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Review Article

An Evaluation On Medicinal Plant Practice For Management Of Diabetes: A Short Review

Arun D. Shinde, Pritam S. Shinde, Saurabh T. Shinde*, Shravani J. Shinde, Vaishnavi T. Shinde, Vinod G. Shingade

Dattakala College Of Pharmacy, Swami Chincholi(Bhigwan),Maharashtra,India

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ABSTRACT

Aim of the present study is evaluated various medicinal plants used for antidiabetic activity. Diabetes mellitus is one of the most common non- communicable diseases globally. It is the fourth leading causes of death in the most developed countries and there in substantial even diced that it in epidemic in many developing and newly industrialized nations. This posing a serious threat to be at with in 21st century. Since ancient time plants have been exemplary source of medicine. Ayurveda and other Indian literature mentioned the used of plants in treatment of various ailments. Out of an estimated 250000 higher plants, less than 1% have been screened pharmacologically and very few in regard to diabetes mellitus. Natural products, including organisms (plants, animals, or microorganisms) have been shown to possess health benefits for animals and humans. According to the estimation of the WHO in developing countries, 80% of the population has still depended on traditional medicines or folk medicines which are mostly prepared from the plant for prevention or treatment diseases. Traditional medicine from plant extracts has proved to be more affordable, clinically effective and relatively less adverse effects than modern drugs.

INTRODUCTION

Diabetes Mellitus a common endocrine disorder of man, is considered one of the major health concerns all over the world today (Rohilla and Ali, 2012). It is a disease of disordered metabolism of carbohydrate, protein and fat, caused by the complete or relative insufficiency of insulin secretion and/or insulin action (Ivorra et al., 1989). The number of people suffering from the disease worldwide is increasing at an alarming rate, according to the WHO, more than 180 million people worldwide have diabetes and that this number is likely to double by 2030 (Wild et al., 2004). This increase in incidence follows the trends of urbanization and lifestyle changes, perhaps most importantly a Western-style diet.

***Corresponding Author:** Saurabh T. Shinde
Address: *Dattakala College Of Pharmacy,Swami Chincholi(Bhigwan), Maharashtra, India*
Email : saurabhts1122@gmail.com
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The greatest increase in prevalence is however expected to occur in Asia and Africa, where most patients will probably be found by 2030. Diabetics is a condition that happens when your blood sugar (glucose) is too high. It develops when your pancreas doesn't make enough insulin or any at all, or when your body is not responding to the effects of insulin properly. Diabetes affects people of all ages. Most form diabetes is chronic, and all forms are manageable with medications and/or lifestyle changes.

Types Of Diabetics:

A. On the basis of blood Sugar Levels

1. Hyperglycemia
2. Hypoglycemia

1. Hyperglycemia:

If our pancreas isn't making enough insulin or our body isn't using it properly, glucose builds up in our bloodstream, causing high blood sugar level (hyper glycemia). Over time, having consistently high blood glucose can cause health problems, such a heart disease nerve damage and eye issues. Hyperglycemia usually doesn't cause symptoms until blood sugar (glucose) levels are high above 180 to 200 milligrams per deciliter (mg/dL), or 10-11.1 millimoles per liter.

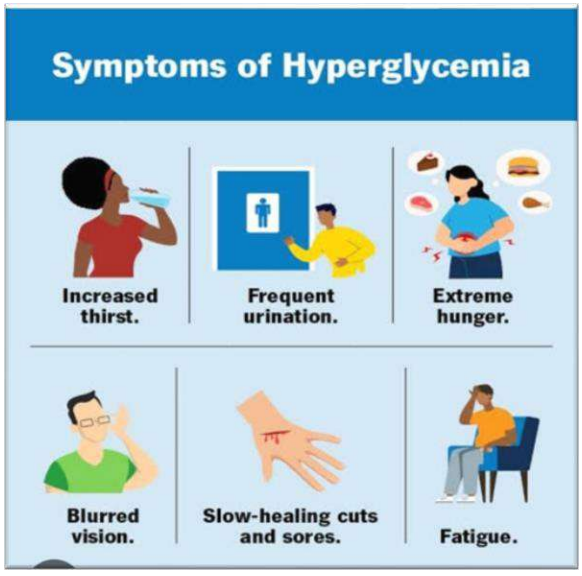

Fig.no. 1 Symptoms of hyperglycemia

- **Symptoms of hyperglycemia include:**

1. Increased thirst and a dry mouth, needing to pee frequently, tiredness.
2. Blurred vision, unintentional weight loss.
3. Recurrent infections, such as thrush.

2. **Hypoglycemia:**

Hypoglycemia happens when the level of sugar (glucose) in our blood drops below the range that's healthy for us. It's also called low blood sugar or low glucose. Hypoglycemia is common in people with diabetics especially Type 1 Diabetics hypoglycemia is when your blood sugar level is below 70 milligrams per deciliter (mg/dL) or 3.9 millimoles per liter (mmol/L).

Symptoms can include:

1. Sweating
2. An irregular or fast heartbeat.
3. Irritability or anxiety.
4. Headache
5. Fatigue

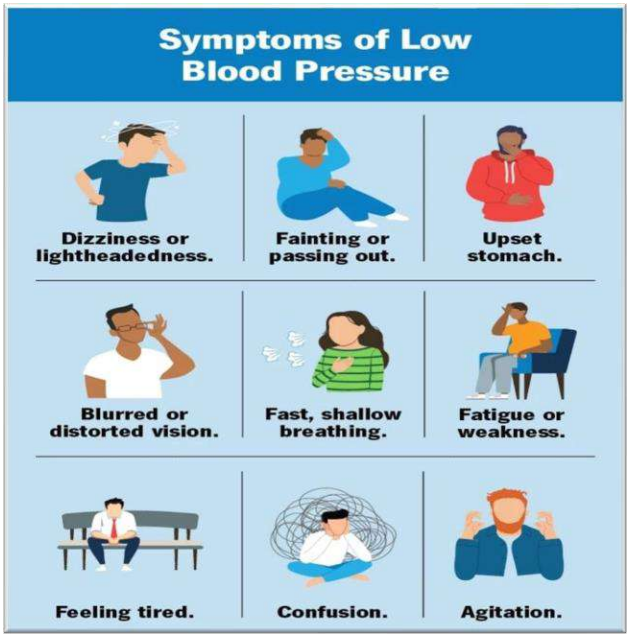

Fig.no. 2 Symptoms of low blood pressure

On the basis of insulin

1. Diabetes mellitus
2. Diabetes insipidus

1. Diabetes mellitus:

Type 1 accounts for 5 to 10% of diabetes cases and is the most common type diagnosed in patients

under 20 years. however, the older term "juvenile-onset diabetes" is no longer used as the disease not uncommonly has onset in adulthood. The disease is characterized by loss of the insulin-producing beta cells of the pancreatic islets, leading to severe insulin deficiency, and can be further classified as immune-mediated or idiopathic (without known cause). The majority of cases are immune-mediated, in which a T cell-mediated autoimmune attack causes loss of beta cells and thus insulin deficiency. Patients often have irregular and unpredictable blood sugar levels due to very low insulin and an impaired counter-response to hypoglycemia.Autoimmune attack in type 1 diabetes. Type 1 diabetes is partly inherited, with multiple genes, including certain HLA genotypes, known to influence the risk of diabetes. In genetically susceptible people, the onset of diabetes can be triggered by one or more environmental factors, such as a viral infection or diet. Several viruses have been implicated, but to date there is no stringent evidence to support this hypothesis in humans.Type 1 diabetes can occur at any age, and a significant proportion is diagnosed during adulthood. Latent autoimmune diabetes of adults (LADA) is the diagnostic term applied when type 1 diabetes develops in adults; it has a slower onset

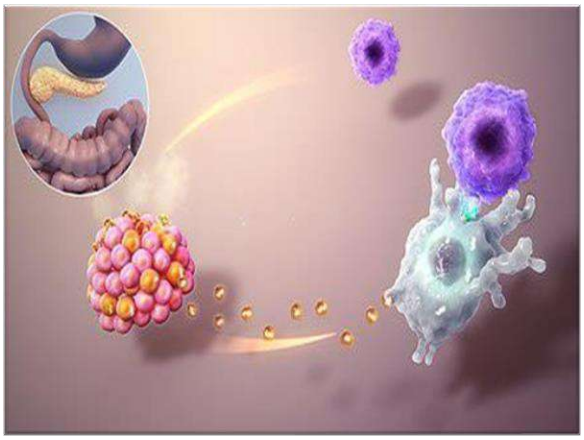

Fig.no. 3

this condition. Adults with LADA are frequently initially misdiagnosed as having type 2 diabetes, based on age rather than a cause LADA leaves adults with higher levels of insulin production than type 1 diabetes, but not enough insulin production for healthy blood sugar level.

2. Diabetes Insipidus:

Type 2 diabetes is characterized by insulin resistance, which may be combined with relatively reduced insulin secretion. The defective responsiveness of body tissues to insulin is believed to involve the insulin receptor. However, the specific defects are not known. Diabetes mellitus cases due to a known defect are classified separately. Type 2 diabetes is the most common type of diabetes mellitus accounting for 95% of diabetes Many people with type 2 diabetes have evidence of prediabetes (impaired fasting glucose and/or impaired glucose tolerance) before meeting the criteria for type 2 diabetes. The progression of prediabetes to overt type 2 diabetes can be slowed or reversed by lifestyle changes or medications that improve insulin sensitivity or reduce the liver's glucose production. Type 2 diabetes is primarily due to lifestyle factors and genetics. A number of lifestyle factors are known to be important to the development of type 2 diabetes, including obesity (defined by a body mass index of greater than 30), lack of physical activity, poor diet, stress, and urbanization. Excess body fat is associated with 30% of cases in people of Chinese and Japanese descent, 60–80% of cases in those of European and African descent, and 100% of Pima Indians and Pacific Islanders. Even those who are not obese may have a high waist–hip ratio.Dietary factors such as sugar-sweetened drinks are associated with an increased risk. The type of fats in the diet is also important, with saturated fat and trans fats increases.

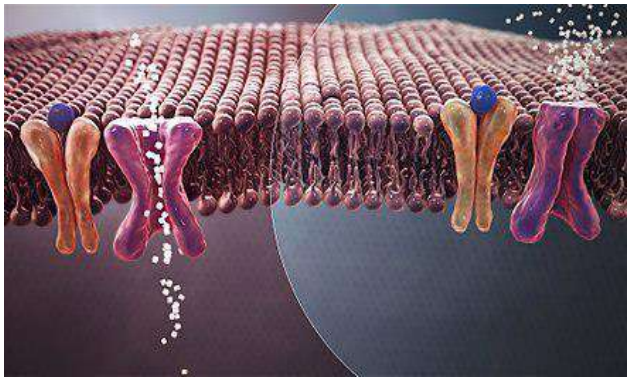

Fig.no. 4 Diabetes insipidus

History:

The object of diabetes treatment is to restore adequate carbohydrate, protein and lipid metabolism. The cornerstone of this treatment has been diet since the end of the 18th century, but true antidiabetic therapy started only with the identification and purification of insulin. Pressure for oral therapy then quickly built up. The hypoglycemic effect of guidelines was discovered in 1919, leading to their therapeutic use, but they were withdrawn in 1932 due to their hepatotoxic effects. The related biguanides appeared in the 1950s but have since diminished in importance so that metformin is practically the only representative still used today. Work in the 1940s and 1950s led to the discovery and development of hypoglycemic sulfonylureas (SU), a therapeutic class unique for its specificity and safety. These products were found to stimulate insulin secretion by the endocrine pancreas. In vitro studies have shown that they bind specifically to an ATP-dependent K+ channel of the beta cell membrane. This binding closes the channel so that K+ outflow ceases, the beta cell membrane depolarizes and voltage-dependent Ca2+ channels open to allow an influx of extracellular calcium. The result is migration and extrusion of insulin granules. Although this mechanism of action has been demonstrated in vitro, it cannot account for all the clinical actions of various SU. They thus appear to have Extrapancreatic actions, probably potentiating the peripheral effects of insulin at a postreceptor site in target cells. Other effects involve fibrinolytic activity of the blood, platelet behavior and vascular reactivity. The future of oral diabetes therapy thus seems to lie with the sulfonylureas. Indian Medicinal Plants with Antidiabetic Potential.

Pathophysiology of diabetes mellitus:

The main role in pathophysiology of diabetes is oxidative stress. The imbalance between production of reactive oxygen species (ROS) and capacity of enzymatic or nonenzymatic antioxidant are known as oxidative stress. Reactive oxygen species contains free radicals such as super oxide, hydroxyl, peroxyl, hydroperoxyl and nonradical species such as hydrogen peroxide. Antioxidant contains super oxide dismutase, glutathione reductase, vitamins A, C and E, carotenoid, glutathione and trace elements. Low density lipoprotein cholesterols are oxidized in the presence of reactive oxygen species which taken up by hunter receptor in scavenger cell and cause formation of foam cells and arterial sclerosis plaques. These ROS can Stimulate various damaging pathway which have important role in growth of diabetes disease. Some important pathways are glucosamine pathway, sorbitol aldose reductase pathway, electron transport chain, protein kinase C stimulation. Stimulation of these pathways and mode of action can lead to atherosclerosis, programmed cell death, lipid per oxidation, advanced glycation end product (Ages) formation, amylin and failure of pancreatic β cell function. It is proven that sequence specific DNA binding factor (nuclear factor erythroid derived 2 like 2) along with their negative regulator (kelch like ECH associated protein 1) have important cell protection mode of action against oxidative stress.

TABLE NO.1 LIST OF INDIAN MEDICINAL PLANTS AND ANTI DIABETIC ACTIVITY

Sr. No.	Plant Name	Family	Common Name	Part Used	Active Constituent	Uses
1.	*Aegle marmelos*	Rutaceae	Bael	Leaves, Fruits	Aegle marmelosine	Anti Inflamatroy, Antidiarrheal [12]
2.	*Allii Cepa Bulbus*	Liliaceae	Onion	Steams ,Bulbs	Dipropyl disulphide oxide, Allicin	Antidiabetic, [20],[21]
3.	*Asparagus racemosus*	Aspragaceae	Satawari	Flowers, Tuberous Roots,	Shatavaroside A, Shatavaroside B	Antidiabetic, lactation,[14] [15]
4.	*Ceylon cinnamon*	Lauraceae	Cinnamn	Barks	Cinnamyl Acetate, Eugenol	Antifungal, Carminative,[17] [25]
5.	*Coccinia Indica*	Cucurbitaceae	Lvy Gourd	Fruits	Glutamic acid, Asparagine	Analgesic, Antipyretic [2]
6.	*Eucalyptus globulus*	Myrtaceae	Sugand Hapatra	Leaves	Cryptone, Spathulenol	Antimicrobial, Antiviral, [18] [19]
7.	*Eugenia jambolana*	Myrtaceae	Jamun	Fruits,Seeds	Oleanolicacid, Ellagic acid	Antihypertensive, Anti Diabetics,[22] [24]
8	*Ficus religiosa*	Moraceae	Peepal	Barks	β-sitosteryl-D-glucoside	Antidiabetic, Antitumor [3], [6],[8]
9	*Finus Bengalnsss*	Moraceae	Sugand hapatra	Leaves	Leucodelphin	Antimicrobial, Antiviral [3],[16]
10	*Gymnema sylvestre*	Asclepiad-aceae	Gurmar	Roots	Gymnemic Acids, Gymnemasaponins	Antidiabetic, antiobesity [5] [23]
11	*Ipomoea batatas*	Convolaceae	Sweet Potato	Tuberous Roots	Flavonoids, Anthocyanins	Antidiabetic, Anticancer ,[13]
12	*Mangifera indica*	Ancardiaceae	Mango	Fruits	Alpha cartotene Beta cartotene	Antidiabetics, Antiseptic,[12] [30]
13	*Momordica charantia*	Cucurbitaceae	Karela	Fruits, Seeds	Sterol, Charantin	Antidiabetic, Antioxidant,[11] [29]
14	*Ocimum sanctum*	Lamiaceae	Tulsi	Leaves	Rosmarinic Acids, Apigenin	Antimicrobial, Gastroprotective[1],[9]
15	*Spergula arvensis*	Caryophy-llaceae	Starwart	Flowers, Leaves	Betacarotene, Lypoene	Antidiabetic, Antibacterial,[10] [31]
16	*Tridax procumbens*	Asteraceae	Jayanti	leaves	Pentacyclin, Triterpens	Antidiabetic, Antibacterial ,[26],[27]
17	*Trigonella foenum-graecum*	Fabaceae	Methi	Seed, Leaves	Diosgenin, Galactomannan	Improve Digestion, antidiabetic [7] [28]
18	*White Mulberry*	Moraceae	Kalpa vruksha	Leaves ,Barks	Xanthophylls, Betasitosterol	Antidiabetics ,[4] [32]

Indian Medicinal Plants with Antidiabetic Potential

Aegle marmelos:

Aegeline 2 extracted from the leaves of A. marmelos an alkaloidal-amide, is found to have antihyperglycemic activity. This is evidenced by lowering the blood glucose levels to about 12.9% and 16.9% when monitored at 5h and 24h respectively, in sucrose challenged streptozotocin induced diabetic rats (STZ-S) model at the dose of 100 mg/kg body weight. Aegeline 2 has also significantly decreased the plasma triglyceride (Tg) levels by 55% ($P < 0.001$), total cholesterol (TC) by 24% ($P < 0.05$), and free fatty acids (FFA) by 24%, accompanied with increase in HDL-C by 28% and HDL-C/TC ratio by 66% in dyslipidemic hamster model at the dose of 50 mg/kg body weight as evidenced in literatures.

Fig.no. 5 Aegle marmelos

Allii Cepa Bulbus:

Commonly called Onion, is a common vegetable, has strong anti-diabetic activity. Onion feeding has shown to improve metabolic status in diabetic conditions, probably because of hypoglycemic and hypocholesterolemic effect. The plant extract has proved to medicate diabetic nephropathy by lowering blood cholesterol levels and decreasing lipid peroxidation. The research results about active principles showed that allyl propyldisulfide and S-methyl cysteine sulfoxide have an anti-diabetic and anti-hyperlipidemic effect, the latter being comparable to glibenclamide and insulin**.**

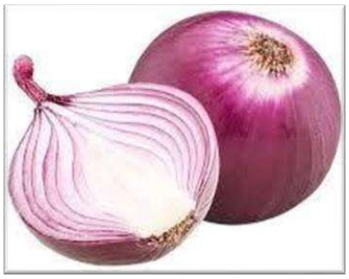

Fig.no. 6 Allii Cepa Bulbus

Asparagus racemosus:

Extracts of Asparagus racemosus wild on α - amylase and α - glucosidase at varying concentrations. Diabetes mellitus is a clinical condition characterized by hyperglycaemia in which an elevated amount of glucose circulates in the blood plasma. α - amylase and α - glucosidase inhibitors are used to achieve greater control over hyperglycemia in type 2 diabetes mellitus. This study is to treat the diabetes using natural resources. We aimed to evaluate of Asparagus racemosus Wild by digestive enzymes inhibitory activity. n-hexane, chloroform, ethyl acetate, methanol, and aqueous was used to extract the root of the asparagus racemosus willd. The different extracts were then used to study its digestives enzymes activity α-amylase and α - glucosidase inhibitory activity. The significant inhibitory of acarbose was extracted by the ethyl acetate and aqueous extracts of the plant. Flavonoids, Tannins and phenolic, Saponins, Amino acids, Protein are the major phytochemical constituents present fect of α-amylase.

Fig.no. 7 Asparagus racemosus

Ceylon cinnamon

Ceylon cinnamon belongs to the Lauraceae family; it originates from Ceylon but is cultivated in various regions of southern Asia and North America. The raw material is bark (Cinnamomi cortex) without the internal layer, the so-called primary bark. Ceylon cinnamon bark contains 0.5% to 4.0% oil, depending on the origin of the raw material. The main components of the oils are as follows: cinnamaldehyde (65–75%), cinnamyl acetate and eugenol (ca. 5% in total), and β-caryophyllene (up to 4%). Moreover, the bark contains polysaccharides (mucilage), phenolic acids (cinnamic acid and its derivatives), oligomeric proanthocyanidins, diterpenes, and others. For centuries, cinnamon has been used in Chinese homes as a spice and also as a traditional Chinese remedy for cold and flu. Historically, it has also been known for its antibacterial, antifungal, and carminative properties.

Fig.no. 8 Ceylon cinnamon

Coccinia Indica:

Coccinia indica Wight. and Arn (Synonym - Cephalandra indica Naud), commonly known as Ivy Gourd or Little gourd belongs to family Cucurbitaceae. It is native of Africa and Asia (India). It shows presence of various chemical constituents such as alkaloids, carbohydrates, glycosides, phenolic compound, gums, mucilages, triterpenoids, flavonoids, anthraquinones and polysaccharides.Ayurveda and Unani systems claim C. indica as antidiabetic agent and other traditional uses are anti-inflammatory, antipyretic, analgesic, antimicrobial, antibacterial, antidepressant and expectorant.Sporadic pharmacological studies have supported traditional claims of C. indica in treating diabetes. But most of these studies have employed uncharacterized crude extract of the plant.

Fig.no. 9 Coccinia Indica

Eucalyptus globulus:

Eucalyptus globulus is a shrubby plant or a flowering tree belonging to the family Myrtaceae. Genus eucalyptus are known to contain more than 700 species and has widely been used for various purposes since thousands of years in the history of mankind. Eucalyptus is basically native to Tunisia and Australia but has also been evident to be found in Africa and from tropical to southern temperate regions of America. Genus eucalyptus further consists of four subspecies which are Eucalyptus bicostata, Eucalyptus pseudoglobulus, Eucalyptus globulus and Eucalyptus maidenii among which Eucalyptus globulus is a medium to large sized evergreen and phytochemical analysis of this plant has revealed that leaf oil contain 1,8-cineole, α-pinene, p-cymene, cryptone and spathulenol. In contrast, essential oil extracted from buds, branches and fruits constitutes α-thujene, 1,8-cineole and aromadendrene as major components.

Fig.no. 10 Eucalyptus globulus

Eugenia jambolana:

Eugenia jambolana (black plum or jamun) belongs to the family Myrtaceae. The most commonly used plant parts are seeds, leaves, fruits, and bark. Eugenia jambolana is an evergreen tropical tree of 8 to 15 m height, with smooth, glossy turpentine-smelling leaves. The bark is scaly gray, and the trunk is forked. There are fragrant white flowers in branched clusters at stem tips and purplish-black oval edible berries. The berries contain only one seed. The taste is generally acidic to fairly sweet but astringent. Eugenia jambolana is one of the widely used medicinal plants in the treatment of diabetes and several other diseases. The plant is rich in compounds containing anthocyanins, glucoside, ellagic acid, isoquercetin, kaempferol, myricetin, and hydrolysable tannins (1-0-galloyl castalagin and casuarinin). The seeds also contain alkaloid jambosine and glycoside jamboline, which slows down the diastatic conversion of starch into sugar.

Fig.no.11 Eugenia jambolana

Ficus religiosa

Ficus religiosa, commonly known as peepal in India, belongs to family Moraceae. Ficus religiosa has been reported to be used in the traditional system of Ayurveda for the treatment of diabetes. F. religiosa has been shown to possess a wide spectrum of in vitro and in vivo pharmacological activities: antidiabetic, hypolipidemic, anticonvulsant, anti-inflammatory, analgesic, antimicrobial, antiviral, antioxidant, antitumor, antiulcer, antianxiety, anthelmintic, antiasthmatic, immunomodulatory, estrogenic, endothelin receptor antagonist, apoptosis inducer, cognitive enhancer, and antihypertensive. Decoction prepared from the bark is used in treatment of diabetes. 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 hypoglycemic activity in rabbits. The bioactive components present in Ficus are leucocyandin 3-O-beta-d-galactosylcellobioside ,leucopelargonidin-3-O-alpha-Lrhamnoside. The phytoconstituents present in Ficus can impart a significant antidiabetic effect. It has been reported to contain phytosterols, flavonoids, tannins, and furanocoumarin derivatives, namely, bergapten

Finus Bengalnsis :

The Finus Bengalnsis Linn. Commonly known as the banyan tree, is member of Moraceae family and its bark is used in Ayurvedic medicine for the treatment of diabetes mellitus. The water and

alcoholic extract of bark of this plant have been shown to produce a hypoglycemic effect in experimental models following oral administration. Some investigators have attempted to purify the active fractions from the bark of Ficus bengalensis in order to establish the mechanism of its hypoglycemic action. All the studies have been restricted to its bark, so the other morphological parts, i.e., the fruits, leaves and aerial roots deserve evaluation for their antidiabetic activity.

Fig.no. 13 Finus Bengalnsis

Gymnema sylvestre:

Gymnema sylvestre (gurmar) belongs to the family Asclepiadaceae. It is a herb native to the tropical forests of India and Sri Lanka. G. sylvestre is a large climber, with roots at nodes. Its potent antidiabetic plant used in ayurvedic preparations. Several studies have proved its antidiabetic potential in animal models; when combined with acarbose it is reported to reduce intestinal transport of maltose in rats. Absorption of free oleic acid in rats has also been reduced. Aqueous extract of G. sylvestre has been reported to cause reversible increases in intracellular calcium and insulin secretion in mouse and human β cells with type 2 diabetes. Regeneration of the cells in the pancreas might raise the insulin levels. A group of triterpene saponins, known as gymnemic acids and gymnema saponins are found to be present in G. sylvestre**.**

Fig.no. 14 Gymnema sylvestre

Ipomoea batatas:

Ipomoea batatas (L.) Lam. belongs to the Ipomoea genus, the largest species within the Convolvulaceae family . There are several varieties of I. batatas, which differ based on the color of the peel and flesh of the tuber, including purple-purple, purple-orange, yellow-yellow purple, and yellow-yellow orange It is a tuberous-rooted perennial plant that is usually grown as an annual. The stems forms a running vine up to 4 m long and are typically prostrate and slender, with milky juice and short unbranched stems. Sweet potatoes are used in various countries for traditional uses such as dietary fiber sources, treating allergies, and providing energy in diabetes mellitus treatment. The primary phytochemical compounds in Ipomoea batatas are phenolic compounds, flavonoids, anthocyanins, and carotenoids. Sweet potato contains several nutritional constituents: vitamin C, protein, fiber, carbohydrates, β- carotene, and minerals. Sweet potato exhibits various pharmacological activities, antioxidant, anticancer, and anti-inflammatory. The types of phytochemical compounds in each part of the plant are different.

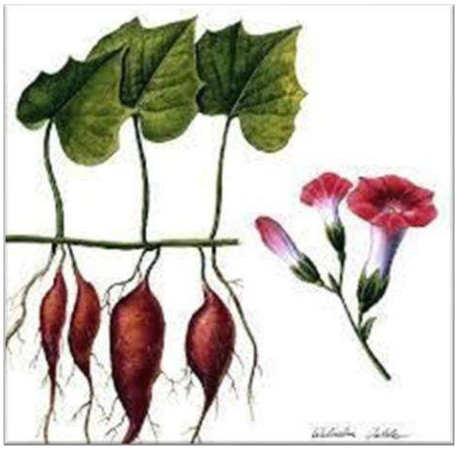

Fig 1.15 Ipomoea batatas

Mangifera Indica

The plant, Mangifera indica L. cultivar Anwar Ratol, commonly known for its sweetness, belongs to Ancardiaceae family. The genus Mangifera contains 69 species of which less than half of the plants produce edible fruits. The mango plant bark is traditionally used to treat diarrhea, cancer, diabetes, prostatitis, toothache and cough and urinary tract and skin infections. The stem bark is also used as emetic, diuretic, antiseptic, astringent and hepatoprotective agent. Studies has shown that the stem bark exhibited anti-inflammatory and anti-amoebic properties, prevented DNA damage and lipid peroxidation in rats and showed immunomodulatory and analgesic properties. Leaf extracts have shown hepatoprotective, antiulcerogenic, hypolipidemic, antioxidant,antibacterial activity against both gram positive and negative microorganisms.

Fig.no. 15 Mangifera Indica

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. It is often used as a vegetable in diet. Bitter gourd contains bioactive substances with antidiabetic potential such as vicine, charantin, and triterpenoids along with some antioxidants. Several preclinical studies have documented the antidiabetic and hypoglycaemic effects of Momordica charantia through various hypothesised mechanisms. Several studies have demonstrated antibacterial, antiviral, anticancer, and antidiabetic activities, in Momordica charantia . however, the antidiabetic activity has been widely reviewed. In several animal studies, bitter gourd has been reported to ameliorate the metabolic syndrome, where diabetes is one of the risk factors. In a study conducted on Taiwanese adults, a significant reduction in waist circumference, improvement in diabetes, and symptoms of metabolic syndrome has been observed.

Fig.no. 17 Momordica charantia

Ocimum sanctum :

Ocimum sanctum L. (holy basil or tulsi) belongs to the family Lamiaceae. Every part of the plant is used as a therapeutic agent against several diseases. Ocimum is reported to grow worldwide.

Nutritional and chemical composition of holy basil makes it a plant with immense potential. Eugenol, the active constituent present in O. sanctum L., has been found to be responsible for its therapeutic potential. Major bioactive constituents present in the leaves and stems of holy basil include flavonoids, saponins, tannins, triterpenoids, rosmarinic acid, apigenin, isothymusin, isothymonin, cirsimaritin, orientin, and vicenin. Tulsi leaves oil contains eugenol, ursolic acid, carvacrol, linalool, limatrol, and caryophyllene along with eugenol. Seeds oil is known to have fatty acids and sitosterol while seed mucilage contains some sugars. Anthocyanins are present in green leaves. Furthermore, tulsi is also rich in vitamins, minerals, chlorophyll, and many other phytonutrients.

Fig.no. 18 Ocimum sanctum

Spergula arvensis:

Commonly known as Corn spurry has been used as a green vegetable from prehistoric times by certain tribes. The composition and nutritional value of this plant, however, is

Fig.no. 19 Spergula arvensis

not known. The nutritional assessment of the plant was therefore, carried out. The components analyzed include moisture carbohydrate, fat, protein, β-carotene, lycopene, micronutrients, macronutrients, vitamin A, vitamin C, energy, total antioxidants and amino acids. Antinutritional components such as tannins, total phenols and minerals were also analyzed. The study shows that the plant has low fat and sugar content but high potassium, calcium and sodium content. Mercury, nickel, lead and palladium are absent. Essential amino acids such as leucine, isoleucine and histidine are high when compared to WHO standard reference values.

Tridax procumbens:

Tridax procumbens L. (T. procumbens) belongs to the Asteraceae family, is an Ayurvedic herb of Asia with a history of traditional use. T. procumbens have been used from ancient times to treat wounds, skin diseases and to stop blood clotting in folk medicine. It possesses

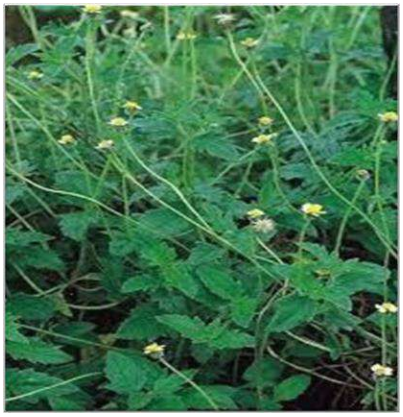

Fig.no. 20 Tridax procumbens

Trigonella foenum-graecum:

Trigonella foenum-graecum (fenugreek, methi) belongs to the family Fabaceae. Seeds and leaves are the most frequently used parts of the plant. Trigonella foenum-graecum L. is cultivated throughout India and in some other parts of the world as a semiarid crop. It is used both as a vegetable and as a spice in India. Fenugreek is well known for its pungent aromatic properties, and it is a flavoring agent in food. Studies on different

experimental models have proved that fenugreek has strong antidiabetic properties. Human studies have also confirmed the glucose and lipid-lowering ability of fenugreek. A study on intestinal and renal disaccharidases activity in STZ-induced diabetic rats proved the beneficial effects of fenugreek seed mucilage by enhancing the reduction in maltase activity during diabetes. The optimistic influence of fenugreek supplementation on intestinal and renal disaccharidases has been reported. A marked reduction in renal toxicity has been observed when fenugreek oil is incorporated in the diet of alloxanized rats.

Fig 1.21 Trigonella foenum-graecum

White Mulberryc.

White mulberry trees are found in subtropical or temperate climates in China, Japan, Korea, India, Pakistan, and other Asian countries (Hocking 1993). White mulberry is a small to medium-sized tree with either white or light pink fruit shaped like a blackberry. Due to its mild sweetness, white mulberry fruit has been used in a wide variety of foodstuffs such as jams, wine, and flavor additives. Historically, though, the greatest demand for white mulberry leaf has been from the silk industry because the leaves are the staple food source for silkworm larvae (USDA 2003). Apart from dietary consumption, traditional Chinese medicine uses white mulberry fruit as well as the leaves and tree bark for therapeutic treatments. Practitioners usually recommend white mulberry leaves to resolve issues such as fever, liver damage, high blood pressure, and joint pain. White mulberry is a small to medium-sized tree with either white or light pink fruit shaped like a blackberry. Due to its mild sweetness, white mulberry fruit has been used in a wide variety of foodstuffs such as jams, wine, and flavor additives. Historically, though, the greatest demand for white mulberry leaf has been from the silk industry because the leaves are the staple food source for silkworm larvae (USDA 2003).

Fig 1.22 White mulberry

CONCLUSION:

The present review has presented comprehensive details of antidiabetic plants used in the treatment of diabetes mellitus. Some of those plant derived medicines, however, offer potential for cost effective management of diabetes through dietary interventions, nutrient supplementation, and combination therapies with synthetic drugs in the short term, and as the sole medication from natural sources over the long term. The presences of bioactive chemicals are mainly responsible for this antidiabetic action. However, many other active agents obtained from plants have not been well characterized. More investigations must be carried out to evaluate the mechanism of action of medicinal plants with antidiabetic effect.

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