

Characterization of Anti-Diabetic Herbs & Potential Therapeutic Agents in Indian Species: A Review

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Abstract: Traditional Medicines derived from medicinal plants are used by about 60% of the world's population. Diabetes mellitus is a public health problem which leads to serious complications over time. Experimentally, many herbs have been recommended for treating diabetes. In most cases, however, the recommendations are based on animal studies and limited evidences available about their clinical usefulness. This review focuses on herbal drugs and plants used in the treatment of diabetes. The search was done in various databases using the key terms diabetes, medical herbs, and antidiabetic and associated illness phytochemical active compound. According to the clinical studies, *Embllica officinalis* Gaertn, *Terminalia bellirica* Roxb, *Terminalia chebula* Retz., *Curcuma longa* Linn., *Berberis species*, *Cyperus scariosus* R. Br., *Tribulus terrestris* Linn., *Tinospora cordifolia* Linn., *Trigonella foenum-graecum* Linn., *Eugenia jambolana* Lam., *Boerhaavia diffusa* Linn., *Asparagus racemosus* Willd., *Butea frondosa* Koenig ex Roxb., *Cissampelos paeira* Linn., *Aegle marmelos* Corr., *Gemnema sylvestre* R.Br., *Terminalia arjuna* Roxb. Wight. & Arn., *Anthocephalus cadamba* Miq., *Valeriana wallichii* DC., *Embeliaribes Burum* f., *Trichosanthes dioica* Roxb. and *Azadirachta indica* A.Juss., have acquired enough reputation for managing diabetes. Thus, these herbs may boost management of diabetes. Etiology in the development of diabetes and its complications is the damage due to radicals and hence an antidiabetic compound with antioxidant properties would be more beneficial in diabetic control. Therefore information on antioxidant effects of these medicinal plants is also included along with antibacterial activities of herbs in this review.

Keywords: diabetes; diabetic complications; alternative medicine; medicinal herbs

I. Introduction

Pathophysiologic alteration is a change in function as distinguished from a structural defect. Diabetes occurs when there is a dis-balance between the demand and production of the hormone insulin. Pathophysiology of type 1 diabetes is that in this condition the immune system attacks and destroys the insulin producing beta cells of the pancreas. There is beta cell deficiency leading to complete insulin deficiency. Whereas in diabetes type 2 there is relative deficiency of insulin and not an absolute deficiency. This means that the body is unable to produce adequate insulin to meet the needs. There is Beta cell deficiency coupled with peripheral insulin resistance. Third type of diabetes is gestational diabetes. It is caused when there are excessive counter-insulin hormones of pregnancy. This leads to a state of insulin resistance and high blood sugar in the mother. There may be defective insulin receptors. (1, 2) The number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014. The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014. Diabetes prevalence has been rising more rapidly in middle- and low-income countries.(3)

Common consequences of diabetes

Diabetes intensifies the danger of long-term complications. Diabetes increases the risk of cardiovascular diseases such as diabetic cardiomyopathy. The chief complications of diabetes due to injury in small blood vessels comprise damage to the eyes, kidneys, and nerves. Damage to the eyes is known as diabetic retinopathy which is triggered by damage to the blood vessels in the retina of the eye leading to diabetic eye complications. Damage to the kidneys, known as diabetic nephropathy, can pave the way to tissue damaging, urine protein damage, and eventually diabetic nephropathy disease. Diabetes is one of the main cause of kidney failure. At least two third of the people with diabetes may have signs of onset of kidney problems at early stage. Damage to the nerves of the body, known as diabetic neuropathy, is the most common complication of diabetes. (4-6)

Complications in uncontrolled diabetic

People with diabetes have an increased risk of developing a number of serious health problems. Consistently high blood glucose levels can lead to serious diseases affecting the heart and blood vessels, eyes, kidneys, nerves and teeth. In addition, people with diabetes also have a higher risk of developing infections. In

almost all high-income countries, diabetes is a leading cause of cardiovascular disease, blindness, kidney failure, and lower limb amputation.(7-11)

Treatment of uncontrolled diabetic mellitus and its consequences is a serious problem, particularly due to therapies aimed to treat the pathogenesis as well as to prevent and treat further complications but unfortunately, almost all antidiabetic drugs have severe side effects. (12)

In 2005, Feng et al. highlighted the beneficial properties of natural products. Traditional medicinal herbs classified as aldose reductase inhibitors seem to prevent and delay diabetic complications, such as diabetic nephropathy, vasculopathy, retinopathy, peripheral neuropathy [13]. In particular, among this class of compounds, great inhibitory capability was ascribed to flavonoids such as quercetin, silymarin, puerarin, baicalim and berberine. (13)

II. Materials And Methods

Systematic literature searches were carried out and the available information on various traditionally used plants for diabetic disease and associated illness was collected via electronic search (using Pubmed, SciFinder, Scopus, Scirus, ScienceDirect, Google Scholar, Google search engine, Medline and Web of Science) and a library search for articles published in peer-reviewed journals and literature available in ancestral ayurveda reference books.

III. Literature Review

Table 1. Taxonomy and beneficial phytoconstituents of medicinal herbson diabetes and pharmacological action on other diseases.

Botanical Name	English Name	Sanskrit name as per Indian literature	Active phytoconstituents	Pharmacological and medicinal use
EmblicaofficinalisGaertn. [1]	Indian gooseberry	Amalki	Gallic acid, ellagic acid, emblicanin A & B, phyllembein, quercetin and ascorbic acid.	Diabetic, immunity, cancers, chronic diseases like hypertension, high Cholesterol, Diabetes, influenza, cough and cold, infections, fatigue and pain.
Terminalia belliricaRoxb. [2]	BelericMyrobalan	Behada	Glucoside, Tannins, Gallic acid, Ethyl Gallate and Chebulinic acid.	Diabetic, antioxidant, microbial infection, diarrhea, cancer, hypertension, hepatic diseases & fever.
Terminalia chebula Retz. [3]	Myrobalan	Haritaki	Fructose, amino acids, succinic acid, betasitosterol, resin, anthraquinone, chebulin, palmitic acid, linoleic acid and oleic acid.	Diabetic, antioxidant, microbial infections, liver diseases, pain, cancer, radioprotective, heart diseases, bleeding gums, rheumatic pain, gastrointestinal motility and wound healing
Curcuma longa Linn.[4,5]	Turmeric	Haridra	Vitamins C, E and Beta-Carotene, tumerone, atlantone, and zingiberone	Diabetic, pain, allergy, anti-oxidant, infection, cancer arthritis and Alzheimer's disease.
Berberis species [6]	Indian barberry	Daruharidra	Berberine, berbamine, lupeol ,stigma sterol, palmatine, oxyberberine , columbamine,	Diabetic, infection, antiemetic, fever, antioxidant, pain, anti-arrhythmic,

			isocorydine, lambertine, magniflorine and bisbenzisoquinolines	sedative, anti-cholinergic, cholagogic, leishmaniasis, and malaria.
Cyperusscariosus R. Br [7]	Nut grass	Nagarmotha	Cyperene, pinene, camphene, trans-pinocarveol, myrtenol, myrtenol, selinene, spathulenol, cryophyllene oxide, myrtenal, copaene, hycloprop (a) naphthalene,, zicrone, alfa-copaene, -selinene, -selinene, iso-patchoulene, corymbolone, pinene, patchoulane, cyperene, longifolene oxide, citral and aristolene	Diabetic, fever, arthritis, diuretic, nervine tonic, diarrhea, dysentery, leprosy, bronchitis, amenorrhea and blood disorders. The fruits of the plant are used as carminative, diuretic tonic and stomachic disease.
Tribulusterrestris Linn [8]	Caltrops	Gokshur	Furostanol and spirostanolsaponins of tigogenin, neotigogenin, gitogenin, neogitogenin, hecogenin, neohecogenin, diosgenin, chlorogenin, ruscogenin, and sarsasapogenin	Diabetic, diuretic, aphrodisiac, immunomodulator, absorption enhancing, hypolipidemia, heart tonic, CNS diseases, liver disease, pain, fever, cancer, antibacterial, larvicidal, and cancer.
Tinosporacordifolia Linn.[9]	Tinospora	Guduchi	Palmatine, jatrorrhizine, magnoflorine, hydroperoxides, ceruloplasmin, vitamin E, choline, tinosporin, isocolumbin, palmatine, tetrahydropalmatine, and magnoflorine	Diabetic, fever, jaundice, chronic diarrhea, cancer, dysentery, bone fracture, pain, asthma, skin disease, poisonous insect, snake bite, eye disorders.
Trigonellafoenum-graecum Linn [10]	Fenugreek	Methi	Trigonelline, sapogenins, 4- hydroxyisoleucine, diosgenin, aponins, yamogenin, gitogenin, tigogenin, and neotigogens, gentianine, 4-hydroxyisoleucine, fenugreekine and carpaine	Diabetic, cholestremia, laxative, stimulant, carminative, stomachic, acidity, colitis, infection, hypertension, thrombotic blood diseases, cancer, antioxidant, kidney and urine formation disorders.
Eugenia jambolana Lam. [11]	Black plum	Jambu	Anthocyanidins/aglycons: delphinidin, cyanidin, petunidin, peonidin and malvidin	Diabetic, bacterial infection, fungal infection, pain, anti-colitis, heart disease, anti-allergic, anticancer, cancer, free radical scavenging, antioxidant, liver failure, and diarrhea.

Boerhaaviadiffusa Linn[12]	Red Hogweed	Punarnava	Punarnavine, boeravinone, urosilic acid punarnavoside, liirodendrin, glycoprotein, sitosterol, palmitic acid, tetracosanoic, hexacosanoic, stearic, arachidic acid, and Hentriacontane.	Diabetic, asthma, urinary disorders, leukorrhea, rheumatism, Jaundice, liver failure, inflammatory bowel disease and encephalitis.
Asparagus racemosusWilld.[13]	Buttermilk root	Shatavari	Essential oils, asparagine, arginine, tyrosine, flavonoids (kaempferol, quercetin, and rutin), resin, and tannin.	Diabetic,prevent ageing, increase longevity, immunity booster, dementia, nervous disorders, dyspepsia, tumors, inflammation, neuropathy, symptoms of AIDS and hepatopathy.
Buteafrondosa Koen ig ex Roxb.[14]	Parrot tree	Palasha	Butin, butein, butrin, isobutrin, palasitrin, coreopsin, isocoreopsin, sulphurein, monospermoside, monospermine, heneicosanoic acid, phytolectin, piperazine, pyroligneous acid, procyanidin, gallic acid or santonin.	Diabetic, male sexual dysfunction, ageing, atherosclerosis, depression, diarrhea, dysentery, intestinal worms, throat infection, externally relieving eczema, itching and/ or other skin and disorders.
Cissampelospaera Linn.[15]	Velvet leaf	Patha	Terpenoids, alkaloids, tannins, amino acid proteins, carbohydrates, cissampareine, Bisbenzy- lisoquinoline, hayatininmethochloride, tropoloisoquinoline alkaloids, pareirubrines A and B, cissampelo flavone, berberine and cissampeline.	Diabetic, dyspepsia, indigestion, flatulence, abdominal pains, diarrhea, dysentery, blood disorders, cardiac disorders, edema. Leprosy, sensation, cough, coryza, asthma, bronchitis, cystitis, dysuria, lactation disorders, ulcers, skin disorders, scabies, leprosy, migraine, leucorrhoea and gonorrhoea.
Aeglemarmelos Corr.[16]	Indian Quince	Bael	Steroids, terpenoids, flavonoids, phenolic compounds, lignin, fat and oil, inulin, proteins, carbohydrates, alkaloids, cardiac glycosides and flavonoids.	Diabetic, cancer, antibacterial, antifungal, antioxidant, liver dysfunction, haemolytic diseases, larvicidal and pain
Gemnemasyvestre R.Br [17]	Milk weed	Aajshringi	Dammaranesaponins, anthraquinones, flavones, hentriacontane, pentatriacontane, phytin.	Diabetes, besides being used for arthritis, diuretic, anemia,

			resins, tartaric acid, formic acid, butyric acid, lupeol, stigmasterol, and calcium oxalate	osteoporosis, hypercholesterol emia, cardiopathy, asthma, constipation, microbial infections, indigestion, and anti-inflammatory
Terminalia arjuna Roxb. Wight & Arn. [18,19]	White Marudah	Arjun	Arjunolone, flavones, luteolin, baicalein, quercetin, kempferol, arjunic acid, arjungenin, arjunetin, terminic acid, and a triterpene carboxylic acid and pelargonidin,	Coronary artery disease (CAD), idiopathic dilated cardiomyopathy, refractory chronic congestive heart failure, stable angina, chest pain, high blood pressure and high cholesterol.
Anthocephalus cadamba Miq. [20]	Wild chinchona	Kadamba	Cadambine, cadamine, β -sitosterol, quinovic acid, chlorogenic acid	antimicrobial, antidiabetic, sedative, antiepileptic, antioxidant, antitumor, analgesic, antipyretic, anti-inflammatory, diuretic, laxative, hepatoprotective, anthelmintic, wound healing and antidiarrhoeal.
Valeriana wallichii DC. [21]	Valerian	Tagar	Alkaloids, borylisovalerianate, chatinine, formate, glucoside, isovalerenic acid, camphene, pinene, resins, terpineol and valerianine.	Diabetic, pain, antispasmodic, infection, antipsychotic, anthelmintic, antioxidant, nervous unrest, emotional arrest (as tranquilizer/sedative), epilepsy, insanity, snake-poisoning, eye-trouble, skin diseases, as a relaxant, carminative, complexion improvement and cytoprotective
Embeliaribes Burum. f. [22]	False Black Pepper	Vayvidang	Benzoquinone compound embelin.	Diabetic, digestive, carminative, anthelmintic and laxative, heart diseases, CNS diseases, cancerous tumors, liver disorders, wound healing, bacterial infection, antioxidant, pain, analgesic and contraceptive activity.

Trichosanthes dioica Roxb.[23]	Pointed gourd	Patol	Flavonoids, alkaloids, reducing sugars, eicosane 2-methyl, octadecane, methoxy acetic acid, methylhexacosane, heptacosane and octacosane	Diabetic, nerve tonic, fever, edema, alopecia, enlargement of liver, alcoholism, jaundice, viral infections, ENT diseases, anemia, bloating, peptic ulcer, duodenal ulcer, flu, enteric fever and skin diseases.
Azadirachta indica A. Juss. [24]	Indian Lilac	Neem	Tannins, alkaloid, steroids, saponin and flavonoids.	Diabetic, viral infection, fungal infection, bacterial infection, spermicidal activity, cancer, pain, malaria, diuretic and insecticidal effect.

Emblica officinalis Gaertn. It is commonly known as Indian gooseberry or amla and/or some of its important phytoconstituents are gallic acid, gallotannin, ellagic acid and corilagin. It possesses anti-diabetic effects through their antioxidant and free radical scavenging properties. Amla has also been reported to prevent/reduce hyperglycemia, cardiac complications, and diabetic nephropathy, neuropathy, cataract and protein losses. [14]

Terminalia bellirica Roxb. Plants have been used as medicines from the ancient times. Fruits are laxative, astringent, anthelmintic and antipyretic; useful in hepatitis, bronchitis, asthma, dyspepsia, piles, diarrhea, coughs, hoarseness of voice, eye diseases and scorpion-sting; used as a hair tonic. Decoction of the green fruit is used for cough. Pulp of the fruit is useful in dysenteric-diarrhea, dropsy, piles and leprosy. Half ripe fruit is used as purgative. Kernel of the fruit is narcotic. Fruits are used in menstrual disorder, seed oil is used in rheumatism and gum for demulcent and purgative. The triterpenoid present in the fruits possess significant antimicrobial activity. [15]

Terminalia chebula Retz. Many species of Terminalia are used for their antibacterial, antifungal, antiprotozoal, antiviral, antidiarrhoeal, analgesic, antimalarial, antioxidant, anti-inflammatory and anticancer activities. Wound healing and cardiovascular effects have also been credited to some species. Many Terminalia species have multiple beneficial effects for multiple diseases and ailments. Indeed, the Indian species Terminalia chebula is known as the king of plants in Ayurveda due to its broad range of medicinal uses. [16]

Curcuma longa Linn. Curcumin (diferuloylmethane), the main yellow bioactive component of turmeric has been shown to have a wide spectrum of biological actions. Rhizome of Haridra is known to possess therapeutic activities and has been used by medical practitioners as an anti-diabetic, hypolipidemic, anti-inflammatory, anti-diarrhoeal, hepatoprotective, anti-asthmatic and anti-cancerous drug. Haridra is widely used in cosmetology. [17, 18]

Berberis species. The genus Berberis includes about 500 species worldwide, while phytochemical properties for all parts of these plants have been reported, including: antimicrobial, antiemetic, antipyretic, antioxidant, anti-inflammatory, anti-arrhythmic, sedative, anti-cholinergic, cholagogic, anti-leishmaniasis, and anti-malaria. The main compounds found in various species of Berberis, are berberine and berbamine. Phytochemical analysis of various species of this genus showed the presence of alkaloids, tannins, phenolic compounds, sterols and triterpenes. [19]

Cyperus scariosus R. Br. It is commonly known as Nagarmotha is found throughout India. Cyperus scariosus R.Br. (Nagarmotha) is a pestiferous perennial, delicate slender sedge found widely in various parts of the country, especially in damp or marshy areas and collected widely for extraction of its essential oil using steam distillation. The rhizomes of C. scariosus possess pleasant aromatic odour, the essential oil is used as anti-inflammatory, anti-microbial and anti-fungal agent. [20]

Tribulus terrestris Linn. Commonly known as Gokshur or Gokharu or puncture vine, has been used for a long time in both the Indian and Chinese systems of medicine for treatment as diuretic, aphrodisiac, anti-urolithic, immunomodulatory, antidiabetic, absorption enhancing, hypolipidemic, cardiogenic, central nervous system, hepatoprotective, anti-inflammatory, analgesic, antispasmodic, anticancer, antibacterial, anthelmintic, larvicidal, and anticarcinogenic activities. [21]

Tinospora cordifolia Linn. A plant with as diverse a role as Tinospora cordifolia is a versatile resource for all forms of life. There are reports as already discussed that the plant extracts have active compounds in the

form of alkaloids, glycosides, lactones and steroids. All these active compounds have immunomodulatory and physiological roles of different types, thereby demonstrating the diverse versatility of the plant. [22]

Trigonella foenum-graecum Linn. Commonly known as fenugreek and used to treat type 2 diabetes worldwide, resulting in large measure from the increasing prevalence of obesity. Since fenugreek has versatile properties and several studies have shown its beneficial effects. Dietary supplements modulate glucose homeostasis and potentially improve lipid parameters would be desirable, is true for diabetes prevention in patients with metabolic syndrome. [23]

Eugenia jambolana Lam. The ripe purple berries of the native Indian plant, *Eugenia jambolana* Lam., known as Jamun, are popularly consumed across the world. It possess a range of pharmacological properties such as antibacterial, antifungal, antiviral, anti-genotoxic, anti-inflammatory, anti-ulcerogenic, cardioprotective, anti-allergic, anticancer, chemopreventive, radioprotective, free radical scavenging, antioxidant, hepatoprotective, anti-diarrheal, hypoglycemic and antidiabetic effects. [24]

Boerhaaviadiffusa Linn. The leaves of plant have potent antibacterial activity against various Gram-negative and Gram-positive bacteria which might be due to the phytochemicals present in the leaves. The whole plant or its specific parts (leaves, stem, and roots) are known to have medicinal properties and have a long history of use by indigenous and tribal people in India. *B. diffusa* is used as an Ayurvedic medicine in India and Unani medicine in Arab countries for the treatment of diabetes, stress, dyspepsia, abdominal pain, inflammation, jaundice, enlargement of spleen and congestive heart failure. The medicinal value of this plant in the treatment of a large number of human ailments is mentioned in Ayurveda, CharakaSamhita, and SushritaSamhita. [25]

Asparagus racemosus Willd. It is considered both a general tonic and a female reproductive tonic. Shatavari may be translated as “100 spouses”, implying its ability to increase fertility and vitality. *Asparagus racemosus* is mainly known for its phytoestrogenic properties. With an increasing realization that hormone replacement therapy with synthetic oestrogens is neither as safe nor as effective as previously envisaged, the interest in plant-derived oestrogens has increased tremendously making *Asparagus racemosus* particularly important. The plant has been shown to aid in the treatment of neurodegenerative disorders and in alcohol abstinence-induced withdrawal symptoms. In Ayurveda, *Asparagus racemosus* has been described as a rasayana herb and has been used extensively as an adaptogen to increase the non-specific resistance of organisms against a variety of stresses. Besides use in the treatment of diarrhoea and dysentery, the plant also has potent antioxidant, immunostimulant, antidyspepsia and antitussive effects. [26]

Buteafrondosa Koenig ex Roxb. It is traditionally used to manage male sexual disorders including erectile dysfunction (ED), sexual desire, disorder of orgasm, disorder of ejaculation, and long lasting priapism “Vajikaranachikitsa” is a branch of Ayurveda, Indian system of alternate medicine, that describes different herbal formulations for management of male sexual disorders including ED. “Vajikarana” herbs/aphrodisiacs are the herbs that have been used in the Ayurvedic system of medicine to treat ED. *Buteafrondosa* has been enlisted in Ayurveda as “Vajikarana- sex enhancer” herb for the management of ED. [27]

Cissampelospareira Linn. It is a medicinally valuable plant commonly referred to as midwife’s herb and it has been traditionally used to combat women’s ailments such as preventing miscarriages, uterine hemorrhages and also a lacto-stimulator. Leaves are used as an antiseptic against inflammations and can be put on wounds in order to heal sores. The present study is to analyze the phytochemical constituents of leaf extracts of *Cissampelospareira*. [28]

Aeglemarmelos Corr. It contains a number of phytoconstituents, which are the key factors in the medicinal value of this plant. Almost all parts of this plant such as leaf, fruit, seed, bark and root are used to cure a variety of diseases. This plant have been extensively studied by advanced scientific techniques and reported for various medicinal properties viz, anticancer activity, antibacterial activity, antifungal activity, antidiabetic activity, antioxidant activity, hepatoprotective activity, haemolytic activity, larvicidal activity and anti-inflammatory activity etc. [29]

Gymnema sylvestre R.Br. It is popularly known as “gurmar” for its distinct property as sugar destroyer. The herb exhibits a broad range of therapeutic effects as an effective natural remedy for diabetes, besides being used for arthritis, diuretic, anemia, osteoporosis, hypercholesterolemia, cardiopathy, asthma, constipation, microbial infections, indigestion, and anti-inflammatory. *G. sylvestre* has good prospects in the treatment of diabetes as it shows positive effects on blood sugar homeostasis, controls sugar cravings, and promotes regeneration of pancreas. [30]

Terminalia arjuna Roxb. Wight. And Arn. It is an ayurvedic plant with important medicinal value. It is commonly known as Arjuna, Indradru, Partha and Veeravriksha nearly 200 species distributed around the world. Various studies support the fact that bioflavonoids inhibit LDL oxidation, endothelial activation and platelet aggregation. Due to the presence of free radical scavenging action of the various phenolic contents in *T. arjuna*, it acts as strong anti-proliferative and anti-oxidant agent.⁶³ There is an inversely relationship between the high intake of dietary flavonoids and the risk of coronary artery disease (CAD), so possible account for intake of high flavonoids is beneficial effects in CAD. [31, 32]

Anthocephaluscadamba Miq. Literature review of Kadamba can be traced back to Vedas, Puranas and Samhita. The plant has been extracted by conventional methods such as infusion, decoction, maceration and percolation. The preliminary phytochemical screening of Anthocephaluscadamba whole plant (barks, leaves, flowers and fruits) showed the presence of saponins, terpenes, sesquiterpenes glycosides, alkaloids and absence of anthraquinones and flavonoids. A variety of phytoconstituents, such as cadambine, cadamine, β -sitosterol, quinovic acid, chlorogenic acid etc. have been isolated from the extracts. The plant has also been studied for its various pharmacological activities such as antimicrobial, antidiabetic, sedative, antiepileptic, antioxidant, antitumor, analgesic, antipyretic, anti-inflammatory, diuretic, laxative, hepatoprotective, anthelmintic, wound healing and antidiarrhoeal. The present review explores its description, traditional uses, chemical constituents and pharmacological activity so that its potential as a multipurpose medicinal agent can be understood and appreciated. [33]

Valerianawallichii DC. Valerianawallichii is an extremely polymorphous complex of sub-species with natural dispersed throughout temperate and polar Eurasian zones. Valerian roots have been used for hundreds of years for its sedative and antispasmodic properties. The plant is widely known for its use in anxiety, insomnia, epilepsy and hysteria. It is considered useful as a potent tranquilizer, antispasmodic and hypotensive, stimulant and also to improve liver function in gastrointestinal disorders. [34]

Embeliaribes Burm. f. It belongs to the family myrsinaceae found in hilly parts of India and an endangered medicinal plant valued for its digestive, carminative, anthelmintic and laxative property since time immemorial. It is also used in diabetes, heart related problems, cancerous tumors and liver disorders. The seeds are also used for wound healing antioxidant, anti-inflammatory, analgesic and contraceptive activity. [35]

Trichosanthesdioica Roxb. Commonly it is called as Pointed Gourd and is one of the important vegetables of this region. The fruits and leaves are the edible parts of the plant which are cooked in various ways either alone or in combination with other vegetables or meats. According to Ayurveda, leaves of the plant are used as antipyretic, diuretic, cardiogenic, laxative, antiulcer, etc. The various chemical constituents present in T. dioica are vitamin A, vitamin C, tannins, saponins, alkaloids, mixture of noval peptides, proteins tetra and pentacyclic triterpenes, etc. Juice of leaves of T. dioica is used as tonic, febrifuge, and in sub-acute cases of enlargement of liver and spleen; in CharakaSamhita, leaves and fruits are used for treating alcoholism and jaundice. Leaves are used in edema and alopecia. It is also used as antipyretic, diuretic, cardiogenic, and laxative. [36]

Azadirachtaindica A. Juss. Azadirachtaindica, commonly known as neem, is one of the most versatile medicinal plants that has gained worldwide importance due to medicinal and insecticide properties. Sixty five patents filed till 2013 include claims for insecticides, fungicidal effects, methods of extraction, and storage stable formulations, of one of the active ingredients, azadirachtin, contraceptives, and medical uses. [37]

IV. Conclusion

In this review we discussed about herbal medicinal plants for the treatment of diabetes mellitus. These medicinal plants are mostly used for rural areas; because the availability. Therefore, treating diabetes mellitus with plant derived compounds which are accessible and do not require laborious pharmaceutical synthesis. In the present review an attempt has been made to search the antidiabetic medicinal property along with effect of pharmacological constituents of diabetic associated diseases or other illness.

Conflict: Nil

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