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USE OF TRADITIONAL PLANTS IN DIABETES MELLITUS: A REVIEW

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ABSTRACT

Diabetes mellitus is a complex metabolic disorder resulting from either insulin insufficiency or deficient. Scientific reports revealed that diabetes cannot be cured completely. The rapid increase in diabetes mellitus is becoming a serious threat to mankind in all parts of the world. In India it is proving to be a major health problem, especially in the urban areas. Though there are various approaches to reduce the ill effects of diabetes and its secondary complications, herbal formulations are preferred more due to lesser side effects. Here in this review we discuss the traditional plants which help in lowering the blood sugar level and are effective as anti diabetic agent.

Keywords: Diabetes mellitus, traditional plants, blood sugar, anti diabetic agents

INTRODUCTION

Natural products from plant, animal and minerals have been the basis of the treatment of human disease from the times immemorial. Today it is estimated that about 80 % of people in developing countries are still depending on traditional medicine based largely on species of plants and animals. Herbal medicines are currently in demand and their necessity is increasing eventually India is the largest producer of medicinal herbs and is called as botanical garden of the world. Ayurveda, Unani, Siddha and Folk (also called tribal) medicines are the major systems of Indian medicines. Among these systems, Ayurveda is most developed and widely practiced in India. A number of plants have been described in Ayurveda and other traditional medicine for the treatment of diabetes. Diabetes mellitus is a clinical syndrome due to relative or absolute deficiency of insulin or resistance to the action of insulin at the cellular level as a result hyperglycemia and glycosuria occurs. Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels, which result from defects in insulin secretion, or action, or both. The WHO reports suggests that the prevalence of diabetes in adults worldwide would increase to 300 million in years 2025. It is the one of the main threats to human health in the 21st century and is the fifth leading cause of deaths in most developed countries.

TYPES OF DIABETES:

Type 1 (IDDM): Insulin Dependent Diabetes Mellitus: ß-cell destruction with little or no endogenous insulin secretory capacity Autoimmune Idiopathic [1].

Type 2 (NIDDM**)** Non Insulin Dependent Diabetes Mellitus ranges from relative insulin deficiency to disorders of insulin secretion and insulin resistance [1].

Type 3 (Gestational Diabetes): Mellitus refers to the onset or initial recognition of glucose intolerance during pregnancy, usually in the second or third trimester. It occurs in about 4% of all pregnancies. Patients with GD have a 30% to 50% chance of developing DM, usually type 2 DM [1].

Some Traditional plants use in the treatment of diabetes:

1. Allium cepa:

Figure 1: Representative image of Allium cepa

Common name: Onion

Family: *Liliaceace*

Geographical source: Native to south Asia but cultivated widely throughout the world

Part used: Bulb

Chemical constituents: The main chemical constituent or the active constituent of the Allium cepa is the allylpropyldisulphide (APDS). The other chemical constituents are the essential amino acids compositions such as arginine, histidine, lysine, tryptophan, phenylalanine, methionine, threonine, leucine & isoleucine.It contains other phenolic acids such as protocatechuic acid, p-hydroxybenzoic acid, vanillic acid, caffeic acid, & o & p- coumaric acids.Citric, abietic, oxalic and mialic acids are also present. The bulb on steam distillations yields oil known as onion oils. It also contains oligosaccharides.

Pharmacological activity and other uses: The active constituent i.e. APDS (allyl propyl disulphide) is responsible for its anti diabetic activity. It stimulates the production of insulin by pancreas and is shown to block the breakdown of insulin by liver [2]. It is also used as an antioxidant.

2. *Aegle* marmelos:

Figure 2: Representative image of Aegle marmelos

Common name: Wood apple

Family: *Rutaceae*

Geographical source: The plant is native to India

Part used: Leaves and fruit

Chemical constituents: The drug contains furocoumarins and coumarins. As well as it contains tannins flavanoids, alkaloid and vitamin A and C. The active principle is marmelosinn .i.e furocoumarin.

Pharmacological activity and other uses: The Aqueous extract of leaves shows hypoglycemic activity in the alloxonized rats [3].It is used as an antidabetic. It is also used in chronic constipation, piles and dysentery.

3. *Azadirachta indica*:

Figure 3: Representative image of Azadirachta indica

Common name: Neem

Family: *Meliaceae*

Geographical source: India, Srilanka, Myanmar, Malaysia and Pakistan

Part used: Whole plant

Chemical constituents: It contains nimbidin, nimbin, nimbinin, nimbidinin, nimbolide, nimbilic acid, unsaponifiable matter i.e. nimbostreol, complex metabolite i.e. azadirachtin. Nimbidin is the active bitter principle .It also contains tannins such as gallic acid. Furthermore, it contains glycerides of saturated and unsaturated fatty acids.

Pharmacological activity and other uses: The neem tree offers opportunity to reduce insulin requirements as safe and proven herb. Clinical trials have been carried out by many scientists using leaf extract supporting its hypoglycemic activity [4]. Anti Inflammatory, Anti pyretic, Anti fungal, Anti bacterial, Anti malarial, Anti arthritis, Spermicidal, Anti tumor, Diuretic, Immunomodulatory etc are other uses.

4. *Allium* sativum:

Figure 4: Representative image of Allium sativum
Common name: Garlic
Family: *Lilaceae*
Geographical source: Central Asia, Southern Europe, USA, India.
Part used: Ripe bulb
Chemical constituents: It contains a wealth of sulphur compounds; most important for the taste is Allicin, which is produced enzymatically from allin. It also contain 65% water, 28% carbohydrate, 2.3% organosulphur compound, 2% proteins, 1.2% free amino acid(mainly arginine) , 1.5% fiber, 0.15% lipids, 0.08% phytic acid, 0.07% saponins.(Rangari, 2007)
Pharmacological activity and other uses: Oral administration of the ethanol extract, juice and oil of allium sativum has shown marked blood sugar lowering effect in normal streptozocin induced diabetic rates through stimulation of insulin secretion from potential cells of pancreas [5]. Allicin has shown significant hypoglycemic activity. Daily oral feeding of garlic extract at 100mg/kg increased plasma insulin level with significant decrease in plasma glucose level.It also exhibits antimicrobial, anticancer ,cardio protective activities, and anti hyperlipidemic activities.

5. *Gymnema* slyvestre:

Figure 5:Representative image of Gymnema slyvestre
Common name: Madhunashini (Hindi), cow plant
Family: *Asclepiadaceae*
Geographical source: India
Part used: leaves
Chemical constituents: *Gymnema sylvestre* are a group of oleanane type triterpenoid saponins known as gymnemic acids. *Gymneme syvestre* leaves contain triterpene saponins belonging to oleanane and dammarene classes. It also contains flavones, anthraquinones, hentri-acontane,pentatriacontane, α and β- chlorophylls, phytin, resins, tartaric acid, formic acid,butyric acid, lupeol, β-amyrin related glycosides and stigmasterol.
Pharmacological activity and other uses: Water soluble extract of the gymnema slyvestre leaves has shown to exhibit hypoglycemic activity by releasing insulin by regenerating beta cells of pancreas[8].Its leaf has been widely used in Ayurvedic traditional medicine and is bitter, acrid, thermogenic, anti-inflammatory, anodyne, digestive and liver tonic. It also known for its antidiabetic, anticancer and antimicrobial properties.

6. *Andrographis* paniculata:

Figure 6: Representative image of Andrographis paniculata.
Common name: Kalmegh, Kariyatu (Guajarati)
Family: *Acanthaceae*
Geographical source: Native to India and Srilanka
Part used: Leaves and roots
Chemical constituents: The primary medicinal component of Andrographis is andrographolide, called as diterpene lactone**.** Other active components include 14-deoxy-11, 12- didehydroandrographolide (andrographlide D), homoandrographolide, andrographan, andrographon, andrographosterin, and stigmasterol.
Pharmacological activity and uses: The ethanol extract of *A. paniculata* possesses antidiabetic property. Good glycemic control and/or use of antioxidants may play an important role in the prevention of complications associated with diabetes. Elevation of blood glucose levels, decrease in the superoxide dismutase and catalase activity were resulted against STZ induced diabetic rats [6, 7].

7. *Emblica* officinalis:

Figure 7: Representative image of Emblica officinalis
Common name: Indian gooseberry

Family: *Phyllanthaceae*
Geographical source: Native to India
Part used: Fruit
Chemical constituents: Tannins 30%, phyllembin (2.4%), phyllemblic acid (6.3%), gallicacid (1.32%), ellagic acid in natural form and cytokine like substances identified as Zeatin, Z riboside, Z nucleotide etc. Amla is a rich natural source of vitamin c. It contains pectin & 75% moisture**.** . Amla fruit ash contains chromium, 2.5; zinc, 4; and copper, 3 ppm.
Pharmacological activity and uses: Presence of chromium is of therapeutic value in diabetes. Chromium, a trace element possesses significant anti diabetic activity in various experimental models of diabetic mellitus. Chromium compounds also improved deranged lipid metabolism of both type 1 and type 2diabetic rats. It has been reported that insulin derived with chromium is capable of reversing blood sugar, serum cholesterol and phospholipids levels to those of normal rats [9]**.** The fruits are sour, astringent, bitter, acrid, sweet, cooling, anodyne, ophthalmic, carminative, digestive, stomachic, laxative,alterant, aphrodisiac, rejuvenative, diuretic, antipyretic and tonic. They are useful in vitiated conditions of tridosha, diabetes, cough,asthma, bronchitis**,** cephalalgia, ophthalmopathy, dyspepsia, colic, flatulence, hyperacidity, peptic ulcer, erysipelas, skin diseases, leprosy, haematogenesis, inflammations, anemia, emaciation, hepatopathy, jaundice, strangury, diarrhoea, dysentery,hemorrhages, leucorrhoea, menorrhagia, cardiac disorders,intermittent fevers and grayness of hair

8. *Tinospora* cordifolia:

Figure 8.Representative image of Tinospora cordifolia
Common name: Guduchi
Family: *Menispermaceae*
Geographical source: it is indigenous to the tropical areas of India, Myanmar and Sri Lanka.
Part used: Whole plant
Chemical constituents: Main chemical constituents are berberine Giloin, tinosporaside, tinosporin, tinosporic acid and tinosporol. . They belong to different classes such as Alkaloids, diterpenoid lactones, glycosides, steroids, Sesquiterpenoid, phenolics, aliphatic compounds and Polysaccharides. Leaves of this plant are rich in protein (11.2%) and are fairly rich in calcium and phosphorus**.**
Pharmacological activity and uses: A definite blood glucose lowering effect within two weeks has been confirmed in alloxan diabetic albino rats. The daily administration of either alcoholic or aqueous extract of *T. cordifolia* decreases the blood glucose level and increases glucose tolerance in rodents. Aqueous extract also caused a reduction in blood sugar in alloxan induced hyperglycemia in rats and rabbits in the dose of 400 mg/kg. However, histological examination of pancreas has not revealed any evidence.(Gangan, et al. 1996). The root and stem of *T. cordifolia* are prescribed in combination with other drugs as an antidote of snake bite and scorpion sting [10].

9. *Catheranthus* roseous:

Figure 9: Representative image of Tinospora cordifolia
Common name: Barmashi
Family: *Apocynaceae*.
Geographical source: found in tropical and subtropical countries
Part used: Leaves
Chemical constituents: The main active compounds here are alkaloids & tannins. The major alkaloid is vincamine. A closely related semi-synthetic derivative of vincamine is vinpocetin. There are over 130 constituents with an indole or dihydroindole structure, including the principal component

vindoline, vinblastine, vincristine, learocristine, vinine, ajmalicine, leurocine, vinomine etc.

Pharmacological activity and uses: Dichlorometahne-methanol extract of leaves and twigs of catheranthus roseous in carbohydrate metabolism shown to enhance secretion of insulin [11]. The juice of fresh leaves of ***Catharanthus roseus*** *has shown* reduction blood glucose apart from anti diabetic activity the plant has significant anticancer as well as antihypertensive effect[12].

10. *Zingiber* officinalis:

Figure 10.Representative image of Zingiber officinalis

Common name: Ginger

Family: *Zingiberaceace*

Geographical source: Indigenous to Southern China and India and also found in Europe and West Africa.

Part used: Rhizomes

Chemical constituents: 6-Gingerol, tannins, polyphenolic compounds, flavonoids and Triterpenoids etc

Pharmacological activity and its uses: Ginger exhibits hypoglycemic activity in both normal and diabetic rats. They further reported that ginger contains magnesium, calcium and phosphorus which play important roles in bone formation, curbing muscle spasm, depression, hypertension, convulsion, nausea, gastrointestinal disorders, paralysis, kidney damage and several other bio-functions necessary for keeping body in homeostatic conditions[13].

11. *Trigonella fonecum* graceum:

Figure 11.Representative image of Trigonella fonecum graceum

Common name: Fenugreek

Family: *Fabaceae*

Geographical source: Grown throughout India

Part used: Leaves and seeds

Chemical constituents: It contains trigonelline, flavonoid, glycosides, saponin, ascorbic acid, fenugreekine. Fenugreek seeds contain only minute quantities of an essential oil. Furthermore , n-alkanes, sesquiterpenes, alkanoles and lactones. The dominant aroma component in fenugreek seeds is a hemiterpenoid γ-lactone. , the furostanol glycosides are probably responsible for the bitter taste.

Pharmacological activity and uses: Trigonelline produces hypoglycemic effect in diabetic rats which lasts for 24 hours [14] **.** The aqueous and alcoholic extracts of Trigonella foenum-graecum leaf were tested for hypoglycemic activity in normal and alloxan-diabetic rats. Apart from these activities immunomodulatory, anti-inflammatory and antipyretic activities are also found. This traditional Indian Anti-Diabetic Plants Attenuate Progression of Renal Damage [15]. It is also used in respiratory tract infections, swelling, body pain, stomach pain, piles, dandruff, baldness, breast pain, lungs infection, ulcer and diarrhea

12. *Momordica* charantia:

Figure 12: Representative image of Momordica charantia

Common name: Karela

Family: *Cucurbitaceae.*

Geographical source: widely grown in Asia and Africa. Widely cultivated in Asia in India east Africa and South America

Part used: Fruit

Chemical constituents: The plant contains biologically active compounds, chiefly momordicin I and II, and cucurbitacin B. The plants contain also bioactive glycosides including momordin, charantin, charantosides, and momordicosides and other terpenoid compounds including momordicin-28, momordicin, momordenol and momordol.

Pharmacological activity and its uses: Effect of *Momordica charantia* fruit powder on serumglucose

level and body weight in Alloxan induced diabetic rats has been studied. It was found that *Momordica charantia* fruit powder is helpful in treating hyper glycemic rats in diabetes mellitus type II [16]. *Momordica charantia* also contains a substance lectin that has insulin-like activity due to its non protein-specific linking together to insulin receptor [17].Along with antidiabetic effect it has, anticancer, anti inflammation, antivirus, antioxidants and cholesterol lowering effect.

13. *Curcurma* longa:

Figure 13.Representative image of Curcurma longa
Common name: Turmeric
Family: *Zingiberaceace*
Geographical source: Native to south East Asia
Part used: Tubers and Rhizomes
Chemical constituents: It contains essential oil, turmerol, curcumin, sesquiterpenic ketone, arturmerone, bisabolane, curlone, guaiane, tumerone, zingiberone. The chief components of curcuminoids are known as curcumin. Volatile oil is composed of mono and sesquiterpens such as alpha& beta pinene, alpha- phellandrene, camphor, camphene, zingiberene, alpha & beta curcumenes
Pharmacological activity and uses: Due to the presence of curcumin and flavonoid it show anti Diabetes activity by lowering the blood glucose level in streptozocin induced diabetic rats is used in whooping cough, asthma, bronchitis, scabies, irritation, chronic skin disorders, wounds,strokes, bruises, eczema, prurigo and ringworm[21].

14. *Eugenia* jamboldana:

Figure 14.Representative image of Eugenia jamboldana
Common name: Jamun
Family: *Myrtaceae.*
Geographical source: Native to Bangladesh, India, Nepal, Pakistan, Srilanka, Malaysia, Philippines, and Indonesia.
Part used: Fruits and seeds
Chemical constituents: Tri-terpenoids, tannins, gallic acid, and oxalic acid were the chemical constituents detected in Eugenia jambolana seed
Pharmacological activity and uses: The extract of jamun pulp showed the hypoglycemic activity in streptozotocin induced diabetic mice within 30 min of administration while the seed of the same fruit required 24 h. The oral administration of the extract resulted in increase in serum insulin levels in diabetic rats [23, 24] .These extracts also inhibited insulinase activity from liver and kidney.

CONCLUSION:

Diabetes is a serious metabolic disorder. Allopathic medicines are not effective in treating the disease leading to various adverse effects. . Therefore, treating diabetes mellitus with plant derived compounds which are accessible & do not require laborious pharmaceutical synthesis seems highly attractive. The efficacy of herbal drugs is significant and they have fewer side effects than the synthetic allopathic medicines. . Discovery of novel compounds can be developed through extensive research work on bioactivity of various constituents. In near future herbal plants will play a crucial role in modern system of medicine.

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