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Review Article

Ethnobotany and Literature survey of Herbal Anti-Diabetic Drugs

Shilpa Subhedar and Pushpendra Goswami*

Central India Institute of Pharmacy, Indore, M.P., India

Abstract

Diabetes mellitus is a heterogeneous group of disorders characterized by abnormalities in carbohydrate, protein, and lipid metabolism. Diabetes mellitus affects approximately 5 to 8% of the population. Although insulin treatment has greatly increased the life expectancy of the diabetic patient, diabetes remains the third leading cause of death by disease, the second leading cause of blindness, and the second leading cause of renal failure.

Plants have evolved the ability to synthesize chemical compounds that help them defend against attack from a wide variety of predators such as insects, fungi and herbivorous mammals. By chance, some of these compounds, whilst being toxic to plant predators, turn out to have beneficial effects when used to treat human diseases. It is vital that people understand that all herbs are plant-derived drugs, without exception. While there are some that are – in the correct dose, with the correct processing, and the correct usage are very beneficial.

Key words: Diabetes, Ethnobotany, Herbal drugs, Literature survey.

Introduction

The term diabetes mellitus describes a metabolic disorder of multiple aetiology, characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The effects of diabetes mellitus include long– term damage, dysfunction and failure of various organs. Diabetes mellitus may present with characteristic symptoms such as thirst, polyuria, blurring of vision, and weight loss. In its most severe forms, ketoacidosis or a non–ketotic hyperosmolar state may develop and lead to stupor, coma and, in absence of effective treatment, death. Often symptoms are not severe, or may be absent, and consequently hyperglycaemia sufficient to cause pathological and functional changes may be present for a long time before the diagnosis is made. The long–term effects of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease. Several pathogenetic processes are involved in the development of diabetes. These include processes which destroy the beta cells of the pancreas with consequent insulin deficiency, and others that result in resistance to insulin action. The abnormalities of carbohydrate, fat and protein metabolism are due to deficient action of insulin on target tissues resulting from insensitivity or lack of insulin. [1]

***Corresponding Author**
E-mail: goswami.pushpendra@yahoo.in
Mob.: +919977406640

Classification

Diabetes mellitus has been traditionally classified into *insulin-dependent* diabetes mellitus (IDDM), also known as type I (formerly called juvenile-onset diabetes mellitus), and *non–insulin-dependent* diabetes mellitus (NIDDM), also known as type II (formerly referred to as adult-onset diabetes mellitus). There are clearly varying degrees of overlap, and though it is often important to know whether a particular individual possesses relative insulin deficiency or relative insulin resistance or both. [2]

Type I: The pathogenesis of type I diabetes is autoimmune destruction of the cells of the pancreas. The factor or factors that trigger this autoimmune response are unknown. Predisposing factors appear to include certain major histocompatibility complex haplotypes and autoantibodies to various islet cell antigens. The progression of the autoimmune response is characterized by lymphocytic infiltration and destruction of the pancreatic cells resulting in insulin deficiency. Type I diabetes mellitus constitutes about 10% of cases of diabetes mellitus.[2] Brittle diabetes, also known as unstable diabetes or labile diabetes, refers to a type of insulin-dependent diabetes characterized by dramatic and recurrent swings in glucose levels, often occurring for no apparent reason.[3] The result can be irregular and unpredictable hyperglycemias, frequently with ketosis, and sometimes serious hypoglycemias. Brittle diabetes occurs no more frequently than in 1% to 2% of diabetics.[4]

Type II: The other type of diabetes mellitus, type II, is far more common. In contrast, type II is not an autoimmune process and may or may not be insulin dependent; that is, a diabetic state that is most effectively managed by insulin therapy. [2]

Gestational diabetes: Gestational diabetes mellitus (GDM) resembles type 2 diabetes in several respects, involving a combination of relatively inadequate insulin secretion and responsiveness. It occurs in about 2%–5% of all pregnancies and may improve or disappear after delivery. Gestational diabetes is fully treatable but requires careful medical supervision throughout the pregnancy. About 20%–50% of affected women develop type 2 diabetes later in life. [5]

In the late 1970s both WHO [6] and the National Diabetes Data Group [7] produced new diagnostic criteria and a new classification system for diabetes mellitus. This brought order to a chaotic situation in which nomenclature varied and diagnostic criteria showed enormous variations using different oral glucose loads. In 1985 WHO slightly modified their criteria to coincide more closely with the NDDG values [8].

Signs and Symptoms

The classical symptoms of diabetes are polyuria (frequent urination), polydipsia (increased thirst) and polyphagia (increased hunger).[9] Frequent urination is sometimes included by definition,[10] but is nonetheless usually an accompanying symptom. Increased production and passage of urine may also

be termed diuresis.[11][12] Symptoms may develop rapidly (weeks or months) in type 1 diabetes while in type 2 diabetes they usually develop much more slowly and may be subtle or absent.

Herbs Used For Diabetes Mellitus

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter [13]. A number of medicinal plants, traditionally used for over 1000 years named rasayana are present in herbal preparations of Indian traditional health care systems [14].

Traditional herbal medicines are naturally occurring; plant-derived substances with minimal or no industrial processing that have been used to treat illness within local or regional healing practices. Traditional herbal medicines are getting significant attention in global health debates. [15]

Advantages of herbal drugs:

Reduced risk of side effects: Most herbal medicines are well tolerated by the patient, with fewer unintended consequences than pharmaceutical drugs. Herbs typically have fewer side effects than traditional medicine, and may be safer to use over time.

Effectives with chronic conditions: Herbal medicines tend to be more effective for long-standing health complaints that don't respond well to traditional medicine. One example is the herbs and alternative remedies used to treat arthritis. Vioxx, a well-known prescription drug used to treat arthritis, was recalled due to increased risk of cardiovascular complications. Alternative treatments for arthritis, on the other hand, have few side effects. Such treatments include dietary changes like adding simple herbs, eliminating vegetables from the nightshade family and reducing white sugar consumption.

Lower cost: Another advantage to herbal medicine is cost. Herbs cost much less than prescription medications. Research, testing, and marketing add considerably to the cost of prescription medicines. Herbs tend to be inexpensive compared to drugs.

Widespread availability: Yet another advantage of herbal medicines are their availability. Herbs are available without a prescription. You can grow some simple herbs, such as peppermint and chamomile, at home. In some remote parts of the world, herbs may be the only treatment available to the majority of people.

Disadvantages of herbal drugs:

Inappropriate for many conditions: Modern medicine treats sudden and serious illnesses and accidents much more effectively than herbal or alternative treatments. An herbalist would not be able to treat serious trauma, such as a broken leg, nor would he be able to heal appendicitis or a heart attack as effectively as a conventional doctor using modern diagnostic tests, surgery, and drugs.

Lack of dosage instructions: Another disadvantage of herbal medicine is the very real risks of doing yourself harm through self-dosing with herbs. While you can argue that the same thing can happen with medications, such as accidentally overdosing on cold remedies, many herbs do not come with instructions or package inserts. There's a very real risk of overdose.

Poison risk associated with wild herbs: Harvesting herbs in the wild is risky, if not foolhardy, yet some people try to identify and pick wild herbs. They run a very real risk of poisoning themselves if they don't correctly identify the herb, or if they use the wrong part of the plant.

Medication interactions: Herbal treatments can interact with medications. Nearly all herbs come with some warning, and many, like the herbs used for anxiety such as Valerian and St. John's Wort, can interact with prescription medication like antidepressants. It's important to discuss your medications and herbal supplements with your doctor to avoid dangerous interactions.

Lack of regulation: Because herbal products are not tightly regulated, consumers also run the risk of buying inferior quality herbs. The quality of herbal products may vary among batches, brands or manufacturers. This can make it much more difficult to prescribe the proper dose of an herb.

A.Jambul (*Eugenia jambolana*)

It is an evergreen tropical tree in the flowering plant from family Myrataceae. It is native to bangladesh, India, Nepal, Pakistan, Sri Lanka and Indonesia. The fruit is also called as “blackberry”. The leaves are antibacterial and are used for strengthning the teeth and gums. The fruits and seeds are sweet, acrid, sour, tonic, and cooling, and are used in diabities, diarrhoea and ringworm. The bark is astringent, sweet sour, diuretic, digestive and anthelmintic. [16]

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B. Bitter melon (*Momordica charantia*)

Momordica charantia is also called bitter melon or bitter gourd in English. It is a tropical and subtropical vine of the family Cucurbitaceae which is widely grown in Asia, Africa, and the Caribbean for its edible fruit, which is among the most bitter of all fruits. There are many varieties that differ substantially in the shape and bitterness of the fruit.

In 1962, Lolitkar and Rao extracted from the plant a substance, which they called charantin, which had hypoglycaemic effect on normal and diabetic rabbits.[17]

Two compounds extracted from bitter melon, α-eleostearic acid (from seeds) and 15,16-dihydroxy-α-eleostearic acid (from the fruit) have been found to induce apoptosis of leukemia cells in vitro.[18] Diets containing 0.01% bitter melon oil (0.006% as α-eleostearic acid) were found to prevent azoxymethane-induced colon carcinogenesis in rats.[19]

Bitter melon has been used in traditional medicine for several other ailments, including dysentery, colic, fevers, burns, painful menstruation, scabies and other skin problems. It has also been used as abortifacient, for birth control, and to help childbirth.[20]

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C. Neem (*Azadirichta indica*)

Azadirachta indica (Neem) is a tree in the mahogany family Meliaceae. It is one of two species in the genus *Azadirachta*, and is native to Indian Subcontinent, growing in tropical and semi-tropical regions. In India, the tree is variously known as "Sacred Tree," "Heal All," "Nature's Drugstore," "Village Pharmacy" and "Panacea for all diseases". Products made from neem tree have been used in India for over two millennia for their medicinal properties: Neem products have been observed to be anthelmintic, antifungal, antidiabetic, antibacterial, antiviral, contraceptive and sedative. [22] Neem products are also used in selectively controlling pests in plants. It is considered a major component in Ayurvedic and Unani medicine and is particularly prescribed for skin disease.[23]

It is found all over India and the fenugreek seeds are usually used as one of the major constituents of Indian spices. 4-hydroxyleucine, a novel amino acid from fenugreek seeds increased glucose stimulated insulin release by isolated islet cells in both rats and humans. Oral administration of 2 and 8 g/kg of plant extract produced dose dependent decrease in the blood glucose levels in both normal as well as diabetic rats. [21]

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D. Holy Basil (*Ocimum sanctum*)

It is commonly known as Tulsi. Since ancient times, this plant is known for its medicinal properties. The aqueous extract of leaves of *Ocimum sanctum* showed the significant reduction in blood sugar level in both normal and alloxan induced diabetic rats. [21] It is an aromatic plant in the family Lamiaceae which is native throughout the Old World tropics and widespread as a cultivated plant and an escaped weed. [24] It is an erect, much branched subshrub 30–60 cm tall with hairy stems and simple opposite green leaves that are strongly scented. Leaves have petioles, and are ovate, up to 5 cm long, usually slightly toothed. Flowers are purplish in elongate racemes in close whorls.[25] There are two main morphotypes cultivated in India—green-leaved (Sri or Lakshmi tulsi) and purple-leaved (Krishna tulsi).[26]

One study showed Tulsi to be an effective treatment for diabetes by reducing blood glucose levels.[27] Another study showed that tulsi's beneficial effect on blood glucose levels is due to its antioxidant properties.[28]

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E.Vinca (*Catharanthus roseus*)

Vinca is a genus of six species in the family Apocynaceae which is native to Europe, northwest Africa and southwest Asia. [29] Catharanthus (Madagascar Periwinkle) is a genus of eight species of herbaceous perennial plants, six endemic to the island of Madagascar, the seventh and eighth native to the Indian subcontinent in southern Asia .[30][31] In Madagascar, extracts have been used for hundreds of years in herbal medicine for the treatment of diabetes, as hemostatics and tranquilizers, to lower blood pressure, and as disinfectants.

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F.Bael (*Aegle marmelos*)

Though more prized for its medicinal virtues than its edible quality, this interesting member of the family Rutaceae is, nevertheless, of sufficient importance as an edible fruit to be included here. The tree grows wild in dry forests on hills and plains of central and southern India and Burma, Pakistan and Bangladesh, also in mixed deciduous and dry dipterocarp forests of former French Indochina. Mature but still unripe fruits are made into jam, with the addition of citric acid. The pulp is also converted into marmalade or sirup, likewise for both food and therapeutic use, the marmalade being eaten at breakfast by those convalescing from diarrhea and dysentery. [32]

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G.Fenugreek (*Trigonella foenum graecum*)

Fenugreek is a plant of family Fabaceae. It is used both as a herb and spice. While the seeds and leaves are primarily used as a culinary spice, it is also used to treat a variety of health problems in Egypt, Greece, Italy, and South Asia.

It is found all over India and the fenugreek seeds are usually used as one of the major constituents of Indian spices. 4-hydroxyleucine, a novel amino acid from fenugreek seeds increased glucose stimulated insulin release by isolated islet cells in both rats and humans. Administration of fenugreek seeds also improved glucose metabolism and normalized creatinine kinase activity in heart, skeletal muscle and liver of diabetic rats. It also reduced hepatic and renal glucose-6-phosphatase and fructose −1,6-biphosphatase activity. [21]

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H.Garlic (*Allium sativum*)

Garlic is a species in the onion genus. It belongs to the family Amaryllidaceae. This is a perennial herb cultivated throughout India. Allicin, a sulfur-containing compound is responsible for its pungent odour and it has been shown to have significant

hypoglycemic activity. This effect is thought to be due to increased hepatic metabolism, increased insulin release from pancreatic beta cells and/or insulin sparing effect. [21]Apart from this, Allium sativum exhibits antimicrobial, anticancer and cardioprotective activities. It is also used as a spice in Indian cuisines.

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I. *Pterocarpus marsopium*

Pterocarpus marsupium or the Indian Kino Tree is a medium to large, deciduous tree that can grow up to 30 metres tall. It is native to India, Nepal, and Sri Lanka, where it occurs in parts of the Western Ghats in the Karnataka-Kerala region. It belongs to the family Fabaceae. The heart wood is used as an astringent and in the treatment of inflammation and diabetes.

It is a deciduous moderate to large tree found in India mainly in hilly region. Pterostilbene, a constituent derived from wood of this plant caused hypoglycemia in dogs showed that the hypoglycemic activity of this extract is because of presence of tannates in the extract. Flavonoid fraction from *Pterocarpus marsupium* has been shown to cause pancreatic beta cell regranulation. [21]

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Miscellaneous herbal drugs

(*Acacia arabica*, *Terminalia catappa*, *Curcuma longa*, Guava)

It belongs to the family Fabaceae and is native to Africa and Indian subcontinent. It may also be used for medicinal purposes, as a demulcent or for conditions such as gonorrhoea, leucorrhoea, diarrhea, dysentery or diabetes. It is styptic and astringent. [33]

It is found all over India mainly in the wild habitat. The plant extract acts as an antidiabetic agent by acting as secretagouge to release insulin. It induces hypoglycemia in control rats but not in alloxanized animals. Powdered seeds of *Acacia arabica* when administered (2, 3 and 4 g/kg body weight) to normal rabbits induced hypoglycemic effect by initiating release of insulin from pancreatic beta cells. [21] *Terminalia catappa* is a large tropical tree in the Leadwood tree family, Combretaceae. Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the ginger family, Zingiberaceae.[34] It is native to tropical South Asia. Guavas are plants in the myrtle family (Myrtaceae) genus *Psidium* (meaning "pomegranate" in Latin),[35] which contains about 100 species of tropical shrubs and small trees. Guava leaves or bark are used in traditional treatments against diabetes. [36]

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Conclusion

As demand for alternative medicine has grown, so have the harvesting and collection pressures for numerous ecologies that produce the medicinal plants of interest. Among the various systems of medicine like allopathy, homeopathy, unani, ayurveda etc. ayurveda is nowadays emerging as a safest and effective way of treatment of various diseases. Even homeopathic medicines, if taken carelessly, may cause harm to the patient. Therefore people prefer ayurveda for long term ailments like Diabetes, arthritis etc. Bitter melon capsules, Divya madhu nashini vati are some examples of herbal medicine that are available in the market for diabetic patients. A lot of researches are taking place in the field of herbal medicine and hopefully in the coming years almost every ailment will have a cure through herbal drugs.

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