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An overview of Diabetes, A Review

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Abstract

Diabetes mellitus (DM) is the commonest endocrine disorder that affects more than 100 million people worldwide (6% of the population). It is caused by the deficiency or ineffective production of insulin by pancreas which results in increase or decrease in concentrations of glucose in the blood. It is found to damage many of the body systems, particularly the blood vessels and nerves. Many herbal plants with hypoglycemic properties are known from across the world. In India, diabetes has been known for a long time, but its incidence is not of the same magnitude across the subcontinent. The wide range of structures of the plant constituents, which appear to be the active hypoglycemic principles, suggests different sites of action within the body. Whether these plants truly possess hypoglycemic properties needs to be investigated for those plants that are commonly used in the management of diabetes. Researches conducted in the last few decades on plants, mentioned in ancient literature or used traditionally for diabetes, have shown anti diabetic property. Among them, 30 plants and their products (active natural principles and crude extracts) that have been mentioned used in the Indian traditional system of medicine have shown experimental or clinical anti diabetic activity. Trigonella foenumgraecum, Momor-dica charantia, Tinospora cordifolia, Enicostema littorae, Gymnema sylvestre, Azadiracta indica, Syzigium cumini are some of the most effective and the most commonly studied Indian plants in relation to diabetes.

Keyword: Trigonella foenumgraecum, Momor-dica charantia, Tinospora cordifolia, Enicostema littorae, Gymnema sylvestre, Azadiracta indica, Syzigium cumini**,** Diabetic

Introduction

Diabetes, the word came from Greek, means to siphon. The most common sign was excessive urination. Mellitus, the word came from Latin, means honey sweet. Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia (high blood glucose) and other signs, as distinct from a single illness or condition (Diagnosis and Classification, 2004). It is a chronic metabolic disease with inability to maintain blood glucose concentrations within physiological limits. It develops when the pancreas does not produce enough insulin or when the body cannot effectively uses the insulin it produces.

Classification of Diabetes Mellitus

Type-1: Autoimmune, Insulin Dependent Diabetes Mellitus (IDDM).

It is a catabolic disorder in which circulating insulin is

virtually absent due to beta cell destruction.

Type-2: Non-autoimmune, Non-Insulin Dependent Diabetes Mellitus (NIDDM)

Circulating endogenous insulin is sufficient but is often either sub-normal or relatively inadequate because of tissue insensitivity.

Type-3: Secondary Diabetes

1. Genetic
2. Insulin receptor abnormality
3. Pancreatic disease
4. Hormonal abnormality
5. Drug and Chemical Induced Diabetes mellitus

Type-4: Gestational Diabetes Mellitus

Some women develop intolerance during pregnancy and it is characterized by excessive hunger, thirst and frequent urge to urinate.

Sign and Symptoms

The major indications of diabetes include excessive thirst and frequent urination (polyuria) which compels to drink a large volume of water (polydipsia), glycosuria, excessive hunger (polyphagia), and loss of weight and lack of energy (asthenia) in case of Type-1 mostly. But Type-2 is different in diagnosis as the symptoms are very vague and unnoticeable. Symptoms of IDDM rise promptly while in NIDDM take a year or more than a year (Memon Badaruddin A., et al. 2002). Dangerous symptoms include smell of acetone on patient's breathing, rapid deep breathing (kussmaul breathing) and altered state of consciousness or arousal which may lead to diabetic coma (Akhtar J., et al. 2005).

Factors Responsible for Diabetes

Major causative factors include genetic susceptibility, autoimmunity, environmental factors, mental stress and strain, obesity, excessive sleep, high carbohydrate diet, high blood pressure, low activity level and poor diet (Memon Badaruddin A., et al. 2002) (Patel D., et al. 2009).

The Risks and Complications of Uncontrolled Diabetes

If not controlled, diabetes can put you at risk for a host of complications that can affect nearly every organ in the body. They include: the heart and blood vessels, eyes, kidneys, nerves, gums and teeth etc. Heart disease and blood vessel disease are the biggest complications that people with uncontrolled diabetes face. Approximately 65% of death from diabetes is due to heart disease and stroke. Diabetes can also cause poor blood flow in the legs and feet (peripheral artery disease). Diabetes cause a number of eye problems include: Glaucoma, Cataracts and Diabetic retinopathy.

Herbal Treatment for Diabetes

Although, many drugs and intervention are available to manage diabetes, in most cases they are expensive, produce serious side effects, and in addition they are not considered to be safe for use during pregnancy. The use of herbal medicines for the treatment of diabetes mellitus has gained importance throughout the world. The W.H.O. also recommended and encouraged this practice especially in countries where access to the conventional treatment of diabetes is not adequate (Trivedi, P. C. et al. 2006).

Medicinal plants are being looked up once again for the treatment of diabetes. Many conventional drugs have been derived from prototypic molecules in medicinal plants. Metformin exemplifies an efficacious oral glucose-lowering agent. Its development was based on the use of *Galega officinalis* to treat diabetes. *Galega officinalis* is rich in guanidine, the hypoglycemic component. Because guanidine is too toxic for clinical use, the alkyl biguanides synthalin A and synthalin B were introduced as oral anti-diabetic agents in Europe in the 1920s but were discontinued after insulin became more widely available. However,

experience with guanidine and biguanides prompted the development of metformin. To date, over 400 traditional plant treatments for diabetes have been reported, although only a small number of these have received scientific and medical evaluation to assess their efficacy.

Major hindrance in amalgamation of herbal medicine in modern medical practices is lack of scientific and clinical data proving their efficacy and safety. There is a need for conducting clinical research in herbal drugs, developing simple bioassays for biological standardization, pharmacological and toxicological evaluation, and developing various animal models for toxicity and safety evaluation. It is also important to establish the active component/s from these plant extracts (Devasagayam P. A. et al. 2007).

Table 1: List of Plants with Putative Anti-Diabetic Effects

Plant (family)	Part	Model	References
St. John's Wort	leaves	streptozotocin-diabetic rats	Özgür Devrim Can et al.(2011)
Pyrus biossieriana Buhse	leaves	Alloxan-rat	Mohammad ES et al.(2011)
coconut	protein	Alloxan-rat	G. Salil a,c, K.G. Nevina,b, T. Rajamohana,?(2011)
Aegle marmelos (Rutaceae)	Leaves	Alloxan-rat	Ponnachan et al. (1993)
Allium cepa (Liliaceae)		STZ-rat	Narendhirakannan et al. (2006)
Allium sativum (Liliaceae)		STZ-rat	Seema et al. (1996)
Amaranthus esculantus (Amaranthaceae)	Seeds	STZ-rat	Kesari et al. (2006)
Annona squamosa (Annonaceae)	Fruits	Alloxan-rabbit	Kamalakannan et al. (2005)
	Bulbs	Alloxan-rabbit	Jain et al. (1974)
	Bulbs	STZ-rat	Jain et al. (1975)
	Whole plant		Kim et al. (2006)
	Leaves	STZ-rat	Gupta et al. (2005); Kaleem et al. (2006)
		Alloxan-rat	Gupta et al. (2005)
Averrhoa bilimbi (Oxalidaceae)	Fruit pulp	STZ-rat, Alloxan-rabbit	Tan et al. (2005)
Baccharis trimera (Myrtaceae)	Leaves	STZ-rat	Oliveira et al. (2005)
Bryophyllum pinatum (Crassulaceae)	Leaves	STZ-mice	Ojewole (2005)
Canarium schweinfurthi (Burseraceae)	Leaves	STZ-rat	Kamtchouing et al. (2005)
Catharanthus roseus (Apocynaceae)	Stem barks	STZ-rat	Singh et al. (2001)
Chamaemelum nobile (Asteraceae)	Whole plant	STZ-rat	Eddouks et al. (2005)
Coscinium fenestratum (Menispermaceae)	Leaves	STZ-rat	Shirwaikar et al. (2005)
Egyptian Morus alba (Moraceae)	Stem barks	STZ-rat	Singap et al. (2005)
Eugenia jambolana (Asteraceae)	Stem barks	STZ-rabbit	Sharma et al. (2006); Ravi et al. (2005)
Hintonia standleyan (Rubiaceae)	Fruit pulp, seeds	STZ-rat	Guerrero-Analco et al. (2005); Navarette et al. (2005) Ojewole (2006)
Hypoxis hemerocallidea (Hypoxidaceae)	Stem barks	STZ-mice, rat	Ojewole (2005)
Leonotis leonurus (Lamiaceae)	Fruits	STZ-mice, rat	
Lepidium sativum (Brassicaceae)			
Lycium barbarum (Solanaceae)			
Malmea depressa (Annonaceae)			
Mangifera indica (Anacardiaceae)			

Momordica charantia (Cucurbitaceae)	Leaves	STZ-rat	Eddouks et al. (2005)
	Leaves	STZ-rat	Zhao et al. (2005); Wu et al. (2006)
	Fruits	STZ-rat	Andrade-Cetto et al. (2005)
Murraya koenigii (Rutaceae)	Roots	Alloxan-rat	Aderibigbe et al. (1999)
		STZ-rat	Ojewole (2005)
	Leaves	STZ-rat	Sekar et al. (2005)
	Stem barks	Alloxan-rat	Reyes et al. (2006)
Ocimum sanctum (Labiatae)	Leaves	STZ-mice	Sitasawad et al. (2000)
Piper betle (Piperaceae)		Alloxan-rat	Yadav et al. (2005)
	Fruits	STZ-rat	Satishsekar et al. (2005)
Psidium guajava (Myrtaceae)		Alloxan-rat and STZ-rat	Yadav et al. (2002)
	Seeds	Alloxan-rabbit	Watal et al. (2005)
Raphanus sativa (Brassicaceae)	Leaves	STZ-rat	Watal et al. (2007)
Retama raetum (Fabaceae)		STZ-rat	Chattopadhyay et al. (1993)
Salvia officinalis (Lamiaceae)			Arambewela et al. (2005); Santhakumari et al. (2006)
Scoparia dulcis (Scrophulariaceae)	Leaves	STZ-rat	Ojewole (2005)
Strobilanthes crispus (Acanthaceae)	Leaves	STZ-at	Taniguchi et al. (2006)
Syzgium cordatum (Myrtaceae)	Leaves	STZ-rat	Maghrani et al. (2005)
Syzgium cumini (Caesalpiniaceae)		STZ-mice, rat	Lima et al. (2006)
Taxus yunnanensis (Taxaceae)	Whole plant	STZ-rat	Pari et al. (2005)
Terminalia chebula (Combretaceae)	Whole plant	STZ-rat	Fadzelly et al. (2006)
Terminalia superba (Combretaceae)	Leaves	STZ-rat	Musabayane et al. (2005)
Trema orientalis (Ulmaceae)	Whole plant	STZ-rat	Oliveira et al. (2005)
Tremella mesenterica (Combretaceae)	Leaves	STZ-mice, rat	Banskota et al. (2006)
Viscum album (Loranthaceae)	Leaves	STZ-rat	Rao et al. (2006)
Zizyphus spina-christi (Rhamnaceae)	Leaves, seeds	STZ-rat	Kamtchouing et al. (2005)
	Woods	STZ-rat	Dimo et al. (2006)
	Seeds	STZ-rat	Lo et al. (2006)
	Stem barks	STZ-rat	Orhan et al. (2005)
	Stem barks	STZ-rat	Abdel-Zaher et al. (2005)
	Fruits		
	Whole plant		
	Leaves		

Table: List of Plants with Putative Anti-Diabetic Effects

Plant (family)	Part	Model	References
Aegle marmelos (Rutaceae)	Leaves	Alloxan-rat	Ponnachan et al. (1993)
		STZ-rat	Narendhirakannan et al. (2006)
		STZ-rat	Seema et al. (1996)
Allium cepa (Liliaceae)		STZ-rat	Kesari et al. (2006)
Allium sativum (Liliaceae)		STZ-rat	Kamalakannan et al. (2005)
Amaranthus esculantus (Amaranthaceae)	Seeds	Alloxan-rabbit	Jain et al. (1974)
	Fruits	Alloxan-rabbit	Jain et al. (1975)
	Bulbs	STZ-rat	Kim et al. (2006)
	Bulbs		

Annona squamosa (Annonaceae)	Whole plant Leaves	STZ-rat Alloxan-rat STZ-rat, Alloxan-rabbit	Gupta et al. (2005); Kaleem et al. (2006) Gupta et al. (2005)
	Fruit pulp	STZ-rat	Tan et al. (2005)
Averrhoa bilimbi (Oxalidaceae)	Leaves	STZ-mice	Oliveira et al. (2005)
Baccharis trimera (Myrtaceae)			
Bryophyllum pinatum (Crassulaceae)			
Canarium schweinfurthi (Burseraceae)	Leaves	STZ-rat	Ojewole (2005)
Catharanthus roseus (Apocynaceae)			
Chamaemelum nobile (Asteraceae)	Leaves	STZ-rat	Kamtchouing et al. (2005)
Coscinium fenestratum (Menispermaceae)			
Egyptian Morus alba (Moraceae)	Stem barks	STZ-rat	Singh et al. (2001)
Eugenia jambolana (Asteraceae)			
Hintonia standleyan (Rubiaceae)	Whole plant	STZ-rat	Eddouks et al. (2005)
Hypoxis hemerocallidea (Hypoxidaceae)			
Leonotis leonurus (Lamiaceae)	Leaves	STZ-rat	Shirwaikar et al. (2005)
Lepidium sativum (Brassicaceae)			
Lycium barbarum (Solanaceae)	Stem barks	STZ-rat	Singap et al. (2005)
Malmea depressa (Annonaceae)			
Mangifera indica (Anacardiaceae)	Stem barks	STZ-rabbit	Sharma et al. (2006); Ravi et al. (2005) Guerrero-Analco et al. (2005); Navarette et al. (2005) Ojewole (2006)
Momordica charantia (Cucurbitaceae)	Fruit pulp, seeds Stem barks	STZ-rat	
Murraya koenigii (Rutaceae)	Fruits	STZ-mice, rat	Ojewole (2005)
	Leaves	STZ-mice, rat	Eddouks et al. (2005)
Ocimum sanctum (Labiatae)	Leaves	STZ-rat	Zhao et al. (2005); Wu et al. (2006) Andrade-Cetto et al. (2005)
Piper betle (Piperaceae)	Fruits	STZ-rat	
Psidium guajava (Myrtaceae)	Roots	STZ-rat	Aderibigbe et al. (1999) Ojewole (2005) Sekar et al. (2005) Reyes et al. (2006) Sitasawad et al. (2000) Yadav et al. (2005) Satishsekar et al. (2005) Yadav et al. (2002)
Raphanus sativa (Brassicaceae)	Leaves	Alloxan-rat	
Retama raetum (Fabaceae)	Stem barks	STZ-rat	
Salvia officinalis (Lamiaceae)	Leaves	STZ-rat Alloxan-rat	
Scoparia dulcis (Scrophulariaceae)	Fruits	STZ-mice	
Strobilanthes crispus (Acanthaceae)		Alloxan-rat	
Syzgium cordatum (Myrtaceae)	Seeds Leaves	STZ-rat Alloxan-rat and STZ-rat	Watal et al. (2005) Watal et al. (2007) Chattopadhyay et al. (1993)
Syzgium cumini (Caesalpiniaceae)		Alloxan-rabbit	
Taxus yunnanensis (Taxaceae)		STZ-rat	
Terminalia chebula (Combretaceae)		STZ-rat	Arambewela et al. (2005); Santhakumari et al. (2006) Ojewole (2005)
Terminalia superba (Combretaceae)	Leaves	STZ-rat	
Trema orientalis (Ulmaceae)	Leaves	STZ-rat	Taniguchi et al. (2006)
Tremella mesenterica (Combretaceae)	Leaves	STZ-at	Maghrani et al. (2005) Lima et al. (2006)
Viscum album (Loranthaceae)	Whole plant	STZ-rat STZ-mice, rat	Pari et al. (2005)
Zizyphus spina-christi (Rhamnaceae)	Whole plant Leaves	STZ-rat	Fadzelly et al. (2006)
	Whole plant	STZ-rat	Musabayane et al. (2005)
		STZ-rat	

	Leaves	STZ-mice, rat	Oliveira et al. (2005)
	Leaves	STZ-rat	Banskota et al. (2006)
	Leaves, seeds Woods	STZ-rat	Rao et al. (2006)
	Seeds	STZ-rat	Kamtchouing et al. (2005)
	Stem barks	STZ-rat	Dimo et al. (2006)
	Stem barks	STZ-rat	Lo et al. (2006)
		STZ-rat	Orhan et al. (2005)
	Fruits	STZ-rat	Abdel-Zaher et al. (2005) Federica Menichini et a(l2011)
	Whole plant		
	Leaves		

Advantages of Herbal Medicine

1. Lower costs than conventional medicine.
2. Reduced side effects compared to conventional treatments.
3. Often aim to remove underlying cause rather than treat symptoms.
4. Holistic approach promoting good overall health.
5. Potential to reduce the burden on conventional medicine.
6. Growing research in activities and improvements in production (Mukherjee, P. K., et al. 2002).

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