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AN ANALYTICAL REVIEW OF PLANTS FOR ANTI DIABETIC ACTIVITY WITH THEIR PHYTOCONSTITUENT & MECHANISM OF ACTION

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ABSTRACT:

Diabetes and its different types is an age old disease for clinicians since centuries. Many aspects of Diabetes needs to be explored with respect to physiological actions of insulin and the various clinical features of this disease such as tissue complication , since this is life style disease , so proper treatment in relation to diet and anti diabetic agents is emphasized In fact, herbal treatment for diabetes is not new. Plants and plant extracts were used to combat the disease as early as 1550 B.C., with as many as 400 "prescribed" before the development earlier this century of effective medications to control diabetes. In this paper an attempt has been made to give an overview of certain Indian plants with their phytoconstituents and mechanism of action which have been studied for their antidiabetic activity.

INTRODUCTION: Herbal medicine is the oldest form of healthcare known to mankind. Herbs had been used by all cultures throughout history. It was an integral part of the development of modern civilization. Primitive man observed and appreciated the great diversity of plants available to him. The plants provided food, clothing, shelter, and medicine. Much of the medicinal use of plants seems to have been developed through observations of wild animals, and by trial and error. As time passes off, each tribe added the medicinal power of herbs in their area to its knowledge base. They methodically collected information on herbs and developed well-defined herbal pharmacopoeias. Indeed, well into the 20th century much of the pharmacopoeia of scientific medicine was derived from the herbal lore of native peoples. Many drugs commonly used today are of herbal origin. Indeed, about 25 percent of the prescription drugs dispensed in the United States contain at least one active ingredient derived from plant material. Some are made from plant extracts; others are synthesized to mimic a natural plant compound.

The World Health Organization (WHO) estimates that 4 billion people, 80 percent of the world population, presently use herbal medicine for some aspect of primary health care. Herbal medicine is a major component in all indigenous peoples' traditional medicine and a common element in Ayurvedic, homeopathic, naturopathic, traditional oriental, and Native American Indian medicine. WHO notes that of 119 plant-derived pharmaceutical medicines, about 74 percent are used in modern medicine in ways that correlated directly with their traditional uses as plant medicines by native cultures. Major pharmaceutical companies are currently conducting extensive research on plant materials gathered from the rain forests and other places for their potential medicinal value. This article has an objective to collect scattered scientific information on the herbs of hypoglycemic activity and to provide present status of plants on which antidiabetic activity has been done,

MATERIAL AND METHOD: The information on the plants having antidiabetic activity was collected from different web sites Journal and books available. These were further studied specifically to analyze the phyto-constituent and different mechanism which can alter the blood glucose metabolism. Based upon the hypothesis plants belong to specific family may have similar type of chemical composition and similar type of mechanism of action. The screening has been done on 83 Indian journals and 13 international journals containing 99 plants 45 families 7 basic phytoconstituent and 8 mechanism of action. After compilation of data the method has been opted from generalization to specification. Table 1 contains List of plants having Antidiabetic activity with their chemical constituents and mode of action; where as Constituent Vs Mode of Activity has been described in Table 2. To understand the mechanism of action fig-1 has been provided along with figures of phytoconstituent in fig-2.

TABLE-1 LIST OF PLANTS HAVING ANTI-DIABETIC ACTIVITY

Botanical Name	Local Name*	Family	Parts used	Mechanism of action	Chemical Constituents
Abies pindrow Royle[1]	Morinda / Rodha	Pinaceae	Entire plant	Insulin secretagogue activity	Volatile oil
***Abroma augusta* Linn**[2]	Devil's cotton	Sterculiaceae	Roots & Leaves	Lowering blood sugar	Fixed oil, Alkaloid
***Acacia arabica* willd**[3]	Babool	Leguminosae	Seed	Initiate release of insulin	arabin
***Achyranthus aspera L*.**[4]	chirchiri	Amaranthaceae	Entire plant	Decrease blood sugar	
***Agrimony eupatoria* L.**[5]		Rosaceae	Leaves	Insulin releasing & insulin like activity	
***Ajauga iva* wall.ex.Benth**[6]	Bugle weed	Labiatae	Entire plant	Decrease plasma glucose level	
***Allium sativum* Linn.**[7]	Lehsun	Liliaceae	Roots	Antihyperglycemic and antinociceptive effect	v.oil, Allin, Allicin
***Allium cepa* Linn.**[8]	Pyaz	Liliaceae	Bulb	Stimulating effects on glucose utilization and antioxidant enzyme	Protein, carbohydrate, vit. A,B,C, Allyl propyldisulphide
***Aloe vera* Tourn. ex. Linn.**[9, 10, 11]	Gheequar	Liliaceae	Entire plant		Aloin glycoside
Aloe barbadensis Miller[12]	Gheequar	Liliaceae	Leaves	Stimulating synthesis and/or release of insulin	Barbaloin, isobarbaloin, resin
***Amaranthus spinosus* Linn.**[13]	Kataili chaulai	Amaranthaceae	Stem		
***Anacardium occidentale* Linn**[14]	Kaju	Anacardiaceae	Entire plant		Flavonols, terpenoid, caumarin, phenolic compound,essential oil
Andrographis paniculata Nees [15, 16]	Kalmegh	Acanthaceae	Entire plant	Increase glucose metabolism	Diterpenoid lactone andrographoloid
Annona squamosa[17]	Sharifa	Annonaceae	Leaves	Hypoglycemic and antihyperglycemic activities of ethanolic leaf-extract, Increased plasma insulin level	Acetogenins- squamosin B, squamosamide,reticulatain -2,isosquamosin
Artemisia pallens Wall[18]	Davana	Compositae	Aerial parts	Hypoglycemic, increases peripheral glucose utilization or inhibits glucose reabsorption	Essential oil, davanone
Averrhoa bilimbi[19, 20]	Bilimbi	Oxalidaceae	Leaves	increase serum insulin level	
***Azadirachta indica* A.juss.**[21]	Neem	Meliaceae	Leaves	Glycogenolytic effect due to epinephrine action was blocked	Nimbidin, Nimbin, Nimbidol, Nimbosterol
***Beta vulgaris* Linn**[22]	chukandar	Chenopodiaceae	Leaves	Reduce blood glucose level by regeneration of β cells	
Bidens pilosa[23]		compositae	Aerial parts		Polyacetylenic glucoside
Bixa orellana L.[24]	Annotta	Bixaceae	Entire plant	Increase plasma insulin conc. & increase insulin binding on insulin receptor	Oleo-resin
Boerhaavia diffusa L. [25]	Punarnava	Nyctaginaceae	Leaves & Entire plant	Increase in hexokinase activity,decrease in glucose-6-phosphatase and fructose bis-phosphatase activity, increase plasma insulin	Alkaloid punarnavaine, punarnavoside

				level	
***Brassica juncea* L.** [26]	Rai	Cruciferae	Leaves & seed	Food adjuvants for diabetic patients	Isothiocyanate glycoside singrin, protein, fixed oil
***Caesalpinia bonducella* Flem.** [27]	Karanju	Leguminose	Seed kernels	Free radicle scavenging	Fatty oil
Camellia sinensis [28]	Green tea (chai)	Theaceae	Leaves	Increase insulin secretion	Polyphenolic constituents (EGCG)
***Capparis deciduas* Edgew** [29]	Karer	Capparidaceae	Powder	Hypoglycemic,antioxidant, hypolipidaemic	
***Capsicum frutescens* Linn.** [30]	Mirch	Solanaceae	Entire plant	Increase insulin secretion & reduction of insulin binding on the insulin receptor	Capsaicin,pritein
***Carum carvi* Linn.** [31]	Shia jira	Umbelliferae	Fruits		V.oil, resin, carvone, fixed oil
Cassia alata [32]	Ringworm senna	Caesalpiniaceae	Leaves		
Cassia auriculata [33]	Tarwar	Caesalpiniaceae	Flower	Increase utilization of glucose through increase glycolysis	
***Catharanthus roseus* G.Don** [34]	Sadabahar	Apocynaceae	Leaves, twig & flower	Increase metabolisation of glucose	Indole alkaloid, vincristine vinblastin
Cinnamomum zeylanicum Nees [25]	Dalchini	Lauraceae	Bark	Elevation in plasma insulin	V.oil, tannin, mannitol, ca.oxalate,
***Clausena anisata* Burm.f.** [36]		Rutaceae	Roots	Stimulate secretion of insulin	
***Coriandrum sativum* Linn.** [37]	Dhania	Umbelliferae	Seed		V.oil, fixed oil, protein
Coscinium fenestratum Calebr [38]	Jharhaldi	Menispermaceae	Stem	Increase enzymatic antioxidants	Barberine ,glycoside,saponin
Croton cajucara Benth [39]	Jamalgota	Euphorbiaceae	Bark		Fixed oil
***Cryptolepis sanguinolenta* R.** [40]	Anantmul	Asclepidaceae	Entire plant	Increase glucose uptake by 3T3-L1 cells	Cryptolepine
***Eclipta alba* Linn.** [41]	Bhringraj	Compositae	Leaves	Decrease activity of glucose-6-phosphatase& fructose-1-6,bisphasphatase	Ecliptin alkaloid
Embellica officinalis Gaertn. [42]	Amla	Euphorbiaceae	Fruits	Reduce 5-hydroxymethylfurfural,creatinine albumin level	Vit.C, tannin
Enicostemma littorale Blume [43, 44, 45]	Chhota chirayata	Gentianaceae	Entire plant	Decrease glycosylated Hb & glucose 6 phosphatase	Swertiamarine glycoside
***Eugenia jambolana* Lam.** [46, 47, 48]	Jamun	Myrtaceae	Seed, fruit , leaves, kernel	Lowers plasma glucose level	
***Eucalyptus globulus* Labill.** [49]	Eucalyptus	Myrtaceae	Leaves	Increase insulin secretion from clonal pancreatic beta line (BRIN-BD 11)	Essential oil , cineol
Euphrasia officinale [50]	Eyebright	Scrophulariaceae	Leaves		
***Ficus religiosa* Linn.** [51]	Peepal	Moraceae	Entire plant	Initiating release of insulin	Tannin
Ficus	Bargad	Moraceae	Bark	Rising serum insulin	Tannin

***bengalensis* Linn.**[52]					
Ficus carica[53]	Anjir	Moraceae	Leaves		
***Gymnema montanum* hook f.**[54]		Asclepiadaceae	Leaves	Antioxidant& antiperoxidative	
***Gymnema sylvestre* R.**[55, 56, 57, 58,]	Gudmar	Asclepiadaceae	Leaves	Lowers plasma glucose level	Gymnemic acid, quercital
***Gentiana olivier*Griseb.**[59]		Gentianaceae	Flowers	Lowers plasma glucose level	Iso-orientin C-glycoside
***Glycerrhiza glabra* Linn.**[60]	Mulethi	Leguminosae	Root	Lowers plasma glucose level	Triterpenoid,saponin, glycerrhizin
Gynura procumbens[61]		Compositae	Leaves	Lowers plasma glucose level	
***Hibiscus rosa sinensis* Linn.**[62]	Gudhal (china rose)	Malvaceae	Entire plant	Stimulate insulin secretion from beta cells	Vit.B,C, Fat,
***Helicteres isora* Linn.**[63]	Indian screw tree	Sterculiaceae	Root	Decrease plasma triglyceride level & insulin sensitizing activity	Saponin ,tannin, lignin
Hordeum vulgare[64]	Jau	Graminaeae	Barley seed		
Hovenia dulcis Thunb[65]	Sicka	Rhamnaceae	Entire plant		flavonoids
***Ipomoea aquatica* Forsk.**[66]	Kalmisag	Convolvulaceae	Leaves	Reduce fasting blood sugar level & serum glucose level	Carotene
***Ipomoea batata* Linn.**[67]	Shakarkand	Convolvulaceae	Tubers	Reduce insulin resistance & blood glucose level	
***Juniperus communis* Linn.**[68]	Hauber	Pinaceae	Fruits	Increase peripheral glucose consumption & induce insulin secretion	
***Lupinus albus* Linn.**[69]	Turmas	Fabaceae	Seed	Lower serum glucose level	Alkaloid , fatty oil, asparagines
***Luffa aegyptiaca* Mill.**[70]	Ghiatori	Cucurbitaceae	Seed	Lactigogue activity	Fatty oil
Leucas lavandulaefolia Rees[71]	Kumbha	Labiatae	Entire plant	Reduce blood glucose level	
Lagerstronemia speciosa[72]	Jarul	Lythraceae	Leaves		
Lepidium sativum[73]	Halim, hurf	Cruciferae	Seeds		
***Mangifera indica* Linn.**[74]	Mango	Anacardiaceae	Leaves	Reduction of intestinal absorption of glucose	Mangiferin
Myrtus communis L.[75]	Vilayati mendhi	Myrtaceae	Leaves	Lower blood glucose level	V.oil mirtii oleum
Memecylon umbellatum Burm[76]	Anjani	Melastomataceae	Leaves	Lower serum glucose	
Momordica cymbalania Fenzl ex naud in[77]	kadavanchi	Cucurbitaceae	Fruit powder	Reduce blood glucose level	
Mucuna pruriens L.[78]	Kiwach	Leguminosae	Seed	Reduce blood glucose level	
***Musa sapientum* Linn.**[79]	Banana	Musaceae	Flower	Reduce blood glucose &glycosylated Hb	
***Momordica charantia* Linn.**[80]	Karela	Cucurbitaceae	Fruit	Reduce blood glucose level	Momordicine alkaloid, ascorbic acid
Morus indica L.[81]	Shehtoot	Moraceae	Leaves	Increase glucose uptake	

***Murraya koeingii (L)spreng*[82]	Curry leaf	Rutaceae	Leaves	Increase glycogenesis , decrease glycogenolysis & gluconeogenesis	
***Nelumbo nucifera* Gaertn.[82]**	Lotus	Nymphaeaceae	Rhizome	Reduce blood sugar level	Nuciferin, nornuciferin
***Ocimum sanctum* Linn.[84]**	Tulsi	Labiatae	Leaves	Lowering blood sugar level	V.oil, phenol, aldehyde, fixed oil, alkaloid, tannin, ascorbic acid
***Olea europia* Linn.[85]**	Olive	Oleaceae	Leaves	Potentiation of glucose , induced insulin released , & increase peripheral uptake of glucose	Oleuropeoside
***Opuntia Ficus indica Mill*[86]**	Indian fig	Cactaceae	Stem		
***Pandanus odorus* Linn.[87]**	Kevra	Pandanaceae	Root	Decrease plasma glucose level	Essential oil
***Panax ginseng* Mey.[88]**	Pannag	Araliaceae	Root & entire plant	Lowering blood sugar level	Glycans, panaxans I,J,K & L
***Punica granatum Linn*[89]**	Anar	Punicaceae	Seed	Reduce blood sugar level	Vit.C, protein, tannin, gallic acid, pelletierine
***Picrorrhiza kurroa Royle ex. Benth*[90]**	Katuka	Scrophulariaceae	Entire plant	Decrease serum glucose	Picrorrhizin, kutkin
***Phyllanthus amarus*[91]**	Bhui amla	Euphorbiaceae	Entire plant	Decrease blood glucose level	Alkaloids
***Phaseolus vulgaris*[92, 120]**	Lobia	Papilionaceae	Pod, seed, whole plant	Hypoglycemic, hypolipidemic, inhibit alpha amylase activity,antioxidant.	
***Salacia oblonga*[93]**	Chundan	Celastraceae	Root	inhibition of alpha glucosidase activity	
***Salacia reticulata* Wight.[94]**	Anukudu chettu	Celastraceae	Stem & root	inhibition of alpha glucosidase activity	
***Swertia chirayata* Roxb.ex.Flem[95]**	Chirayata	Gentianaceae	Entire plant	Stimulates insulin release from islets	Zanthone mangiferin, gentianine, swerchirin
***Syzygium cumini Linn*[96]**	Jamun	Myrtaceae	Seed	Decrease blood glucose level	
***Scoparia dulcis* Linn.[97]**	Mithi patti	Scrophulariaceae	Leaves	Decrease glycosylated Hb & Inc. total Hb, Insulin-secretagogue activity	
***Trigonella foenum graceum*[98]**	Methi	Leguminosae	Seed	Decrease blood glucose concentration	Protein, fat, V.oil, fixed oil, carbohydrate
***Tribulus terrestris* Linn.[99]**	Gokhru	Zygophyllaceae	Saponin	Decrease serum glucose	Harmine
***Tinospora crispa* Linn.[100]**	Giloe	Menispermaceae	Stem	Anti-hyperglycemic, stimulates insulin release from islets	
***Tinospora cardifolia* Willd.[101]**	Giloe	Menispermaceae	Root	Decrease blood glucose & brain lipid	Berberine, starch
***Tamarindus indica* Linn.[102]**	Imli	Caesalpimiaceae	Seed		

***Teramnus labialis* (Roxb) Benth**[103]	Mashoni	Fabaceae	Aerial parts		Caumarin -fraxidin
***Urtifca dioica* Linn.**[104]	Bichhu booti	Urticaceae	Leaves	Increase insulin secretion	Fatty oil
***Viscum album* Linn.**[105]	Vadank	Loranthaceae	Entire plant	Alpha glucosidase inhibitor	
Vinca rosea[106]	Sadabahar	Apocynaceae	Leaves	Beta cell rejuvenation, regeneration, & stimulation	Vincristine , vinblastine
***Withania somnifera* Dunal**[107]	Ashwagandha	Solanaceae	Root	Decrease blood sugar level	Withanine, somnine, withaferine, withanolides
Xanthium strumarium[108]	Chhota gokhru	Compositae	Fruits	Increase glucose utilization	Phenolic compound ,caffeic acid
Zingiber officinale Roscoe[109]	Adrak	Zingiberaceae	Rhizome	Increase insulin level & decrease fasting glucose level	Sesquiterpene
Zizyphus sativa Gaertn[110]	Pitni-ber	Rhamnaceae	Leaves	Dose dependent reduction in blood glucose level	Tannin

TABLE-– 2 CONSTITUENTS Vs MODE OF ACTIVITY

Constituents	Mode of Activity
Alkaloids[113]	**Inhibit alpha-glucosidase and decrease glucose transport through the intestinal epithelium**
Imidazoline compounds[114]	**Stimulates insulin secretion in a glucose-dependent manner.**
Polysaccharides[115]	**Increased the levels of serum insulin, reduce the blood glucose levels and improve tolerance of glucose**
Flavonoids[116]	**Suppressed the glucose level, reduced plasma cholesterol and triglycerides significantly and increased their hepatic glucokinase activity probably by enhancing the insulin release from pancreatic islets**
Dietary fibers[117]	**Effectively adsorbed glucose, retard glucose diffusion and inhibit the activity of alpha-amylase and may be responsible for decreasing the rate of glucose absorption and concentration of postprandial serum glucose**
Saponin, (Triterpenoid +steroidal glycosides) [118]	**Stimulates the release of insulin and blocks the formation of glucose in the bloodstream,**
Ferulic acid[119]	**Stimulatory effects on insulin secretion**

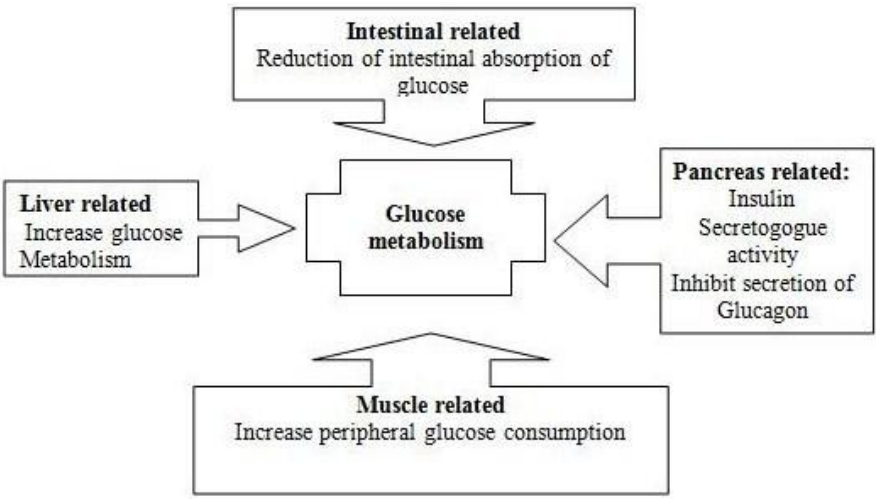
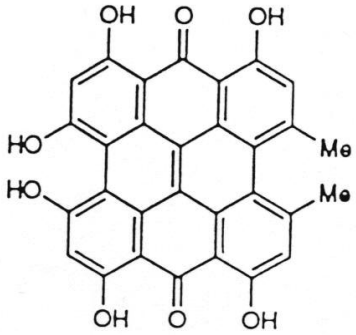
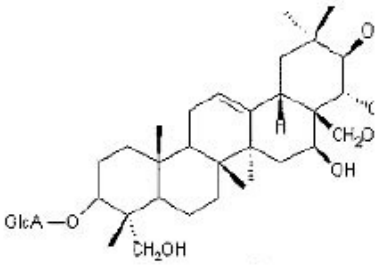


Fig 1: Explaining Mechanism of action to control Glucose metabolism

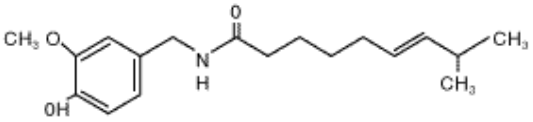


Hypericine

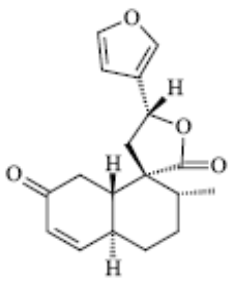


Gymnemic acid

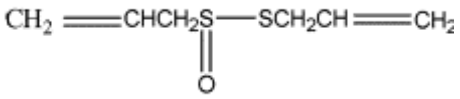
	R_1	R_2
Gymnenic acid 2:	2-Methylbutyloyl	Ac
Gymnemic acid 3:	2-Methylbutyloyl	H
Gymnemic acid 4:	Tigloyl	H



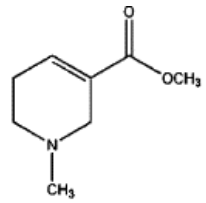
Capsaicin



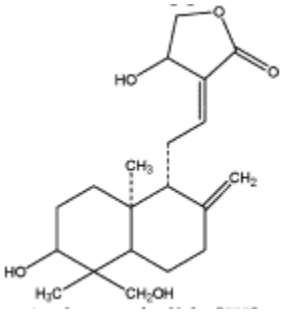
trans-dehydrocrotonin



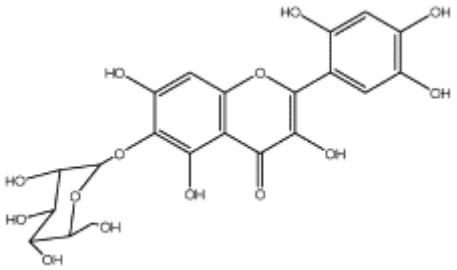
Allicin



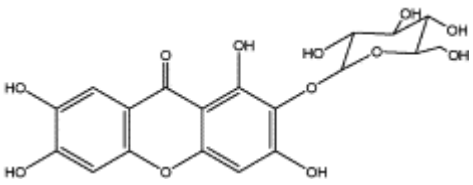
Arecoline



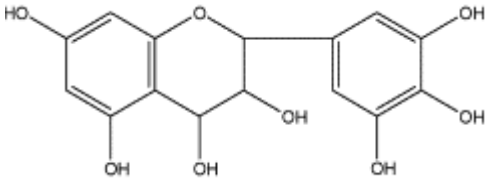
Andrographolide



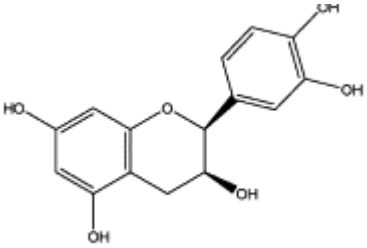
Shamimin



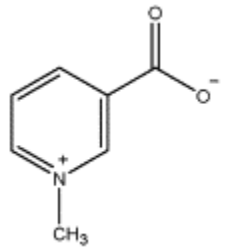
Mangiferin (IX)



Leucodelphidin **(**X)



(-) Epicatechin



Trigonellin

Fig-2: Structures of chemical constituents belong to hypoglycemic activity

CONCLUSION: Diabetes is a disorder of carbohydrate, fat and protein metabolism attributed to diminished production of insulin or mounting resistance to its action. Herbal treatments for diabetes have been used in patients with insulin-dependent and non-insulin-dependant diabetes, diabetic retinopathy, diabetic peripheral neuropathy, etc. Scientific validation of several Indian plant species has proved the efficacy of the botanicals in reducing the sugar level.

There are several plants known for their antidiabetic activity, with different mode of action and phytoconstituents. This is an effort to streamline the phytoconstituents of specific family with specific mode of action to reduce plasma glucose. Keeping in view from the reports on their potential effectiveness against diabetes, it is assumed that the botanicals have a major role to play in the management of diabetes, which needs further exploration for necessary development of drugs and nutraceuticals from natural resources[111-11].

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