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Potent Role of Some Indigenous Herbs in Managing Diabetes

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Abstract

Diabetes mellitus is one of the world's fastest growing metabolic diseases, characterized by hyperglycaemia (high blood sugar) which leads to significant changes in the metabolism of lipids, carbohydrates, and proteins. In long term, the disease causes microvascular complications (viz retinopathy, nephropathy) as well as macrovascular complications such as strokes, cardiovascular problems, and peripheral vascular diseases. The disease is more prevalent among adults and there has been almost two-fold increase in its global prevalence since 1980. It is feared that in the absence of proper strategies for its management such an alarming rise in the disease will have serious implications for global health in future. It is also likely to affect the longevity of human beings and will have an adverse effect on the world economy. India being a nation having high population density has a high incidence of Diabetes too. Since it is a life style disease it is more prevalent among urban population. Although there are various approaches to provide symptomatic relief from the ill effects of diabetes and its secondary complications, it is widely held that herbal formulations can be a preferred alternative because of being cheap and relatively safer. Currently, close to two third of global population uses conventional medicines. This review focuses on Indian Herbal cures frequently mentioned in traditional texts as a drug for diabetes, especially in India. As estimated by the World Health Organization, plant-based traditional medicine is used by about 90% of the population in third world countries. Antihyperglycemic potential has been reported in about 800 plants belonging to the Indian region.

Keywords: Hypoglycaemia**;** Diabetes mellitus; Herbal drugs; Alternative medicine; Medicinal herbs

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Introduction

Glucose is the principal source of energy for most living cells and maintenance of its optimum levels is an important aspect of homeostasis. Any significant rise of blood glucose above the optimum level is called hyperglycaemia. Diabetes mellitus is a group of metabolic diseases that are characterized by hyperglycaemia and arise from defects in insulin secretion, insulin action, or both. Chronic hyperglycaemias, or raised blood sugar, is a common effect of uncontrolled diabetes, and this is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels.

Diabetes mellitus is classified into three main types on the basis of the mechanism of its development - Type 1, Type 2 and gestational diabetes mellitus. Type 1 Diabetes mellitus is known as insulin dependent diabetes mellitus (IDDM) because it results from a complete loss of function of β cell of the islets of Langerhans which are present in the pancreas and secrete insulin. Type 2 Diabetes which is also known as non-insulin dependent diabetes mellitus (NIDDM) involves a temporary loss of pancreatic β cell mass and is more prevalent than type 1 diabetes. The type 2 diabetes is a life style disease which is late-onset and has high genetic predisposition. It is associated with hypertension, obesity, and elevated cholesterol. The prognosis of NIDMM is aimed at increasing insulin secretion and decreasing insulin resistance. The third type of diabetes is Gestational diabetes which is characterised by high blood sugar levels in pregnant women only.

The prevalence of the disease in Indians is considerably higher than elsewhere. Similarly, the insulin level is also higher in Asian population which positively correlates with higher peripheral insulin resistance (Banerji et al., 1999). The insulin resistance in Indians is thought to be due to their high body fat percentage and low muscle mass along with certain racial predisposition. Going by the official figures of World Health Organization (WHO), plant-based traditional medicines are used by a huge proportion (about 90%) of the population in poor countries where primary health care relies heavily on herbals. Of the 21000 plants listed by the WHO, about 2500 plants belong to the Indian region including 800 herbs which have promising prospects as hypoglycaemic drugs.

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Traditional herbal Anti diabetic drugs

There is a long list of medicinal plants and herbs having antidiabetic activity which are described in the traditional Indian literature of Ayurveda (Kar A et al., 2003). Most of these are used as extracts of the herb for making drugs. A common observation is that the plants having bitter principles are usually having antidiabetic effect and this has been confirmed in case of certain plants which are claimed to cause blood sugar lowering (Fatema A et al., 2012). Various clinical studies even point to restoration of the endocrine activity of pancreatic β- cells in response to administration of herbal extracts (Dwivedi & Daspaul, 2013; Khan et al, 2014). Here is a brief description of some of the medicinal herbs having experimental evidence about their hypoglycaemic potential.

Acacia arabica

Acacia arabica, commonly known as 'babool' in India, belongs to the family Fabaceae. It is native to Asian regions of South East Asia, Middle East and Africa. The description of the plant appears in the 'Materia medica' of Dioscorides. The exudate of the plant is known as Gum Arabic and has several medicinal uses. The plant extract acts as an antidiabetic agent by acting as secretagogue to release insulin. It induces hypoglycaemia in control rats but not in those rats which developed diabetes after treatment with alloxan (Wadood A, 1989).

Ficus religiosa

Ficus religiosa, which is a member of family Moraceae is familiar to the natives by its vernacular name 'peepal' in India. In English it is called sacred fig because of its significance in religious texts. The shade of this tree is considered very healthy because it gives out a lot of oxygen from photosynthesis. It is reported to have been extensively used for various ailments including 'madhumeha' (a synonym for diabetes) in the traditional Ayurvedic medicine. The milky latex of the plant is used to treat impotency whereas the paste of its leaves is used to treat skin defects. For treating diabetes, the decoction of its bark is given in a dose of about 50 ml and has been proven effective. The plant is believed to contain several bioactive principles including tannins, saponins, polyphenolic compounds, flavonoids, and sterols. Sitosterol-d-glucoside present in the bark of *Ficus religiosa* is believed to elicit hypoglycaemic activity in rabbits (Deepa P et al, 2018). Oral incorporation of the aqueous extract of *Ficus religiosa* for

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21 days caused a significant lowering in blood glucose levels which was accompanied with elevated level of insulin (Pandit et al., 2010).

Allium sativum

Allium sativum (garlic), commonly called 'lahsun' in Hindi, belongs to the family Amaryllidaceae. Leaves and bulb are the parts frequently used (Eidi et al., 2006). The principal bioactive components present in garlic are allicin, allixin, ajoene, and other organosulphur compounds. Garlic may act as an antidiabetic agent by increasing either the pancreatic secretion of insulin from the β cells or the release of bound insulin. Allicin, a sulfur-containing compound, is responsible for the pungent flavour and significant hypoglycemic activity in garlic. This effect is supposed to be due to enhanced hepatic metabolism, release of insulin, and/or insulin-sparing effect, Cardiovascular complications of diabetes are reported to be prevented by the consumption of garlic.

Phytochemicals present in garlic also show antioxidant property which is evidenced by scavenging of reactive oxygen species and increasing cellular antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidase etc.

Momordica charantia

Momordica charantia (bitter gourd or 'Karela') belongs to the family Cucurbitaceae. Fruit as a whole and fruit's seeds are the parts most frequently used for therapeutic benefits. *Momordica charantia* is a popular fruit used for the treatment of diabetes, cardiovascular diseases, and related conditions amongst the indigenous population of Asia, South America, and East Africa. Several studies have demonstrated antibacterial, antiviral, anticancer, and antidiabetic activities, in *Momordica charantia*. However, the antidiabetic activity has been widely reviewed. The hypoglycemic and lipid-lowering properties of bitter melon have been observed very frequently (Cortez-Navarrete M et al, 2018). Studies have shown that *Momordica charantia* can repair damaged β-cells thereby stimulating insulin levels and also improve sensitivity/signalling of insulin (Malekshahi H et al., 2019; Leung et al, 2009). Bitter melon is also effective in loosening adiposity. It is reported to decrease the weight of epididymal and retroperitoneal white adipose tissues.

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Pterocarpus marsupium

Pterocarpus marsupium (Indian 'kino' tree, bijasar) belongs to the family Fabaceae. Its heart wood, leaves, flowers, bark, and gum are most commonly used plant parts. According to Ayurvedic texts, it is one of the most versatile medicinal plants with a wide spectrum of biological activities (Dhanabal SP et al, 2006). Almost every part of the tree has been acknowledged for its therapeutic potential. *P. marsupium* is known for its broad medicinal properties which include its effects against obesity, ulcers and tumour formation. It is also anti-inflammatory and prevents oxidative stress. Besides, its anthelminthic effects have also been reported in literature. Apart from these, there is a strong evidence of the antidiabetic property of this plant. It decreases blood sugar levels in diabetics by stimulating the secretion of insulin from pancreatic islets.

Gymnema sylvestre

Gymnema sylvestre (gurmar) belongs to the family Asclepiadaceae. Aqueous extract of *G. sylvestre* has been reported to cause reversible increases in intracellular calcium and insulin secretion in mouse and human β cells from subjects having with type 2 diabetes. Oral administration of *Gymnema* is reported to be effective against chronic inflammation, obesity, and pancreatic β cell dysfunction and in rats it increased utilization of glucose and/or decreased the mobilization of fat (Pothuraju et al., 2014; Zuñiga et al., 2017). A significant reduction in body weight, plasma proteins, and total haemoglobin levels has also been observe.

Trigonella foenum-graecum

Trigonella foenum-graecum (Fenugreek, 'Methi' in Hindi) belongs to the family Fabaceae. Seeds and leaves are the most frequently used parts of the plant. Studies on different experimental models have proved that fenugreek has strong antidiabetic properties (Vats V et al, 2004). Human studies have also confirmed the glucose- and lipid-lowering ability of fenugreek. Several studies have demonstrated that fenugreek seed extract, mucilage of seeds, and leaves can decrease blood glucose and cholesterol levels in humans and experimental diabetic animals. The antihyperglycemic effect has been correlated with decline in somatostatin and high plasma glucagon levels.

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Ocimum sanctum

It is known as 'Tulsi' in vernacular language and belongs to Labiateae family. This plant which is widely distributed all over India, is considered sacred and worshipped. It is used in Indian Ayurvedic medicines for treatment of various diseases (Kapoor S, 2008). Various animal studies proved that the aqueous extract of *Ocimum sanctum* leaves (200 mg/kg) showed significant hypoglycemic activity in streptozotocin-induced rats (Husain et al., 2015). Tulsi has prominent antimicrobial properties and for this reason it is used for the treatment of viral and fungal infections. It is also used for relieving stress as tranquilizer and antidepressant, for preventing the growth of tumors, and for treating gastric ulcers (Bhanuprakash et al., 2015).

Allium cepa

It is locally known as onion or 'pyaz' and belongs to family Liliaceae. When extracted in ether, anti-hyperglycemic activity is exhibited by ether-soluble part as well as ether-insoluble part of dried onion powder. It contains a chemical ingredient allyl propyl disulphide (APDS) which inhibits insulin destruction by the liver and stimulates the production of insulin by the pancreas which enhances the concentration of insulin and decreases the levels of glucose in the blood (Galavi et al., 2021). Crucial oil (100mg/kg) collected from red onion frequently shows anti-hyperglycemic activity, antistatin and antioxidant effects in alloxan-induced diabetic rats. A dose of 300 mg/kg has been found very effective in the treatment of hyperglycemia and hyperlipidemia. Various clinical trials and animal researches have yielded information about the usefulness of onion in the treatment of several medical complications including asthma, diabetes, cancer and several viral diseases.

Conclusion

Diabetes mellitus is a major endocrine disorder and is a global health concern owing to its prevalence among the middle aged and the elderly people. It is especially common in the urban population and is more of a lifestyle disease. Type 2 Diabetes warrants special attention mainly because of two reasons – first, it has far greater prevalence (80%) than type I or juvenile Diabetes combined (20%), and second, because of the lack of response towards insulin in this case. Type 2 Diabetes may result from a defect at multiple levels ranging from glucose transporters to insulin receptors and even the molecules involved in insulin-mediated signaling.

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The fact that there can be multiple reasons leading to Type 2 Diabetes further complicates its management.

Although there exist several classes of drugs to treat NIDDM, the relief is only symptomatic and the lost potential of pancreatic β-cells to produce insulin is never regained. This necessitates a search for alternative therapies and substitutes for the commonly used antihyperglycemic drugs. Ayurvedic and other time-tested cures for diabetes are immensely popular among people in developing countries due to their low cost and minimal side effects. However, a rigorous scientific basis for their efficacy is not known in a majority of cases. The fact that there has been a renewed interest in exploring the mechanisms behind the antihyperglycemic effects of these traditional Ayurvedic remedies is very reassuring. This paper presents a glimpse of some Ayurvedic drugs which are very effective in treating diabetes. At present, only a small fraction of the huge collection of Ayurvedic antidiabetic drugs has been explored using proper scientific method. The therapeutic potential of a lot more such drugs is yet to be explored in labs and in the clinic. It is hoped that future studies may target isolation, purification, and characterization of bioactive compounds present in these plants.

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