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Herbal cure of diabetes: A review

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Abstract

Diabetes is now most common disease in all age groups. Due to diabetes several other problems in the body initiate like renal disorder, eye sight problem etc. Though several drugs and insulin like allopathic medicine are available which though reduce blood sugar level but in turn provide several side effects? Herbal drugs prove to be a better alternative this regards. Several researches on herbal drugs have been carried out using various plant substances to reduce sugar level. A review of such studies is presented in the paper.

Keywords: Herbal drugs, renal disorders, side effects

1. Introduction

In the present lifestyle, physical work and exercise in daily routine is very less day by day. COVID problem adds to this as movement is comparatively less and fast food eating not only causes weight gain but also causes severe diseases. Diabetes is most commonly occurring above 50 years of age, however now it is occurring in the younger generation at an alarming rate. Diabetes mellitus is a very prevalent disease affecting citizens of both developing and developed countries. According to an estimate, about 25 percent of the world population is affected by diabetes. Clinically diabetes mellitus is caused by abnormality of carbohydrate metabolism which is linked to low blood insulin level or insensitivity of target organs to insulin? The metabolic disorder of the metabolism of carbohydrates, fat, and lipid create high fasting blood sugar that further causes series endocrine disorder resulting in millions of deaths worldwide. According to the World Health Organization (WHO) about 30 million people were suffering from diabetes in 1985 which increased to 171 million in 2000 and it is expected to cross over 366 million or more by 2030 which is a very alarming situation. It is increasing in the age group of 45-65 years and it is more severe in developing countries. Owing to unhealthy diet, obesity and sedentary life style these figures are increasing day by day. It not only increases the death rate but also increases the cost of healthcare which affects the economy of people [1].

2. Classification of diabetes**2.1 Clinically diabetes can be of three types**

2.1.1 Type I or insulin dependent diabetes mellitus: In this type, insulin is completely absent due to pancreas lacking cells or containing defective cells. It occurs in genetically susceptible individuals and they have complications like kidney dysfunction, nerve impairment, cardiovascular complications as well as blindness [2, 3].

2.1.2 Type II or non-insulin dependent diabetes mellitus: It is characterized by reduced insulin secretion in response to glucose levels and insulin resistance which leads to insufficient absorption of glucose into the cell for energy. It usually occurs in obese individual and it suppresses the synthesis of insulin receptor [4].

2.1.3 Gestational diabetes mellitus: It is defined as any degree of glucose intolerance with onset or first recognition during pregnancy irrespective of the glycemic status after delivery. Gestational diabetes has increased the risk of type II diabetes mellitus and heart disease later in life. Besides these genetic defects of B cell function also causes diabetes [5].

3. Complications

Diabetes mellitus disease causes microvascular complications leading to the damage of small blood vessels. Diabetes retinopathy affects blood vessel formation in the retina of the eye that causes reduced vision and potential blindness. Drastic change in kidney tissue, loss of large amounts of protein in urine and gradually causing chronic kidney disease requiring dialysis by

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diabetic nephropathy which may lead to diabetic foot problem [6].

4. Medications

Various antidiabetic drugs were given to normalize the blood sugar level which includes insulin treatment as well as oral hypoglycemic therapy based on type of diabetes and patient condition. Insulin is a hormone produced by beta cells of islet of langerhans in the pancreas naturally but now synthetic insulin with various doses is given for immediate action. Besides these several types of glucose lowering drugs like insulin secretagogues (sulfonyleurea, meglitinides), insulin sensitizer (biguanides, metformin, etc.) and alpha glucosidase inhibitor (miglitol, acarbose, etc) were given by the advice of medical practitioner. However, these antidiabetic drugs have a number of server-side effects and its long-term use may cause several other chronic diseases. Thus, managing diabetes without any side effects is really a challenge. Herbal plants proved to be a milestone in this respect. Various researchers have found that many herbal plants are anti-diabetic and have very low or almost no side effects.

5. Herbal Medicine

Traditional use of plant based herbal medicine for curing various diseases exists in Indian literature. National products are easily available, have less or no side effects and low cost to make them possible to be used by large rural populations. These herbs have different mechanisms of action that include stimulation of insulin secretion, secretion from beta cells of islets of langerhans with stimulation of glycogenesis and hepatic glycolysis. They provide necessary elements like calcium, magnesium etc and thus helpful in management of glucose level. Various plants were found useful as herbal medicine for diabetes management. They are:

- 1) ***Cinnamomum zeylanicum***: Commonly called as cinnamon belong to the family Lauraceae and widely used in East Asia and Europe. It is the most commonly used folk medicine to treat diabetes. Its ingestion decreased total plasma sugar level with improvement in insulin sensitivity [7].
- 2) ***Trigonella foenum graecum***: Commonly known as “methi” in Hindi and in English “fenugreek” which belong to Fabaceae family. It has a hypoglycemic effect used for antidiabetic activity. Effect of fenugreek extracts on intestinal sodium dependent glucose uptake and hepatic glycogen phosphorylase [8].
- 3) ***Aegle marmelos***: Commonly called Bel or holy fruit tree belong to Rutaceae family. It increases utilization of glucose either by direct glucose uptake. It also has antioxidant properties [9].
- 4) ***Syzygium cumini***: Commonly called “jamun” or “black plum” belongs to Myrtaceae family and it has been commonly used for diabetes treatment for many decades traditionally. Oral administration of the pulp extract of the fruit resulted in the enhancement of insulinemia through insulin secretion stimulation and insulinase activity suppression from liver and kidney.
- 5) ***Hibiscus rosa-sinensis***: Commonly called “Gudhal” or “china rose” belongs to Malvaceae family. It stimulates insulin secretion from pancreatic beta cells and increases utilization of glucose either by direct stimulation of glucose uptake or the medication of enhanced insulin secretion [10].
- 6) ***Catharanthus roseus***: Commonly called “Sadabahar” belongs to Apocynaceae family. It reduces blood glucose

through enhanced secretion of insulin from the beta cells of islets of Langerhans [11].

- 7) ***Momordica charantia***: Commonly known as “bitter melon” or “vegetable insulin”. It is reported that it suppresses post prandial hyperglycemia by inhibition of alpha glucosidase activity [12].
- 8) ***Tecoma stans***: It belongs to the family Bignoniaceae used as a diabetes mellitus remedy. Its aqueous extract shows potent antidiabetic activity by enhancing glucose uptake [13].
- 9) ***Casearia esculenta***: Its root aqueous extract is widely used in traditional systems of medicine to treat diabetes in India. It belongs to the family Flacourtiaceae. Its aqueous root extract (300 mg/kg body weight) given for 45 days results in blood glucose reduction [14].
- 10) ***Coccinia indica***: It belongs to the family Cucurbitaceae. In the Ayurveda system it is used as indigenous plant in India. Its dried extract (500mg/kg body weight) given for 6 weeks, restored activities of lipoprotein lipase enzyme, glucose-6-phosphate and lactate dehydrogenase which rises in untreated diabetes [15].
- 11) ***Helicteres isora***: It belongs to the family Sterculiaceae and is found in forests throughout India. Its hot water extract of fruit shows significant antioxidant activity and moderate antidiabetic activity [16].
- 12) ***Cuminum nigrum***: It is found in Central Asia and India. It belongs to the family Apiaceae. It promotes glucose uptake with increased insulin sensitivity in muscle cells as a potential antidiabetic therapeutic agent [17].
- 13) ***Embelica officinalis***: It is commonly called as “amla” and belongs to Euphorbiaceae family. Its different solvent extracts act as alpha amylase and alpha glucosidase inhibitor. Due to significant antiglycation activity against diabetes [18].
- 14) ***Allium cepa (onion) and Allium sativum (garlic)***: Both belong to Liliaceae family and normally part of dietary supplements. Studies show that oral administration of ethanol extract of garlic regulated the blood sugar level. Union ether fractions shows significant hypoglycemic effect by decreasing the glucose peak in subcutaneous glucose tolerance tests.
- 15) ***Ocimum sanctum***: It is commonly called as tulsi and since ancient times it is known for its medicinal uses. Its aqueous extract of leaves shows significant reduction in blood sugar in rats. It also has antioxidant, antibacterial, antifungal and other properties [19].
- 16) ***Pterocarpus marsupium***: It belongs to the family Papilionaceae and is widely used in Ayurveda as “Rasayana” for management of various metabolic disorders. Its aqueous extract of wood at an oral dose (250mg/kg) shows significant hypoglycemic activity for this Marsupin [20], Pterosupin and Liquiritigenin were obtained which shows antihyperlipidemic activity [21]. Epicatechin; its active principle found to be insulinogenic which enhances insulin release and conversion of proinsulin to insulin *in vitro* [22].
- 17) ***Coptis chinensis***: It is used in China for diabetes treatment. Berberine is an alkaloid present in its roots, rhizome, stems and barks. In an experiment in diabetic rats it decreases fasting blood glucose level as well as total cholesterol, triglycerides, etc [23].
- 18) ***Tinospora cordifolia***: It is known as “Gudhichi” and belongs to Menispermaceae family. It is found in tropical areas of India, Myanmar and Sri Lanka. Its oral administration of root extract to diabetic rats causes

- significant reduction in blood glucose and brain lipids [24].
- 19) ***Myrcia uniflora***: This plant is used in Northern Brazil for diabetes treatment. Its aqueous extract has a beneficial effect on diabetic state by improving metabolic parameters of glucose homeostasis which reduces hyperglycemia, polyphagia, polydipsia, urine volume and urinary excretion of glucose and urea [25].
 - 20) ***Phyllanthus amarus***: This herb belongs to family Euphorbiaceae and is a traditional Ayurvedic herb used in Southern India. Its methanolic extract has potential antioxidants as well as it reduces blood sugar in alloxanized diabetic rats [26].
 - 21) ***Panax ginseng***: It belongs to the family Araliaceae and its roots are used for type II diabetes. Its extract shows anti hyperglycemic activity [27]. Oral administration of its root improves insulin sensitivity and may be used as an adjuvant therapy for treating diabetic patients with insulin resistance [28].
 - 22) ***Suaeda fruticosa***: It belongs to the family. Its aqueous extract at a dose of 192 mg/kg produces significant decrease in blood sugar level in rats. Its hypoglycemic effect may be due to extra pancreatic action [29].
 - 23) ***Psidium guajava***: It is an indigenous medicinal plant used in the Indian system of medicine for diabetes control. It belongs to the family Myrtaceae. Its ethanol stem bark extract exhibits hypoglycemic activity in alloxan induced hyperglycemic rats. Their aqueous extracts also have hypolipidemic activity in addition to its hypoglycemic and antidiabetic activity [30].
 - 24) ***Morinda lucida***: It belongs to the family Rubiaceae. In hyperglycemic rats its extract with 400mg/kg produces significant anti diabetic effect 3 days after oral administration [31, 32].
 - 25) ***Nigella sativa***: It belongs to Ranunculaceae family. Its seed, ethanolic extract (300 mg/kg body weight/weight) to streptozotocin induced diabetic rats for 30 days significantly reduces blood glucose, lipids, plasma insulin and improved altered levels of lipid peroxidation products [33].
 - 26) ***Origanum vulgare***: It is native to warm temperatures in western and southern Eurasia and the Mediterranean region. It belongs to the family Lamiaceae. Its oral administration of aqueous extract (20 mg/kg) produces significant decrease in blood glucose level in STZ diabetic rats [34].
 - 27) ***Otholobium pubescens***: It belongs to the family Papilionaceae. It gives the compound "Bakuchiol" which reduces blood sugar level in a dose dependent fashion in mice [35].
 - 28) ***Abelmoschus moschatus***: It is an aromatic medicinal plant native to India and belongs to Malvaceae family. An active compound Myricelin obtained from it improves insulin sensitivity. It may be used as a model substance for the development of antidiabetic compounds [36].
 - 29) ***Telfaria occidentalis***: It is grown in West Africa as a leaf vegetable and its seeds are edible. It belongs to the family Cucurbitaceae. Its aqueous extract given orally in 1 g/kg to mice for 60 minutes before glucose administration reduces the blood glucose level from day two. Its leaves extract possess' hypoglycemic activity [37].
 - 30) ***Acacia arabica***: It belongs to Mimoseae family and is found all over India. Its extract acts as an antidiabetic agent by acting as secretagogue to release insulin powdered seeds of *A. arabica* when given to normal rabbits (2, 3 and 4 g/kg bodyweight) induces hypoglycemic effects by initiating release of insulin from pancreatic beta cells [38].
 - 31) ***Aloe vera***: It grows in arid climates and widely distributed in India, Africa and other arid areas. It belongs to the family Asphodelaceae. Its gel at 200mg/kg poses significant antidiabetic, cardio protective activity in diabetic rats [39, 40].
 - 32) ***Andrographis paniculate***: It is a herbaceous plant native to India, Sri Lanka and widely cultivated in southern India. It is commonly known as "Kalmegh" and belongs to the family Acanthaceae. It's ethanolic extract posse's antidiabetic properties and may be attributed at least in part to increased glucose metabolism [41,42].
 - 33) ***Coriandrum sativum***: It belongs to the family Apiaceae. It is an annual herb native to North Africa to South Western Asia and Southern Europe. Its seed extract (200 mg/kg) increases the activity of beta cells and decreases serum glucose in streptozotocin induced diabetic rats with release of insulin from the beta cells of pancreas [43].
 - 34) ***Lepidium sativum***: It is a fast-growing edible herb belonging to Brassicaceae family. Its aqueous leaf extract at a dose of 10mg/kg causes a potential inhibition of renal glucose reabsorption which in turn reduces blood sugar in normal and diabetic rats [44].
 - 35) ***Gongronema latifolium***: It is believed to have originated from Nigeria in West Africa and belongs to Asclepiadaceae family. Its leaves aqueous extract is able to increase the hepatic hexokinase activity and decrease the glucokinase activity. Due to its antioxidant properties its leaves could exert antidiabetic activities [45].
 - 36) ***Mangifera indica***: It belongs to Anacardiaceae family. Its leaves aqueous extract produces reduction of blood glucose level in rats [46].
 - 37) ***Bumelia sartorum***: It belongs to sapotaceae family and in Brazilian folklore it is mentioned for its use in the treatment of diabetes mellitus and inflammatory disorders. Basic acid isolated from its root bark, ethanol extract possess' hypoglycemic activity and increases plasma insulin level in rats [47].
 - 38) ***Cichorium intybus***: It belongs to Asteraceae family. It is a bushy perennial herb found widely on roadside in Europe, North America and Antarctica. Its plant extract of 125mg/kg body weight shows potent hypoglycemic effect [48].
- ## 6. Traditional system for diabetes treatment
- In a study conducted in two districts of Kerala namely Thiruvananthapuram and Kollam where educational level and modern medical facilities are available but still people have faith in herbal medicine. Some plants and their ethnic practices are as –
- 1) ***Gymnema sylvestre***: Locally known as chakkarakolli and belongs to Asclepiadaceae. Its leaf mercerized with water and juice is taken daily. Its leaf powder mixed with water is taken before meals.
 - 2) ***Hordeum vulgare***: It belongs to Poaceae family and is commonly known as Barley. It is given as food for diabetic patients.
 - 3) ***Costus picatus***: Locally known as insulin chedi and plant belongs to zingiberaceae. Its two or three leaves are consumed twice daily.
 - 4) ***Helicteres isora***: It is locally known as Edampiri Valampiri. Its root bark decoction is given twice a day.
 - 5) ***Eugenia jambolana***: Locally known as Njaval and belongs to the Myrtaceae family. Its seed powder is taken

twice or thrice daily.

- 6) **Curcuma longa:** Locally known as “Manjal” belongs to the family zingiberaceae. Mixture of bark juice of *Tinospora cordifolia*, *Embelica officinalis* and *Curcuma loya* powder is taken in an empty stomach.
- 7) **Acacia catechu:** Locally called as “Karinjali” belongs to Leguminosae family. Its decoction of the hardwood is used. Water extract of the hardwood and areca nut is taken in the morning and evening.
- 8) **Acacia arabica:** It is locally called “karuvelam” and belongs to the family Leguminosae. Its leaf powder and bark gum is used to treat diabetic ulcers. Bark decoction mixed with milk is given before sleep.
- 9) **Aerva lanata:** Locally called as “cherula”, belongs to the Amaranthaceae family. Decoction of *Curcuma longa*, *Strychnos potatorum*, *Salacia oblongata* and *Aerva lanata* is given twice a day.
- 10) **Benincasa hispida:** It is locally known as “kumbalam” and belongs to the Cucurbitaceae family. Its fruit juice is taken daily.
- 11) **Alpinia calcarata:** Locally known as “chittaratha” belongs to zingiberaceae family. One teaspoonful rhizome juice is taken at bed time.
- 12) **Echinops echinatus:** Locally called as “uthkandam” and belongs to the family Asteraceae. Its water extract is given twice daily. Leaf powder is taken with milk.

Besides these several other plants were used traditionally in Kerala for treatment of diabetes. However, it is advised to use these herbal drugs with the advice from authorized Ayurvedic consultants.

7. Herbal v/s Allopathic

Herbs have been used since ancient times in our traditional system for promoting wellness. They are used as food since they have natural products. However nowadays a flood of herbal products in the market makes it difficult for common man to select. Synthetic drugs like metformin, insulin etc are very common in allopathic systems but they have some side effects over long term use. In contrast herbal medicines have great body balance and help in regulating body function when used correctly, herbal medicines are considered safer than conventional medicines. In severe cases allopathic medicines may be more effective and act rapidly but herbal medicines tend to be more effective for long standing health complaints and have no or few side effects.

8. Conclusion

Diabetes is nowadays a very common and serious disease and it also induces several other health related issues by damaging vital organs like the eye, kidney etc. It may be due to obesity, stress, hormonal imbalance and also hereditary causes. Herbal medicines can be very useful for long term use and with little or no side effects. However, use of proper and correct medicine in supervision of a qualified Ayurvedic doctor is always advisable. *Stevia rebaudiana*, *Cuymnema sylvestris*, *Syzimium cumini* etc are widely acceptable herbal medicines. More and extensive research and value addition of their products are needed to make a healthy and happy world.

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