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ANTIDIABETIC ACTIVITY OF MAGIC HERB GILOE: A REVIEW

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ABSTRACT

Tinospora cordifolia (Guduchi) is a perennial climber that is evergreen. This deciduous and dioecious plant belongs to the family Menispermaceae. It is a plant of significant medicinal importance in the Indian system and designated as Rasayana. The current medical establishment has acknowledged its efficacy as well. The stem is approved for use in medicine, however the entire plant is used medicinally. This is due to the stems having a higher alkaloid content than the leaves. The plant mainly contains alkaloids, glycosides, steroids, diterpenoid lactones, sesquiterpenoid, aliphatic compound and other miscellaneous compound. The purpose of this review is to emphasise giloy's anti-diabetic properties. Currently current traditional diabetic mellitus treatments have their own set of limitations, thus researchers are looking for alternatives from medicinal plants with antihyperglycemic properties to fill the gap. Tinospora cordifolia's anti-diabetic benefits are well-known in Ayurveda and even in recent modern studies. Several studies on its extracts (such as immune-modulatory, anti-hyperglycemic, antioxidant, adaptogenic, hepatoprotective, hormone regulator, and so on) and isolated phytoconstituents (such as tinosporin, berberine, jatrorrhizine, and so on) have reported that it is a preventive and curative antidiabetic herb, which has been supported by clinical trials.

KEYWORDS: Diabetes mellitus, Guduchi, Herbal remedies, Tinospora cordifolia, Traditional medicine.

INTRODUCTION

Diabetes mellitus is the world's most common endocrine disorder and one of the major causes of cardiovascular disease. By the year 2025, diabetes is predicted to affect almost 300 million people around the world. There are several anti-diabetic medications on the market that are beneficial to these patients, but with recent trends of hypoglycemic drug overuse, the risk of resistance and problems increases. Furthermore, due to its sensitivity and effectiveness in long-term usage of one type of medicine, the therapeutic dosage in patients must be increased. As a result, many are turning to Ayurveda and herbal treatments, which have less side effects, are less expensive, and have fewer contraindications. It is a fact that diabetes cannot be completely cured, as no one has ever claimed to be completely free of it. If this is the case, why would anyone choose traditional anti-diabetic medicines, which are either expensive or frequently associated with side effects?[1] Ayurvedic herbs are superior choices because they have less adverse effects and are less expensive.[2]

Giloy (Tinospora Cordifolia) is an Ayurvedic herb with a long history of usage in Indian medicine. Giloy is a perennial, deciduous climbing shrub with a succulent stem and alternate heart-shaped leaves. 3 Tinospora cordifolia stems are commonly observed to be fleshy, succulent, and climbing in nature. It has filiform, succulent aerial roots that are long and filiform. It has heart-shaped, juicy, cordate leaves. **Fruits** - Pea shaped, fleshy, shiny turn red when boiled**. Flowers** - Bloom during summer a. Male flower - Small, yellow or green coloured occur in clusters. **Seeds** - curved, pea sized. The fact that it is called "Amrita" signifies its use for revitalization and its importance in Ayurveda. This significant plant is also mentioned in important Pharmacopoeias.[4,5,6]

Distribution: It is indigenous to areas of India, Myanmar, Sri Lanka, China, Thailand, Philippines, Indonesia, Malaysia, Borneo, Vietnam, Bangladesh, North Africa, West Africa, and South Africa It can be found in deciduous and dry forests up to 1000 feet in elevation.[7,8,9,10]

Vernacular names: The common names are Gilo (Arabic); Amarlata (Assamese); Gadancha, Guluncha, Giloe (Bengali); K'uan chu Hsing (Chinese); Culancha (French); Tinospora (English); Gado, Galo, Gulo (Gujerati); Giloe, Gulbel, Gurcha (Hindi); Amrytu, Sittamrytu (Malayalam); Ambarvel, Giroli, Gulvel (Marathi), Garjo (Nepali); Gulancha (Oriya); Gulbel (Persian); Gilo (Punjabi, Kashmiri), Amrita, Guduchi, (Sanskrit); Gurjo

(Sikkikim); Amridavalli, Niraidarudian (Tamil); Guduchi, Iruluchi (Telugu) and Guruch (Urdu).[11,12]

Fig. 1: Leaves (Tinospora cordifolia).

Fig. 2: Fruit (Tinospora cordifolia).

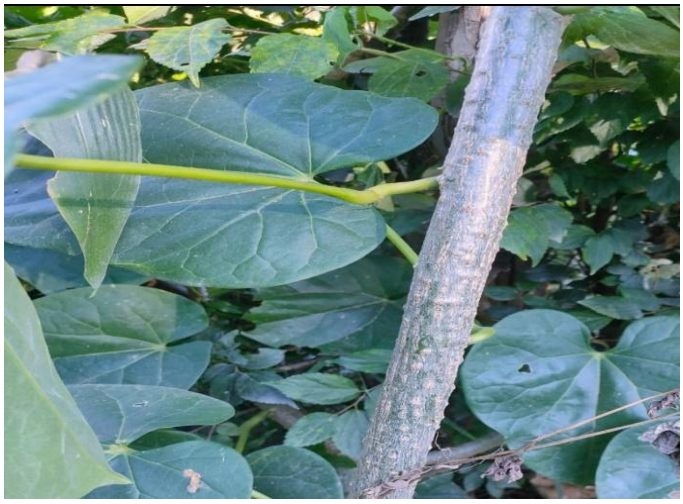

Fig. 3: Stem (Tinospora cordfolia).

Cultivation Soil and Climate

It grows well in almost any type of soils and under varying climatic conditions. Nursery raising and planting: The plant is cultivated by stem cutting in the month of May-June. It requires some support preferably Neem and Mango trees, such plants are supposed to possess better medicinal values. Weeding and Hoeing: Periodical hoeing is done, both in the nursery and field as per requirement. Manures, Fertilisers and Pesticides: The medicinal plants have to be grown without chemical fertilizers and use of pesticides. Organic manures like, Farm Yard Manure (FYM), Vermi-Compost, Green Manure etc. may be used as per requirement of the species. To prevent diseases, bio-pesticides could be prepared (either single or mixture) from Neem (kernel, seeds & leaves), Chitrakmool, Dhatura, Cow's urine etc. Irrigation: The

field after plantation should be irrigated periodically as and when required. Weekly or fortnightly. Harvesting/Post Harvesting Operation: Mature plants are collected, cut into small pieces and dried in shad.[13]

Chemical constituents: The plant mainly contains alkaloids, glycosides, steroids, sesquiterpenoid, aliphatic compound, essential oils, mixture of fatty acids and polysaccharides. The alkaloids include berberine, bitter gilonin, non-glycoside gilonin gilosterol.[14] The major phytoconstituent in Tinospora cordifolia include tinosporine, tinosporide, tinosporaside, cordifolide, cordifol, heptacosanol, clerodane furano diterpene, diterpenoid furanolactone tinosporidine, columbin and b-sitosterol. Berberine, Palmatine, Tembertarine, Magniflorine, Choline, and Tinosporin are reported from its stem.[15,16,17]

Nutritive composition of tinospora cordifolia: T. cordifolia contains high fibre (15.9%), sufficient protein (4.5%-11.2%), sufficient carbohydrate (61.66%), and low fat (3.1%). Its nutritive value is 292.54 calories per 100 g. It has high potassium (0.845%), high chromium (0.006%), sufficient iron (0.28%) and sufficient calcium (0.131%), important in various regulatory functions.[18]

Antidiabetic property of giloe

Giloe mainly contains protein and dietary fibre contents, appreciable levels of major and minor elements namely Zn, Mn, Cl, K, Ca, Ti, Cr, Fe, Co, Ni, Cu, Br, and Sr are found in this herb, which act as micronutrients for health restoration and alleviate degenerative processes in diabetes.[19,20] Crude values for food content in Tinospora include high fibre (15.19%), sufficient protein (4.5%- 11.2%), sufficient carbohydrate (61.66%), and low fat (3.1%). Nutritive value is 292.54 calories per 100 g. It has high potassium (0.845%) (regulatory function of nerve impulses), high chromium (0.006%) (regulation of carbohydrate utilization pathophysiological alterations in diabetes), sufficient iron (0.28%) (to improve haematopoietic functions especially in diabetic nephropathy where erythropoietin release from kidney is compromised), and sufficient calcium (0.131%) (regulatory functions in nervous, cardiovascular, and musculoskeletal systems).[21]

The stem of *Tinospora cordifolia* is widely used in the therapy of diabetes by regulating the blood glucosein traditional folk medicine of India. It has been reported to mediate its anti-diabetic potential through mitigating oxidative stress (OS), promoting insulin secretion and also by inhibiting gluconeogenesis and glycogenolysis, thereby regulating blood

glucose.Alkaloids, tannins, cardiac glycosides, flavonoids, saponins, and steroids as the major phytoconstituentsof *Tinospora cordifolia* have been reported to play an anti-diabetic role.[22,23]

The isoquinoline alkaloid rich fraction from stem, including, palmatine, jatrorrhizine, and magnoflorine have been reported for insulin-mimicking and insulin-releasing effect both *in vitro* and *in vivo*. Oral treatments of root extracts have been reported to regulate blood glucose levels, enhance insulin secretion and suppress OS markers. Initiation and restoration of cellular defence anti-oxidant markers including superoxide dismutase (SOD), glutathione peroxidase (GPx) and glutathione (GSH), inhibition of glucose 6-phosphatase and fructose 1, 6-diphosphatase, restoration of glycogen content in liver was reported in *in vitro* studies. The crude stem ethyl acetate, dichloromethane (DCM), chloroforms and hexane extracts of *Tinospora cordifolia* inhibited the enzyme's salivary and pancreatic amylase and glucosidase thus increasing the post-prandial glucose level and finds potential application in treatment of diabetes mellitus.[24]

Glycosylated haemoglobin, plasma thiobarbituric acid reactive substances, hydro peroxides, ceruloplasmin, and vitamin E levels were all lower in diabetic rats given the root of Tinospora cardifolia extract. Oral administration of *Tinospora cordifolia* extract in "Ilogen-Excel" formulation (Ayurvedic herbal formulation) composed of eight medicinal plants including *Curcuma longa*, *Strychnos potatorum*, *Salacia oblonga*, *Tinospora cordifolia*, *Vetivelia zizanioides*, *Coscinium fenestratum*, *Andrographis paniculata*, and *Mimosa pudica* is reported to reduce GSH and vitamin C[25]in blood and urine glucose and lipids in the serum and tissues in alloxan diabetic rats with a subsequent decrease in body weight.[26] Decreased concentration of GSH, GPx, and SOD, catalase activity is reported in heart and brain of diabetic rats.[27] *T. cardifolia* root extract (TCE) has been reported to cause an increase in body weight, total hemoglobin and hepatic hexokinase[28] and lowering hepatic glucose-6-phosphatase, serum acid phosphatase (ACP), alkaline phosphatase (ALP), and lactate dehydrogenase (LDH) in diabetic rats thus having hypoglycemic and hypolipidaemic effect.[29] The protective effects of TCE were reported in presence of higher levels of anti-oxidant molecules and enzymes. TCE has been shown to significantly counterbalance the diabetes-associated OS in the maternal liver by lowering the levels of malondialdehyde and ROS and the increased levels of GSH and total thiols.[30]

Antidiabetic Activities of Tinospora cordifoliaAqueous extract of tinospora cordifolia showed significant anti hyper-glycemic activity in mild to moderate degree of hyper glycemia .In mild diabetes,the maximum percent reduction in glucose was seen in groups receiving 400mg kg per day Alloxan-rats was used as animal model for 21- 120 d Antihyperglycemic Effects on key metabolic enzymes involved in carbohydrate metabolism, significant glycemic control in mild and moderate type diabetes Increases in body weight, total hemoglobin and hepatic hexokinase[31] Aqueous extract of tinospora cordifolia showed significant anti hyper-glycemic by using Streptozotocin-rats' for 6 weeks antihyperglycemic Significant reduction in blood and urine glucose.[32]

Pharmacological studies have proven in vivo antidiabetic potential of various extracts of T. cordifolia. Aqueous extract of stem obtained from another species of Tinospora- 'Tinospora crispa' also reported to possess antihyperglycemic effect probably by stimulation of insulin release via modulation of β-cell and Ca2+ concentration.[33] Borapetoside C isolated from Tinospora crispa (5 mg/kg, i.p.) attenuated the elevated plasma glucose in diabetic mice, increased glucose utilization, delayed the development of insulin resistance and then enhanced insulin sensitivity. The activation of insulin-induced IR-Akt-GLUT2 expression in liver and the enhancement of insulin sensitivity may have contributed to the hypoglycemic action of borapetoside C.[34]

One Ayurvedic polyherbal formulation 'Ilogen-Excel', which contains T. cordifolia as one of the constituents, administered at the dose of 50 and 100 mg/kg for 60 d which has shown significant decrease in blood glucose levels and increase in plasma insulin, hepatic glycogen and total hemoglobin. The root extract of plant lowered the levels of glycosylated hemoglobin, plasma thiobarbituric acid reactive substances, hydroperoxides and ceruloplasmin in diabetic rats.[35]A herbomineral formulation 'Hyponidd' is reported for its hypoglycemic potential as well as antioxidant activity and the results are comparable with earlier reports on this plant.[36]

Anti-Diabetic Activity The extract of T. cordifolia stem ameliorates the derangements in lipid metabolism caused by diabetes mellitus in streptozotocin induced diabetic rats.[37] The oral administration of various extracts (hexane, ethyl acetate and methanol) of T. cordifolia stem was found to have potent antidiabetic property by reducing blood sugar level in streptozotocin induced diabetic rats at a dose of 250 mg/kg.[38] The polyherbal formulation, Dihar containing eight different herbs viz., Syzygium cumini, Momordica charantia, Emblica

officinalis, Gymnema sylvestre, Enicostemma littorale, Azadirachta indica, T. cordifolia and Curcuma longa significantly reduces level of lipid peroxidation and increases activity of antioxidant enzymes in streptozotocin induced diabetic rats.[39] The ethyl acetate, dichloromethane, chloroform and hexane extracts of T. cordifolia stem were evaluated for alpha glucosidase inhibition activity and resulted that the dichloromethane extract was the most effective i.e. 100% inhibition of the alpha glycosidase than others.[40] The ethanol extract of T. cordifolia demonstrates an androgenic activity. Saponarin isolated from leaf extract of T. cordifolia showedhypoglycaemic activity at doses of 20-80 mg/kg. [The hydro alcoholic and chloroform extracts of T. cordifolia stem demonstrates significant antidiabetic property at 250 and 500 mg/kg dose dependently in alloxan induced diabetic rats.[41]

Diabetic patients are advised to use guduchi with caution, since it can lower blood sugar levels. In case you are about to undergo a surgery, stop consuming guduchi two weeks beforehand, since it can interfere with blood sugar control during the surgery. Guduchi should be avoided during pregnancy and breastfeeding. The samoolam, or whole plant, is crushed and juice extracted under the Siddha System of Medicines for Diabetes,[42] the samoolam or the whole plant is crushed and juice is extracted. 2 to 3 ounce of this juice is given 3 times daily before food and it is a very effective remedy to control the glucose level. The leaves are baked in fire and applied externally over the ulcers Fever can be treated with the decoction prepared by the samoolam. This decoction can be made with parpadakam, chandanam, chukku, and koraikizhangu for better outcomes. Seenthil sarkarai or Seenthil uppu is an efficient Siddha medicine for sexual illnesses, diabetes, skin problems, spleenomegally, jaundice, cough, and other ailments. Suram (fever), diarrhoea, venereal infections, and other ailments respond well to Seethil leghyam. The juice of this plant is recommended daily in the case of AIDS. This plant's research has shown that it boosts the patient's immunity and defence mechanisms against the retrovirus, as well as lengthening their lives. For rheumatic symptoms like rheumatoid arthritis, 20 to 30 ml of this plant's juice twice daily is recommended. In conditions such as chronic skin problems, bone disorders, and infertility, Seenthil choornam and Seethil uppu have been proven to provide outstanding outcomes.[43]

Various phytoconstituents isolated from different parts of T. cordfolia are responsible for cure of diabetes mellitus. These phytochemicals include alkaloids, tannins, cardiac glycosides, flavonoids, saponins and steroids.[44] It has the magical potential of lowering the

blood sugar level in human beings. The isoquinoline alkaloid rich fraction from stem, includes palmatine, jatrorrhizine and magnoflorine which show insulin mimicking and insulin releasing effect both in vitro (using rat pancreatic β-cell line, RINm5F) and in vivo 45. Another isoquinoline alkaloid 'berberin' is reported to be highly effective for curing human diabetes. It lowers elevated glucose level as effectively as metformin. It also improves hepatic metabolism during insulin resistance and metabolic syndrome by inhibiting FOXO1 which integrates mitochondrial function with insulin signaling. By adenosine. monophosphate-activated protein kinase activation, it decreases the blood sugar and cholesterol level and maintains the blood pressure. Besides, tinosporin, isocolumbin, palmatine, tinocordiside, cordioside and βsitosterol compounds present in stem and root are also reported to possess ant diabetic, antihyperlipidemic and antioxidant properties as shown.[45] Due to presence of major and minor essential minerals such as Zn, Mn, Cl, K, Ca, Fe, Co, Ni and Cu and proteins and fibres in T. cordifolia parts, it helps in health restoration and in alleviation of degenerative processes in diabetes.[46] Crude values for food content in Tinospora cordifolia include high fibre (15.19%), sufficient protein (4.5%-11.2%), sufficient carbohydrate (61.66%), and low fat (3.1%). Nutritive value is 292.54 calories per 100 g. It has high potassium (0.845%) (regulatory function of nerve impulses), high chromium (0.006%) (regulation of carbohydrate utilization pathophysiological alterations in diabetes), sufficient iron (0.28%) (to improve haematopoietic functions especially in diabetic nephropathy where erythropoietin release from kidney is compromised), and sufficient calcium (0.131%) (regulatory functions in nervous, cardiovascular, and musculoskeletal systems).[47]

CONCLUSION

Diabetes mellitus is the world's most common endocrine ailment and one of the leading causes of cardiovascular disease. By the year 2025, diabetes is predicted to affect almost 300 million people around the world. There are several anti-diabetic medications on the market that are beneficial to these patients, but with recent trends of hypoglycemic drug overuse, the risk of resistance and problems increases. Moreover, due to its sensitivity and effectiveness in long-term usage of one type of medicine, the therapeutic dosage in patients must be increased. As a result, individuals are turning to Ayurvedic and herbal treatments, which have less side effects, are less expensive, and have fewer contraindications. The current study is designed to evaluate the anti-diabetic properties of T. cordifolia which is quite promising reaseach studies conducted on its extracts proving it as a preventive as well as curative anti-

diabetic herb, which are substantiated by clinical trials. This is really a miraculous herb having the choice to be used in each and every ailments.

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