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REVIEW ARTICLE

MEDICINAL PLANTS WITH POTENTIAL HYPOGLYCEMIC PROPERTY-A REVIEW

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ABSTRACT

Diabetes mellitus is a clinical syndrome characterized by a deficiency in insulin production or resistance to insulin action. Consequently, it leads to inappropriate hyperglycemia. Prolonged hyperglycemia can cause severe complications that probably affect every system of the body and every drug taken by the patient. This study highlights the most popular medicinal plants with potential antdiabetic significance and their modes of action.

Keywords: Diabetes mellitus, Medicinal Plants, Diet

INTRODUCTION:

Diabetes mellitus (DM) is a chronic disease characterized by a deficiency in insulin production and its action or both. That leads to prolonged hyperglycemia with disturbances in most metabolic processes inside the human body . Untreated cases show severe tissue and vascular damage leading to serious complications such as retinopathy , neuropathy , nephropathy , cardiovascular complications and ulceration . Moreover, diabetes has an indirect relation with a many other diseases being the most common endocrine disorder. It was estimated that about 200 million people worldwide suffered from DM in 2010, and it is expected to reach 300 million by 2025 [1].

Diabetes mellitus can be classified into two major types ; type 1 and type 2 . Type 1 (IDDM) occurs in patients with little or no insulin secretory capacity. Consequently, they are in need for a replacement therapy of insulin for survival. The two major forms of type 1diabetes are type 1a (90%) and type 1b (10%). Type 1a (autoimmune) results from immunological destruction of pancreatic ß cells associated with diseases such as Addison's disease, Grave's disease and Hashimoto's thyroiditis . However, type 1b is idiopathic where no ß cells antibody is found. On the other hand, type 2 (NIDDM), is the most known form of diabetes, and it is characterized by abnormality in insulin secretion and its resistance . Traditionally, it is predominant among elderly people (over 40 years). Commonly, it occurs in people with obesity, decreased body activity, and it may also be inherited . The disease is often enhanced through dietary supplements, physical activity along with oral hypoglycemic agents . [2]

Moreover, there is another temporary disease related to diabetes, which is known as gestational diabetes (GD) mellitus. It refers to the occurrence or initial recognition of glucose intolerance during the period of pregnancy . Other types of diabetes include genetic abnormalities in the ß-cell of the pancreas or mutations in insulin receptor or post-receptor deformities . Diseases of the exocrine pancreas such as pancreatitis, cystic fibrosis and excessive production of insulin counter regulatory hormones such as Cushing's syndrome and acromegaly ultimately leads to DM.[3]

Symptoms are nearly the same in the two major types of diabetes, but they differ in their intensity. The initial symptoms of untreated diabetic patients are attributed to elevated blood-glucose levels. Consequently, a loss of glucose in urine occurs, which increases urine output, leading to dehydration accompanied by thirst and raised water consumption. Insulin deficiency eventually results in weight loss in spite of an increase in appetite and food consumption and also suffer from fatigue, nausea and vomiting. They are susceptible to develop bladder, skin, and vaginal infections. Fluctuations in blood sugar levels can cause blurred vision. Moreover, very high sugar-levels can result in coma and even death. The most popular methods for diagnosis of diabetes include the measuring of fasting plasma glucose level (FPG), which is done in the early morning. Patients with FPG below 100 mg/dl are considered normal; those between 100 and 125 mg/dl indicate pre-

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diabetic while those individuals with glucose levels above 125 mg/dl are considered diabetic [4]

Commonly used drug for the treatment of diabetes are Glimepiride,Metformin, Acarbose etc. Oral antidiabetic agents exert their effects by various mechanisms: (1) stimulation of β-cells in the pancreas to produce more insulin (sulfonylureas and meglitinides), (2) increasing the sensitivity of muscles and other tissues to insulin (thiazolidinediones), (3) decreasing gluconeogenesis by the liver (biguanides), and (4) delaying the absorption of carbohydrates from the gastrointestinal tract (α-glycosidase inhibitors).

Metformin is an oral antidiabetic drug used for the treatment of non-insulin-dependent diabetes mellitus (NIDDM) patients. Metformin is now believed to be the most widely prescribed antidiabetic drug in the world it was first derived from a medicinal plant Galega officinalis, which was historically used for treatment of diabetes in medieval Europe.[5]

There is a growing interest in herbal remedies due to the side effects associated with the therapeutic agents (oral hypoglycemic agents and insulin for the treatment of diabetes mellitus. Hyperglycemia is involved in the etiology of development of diabetic complications. Hypoglycemic herbs increase insulin secretion, enhance glucose uptake by adipose or muscle tissues and inhibit glucose absorption from intestine and glucose production from liver. An herbal formulation containing the three medicinal fruits Phyllanthus eniblica (Amla), Terminalia belerica (Bibhitaki) and Tennina- lia chebula (Haritaki) named Triphala (Sanskrit, tri = three and phala = fruits), is traditionally used medicine for the treatthent of diabetes.[6]

Medicinal Plants having Potential Hypoglycemic Property:

1. Azadirachta indica (Meliaceae)

Its leaves stem bark and seeds possess hypoglycemic activity via increasing insulin secretion from the beta cells of the pancreas. Its leaves are characterized by the presence of high fiber content that is potent in diabetes management and controlling of post-prandial hyperglycemia through delaying gastric emptying, increasing viscosity of GIT content thus, suppressing digestion and absorption of carbohydrate with no risk of hypoglycemia, hyperinsulinemia and undesirable weight gain [7].

2. Cinnamomum zeylanicum (Lauraceae)

It is commonly known as Cinnamon and widely used in East Asia and Europe. It contains volatile oils, mainly cinnamaldehyde. Cinnamon ingestion decreased total plasma sugar level with insulin sensitivity improvement. It also significantly reduced gastric emptying and profoundly decreasing postprandial glycemic response. In addition, cinnamon aqueous extract revealed a potent antidiabetic effect through its up regulation of uncoupling protein-1 (UCP-1) and enhancing the translocation of GLUT4 in the muscle and adipose tissues. Oral administration of cinnamaldehyde, its chief active constituent, resulted in significant reduction in serum glucose, glycosylated hemoglobin, total cholesterol and triglyceride levels accompanied by a marked increase in serum insulin, hepatic glycogen and high-density lipoprotein in a dose-dependent manner [8].

3. Ocimum sanctum (Labiateae)

Administration of O. sanctum leaves alcohol extract, orally, significantly reduced glycemia and enhanced exogenous insulin action. Administration of leaf powder to healthy and diabetic rats resulted in reduction of FBG after one month. Its pronounced therapeutic potential as antidiabetic agent can be attributed to the presence of eugenol, its chief active constituent, reducing elevated serum sugar, cholesterol triglyceride levels as well as lactate dehydrogenase, alanine transaminase, aspartate transaminase and alkaline phosphatase [9].

4. Zingiber officinale (Zingiberaceae)

Z. officinale rhizome exhibited a pronounced increase in serum insulin together with a marked decrease in FBG levels in STZ- induced diabetic rats. It also exerted suppression in serum cholesterol, triglyceride and blood pressure in diabetic rats. This glycemic control particularly involves serotonin (5-HT) receptors. Ginger extracts stimulate the 3T3-L1 preadipocytes differentiation. Recent studies showed that gingerol, its chief active constituent, enhanced cell-mediated glucose uptake via increasing insulin-sensitivity, thus improving chronic disease, as diabetes [10].

5. Picrorrhiza kurroa(Scrophulariaceae)

Commonly known as Kutki. Its alcohol extract reduced the sugar level in alloxan-induced diabetic rats through acting as a free radical scavenger. It can also decrease elevated blood urea nitrogen, serum lipid peroxides levels as well as ameliorating white blood cells destruction, protecting vital tissues including the pancreas and inhibiting undesirable body weight loss thus reducing the causation of diabetes Picrosides from Katuki constituted the major active ingredient responsible for its potent hypoglycemic activity

presenting a natural and safe remedy for prevention or delaying of diabetic complications [11].

6. Allium cepa (onion): (Liliaceae)

Various ether soluble fractions as well as insoluble fractions of dried onion powder show anti-hyperglycemic activity in diabetic rabbits. A.cepa also known to have antioxidant and hypolipidemic activity. Administration of a sulfur containing amino acid, S-methyl cysteine sulphoxide (SMCS) (200 mg/kg for 45 days) to alloxan induced diabetic rats significantly controlled blood glucose as well as lipids in serum and tissues. It normalizes the activities of liver hexokinase, glucose 6-phosphatase and HMG Co A reductase. When diabetic patients were given single oral dose of 50 g of onion juice, it significantly controlled post-prandial glucose levels [12].

7. Allium sativum L. (garlic): (Liliaceae)

It is a perennial herb cultivated throughout India. Oral administration of the garlic extract significantly decreases serum glucose, total cholesterol, triglycerides, urea, uric acid, creatinine, AST and ALT levels, while increases serum insulin in diabetic rats but not in normal rats when compared with antidiabetic drug glibenclamide. The antidiabetic effect of the extract was more effective than glibenclamide. It is concluded that the plant must be considered as excellent candidate for future studies on diabetes mellitus [13].

8. Aloe vera (Asphodelaceae)

Aloe vera gel at 200 mg/kg possesses significant antidiabetic, cardioprotective activity, reduces the increased TBARS, maintains the Superoxide dismutase and Catalase activity up to the normal level and increases reduced glutathione by four times in diabetic rats. The leaf pulp extract showed hypoglycemic activity on IDDM and NIDDM rats, the effectiveness being enhanced for type II diabetes in comparison with glibenclamide [14].

9. Catharanthus roseus (Apocynaceae)

Oral administration at dose-dependent of 0.5, 0.75 and 1.0 mL/kg body weight reduced the blood glucose of both normal and diabetic rabbits comparable with that of the standard drug, glibenclamide. The results indicate a prolonged action in reduction of blood glucose by C. roseus and the mode of action of the active compound(s) is probably mediated through enhance secretion of insulin from the beta- cells of Langerhans or through extra pancreatic mechanism [15].

Some medicinal plants found in Nepal with hypoglycemic activity:[21]

10. Coriandrum sativum L (Apiaceae)

An annual herb native to southern Europe and North Africa to southwestern Asia. Coriander seed extract (200 mg/kg) significantly increases the activity of the beta cells in comparison with the diabetic control rats and decreases serum glucose in streptozotocin-induced diabetic rats and releases insulin from the beta cells of the pancreas [50]. The extract shows antihyperglycemic, insulin-releasing and insulin-like activity [16].

11. Emblica officinalis (Euphorbiaceae)

Different solvent extracts of E. officinalis acts as α-amylase and α-glucosidase inhibitor. Significant antiglycation activity also confirms the therapeutic potential of these extracts against diabetes. Methanol extracts significantly inhibits the oxidation of LDL under in vitro conditions [17].

12. Euccalyptus globulus (Myrtaceae)

Aqueous extract of Euccalyptus globulus (0.5 g/L of solution) increased peripheral glucose utilization in the mouse abdominal muscle and increased insulin secretion from the clonal pancreatic beta cell line[18].

13. Asparagus racemosus (Liliaceae)

The ethanol extract, hexane, chloroform and ethyl acetate fractions of Asparagus racemosus root were shown to have dose-dependent insulin secretion in isolated perfused rat pancreas, isolated rat islet cells and clonal beta -cells. These findings reveal that constituents of Asparagus racemosus root extracts have insulinotropic activity [19]

14. Ricinus communis (Euphorbiaceae)

Administration of ethanolic extract of Ricinus communis to the diabetic rats at 500 mg/kg, p.o. for 20 days, significantly increased the insulin levels and caused improvement in lipid profile and body weight of the diabetic animals [19].

15. Acacia catechu (Mimosaceae)

It commonly known as Khair in Hindi and Nalla Sandra in Telgu. It is mainly distributed in India, Pakistan, Nepal and China. The bark and heartwood of the plant mainly used for the treatment of diabetes [19]

Table 1:

Scientific name	Family	Nepali name:
Justicia adhatada	Acanthaceae	Asuro
Centella asiatica	Mackinlayaceae	Ghortapre
Holarrhena antidysenterica	Apocynaceae	Indrajau
Terminalia bellirica	Noctuidae	Barro
Terminalia chebula	Combretaceae	Harro
Rhododendron arboreum	Ericaceae	Laligurans
Swertia chirayita	Gentianaceae	Chiraito
Acacia catechu	Fabaceae	Khayar
Cassia fistula	Fabaceae	Rajbrikksha
Woodfordia fruticosa,	Lythraceae	Dhaniyaro
Myrica esculenta	Myricaceae	Kaphal
Nymphaea stellata	Nymphaeaceae	Neelkamal
Rheum emodi,	Polygonaceae	Padamchal
Rubia manjith	Rubiaceae	Majhitho
Sapindus mukorossi	Sapindaceae	Ritha
Bergenia ciliata	Saxifragaceae	Pakhanbed
Taxus baccata	Taxaceae	Tulsipatra
Aloe vera	Liliaceae	Ghrita- kumari
Azadirachta indica	Meliacea	Neem

DIABETES AND DIET

The uncontrolled diabetes can lead to long-term organ damage, resulting sometimes in heart disease, stroke, vision loss, kidney failure. foot amputation or death. The diet frequently recommended for people who suffer from diabetes is one that is high in dietary fibre, especially soluble fibre, but low in fat (especially saturated fat) and sugar. Highly processed, calorie-dense, nutri- ent depleted diet leads to exaggerated increase in blood glucose and lipids that induces immediate oxidative stress. A statement of American Diabetes Association recommended the medical nutrition therapy (MNT) for diabetics. MNT is important in preventing diabetes, managing existing diabetes, and preventing, or at least slowing, the rate of de- velopment of diabetes complications. MNT is an integral component of diabetes self-management at all levels of diabetes prevention Energy balance, overweight, and obesity. [20]

CONCLUSION:

Diabetes is a serious metabolic disorder. Differences in social structure, psychic stress, obesity, hormonal imbalance and heredity are optimizing the growth of pandemic. At present, the treatment of diabetes mainly involves a sustained reduction in hyperglycemia by the use of biguanides,thiazolidinediones,sulphonylureas, D-phenylalanine derivatives, meglitinides and α-glucosidase inhibitors in addition to insulin. However, due to unwanted side effects the efficacies of these compounds are debatable and there is a demand for new compounds for the treatment of diabetes In conclusion, this paper has presented a list of anti- diabetic plants used in the treatment of diabetes mellitus. It showed that these plants have hypoglycaemic effects and can be used to treat various type of secondary complications of diabetes mellitus. Plants have been a good source of medicine for the treatment of various type of disease, still many plants and active compounds obtained from plants have not been well characterized. More investigations must be carried out to evaluate the exact mechanism of action of medicinal plants with antidiabetic and insulinomimetic activity. It is always believed that plant is safe, but so many plant materials are not safe for the human being, that's why toxicity study of these plants should also be elucidated before consumption of these plant materials.

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