
		O	
30.	*Ocimum gratissimum*	Anti - Diabetic, Rheumatism, Ejaculation	42

31.	*Ocimum sanctum*	Anti - Diabetic, Anti spasmodic, Analgestic, Hypotensive, Febrifuge, Adoptogenic, Anti inflammatory	43
		P	
32.	*Phragmites vallatoria*	Anti - Diabetic, Wound healing, Rheumatoid arthritis	44, 45
33.	*Pterocarpus marsupium*	Anti - Diabetic, Astringent, Diarrhea, Pyrosis, Syphilis, Cholera, Dysentery	46
		Q	
34.	*Quercus infectoria*	Anti - Diabetic, Astringent, Eczema, Dysentery, Haemorrhages, Diarrhea	47
35.	*Quercus robur*	Anti – Diabetic, Bach, Haemostatic, Decongestant, Astringent	48
		R	
36.	*Rauwolfia serpentina*	Anti - Diabetic, Anti hypertensive, Hypnotic, Sedative	49
37.	*Rehmannia glutinosa*	Anti - Diabetic, Diuretic, Anemia, Promotes healing, Anti inflammatory, Liver disorders	50
		S	
38.	*Saccharum officinarum*	Anti - Diabetic, Anti septic, Preservative, Demulcent, Laxative, Diuretic	51
39.	*Salacia macrosperma*	Anti - Diabetic, Anti human immuno deficiency virus	52
		T	
40.	*Talinum cuneifolium*	Anti - Diabetic, Aphrodisiac	53
41.	*Tamarindus indica*	Anti - Diabetic, Laxative, Refrigerant, Digestive	54
42.	*Trigonella foenum-graecum*	Anti - Diabetic, Carminative, Anti tumor, Restorative, Laxative, Hypotensive, Diuretic	55
		U	
43.	*Urginea indica*	Anti - Diabetic, Asthma, Rheumatism, Dropsy, Cardio tonic	56
44.	*Urtica dioica*	Anti - Diabetic, Anti asthmatic, Haemostatic, Diuretic, Astringent, Galactogogue, Anti dandruff	57
		V	
45.	*Vaccinium myrtillus*	Anti - Diabetic, Anti septic, Astringent, Diuretic, Kidney disorders, Ophthalmic	58
46.	*Vinca rosea*	Anti - Diabetic, Anti tumor, Diuretic, Malaria fever	59
		W	
47.	*Withania coagulans*	Anti - Diabetic, Anthelmintic	60
48.	*Withania sommifera*	Anti - Diabetic, Aphrodisiac, Diuretic, Nervine sedative, Immuno modulator, Adaptogenic	61
		X	
49.	*Xanthium pungens*	Anti - Diabetic, Anti microbial	62
50.	*Xanthium strumarium*	Anti - Diabetic, Anodyne, Anti bacterial, Anti fungal, Anti periodic, Anti spasmodic, Diuretic	63
		Z	
51.	*Zingiber zerumbet*	Anti – Diabetic, Anthelmintic, Anti tumor, Anti bacterial, Anti inflammatory	64
52.	*Ziziphus mauritiana*	Anti – Diabetic, Anti diarrheal, Anti microbial, Anti viral	65