International Journal for Pharmaceutical Research Scholars (IJPRS)

V-3, I-1, 2014 ISSN No: 2277 - 7873

REVIEW ARTICLE

Medicinal Plants with Antidiabetic Potential - A Review on Ten Years of Research (2003-2013)

Km. Preeti*, Anshu bala Verma, Babita Gautam, Arun bala Saroj, Shalini Tripathi

Department of Pharmacology, Rameshwaram Institute of Technology and Management, Lucknow-227202, India.

Manuscript No: IJPRS/V3/I1/00062, Received On: 05/02/2014, Accepted On: 12/02/2014

ABSTRACT

Medical plants play an important role in the management of diabetes mellitus especially in developing countries where resources are meagre. This review presents the profiles of plants with hypoglycaemic properties, reported in the literature from 2003 to 2013. The profiles presented include vital information about herbal drugs. The large number of plants described in this review clearly demonstrated the importance of herbal plants in the treatment of diabetes. It also shows the effort to isolate new potential antidiabetic agents. Many studies have confirmed the benefits of medicinal plants with hypoglycaemic effects in the management of diabetes mellitus. The effects of these plants may delay the development of diabetic complications and correct the metabolic abnormalities. Moreover, during the past few years some of the new bioactive drugs isolated from hypoglycaemic plants showed antidiabetic activity with more efficacy than oral hypoglycaemic agents used in clinical therapy.

KEYWORDS

Hypoglycaemic, Antidiabetic, Medicinal Plants, Diabetes Mellitus

INTRODUCTION

Diabetes mellitus is chronic metabolic disorders that affect human body in terms of physical, psychological and social health. It is defined as a group of disorders characterized by hyperglycemia, altered metabolism of lipids, carbohydrates and proteins.[1,2] It is becoming the third "killer" of the health of mankind along with cancer, cardiovascular and cerebrovascular diseases.[3] The prevalence of diabetes mellitus is expected to reach up to 4.4% in 2030, and the occurrence was found to be high in India, China, and USA. Historical accounts reveal that as early as 200 BC, diabetes mellitus was well recognized disease in India even as distinguished in two types:

***Address for Correspondence:**
Km. Preeti
Department of Pharmacology,
Rameshwaram institute of technology and management,
Lucknow-227202, India.
E-Mail Id: preeti30sept@gmail.com

a genetically based disorder and a dietary related disorder.[4] Diabetes mellitus is a global health crisis, which has been persistently affecting the humanity, irrespective of the socioeconomic profile and geographic location of the population. According to an estimate, one person is detected with diabetes every 5 sec somewhere in the world, while someone dies of it every 10 sec.[5]

Several medicinal plants have been used as dietary adjunct and in the treatment of numerous diseases without proper knowledge of their function. Although phytotherapy continues to be used in several countries, few plants have received scientific or medical scrutinity.[6] Plants and plant derived compounds have a great potential to cure and control diabetes, additionally they are safer and cost effective. Since the antiquity Diabetes has been treated

with plant medicines and many plants were known for their antihyperglycaemic activity across the world. Now a days more than 400 plants species having hypoglycemic property and many of them still remain to be scientifically evaluated.[7,8]

We believe that the list of medicinal plants presented in this review is useful to researchers, as well as practitioners. This list is best used only as a preliminary screening of potential antidiabetic plants, not as a definitive or complete list of hypoglycaemic plant.

Plant name	Family	Part used	Result/ Experimental modal	Ref.
Ipomoea aquatica	Convolvaceae	Leaf	Reduces the fasting blood sugar level of streptozotocin induced diabetic rats	[9]
Panax ginseng	Araliaceae	Root, Berry	Antidiabetic and antihyperglycemic activity	[10]
Sclerocarya birrea	Anacardiaceae	Stem bark	Hypoglycemic activity in normal and in alloxan induced diabetic rats	[11]
Acosmium panamense	Fabaceae	Bark	Glucose lowering activity in streptozotocin diabetic rats	[12]
Barleria lupulina	Acanthaceae	Aerial part	Reduction of blood glucose in streptozotocin hyperglycemic rats	[13]
Bauhinia candicans	Fabaceae	Leaf	Hypoglycemic activity in alloxan-induced diabetic rabbits	[14]
Boerhavia diffusa	Nyctaginaceae	Leaf	Significant reduction in serum and tissue cholesterol, free fatty acids, phospholipids, and triglycerides in alloxone induced diabetic rats.	[15]
Brassica oleracea	Brassicaceae	Stem	Hypoglycemic activity in alloxan induced hyperglycemic rats	[16]
Calamintha officinalis	Lamiaceae	Aerial part	Hypoglycemic effect independently of insulin secretion in streptozotocin induced diabetic rats	[17]
Caralluma attenuata	Asclepidaceae	Whole plant	Glucose lowering activity in both diabetic and normal rats	[18]
Cogniauxia podolaena	Cucurbitaceae	Leaf	Hypoglycemic activity in alloxan induced diabetic rats	[19]
Cyamopsis tetragonoloba	Fabaceae	Bean	Antihyperglycaemic activity in alloxan induced diabetic rats	[20]
Datura metel	Solanaceae	Seed	Blood glucose lowering effect in normoglycemic and in alloxan-induced hyperglycemic rats	[21]
Ficus hispida	Moraceae	Bark	Hypoglycemic activity in normal and diabetic rats	[22]
Helicteres isora	Sterculiaceae	Fruit	Exhibit significant antioxidant activity and moderate antidiabetic activity	[23]
Loranthus micranthus	Loranthaceae	Leaf	Hypoglycemic and antihyper glycaemic activity	[24]
Murraya koenigii	Rutaceae	Leaf	Increases plasma insulin level in alloxan-induced diabetic rats	[25]

Origanum vulgare	Lamiaceae	Leaf	Antihyperglycemic activity in STZ diabetic rats without affecting insulin secretion	[26]
Rehmannia glutinosa	Scrophulariaceae	Root	Hypoglycemic activity in glucose-induced hyperglycemic and alloxan-induced diabetic rats	[27]
Silybum marianum	Asteraceae	Aerial part	Hypoglycemic and antihyperglycemic activity in normal and STZ diabetic rats without affecting insulin secretion	[28]
Tamarindus indica	Fabaceae	Seed	Antidiabetic activity in streptozotocin induced diabetic rats	[29]
Tetrapleura tetraptera	Fabaceae	Fruit	Hypoglycemic activity	[30]
Aegle marmelos	Rutaceae	Fruit	improve functional state of the pancreatic ss-cells and partially reversed the damage caused by STZ to the pancreatic islets	[31]
Bryophyllum pinnatum	Crassulaceae	Leaf	Antidiabetic properties in streptozotocin (STZ)-induced diabetes mellitus	[32]
Curcuma longa	Zingiberaceae	Rhizome	Significantly suppressed an increase in blood glucose level in type 2 diabetic KK-A(y) mice	[33]
Malmea depressa	Annonaceae	Root	Hypoglycemic effect in streptozotocin diabetic rats	[34]
Morus alba	Moraceae	Root bark	Hypoglycemic effect in streptozotocin-induced diabetic rats	[35]
Phyllanthus niruri	Euphorbiaceae	Leaf	Reduces the levels of plasma glucose	[36]
Retama raetam	Fabaceae	Flower	Hypoglycaemic activity in normal and diabetic rats	[37]
Salvia oficinalis	Lamiaceae	Leaf	Hypoglycaemic effect on streptozotocin-induced hyperglycaemic rats	[38]
Syzygium cordatum	Myrtaceae	Leaf	Short-term hypoglycaemic effect in streptozotocin-induced diabetic rats	[39]
Vernonia colorata	Composeae	Leaf	Antidiabetic activity in normoglycaemic and alloxan-induced diabetic rats	[40]
Zizyphus spina-christi	Rhamnaceae	Leaf	Antidiabetic activity	[41]
Bougainvillea spectabilis	Nyctaginaceae	Bark	Sugar-lowering capacity streptozotocin induced diabetic albino rats	[42]
Garuga pinnata	Burseraceae	Bark	Significant increase in the liver glycogen and serum insulin level and a significant decrease in fasting blood glucose and glycated hemoglobin levels	[43]

Pterocarpus marsupium	Fabaceae	Bark	Exhibits significant antidiabetic activity and corrects the metabolic alterations in diabetic rats and this activity may resemble insulin-like properties.	[44]
Sizygium cumini	Myrtaceae	Bark	Significantly decreased the blood glucose, effect exerted by the extract was greater than that of glibenclamide.	[45]
Zizyphus jujuba	Rhamnaceae	Leaf	Significantly reduced fasting serum glucose level and increase serum insulin level	[46]
Anacardium occidentale	Anacardiaceae	Leaf	significantly reduced the blood glucose levels in a dose dependent manner in diabetic rats	[47]
Cichorium intybus	Asteraceae	Whole plant	Shows Antidiabetic Effect in STZ-Diabetic Rats	[48]
Desmodium gangeticum	Fabaceae	aerial parts	Significant reduction in blood glucose & increase in insulin secretion from MIN6 cells grown as monolayers and as pseudo islets, indicating the antidiabetic activity	[49]
Terminalia chebula	Combretaceae	Fruit	Significantly reduced the elevated blood glucose and elevated glycosylated hemoglobin	[50]
Aloe vera	Liliaceae	Leaf	Significant reduction in blood glucose level	[51]
Cyanodon dactylon	Poaceae	Whole plant	Aqueous extract and non-polysaccharide fraction of Cyanodon dactylon shows Antidiabetic activity	[52]
Hemidesmus indicus	Asclepiadaceae	Root	Decrease blood glucose level significantly and restored serum electrolytes, glycolytic enzymes and hepatic cytochrome P-450-dependent enzyme systems	[53]
Mucuna pruriens	Fabaceae	Seed	Hypoglycemic activity in STZ induced diabetic rats.	[54]
Psidium guajava	Myrtaceae	Leaf	Increase the plasma insulin level and glucose utilization in diabetic rats	[55]
Tridax procumbens	Asteraceae	Leaf	Shows antidiabetic activity	[56]
Astragalus membranaceus	Fabaceae	PLSH. fraction	Shows hypoglycemic effect of polysaccharides enriched extract	[57]
Abutilon indicum	Malvaceae	Whole plant	Aqueous extract inhibits glucose absorption and stimulates insulin secretion in rodents.	[58]

Artemisia judaica	Asteraceae	Whole plant	Significantly reduce the blood glucose level in diabetic rats.	[59]
Panax quinquefolius	Araliaceae	Root	significant effects on fasting blood glucose levels and glucose tolerance test	[60]
Butea monosperma	Fabaceae	Leaf	Significant hypoglycemic and anti-oxidant activity in alloxan induced diabetic male adult mice	[61]
Costus speciosus	Costaceae	Root	Significantly decreased Plasma glucose level, glycosylated hemoglobin (HbA(1c)), increased plasma insulin & tissue glycogen.	[62]
Diospyros peregrina	Ebenaceae	Fruit	Possess significant dose dependent hypoglycemic and hypolipidemic activity	[63]
Eugenia jambolana	Myrtaceae	Seed	Showed dose-dependent decrease in blood glucose level in diabetic rats	[64]
Eucalyptus globulus	Myrtaceae	Leaf	Reduces the oxidative stress in alloxan-induced rat	[65]
Ficus bengalensis	Moraceae	Aerial root	Hypoglycemic effect in normoglycemic and antidiabetic effect in sub- and mild-diabetic models	[66]
Gymnema sylvestre	Asclepiadaceae	Leaf	Significant reduction in fasting blood glucose, cholesterol and serum triglyceride content	[67]
Helicteres isora	Sterculiaceae	Fruit	Exhibit significant antioxidant activity and moderate antidiabetic activity	[68]
Inula racemosa	Asteraceae	Root	Significant decrease in blood glucose levels, super oxide dismutase and glutathione	[69]
Leucas lavandulaefolia	Lamiaceae	Whole plant	Significant and consistent hypoglycemic effects in Alloxan hyperglycemic rats	[70]
Moringa oleifera	Moringaceae	Leaf	FBG and PPG levels were reduced whereas, total protein, body weight and haemoglobin were increased	[71]
Otostegia persica	Labiateae	Whole plant	Shows antidiabetic effects on STZ diabetic rats.	[72]
Scorparia dulcis	Scrophulariaceae	Whole plant	Significant increase in plasma insulin levels, evoked two-fold stimulation of insulin secretion from isolated islets, indicating its insulin secretagogue activity	[73]
Tinospora cordifolia	Meninspermaceae	Stem	prevented the rise in glucose levels by 21.3%, insulin by 51.5%, triglycerides by 54.12% and glucose-insulin index by 59.8% of the fructose fed rats	[74]

Withania somnifera	Solanaceae	Root, Leaf	Possess hypoglycaemic and hypolipidaemic activities in alloxan-induced diabetes mellitus (DM) rats	[75]
Annona squamosa	Annonaceae	Root	Shows Antidiabetic activity in Streptozotocin induced- hyperglycemic Rats	[76]
Berberis aristata	Berberidaceae	Root	Strong potential to regulate glucose homeostasis through decreased gluconeogenesis and oxidative stress.	[77]
Begonia malabarica	Begoniaceae	Stem	Reduction in fasting and postprandial plasma glucose levels, increase inSerum insulin levels and liver glycogen levels	[78]
Andrographis stenophylla	Acanthaceae	Leaf	Shows Hypoglycaemic Activity	[79]
Artocarpus heterophyllus	Moraceae	Leaf	Significant reduction in the F.B.S. conc. and a significant improvement in glucose tolerance in normoglycemic rats	[80]
Benincasa hispida	Cucurbitaceae	Fruit	Improve the glucose level and metabolic derangements in lipid caused by alloxan induced diabetes in rats	[81]
Catharanthus roseus	Apocynaceae	Leaf	Lowering of plasma glucose and an increase in plasma insulin were observed	[82]
Costus igneus	Costaceae	Leaf	Reduced the fasting and postprandial blood sugar levels, bringing them towards normal, in dexamethasone-induced hyperglycemia in rats.	[83]
Cecropia pachystachya	Urticaceae	Leaf	Significant hypoglycemic effect with a blood glucose reduction & antioxidant activity	[84]
Cucumis trigonus	Cucurbitaceae	Fruit	Significant increase in the body weight, liver glycogen and serum insulin level and decrease in the blood glucose, glycosylated hemoglobin levels.	[85]
Enicostemma littorale	Gentianaceae	Whole plant	Significant decrease in serum glucose and triglycerides	[86]
Ficus glomerata	Moraceae	Leaf	Shows hypoglycaemic Activity in alloxan Induced Diabetic Rats	[87]
Ficus religiosa	Moraceae	Bark	Significant reduction in blood glucose levels glucose-loaded hyperglycemic and streptozotocin (STZ)-induced diabetic rats.	[88]
Indigofera tinctoria	Fabaceae	Leaf	Significant decrease in blood glucose level of rabbits as estimated by Folin-Wu Method.	[89]
Jatropha curcas	Euphorbiaceae	Leaf	Significant reduction in blood glucose level inalloxan induced diabetic rats.	[90]

Ocimum sanctum	Labiatae	Leaf	Restored the depressed hepatic glycogen levels possibly by increasing the level of insulin	[91]
Paspalum scrobiculatum	Poaceae	Grain	Significant increase in serum insulin level, liver glycogen and a significant decrease in glycated haemoglobin levels	[92]
Phoenix dactylifera	Arecaceae	Leaf	significantly reduced blood glucose &Plasma insulin level increased in alloxan-induced diabetic rats	[93]
Pterocarpus santalinus	Fabaceae	Bark	Significant antidiabetic activity by reducing the elevated blood glucose levels and glycosylated hemoglobin, improving hyperlipidemia and restoring the insulin levels in treated experimental induced diabetic rats	[94]
Pongamia pinnata	Fabaceae	Leaf	Decreased the blood glucose level in alloxan-induced diabetic albino rats	[95]
Vinca rosea	Apocyanaceae	Whole plant	Shows antidiabetic activity in Allaxon diabetic rats.	[96]
Adhatoda zeylanica	Acanthaceae	Leaf	Significant reduction in blood glucose level	[97]
Aloe barbedensis	Liliaceae	Leaf	significant decrease in serum glucose, total cholesterol and triacylglycerols	[98]
Azadirachta indica	Meliaceae	Seed	the whole oil and the acidic portion of oil shows very significant hypoglycaemic effect	[99]
Brassica juncea	Brassicaceae	Seed	Significant dosage dependent augmenting effect of the seed extract on the serum insulin was recorded on streptozotocin induced diabetic male albino rats.	[100]
Camellia sinensis	Theaceae	Leaf	Effective to reduce most of the diabetes associated abnormalities in a steptozotocin-induced diabetes model of rats	[101]
Carum carvi	Apiaceae	Seed	Caraway has both antihyperglycemic and hypolipidemic activity in diabetic	[102]
Coccinia indica	Cucurbitaceae	Fruit	Reduction of fasting blood sugar alloxan induced diabetic rats.	[103]
Coriandrum sativum	Apiaceae	Fruit	Reduced plasma glucose ,insulin and IR, TC, LDL-cholesterol in obese-hyperglycemic-hyperlipidemic (OHH) Meriones shawi rats	[104]
Clerodendron infortunatum	Verbenaceae	Leaf	Significantly reduced blood glucose levels SGOT, SGPT, alkaline phosphatase in STZ diabetic rats.	[105]

Dillenia indica	Dilleniaceae	Leaf	Beneficial effect on blood glucose level and enhance serum insulin level	[106]
Dioscorea alata	Dioscoriaceae	Tuber	Blood glucose level was reduced significantly and Serum lipid levels, total protein, albumin, and creatinine were reversed toward near normal	[107]
Ganoderma lucidum	Ganodermataceae	Fruiting bodies	Body weights and serum insulin levels of the Gl-PS treated groups are significantly higher whereas FBG levels are significantly lower.	[108]
Luffa cylindrica	Cucurbitaceae	Fruit	Shows promising antidiabetic activity in alloxan-induced diabetic Wistar rats.	[109]
Mangifera indica	Anacardiaceae	Leaf Kernel	Significantly increased insulin level at the dose level of 100, 200 mg/kg in alloxan induced diabetic rats.	[110]
Plectranthus amboinicus	Lamiaceae	Leaf	Significant reduction in blood glucose, possesses hypoglycemic and antihyperlipidemic effects mediated through the restoration of the functions of pancreatic tissues and insulinotropic effect	[111]
Stevia rebaudiana	Asteraceae	Leaf	Significant decrease in the blood glucose level, without producing condition of hypoglycemia	[112]
Swietenia macrophylla	Meliaceae	Seed	Significantly reduced blood glucose levels after 45 days of treatment in STZ-diabetic rats	[113]
Symplocos cochinchinensis	Symplocaceae	Leaf	Significant reduction in plasma insulin, plasma and hepatic total cholesterol and a significant increase in liver glycogen were observed in treated diabetic rats.	[114]
Terminalia arjuna	Combretaceae	Leaf	Demonstrated remarkable antihyperglycemic activity in STZ-induced diabetic rats	[115]
Tectona grandis	Lamiaceae	Flower	Shows antidiabetic activity in STZ induced diabetic rats	[116]
Zingiber officinale	Zingiberaceae	Rhizome	Reduced fasting blood glucose, increased serum insulin level and also enhanced insulin sensitivity in alloxan-induced diabetic and insulin resistant diabetic rats	[117]
Biophytum sensitivum	Oxalidaceae	Leaf	Significantly reduce the blood glucose and glycosylated haemoglobin level	[118]
Caesalpinia bonducella	Caesalpiniaceae	Seed	Significant recovery in the activities of carbohydrate metabolic enzymes along with correction in FBG and glycogen levels	[119]

Carica papaya	Caricaceae	Leaf	Exerted a hypoglycemic and antioxidant effect and also improved the lipid profile in diabetic rats	[120]
Cassia fistula	Fabaceae	Stem	Reduced serum blood glucose conc., induced favorable changes in body weight, improved transaminase activity.	[121]
Citrullus colocynthis	Cucurbitaceae	Root	Significant reduction in blood sugar level, serum creatinine, serum urea and serum protein	[122]
Carthamus tinctorius	Asteraceae	Flower	Meaningful decrease in FBS, triglyceride, cholesterol, LDL-C and VLDL-C in diabetic rats	[123]
Cinnamomum tamala	Lauraceae	Oil	Significant reduction in blood glucose level liver glycogen content, plasma insulin level and glycosylated hemoglob instreptozotocin induced diabetic rats	[124]
Cucurbita ficifolia	Cucurbitaceae	Fruit	Hypoglycemic action, improve GSH redox state, increasing glutathione pool	[125]
Dalbergia sissoo	Fabaceae	Bark	Significant reduction in blood glucose levels increase in glycogen content in liver of Alloxan-induced diabetic rats	[126]
Dioscorea bulbifera	Dioscoriaceae	Bulb	Showed α-amylase inhibitory activity	[127]
Emblica officinalis	Euphorbiaceae	Leaf	Showed a significant decrease in fasting blood glucose and increase insulin level as compared with the diabetic rats	[128]
Juglans regia	Juglandaceae	Leaf	Significant reduction of glucose, HbA1c, total cholesterol and serum triglycerides	[129]
Kigelia pinnata	Bignoniaceae	Flower	Significantly reduced blood glucose, serum cholesterol and triglycerides levels	[130]
Luffa acutangula	Cucurbitaceae	Seed	Significantly reduced fasting blood sugar of Streptozotocin diabetic rats in a dose-related manner, with maximum hypoglycemic effect at after 21 days	[131]
Momordica charantia	Cucurbitaceae	Fruit	Isolated compounds, bitter gourd extract, juices and powders have demonstrated potential in lowering blood sugar	[132]

Merremia emarginata	Convulvulaceae	Whole plant	Carbohydrate metabolizing enzymes such as hexokinase were significantly increased whereas G-6-P, fructose-1, 6-bisphosphatase were significantly decreased in diabetic rats.	[133]
Morinda citrifolia	Rubiaceae	Fruit	Gluconeogenic genes, phosphoenolpyruvate C kinase (PEPCK) and glucose-6-phosphatase (G6P), were significantly inhibited	[134]
Merremia tridentata	Convulvulaceae	Root	Significant increase in serum insulin, body weight and glycogen content in liver and skeletal muscle of STZ-induced diabetic rats	[135]
Punica granatum	Punicaceae	Rind ,Leaf	Showed significant and dose dependent antidiabetic activity by maintaining the blood glucose levels within the normal limits.	[136]
Pandanus fascicularis	Pandanaceae	Arieal root	Significant dose-dependent reduction in serum glucose in both normoglycemic and hyperglycemic rats and also improved glucose tolerance test	[137]
Salacia Oblonga	Celastaceae	Root	Serum insulin was significantly increased & Plasma HbA1c was significantly decreased	[138]
Salmalia malabarica	Bombacaceae	Sepal	A significant reduction of FBG level in STZ-induced diabetic rat.	[139]
Santalum album	Santalaceae	Heart wood	Santalum album pet ether fraction has potential antihyperlipidemic activity that can help in overcoming insulin resistance	[140]
Sida tiagii	Malvaceae	Fruit	Significant improvement in blood glucose level, glycated hemoglobin and liver glycogen contents	[141]
Stereospermum suaveolens	Bignoniaceae	Bark	Significantly reduced the fasting blood glucose and pancreatic TBARS level and significantly increased the liver glycogen	[142]
Toddalia asiatica	Rutaceae	Leaf	Significant decrease in blood glucose, plasma enzymes (SGOT, SGPT and ALP) and significant increase in body weight, total protein, serum insulin and liver glycogen levels in treated diabetic rats	[143]
Terminalia paniculata	Combretaceae	Bark	Significantly reduced elevated blood glucose, HbA1c, creatinine, urea, SGPT and SGOT levels	144]

Trigonella foenumgraecum	Meninspermaceae	Seed	reverse the hyperglycemia induced changes to normal levels in diabetic rat brain	[145]
Viscum album	Viscaceae	Leaf, stem	Shows anti-diabetic and anti-hyperlipidemic effects in STZ-diabetic rats	[146]
Withania coagulans	Solanaceae	Fruit	activities of glucokinase and phosphofructokinase were significantly increased ,whereas glucose-6-phosphatase activity was significantly decreased	[147]
Adenia lobata	Passifloraceae	stem	Significant reduction in blood glucose level	[148]
Ginkgo biloba	Ginkoaceae	Root	Antihyperglycaemic, antioxidant & antihyperlipidemia activities in STZ-induced chronic diabetic rats	[149]

DISCUSSION AND CONCLUSION

In conclusion, this paper has presented a list of anti-diabetic plants used in the treatment of diabetes mellitus. It showed that these plants have hypoglycaemic effects. Many new bioactive drugs isolated from plants having hypoglycaemic effects showed antidiabetic activity equal and sometimes even more potent than known oral hypoglycaemic agents such as daonil, tolbutamide and chlorpropamide. 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. It is very essential to have a proper documentation of medicinal plants and to know their potential for the improvement of health and hygiene through an ecofriendly system. Thus, a detailed and systematic ethnomedicinal study is required for identification, cataloguing and documentation of plants, which may provide a meaningful way for the promotion of the traditional knowledge of the herbal medicinal plants.

REFERENCES

1. Patel, D. K., Kumar, R., Prasad, S. K., Sairam, K., & Hemalatha, S. (2011). Anti-diabetic and in vitro antioxidant potential of Hybanthus enneaspermus (Linn) F. Muell in streptozotocin-induced diabetic rats. *Asian Pac J Trop Biomed*, 1(4), 316-322.
2. Singh, L. W. (2011). Traditional medicinal plants of Manipur as anti-diabetics. *J Med Plants Res*, *5*(5), 677-687.
3. Chauhan, A., Sharma, P. K., Srivastava, P., Kumar, N., & Dudhe, R. (2010). Plants having potential antidiabetic activity: a review. *Der Pharmacia Lettre*, *2*(3), 369-387.
4. Grover, J. K., Yadav, S., & Vats, V. (2002). Medicinal plants of India with anti-diabetic potential. *Journal of ethnopharmacology*, *81*(1), 81-100.
5. Colagiuri, R. (2010). Diabetes: a pandemic, a development issue or both?. *Expert Rev Cardiovasc Ther.*, 8, 305–359.
6. Marles, R. J., & Farnsworth, N. R. (1994). Plants as sources of antidiabetic agents. *Economic and medicinal plant research*, *6*, 149-187.
7. Oliver, B. B. (1986). Oral hypoglycemic action of medicinal plants in tropical West Africa. *Cambridge University Press, London*, 245-267.
8. Rai, M. K. (1995). A review on some antidiabetic plants of India. *Ancient Science of Life*, *14*(3), 42-54.
9. Malalavidhane, T. S., Wickramasinghe, S. M. D. N., Perera, M. S. A., & Jansz, E. R. (2003). Oral hypoglycaemic activity of

Ipomoea aquatica in streptozotocin-induced, diabetic wistar rats and Type II diabetics. *Phytotherapy research*, *17*(9), 1098-1100.

10. Dey, L., Xie, J. T., Wang, A., Wu, J., Maleckar, S. A., & Yuan, C. S. (2003). Anti-hyperglycemic effects of ginseng: comparison between root and berry.*Phytomedicine*, *10*(6), 600-605.
11. Ojewole, J. A. O. (2003). Hypoglycemic effect of Sclerocarya birrea {(A. Rich.) Hochst.}[Anacardiaceae] stem-bark aqueous extract in rats. *Phytomedicine*, *10*(8), 675-681.
12. Andrade-Cetto, A., & Wiedenfeld, H. (2004). Hypoglycemic effect of Acosmium panamense bark on streptozotocin diabetic rats. *Journal of ethnopharmacology*, *90*(2), 217-220.
13. Suba, V., Murugesan, T., Rao R. B. Ghosh, L., Pal, M., Mandal, S. C., & Saha, B. P. (2004). Anti-diabetic potential of Barleria lupulina extract in rats. *Fitoterapia*, 75, 1-4.
14. Fuentes, O., Arancibia-Avila, P., & Alarcón, J. (2004). Hypoglycemic activity of Bauhinia candicans in diabetic induced rabbits. *Fitoterapia*, *75*(6), 527-532.
15. Pari, L., & Satheesh, M. A. (2004). Antidiabetic activity of Boerhaavia diffusa L.: effect on hepatic key enzymes in experimental diabetes. *Journal of ethnopharmacology*, *91*(1), 109-113.
16. Koti, B. C., Maddi, V. S., Jamakandi, V. G., & Patil, P. A. (2004). Effect of crude petroleum ether extract of Brassica oleracea on euglycemic and alloxan induced hyperglycemic albino rats. *Indian Drugs-Bombay-*, *41*(1), 54-55.
17. Lemhadri, A., Zeggwagh, N. A., Maghrani, M., Jouad, H., Michel, J. B., & Eddouks, M. (2004). Hypoglycaemic effect of Calamintha officinalis Moench. in normal and streptozotocin-induced diabetic rats. *Journal of pharmacy and pharmacology*, *56*(6), 795-799.
18. Jayakar, B., Rajkapoor, B., & Suresh, B. (2004). Effect of Caralluma attenuata in normal and alloxan induced diabetic rats. *Journal of herbal pharmacotherapy*, *4*(1), 35-40.
19. Diatewa, M., Samba, C. B., Assah, T. C. H., & Abena, A. A. (2004). Hypoglycemic and antihyperglycemic effects of diethyl ether fraction isolated from the aqueous extract of the leaves of Cogniauxia podoleana Baillon in normal and alloxan-induced diabetic rats. *Journal of ethnopharmacology*, *92*(2), 229-232.
20. Mukhtar, H. M., Ansari, S. H., Ali, M., Bhat, Z. A., & Naved, T. (2004). Effect of aqueous extract of Cyamopsis tetragonoloba Linn. beans on blood glucose level in normal and alloxan-induced diabetic rats. *Indian J. Exp. Biol*, *42*, 1212-15.
21. Krishna Murthy, B., Nammi, S., Kota, M. K., Krishna Rao, R. V., Koteswara Rao, N., & Annapurna, A. (2004). Evaluation of hypoglycemic and antihyperglycemic effects of Datura metel (Linn.) seeds in normal and alloxan-induced diabetic rats. *Journal of ethnopharmacology*, *91*(1), 95-98.
22. Rajib, G., Kh, S., Rita, S., & Thokchom, I. S. (2004). Hypoglycemic activity of Ficus hispida (bark) in normal and diabetic albino rats. *Indian Journal of Pharmacology*, *36*(4), 222-225.
23. Venkatesh, S., Dayanand Reddy, G., Reddy, Y. S. R., Sathyavathy, D., & Madhava Reddy, B. (2004). Effect of Helicteres isora root extracts on glucose tolerance in glucose-induced hyperglycemic rats. *Fitoterapia*, *75*(3), 364-367.
24. Osadebe, P. O., Okide, G. B., & Akabogu, I. C. (2004). Study on anti-diabetic activities of crude methanolic extracts of Loranthus micranthus (Linn.) sourced from five different host trees. *Journal of ethnopharmacology*, *95*(2), 133-138.
25. Kumar, G., & JP, R. (2004). Effect of extracts of Murraya koenigii leaves on the levels of blood glucose and plasma insulin in alloxan-induced diabetic rats. *Indian J Physiol Pharmacol*, *48*(3), 348-352.
26. Lemhadri, A., Zeggwagh, N. A., Maghrani, M., Jouad, H., & Eddouks, M. (2004). Anti-

hyperglycaemic activity of the aqueous extract of Origanum vulgare growing wild in Tafilalet region. *Journal of ethnopharmacology*, *92*(2), 251-256.

27. Zhang, R., Zhou, J., Jia, Z., Zhang, Y., & Gu, G. (2004). Hypoglycemic effect of Rehmannia glutinosa oligosaccharide in hyperglycemic and alloxan-induced diabetic rats and its mechanism. *Journal of ethnopharmacology*, *90*(1), 39-43.
28. Maghrani, M., Zeggwagh, N. A., Lemhadri, A., El Amraoui, M., Michel, J. B., & Eddouks, M. (2004). Study of the hypoglycaemic activity of Fraxinus excelsior and Silybum marianum in an animal model of type 1 diabetes mellitus. *Journal of ethnopharmacology*, *91*(2), 309-316.
29. Ghosh D., Jana D., Maiti R. and Das V.K.,. Antidiabetic effect of aqueous extract of seed of Tamarindus indica in streptozotocin induced diabetic rats, J. Ethnopharmacology,2004; 92: 85-91
30. O Ojewole, J. A., & Adewunmi, C. O. (2004). Anti-inflammatory and hypoglycaemic effects of Tetrapleura tetraptera (Taub)[fabaceae] fruit aqueous extract in rats. *Journal of ethnopharmacology*, *95*(2), 177-182.
31. Kamalakkannan, N., & Prince, P. S. M. (2005). The effect of Aegle marmelos fruit extract in streptozotocin diabetes: a histopathological study. *Journal of herbal pharmacotherapy*, *5*(3), 87-96.
32. Ojewole, J. A. (2005). Antinociceptive, anti-inflammatory and antidiabetic effects of Bryophyllum pinnatum (Crassulaceae) leaf aqueous extract. *Journal of ethnopharmacology*, 100, 310–313.
33. Kuroda, M., Mimaki, Y., Nishiyama, T., Mae, T., Kishida, H., Tsukagawa, M., & Kitahara, M. (2005). Hypoglycemic effects of turmeric (Curcuma longa L. rhizomes) on genetically diabetic KK-Ay mice. *Biol Pharm Bull*, *28*(5), 937-939.
34. Andrade-Cetto, A., Martínez-Zurita, E., & Wiedenfeld, H. (2005). Hypoglycemic effect of Malmea depressa root on streptozotocin diabetic rats. *Journal of ethnopharmacology*, *100*(3), 319-322.
35. Singab, A. N. B., El-Beshbishy, H. A., Yonekawa, M., Nomura, T., & Fukai, T. (2005). Hypoglycemic effect of Egyptian Morus alba root bark extract: Effect on diabetes and lipid peroxidation of streptozotocin-induced diabetic rats. *Journal of ethnopharmacology*, *100*(3), 333-338.
36. Bavarva, J. H. & Narasimhacharya, A. V. R. L. (2005). Antidiabetic and antihyperlipidemic effects of ethanolic extract of Phyllanthus niruri L. leaves, *J. Cell and Tissue Research, 5(2),* 461-464.
37. Maghrani, M., Michel, J. B., & Eddouks, M. (2005). Hypoglycaemic activity of Retama raetam in rats. *Phytotherapy Research*, *19*(2), 125-128.
38. Eidi, M., Eidi, A., & Zamanizadeh, H. (2005). Effect of Salvia officinalis L. leaves on serum glucose and insulin in healthy and streptozotocin-induced diabetic rats. *Journal of ethnopharmacology*, *100*(3), 310-313.
39. Musabayane, C. T., Mahlalela, N., Shode, F. O., & Ojewole, J. A. O. (2005). Effects of Syzygium cordatum (Hochst.)[Myrtaceae] leaf extract on plasma glucose and hepatic glycogen in streptozotocin-induced diabetic rats. *Journal of ethnopharmacology*, *97*(3), 485-490.
40. Sy, G. Y., Cisse, A., Nongonierma, R. B., Sarr, M., Mbodj, N. A., & Faye, B. (2005). Hypoglycaemic and antidiabetic activity of acetonic extract of Vernonia colorata leaves in normoglycaemic and alloxan-induced diabetic rats. *Journal of ethnopharmacology*, *98*(1), 171-175.
41. Abdel-Zaher, A. O., Salim, S. Y., Assaf, M. H., & Abdel-Hady, R. H. (2005). Antidiabetic activity and toxicity of Zizyphus spina-christi leaves. *Journal of ethnopharmacology*, *101*(1), 129-138.
42. Purohit, A., & Sharma, A. (2006). Antidiabetic efficacy of Bougainvillea spectabilis bark extract in streptozotocin

induced diabetic rats, J. *Cell and Tissue Research*, *6*(1), 537-540.

43. Shirwaikar, A., Rajendran, K., & Barik, R. (2006). Effect of aqueous bark extract of Garuga pinnata Roxb. in streptozotocin-nicotinamide induced type-II diabetes mellitus. *Journal of ethnopharmacology*, *107*(2), 285-290.
44. Dhanabal, S. P., Kokate, C. K., Ramanathan, M., Kumar, E. P., & Suresh, B. (2006). Hypoglycaemic activity of Pterocarpus marsupium Roxb. *Phytotherapy research*, *20*(1), 4-8.
45. Saravanan, G., & Leelavinothan, P. (2012). Effects of Syzygium cumini bark on blood glucose, plasma insulin and c-peptide in streptozotocin induced diabetic rats. *International Journal of Endocrinology and Metabolism*, *4*(2), 96-105.
46. Hussein, H. M., El-Sayed, E. M., & Said, A. A. (2006). Antihyperglycemic, antihyperlipidemic and antioxidant effects of Zizyphus spina christi and Zizyphus jujuba in alloxan diabetic rats. *International journal of pharmacology*, 2(5), 563-570.
47. Sokeng, S. D.et al. (2007). Hypoglycemic Effect of Anacardium occidentale L. Methanol Extract and Fractions on Streptozotocin-induced Diabetic Rats, *Global Journal of Pharmacology*, 1(1), 01-05
48. Pushparaj, P. N., Low, H. K., Manikandan, J., Tan, B. K. H., & Tan, C. H. (2007). Anti-diabetic effects of Cichorium intybus in streptozotocin-induced diabetic rats. *Journal of ethnopharmacology*, *111*(2), 430-434.
49. Govindarajan, R., Asare-Anane, H., Persaud, S., Jones, P., Houghton, P. J., Singh, M., & Mehrotra, S. (2007). Effect of Desmodium gangeticum extract on blood glucose in rats and on insulin secretion. *Planta medica*, *73*(5), 427-432.
50. Murali, Y. K., Anand, P., Tandon, V., Singh, R., Chandra, R., & Murthy, P. S. (2007). Long-term effects of Terminalia chebula Retz. on hyperglycemia and associated hyperlipidemia, tissue glycogen content and in vitro release of insulin in streptozotocin induced diabetic rats. *Experimental and Clinical Endocrinology and Diabetes*, *115*(10), 641-646.
51. Noor, A., Gunasekaran, S., Soosai Manickam, A., & Vijayalakshmi, M. A. (2008). Antidiabetic activity of Aloe vera and histology of organs in streptozotocin-induced diabetic rats. *Current science*, *94*(8), 1070-1076.
52. Jarald, E. E., Joshi, S. B., & Jain, D. C. (2008). Antidiabetic activity of aqueous extract and non polysaccharide fraction of Cynodon dactylon Pers. *Indian journal of experimental biology*, *46*(9), 660-667.
53. Gayathri, M., & Kannabiran, K. (2008). Hypoglycemic activity of Hemidesmus indicus R. Br. on streptozotocin-induced diabetic rats. *International journal of diabetes in developing countries*, *28*(1), 6-10.
54. Bhaskar, A., Vidhya, V. G., & Ramya, M. (2008). Hypoglycemic effect of Mucuna pruriens seed extract on normal and streptozotocin-diabetic rats. *Fitoterapia*, *79*(7), 539-543.
55. Shen, S. C., Cheng, F. C., & Wu, N. J. (2008). Effect of guava (Psidium guajava Linn.) leaf soluble solids on glucose metabolism in type 2 diabetic rats. *Phytotherapy research*, *22*(11), 1458-1464.
56. Bhagwat, D. A., Killedar, S. G., & Adnaik, R. S. (2008). Anti-diabetic activity of leaf extract of Tridax procumbens. *International Journal of Green Pharmacy*, *2*(1), 126-128.
57. Mao, X. Q., Yu, F., Wang, N., Wu, Y., Zou, F., Wu, K., & Ouyang, J. P. (2009). Hypoglycemic effect of polysaccharide enriched extract of Astragalus membranaceus in diet induced insulin resistant C57BL/6J mice and its potential mechanism. *Phytomedicine*, *16*(5), 416-425.
58. Krisanapun, C., Peungvicha, P., Temsiririrkkul, R., & Wongkrajang, Y. (2009). Aqueous extract of Abutilon indicum Sweet inhibits glucose absorption

and stimulates insulin secretion in rodents. *Nutrition research*, *29*(8), 579-587.

59. Nofal, S. M., Mahmoud, S. S., Ramadan, A., Soliman, G. A., & Fawzy, R. (2009). Anti-Diabetic Effect of Artemisia judaica Extracts. *Research Journal of Medicine & Medical Sciences*, *4*(1), 42-48.
60. Xie, J. T., Wang, C. Z., Li, X. L., Ni, M., Fishbein, A., & Yuan, C. S. (2009). Anti-diabetic effect of American ginseng may not be linked to antioxidant activity: Comparison between American ginseng and Scutellaria baicalensis using an ob/ob mice model. *Fitoterapia*, *80*(5), 306-311.
61. Sharma, N., & Garg, V. (2009). Antidiabetic and antioxidant potential of ethanolic extract of Butea monosperma leaves in alloxan-induced diabetic mice. *Indian journal of biochemistry & biophysics*, *46*(1), 99-105.
62. Eliza, J., Daisy, P., Ignacimuthu, S., & Duraipandiyan, V. (2009). Antidiabetic and antilipidemic effect of eremanthin from Costus speciosus (Koen.) Sm., in STZ-induced diabetic rats. *Chemico-biological interactions*, *182*(1), 67-72.
63. Dewanjee, S., Das, A. K., Sahu, R., & Gangopadhyay, M. (2009). Antidiabetic activity of Diospyros peregrine fruit: Effect on hyperglycemia, hyperlipidemia and augmented oxidative stress in experimental type 2 diabetes. *Food and chemical toxicology*, *47*(10), 2679-2685.
64. Chaturvedi, A., Bhawani, G., Agarwal, P. K., Goel, S., Singh, A., & Goel, R. K. (2009). Antidiabetic and antiulcer effects of extract of eugenia jambolana seed in mild diabetic Rats: Study on gastric mucosal offensive acid-pepsin secretion. *Indian J Physiol Pharmacol.*, 53(2), 137-146.
65. Ahlem, S., Khaled, H., Wafa, M., Sofiane, B., Mohamed, D., Jean-Claude, M., & Abdelfattah, E. F. (2009). Oral administration of Eucalyptus globulus extract reduces the alloxan-induced oxidative stress in rats. *Chemico-biological interactions*, *181*(1), 71-76.
66. Singh, R. K., Mehta, S., Jaiswal, D., Rai, P. K., & Watal, G. (2009). Antidiabetic effect of Ficus bengalensis aerial roots in experimental animals. *Journal of ethnopharmacology*, *123*(1), 110-114.
67. Mall, G. K., Mishra, P. K., & Prakash, V. (2009). Antidiabetic and hypolipidemic activity of Gymnema sylvestre in alloxan induced diabetic rats.*Global Journal of Biotechnology & Biochemistry*, *4*(1), 37-42.
68. Suthar, M., Rathore, G. S., & Pareek, A. (2009). Antioxidant and antidiabetic activity of Helicteres isora (L.) fruits. *Indian journal of pharmaceutical sciences*, *71*(6), 695–699.
69. Ajani, H. B., Patel, H. P., Shah, G. B., Acharya, S. R., & Shah, S. K. (2009). Evaluation of antidiabetic effect of methanolic extract of inula racemosa root in rats. *Pharmacologyonline*, *3*, 118-129.
70. Chandrashekar, K. S., & Prasanna, K. S. (2009). Hypoglycemic Effect of Leucas lavandulaefolia Willd in Alloxan-Induced Diabetic Rats. *Journal of Young Pharmacists*, *1*(4) 326-329.
71. Jaiswal, D., Kumar Rai, P., Kumar, A., Mehta, S., & Watal, G. (2009). Effect of Moringa oleifera Lam. leaves aqueous extract therapy on hyperglycemic rats. *Journal of ethnopharmacology*, *123*(3), 392-396.
72. Ebrahimpoor, M. R., Khaksar, Z., & Noorafshan, A. (2009). Antidiabetic effect of Otostegia persica oral extract on streptozotocin-diabetic rats. *Res J Biol Sci*, *4*(12), 1227-1229.
73. Latha, M., Pari, L., Ramkumar, K. M., Rajaguru, P., Suresh, T., Dhanabal, T., & Bhonde, R. (2009). Antidiabetic effects of scoparic acid D isolated from Scoparia dulcis in rats with streptozotocin-induced diabetes. *Natural product research*, *23*(16), 1528-1540.
74. Reddy, S. S., Ramatholisamma, P., Karuna, R., & Saralakumari, D. (2009). Preventive effect of Tinospora cordifolia against high-fructose diet-induced insulin resistance and oxidative stress in male Wistar rats. *Food and chemical toxicology*, *47*(9), 2224-2229.

75. Udayakumar, R., Kasthurirengan, S., Mariashibu, T. S., Rajesh, M., Anbazhagan, V. R., Kim, S. C., & Choi, C. W. (2009). Hypoglycaemic and hypolipidaemic effects of Withania somnifera root and leaf extracts on alloxan-induced diabetic rats. *International journal of molecular sciences*, *10*(5), 2367-2382.
76. Mohd, M., Alam, K. S., Mohd, A., Abhishek, M., & Aftab, A. (2009). Antidiabetic activity of the aqueous extract of Annona Squamosa in Streptozotocin induced-Hyperglycemic Rats. *The Pharma Research*, *2*, 59-63.
77. Singh, J., & Kakkar, P. (2009). Antihyperglycemic and antioxidant effect of Berberis aristata root extract and its role in regulating carbohydrate metabolism in diabetic rats. *Journal of ethnopharmacology*, *123*(1), 22-26.
78. Pandikumar, P., Babu, N. P., & Ignacimuthu, S. (2009). Hypoglycemic and antihyperglycemic effect of Begonia malabarica Lam. in normal and streptozotocin induced diabetic rats. *Journal of ethnopharmacology*, *124*(1), 111-115.
79. Parasuraman, S., Sankar, N., Chandrasekar, T., Murugesh, K., Neelaveni, T. (2010). Phytochemical Analysis and Oral Hypoglycemic Activity of Leaf Extract of Leaves of Andrographis Stenophylla C.B. Clarke (Acanthaceae), *IJABPT*, I(2),442-448.
80. Chackrewarthy, S., Thabrew, M. I., Weerasuriya, M., & Jayasekera, S. (2010). Evaluation of the hypoglycemic and hypolipidemic effects of an ethylacetate fraction of Artocarpus heterophyllus (jak) leaves in streptozotocin-induced diabetic rats. *Pharmacognosy magazine*, *6*(23), 186-190.
81. Patil, R. N., Patil, R. Y., & Ahirwar, D. (2010). Study of some medicinal plants for antidiabetic activity in alloxan induced diabetes rats. *Pharmacologyonline*, 1, 53-60.
82. Rasineni, K., Bellamkonda, R., Singareddy, S. R., & Desireddy, S. (2010). Antihyperglycemic activity of Catharanthus roseus leaf powder in streptozotocin-induced diabetic rats. *Pharmacognosy research*, *2*(3), 195-201.
83. Shetty, A. J., Choudhury, D., Rejeesh, V. N., Kuruvilla, M., & Kotian, S. (2010). Effect of the insulin plant (Costus igneus) leaves on dexamethasone-induced hyperglycemia. *International journal of Ayurveda research*, *1*(2), 100–102.
84. Aragao, D. M., Guarize, L., Lanini, J., da Costa, J. C., Garcia, R. M., & Scio, E. (2010). Hypoglycemic effects of Cecropia pachystachya in normal and alloxan-induced diabetic rats. *Journal of ethnopharmacology*, *128*(3), 629-633.
85. Salahuddin, M., & Jalalpure, S. S. (2010). Antidiabetic activity of aqueous fruit extract of Cucumis trigonus Roxb. in streptozotocin-induced-diabetic rats. *Journal of ethnopharmacology*, *127*(2), 565-567.
86. Vishwakarma, S. L., Sonawane, R. D., Rajani, M., & Goyal, R. K. (2010). Evaluation of effect of aqueous extract of Enicostemma littorale Blume in streptozotocin-induced type 1 diabetic rats. *Indian J Exp Biol.*, 48(1), 26-30.
87. Sharma, V. K., Kumar, S., Patel, H. J., & Hugar, S. (2010). Hypoglycemic activity of Ficus glomerata in alloxan induced diabetic rats. *International Journal of Pharmaceutical Sciences Review and Research*, *1*(2), 18-22.
88. Pandit, R., Phadke, A., & Jagtap, A. (2010). Antidiabetic effect of Ficus religiosa extract in streptozotocin-induced diabetic rats. *Journal of ethnopharmacology*, *128*(2), 462-466.
89. Verma, S. M., Suresh, K. B., & Verma, A. (2010). Antidiabetic Activity of Leaves of Indigofera tinctoria Linn (Fabaceae). *International Journal of Toxicological and Pharmacological Research*, *1*(2), 42-43.
90. Mishra, S. B., Vijayakumar, M., Ojha, S. K., & Verma, A. (2010). Antidiabetic effect of Jatropha curcas Leaves extract in normal

and alloxan-induced diabetic rats. *Int. J. Ph. Sci*, *2*(1), 482-487.

91. Khan, M. R. I., Islam, M. A., Hossain, M. S., Asadujjaman, M., Wahed, M. I. I., Rahman, B. M., & Ahmed, M. (2009). Antidiabetic effects of the different fractions of ethanolic extracts of Ocimum sanctum in normal and alloxan induced diabetic rats. *Journal of Scientific Research*, *2*(1), 158-168.
92. Jain, S., Bhatia, G., Barik, R., Kumar, P., Jain, A., & Dixit, V. K. (2010). Antidiabetic activity of Paspalum scrobiculatum Linn. in alloxan induced diabetic rats. *Journal of ethnopharmacology*, *127*(2), 325-328.
93. Mard, S. A., Jalalvand, K., Jafarinejad, M., Balochi, H., & Naseri, M. K. G. (2010). Evaluation of the antidiabetic and antilipaemic activities of the hydroalcoholic extract of Phoenix dactylifera palm leaves and its fractions in alloxan-induced diabetic rats. *The Malaysian journal of medical sciences: MJMS*, *17*(4), 4-13.
94. Kondeti V.K., Badri K.R., Maddirala D.R., Thur S.K., Fatima S.S., Kasetti R.B., Rao C.A.,Effect of Pterocarpus santalinus bark, on blood glucose, serum lipids, plasma insulin and hepatic carbohydrate metabolic enzymes in streptozotocin-induced diabetic rats,Food Chem Toxicol., 2010; 48(5):1281-7.
95. Sikarwar, M. S., & Patil, M. B. (2010). Antidiabetic activity of Pongamia pinnata leaf extracts in alloxan-induced diabetic rats. *International journal of Ayurveda research*, *1*(4), 199.
96. Ahmed, M. F., Kazim, S. M., Ghori, S. S., Mehjabeen, S. S., Ahmed, S. R., Ali, S. M., & Ibrahim, M. (2010). Antidiabetic activity of Vinca rosea extracts in alloxan-induced diabetic rats. *International journal of endocrinology*.
97. Bhatt, M., Gahlot, M., Juyal, V., & Singh, A. (2011). Phytochemical investigation and anti-diabetic activity of adhatoda zeylanica. *Asian Journal of Pharmaceutical & Clinical Research*, *4*(2), 2730.
98. Mohamed, E. A. K. (2011). Antidiabetic, Antihypercholestermic and Antioxidative Effect of Aloe Vera Gel Extract in Alloxan Induced Diabetic Rats. *Journal of Applied Sciences Research*, *7*(11), 1321-1327
99. Koffuor, G. A., Amoatengor, P., Okai, C. A., & Fiagbe, N. I. Y. (2011). Hypoglycemic Effects Of Whole And Fractionated Azadirachta Indica (Neem) Seed Oils On Alloxan-Induced Diabetes In New Zealand White Rabbits. *Journal of the Ghana Science Association*, *13*(1).
100. Thirumalai, T., Therasa, S. V., Elumalai, E. K., & David, E. (2011). Hypoglycemic effect of Brassica juncea (seeds) on streptozotocin induced diabetic male albino rat. *Asian Pacific journal of tropical biomedicine*, *1*(4), 323-325.
101. Islam, M. (2011). Effects of the aqueous extract of white tea (Camellia sinensis) in a streptozotocin-induced diabetes model of rats. *Phytomedicine*, *19*(1), 25-31.
102. Haidari, F., Seyed-Sadjadi, N., Taha-Jalali, M., & Mohammed-Shahi, M. (2011). The effect of oral administration of Carum carvi on weight, serum glucose, and lipid profile in streptozotocin-induced diabetic rats. *Saudi medical journal*, *32*(7), 695-700.
103. Ramakrishnan, M., Bhuvaneshwari, R., Duraipandiyan, V., & Dhandapani, R. (2011). Hypoglycemic activity of Coccinia india Wight & Arn. Fruits in Alloxan-induced diabetic rats. *Indian Journal of Natural Products and Resources*, *2*(3), 350-353.
104. Aissaoui, A., Zizi, S., Israili, Z. H., & Lyoussi, B. (2011). Hypoglycemic and hypolipidemic effects of Coriandrum sativum L. in Meriones shawi rats. *Journal of ethnopharmacology*, *137*(1), 652-661.
105. Das, S., Bhattacharya, S., Prasanna, A., Kumar, R. S., Pramanik, G., & Haldar, P. K. (2011). Preclinical evaluation of antihyperglycemic activity of Clerodendron infortunatum leaf against streptozotocin-induced diabetic rats. *Diabetes Therapy*, *2*(2), 92-100.
106. Kumar, S., Kumar, V., & Prakash, O. (2011). Antidiabetic, hypolipidemic and

histopathological analysis of Dillenia indica (L.) leaves extract on alloxan induced diabetic rats. *Asian Pacific journal of tropical medicine*, *4*(5), 347-352.

107. Maithili, V., Dhanabal, S. P., Mahendran, S., & Vadivelan, R. (2011). Antidiabetic activity of ethanolic extract of tubers of Dioscorea alata in alloxan induced diabetic rats. *Indian journal of pharmacology*, *43*(4), 455-459.
108. Li, F., Zhang, Y., & Zhong, Z. (2011). Antihyperglycemic effect of Ganoderma lucidum polysaccharides on streptozotocin-induced diabetic mice. *International journal of molecular sciences*, *12*(9), 6135-6145.
109. Hazra, M., KunduSen, S., Bhattacharya, S., Haldar, P. K., Gupta, M., & Mazumder, U. K. (2011). Evaluation of hypoglycemic and antihyperglycemic effects of Luffa cylindrica fruit extract in rats. *Journal of Advanced Pharmacy Education & Research*, *2*, 138-146.
110. Petchi, R. R., Parasuraman, S., Vijaya, C., Darwhekar, G., & Devika, G. S. (2011). Antidiabetic effect of kernel seeds extract of mangifera indica (Anacardiaceae). *International Journal of Pharma & Bio Sciences*, *2*(1), 385-393.
111. Viswanathaswamy, A. H., Koti, B. C., Gore, A., Thippeswamy, A. H., & Kulkarni, R. V. (2011). Antihyperglycemic and antihyperlipidemic activity of plectranthus amboinicus on normal and alloxan-induced diabetic rats. *Indian journal of pharmaceutical sciences*, *73*(2), 139-145.
112. Misra, H., Soni, M., Silawat, N., Mehta, D., Mehta, B. K., & Jain, D. C. (2011). Antidiabetic activity of medium-polar extract from the leaves of Stevia rebaudiana Bert.(Bertoni) on alloxan-induced diabetic rats. *Journal of Pharmacy and Bioallied Sciences*, *3*(2), 242-248.
113. Kalpana, K., & Pugalendi, K. V. (2011). Antioxidative and hypolipidemic efficacy of alcoholic seed extract of Swietenia macrophylla in streptozotocin diabetic rats. *Journal of basic and clinical physiology and pharmacology*, *22*(1-2), 11-21.
114. Sunil, C., Ignacimuthu, S., & Agastian, P. (2011). Antidiabetic effect of Symplocos cochinchinensis (Lour.) S. Moore. in type 2 diabetic rats. *Journal of ethnopharmacology*, *134*(2), 298-304.
115. Biswas, M., Kar, B., Bhattacharya, S., Kumar, R. S., Ghosh, A. K., & Haldar, P. K. (2011). Antihyperglycemic activity and antioxidant role of Terminalia arjuna leaf in streptozotocin-induced diabetic rats. *Pharmaceutical biology*, *49*(4), 335-340.
116. Ramachandran, S., Rajasekaran, A., & Kumar, K. T. (2011). Antidiabetic, antihyperlipidemic and antioxidant potential of methanol extract of Tectona grandis flowers in streptozotocin induced diabetic rats. *Asian Pacific journal of tropical medicine*, *4*(8), 624-631.
117. Iranloye, B. O., Arikawe, A. P., Rotimi, G., & Sogbade, A. O. (2013). Anti-diabetic and anti-oxidant effects of Zingiber Officinale on alloxan-induced and insulin-resistant diabetic male rats. *Nigerian Journal of Physiological Sciences*, *26*(1), 89-96.
118. Ananda, P. K., Kumarappan, C. T., Christudas, S., & Kalaichelvan, V. K. (2012). Effect of Biophytum sensitivum on streptozotocin and nicotinamide-induced diabetic rats. *Asian Pacific journal of tropical biomedicine*, *2*(1), 31-35.
119. Jana, K., Chatterjee, K., Ali, K. M., De, D., Bera, T. K., & Ghosh, D. (2012). Antihyperglycemic and antioxidative effects of the hydro-methanolic extract of the seeds of Caesalpinia bonduc on streptozotocin-induced diabetes in male albino rats. *Pharmacognosy research*, *4*(1), 57-62.
120. Juárez-Rojop, I. E., Díaz-Zagoya, J. C., Ble-Castillo, J. L., Miranda-Osorio, P. H., Castell-Rodríguez, A. E., Tovilla-Zárate, C. A., ... & Bermúdez-Ocaña, D. Y. (2012). Hypoglycemic effect of Carica papaya leaves in streptozotocin-induced diabetic rats. *BMC complementary and alternative medicine*, *12*(1), 236.
121. Daisy, P., & Saipriya, K. (2012). Biochemical analysis of Cassia fistula aqueous extract and phytochemically

synthesized gold nanoparticles as hypoglycemic treatment for diabetes mellitus. *International journal of nanomedicine*, *7*, 1189–1202.
122. Agarwal, V. I. P. I. N., Sharma, A. K., Upadhyay, A. N. S. H. U., Singh, G. O. P. E. N. D. R. A., & Gupta, R. A. J. I. V. (2012). Hypoglycemic effects of Citrullus colocynthis roots. *Acta Pol Pharm*, *69*(1), 75-9.
123. Asgary, S., Rahimi, P., Mahzouni, P., & Madani, H. (2012). Antidiabetic effect of hydroalcoholic extract of Carthamus tinctorius L. in alloxan-induced diabetic rats. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*, *17*(4), 386-92.
124. Kumar, S., Vasudeva, N., & Sharma, S. (2012). GC-MS analysis and screening of antidiabetic, antioxidant and hypolipidemic potential of Cinnamomum tamala oil in streptozotocin induced diabetes mellitus in rats. *Cardiovasc Diabetol*, *11*, 95.
125. Díaz-Flores, M., Angeles-Mejia, S., Baiza-Gutman, L. A., Medina-Navarro, R., Hernández-Saavedra, D., Ortega-Camarillo, C., & Alarcon-Aguilar, F. J. (2012). Effect of an aqueous extract of Cucurbita ficifolia Bouché on the glutathione redox cycle in mice with STZ-induced diabetes. *Journal of ethnopharmacology*, *144*(1), 101-108.
126. Vyawahare, N. S. et al. (2012). Antidiabetic Evaluation of Dalbergia Sissoo against alloxan induced diabetes mellitus in wistar albino rats, *J. Nat. Prod. Plant Resour.*, 2 (1), 81-88.
127. Chopade, B. A. et al. (2012). Antidiabetic Activity of Gnidia glauca and Dioscorea bulbifera: Potent Amylase and Glucosidase Inhibitors, *Evidence-Based Complementary and Alternative Medicine*, Article ID 929051, 1-10.
128. Nain, P., Saini, V., Sharma, S., & Nain, J. (2012). Antidiabetic and antioxidant potential of Emblica officinalis Gaertn. leaves extract in streptozotocin-induced type-2 diabetes mellitus (T2DM) rats. *Journal of ethnopharmacology*, *142*(1), 65-71.
129. Mohammadi, J., Delaviz, H., Malekzadeh, J. M., & Roozbehi, A. (2012). The effect of hydro alcoholic extract of Juglans regia leaves in streptozotocin-nicotinamide induced diabetic rats. *Pakistan journal of pharmaceutical sciences*, *25*(2), 407-411.
130. Kumar, S., Kumar, V., & Prakash, O. (2012). Antidiabetic and hypolipidemic activities of Kigelia pinnata flowers extract in streptozotocin induced diabetic rats, *Asian Pac J Trop Biomed.*, 2(7), 543-546.
131. Raj, S. M., Mohammed, S., Kumar, S. V., & Debnath, S. (2012). Antidiabetic Effect of Luffa acutangula Fruits and Histology of Organs in Streptozotocin Induced Diabetic in Rats. *Research Journal of Pharmacognosy and Phytochemistry*, *4*(2), 64-69.
132. Izharul, H. & Khatoon, S. (2012). Effect of momordica charantia (bitter gourd) tablets indiabetes mellitus: Type 1 and Type 2, *Prime Research on Medicine*, 2(2), 72-74.
133. Gandhi, G. R., & Sasikumar, P. (2012). Antidiabetic effect of Merremia emarginata Burm. F. in streptozotocin induced diabetic rats. *Asian Pacific journal of tropical biomedicine*, *2*(4), 281-286.
134. Nerurkar, P. V., Nishioka, A., Eck, P. O., Johns, L. M., Volper, E., & Nerurkar, V. R. (2012). Regulation of glucose metabolism via hepatic forkhead transcription factor 1 (FoxO1) by Morinda citrifolia (noni) in high-fat diet-induced obese mice. *British Journal of Nutrition*, *108*(2), 218-28.
135. Arunachalam, K., & Parimelazhagan, T. (2012). Antidiabetic activity of aqueous root extract of Merremia tridentate (L.) Hall. f. in streptozotocin–induced–diabetic rats. *Asian Pacific journal of tropical medicine*, *5*(3), 175-179.
136. Jain, V., Viswanatha, G. L., Manohar, D., & Shivaprasad, H. N. (2012). Isolation of antidiabetic principle from fruit rinds of Punica granatum. *Evidence-Based Complementary and Alternative Medicine*, 147202.

137. Kumari, S., Wanjari, M., Kumar, P., & Palani, S. (2012). Antidiabetic activity of Pandanus fascicularis Lamk-aerial roots in alloxan-induced hyperglycemic rats.*International Journal of Nutrition, Pharmacology, Neurological Diseases*, *2*(2), 105-110.
138. Bhat, B. M., Raghuveer, C. V., D'Souza, V., & Manjrekar, P. A. (2012). Antidiabetic and hypolipidemic effect of Salacia oblonga in streptozotocin induced diabetic rats. *Journal of clinical and diagnostic research: JCDR*, *6*(10), 1685–1687.
139. De, D., Ali, K. M., Chatterjee, K., Bera, T. K., & Ghosh, D. (2012). Antihyperglycemic and antihyperlipidemic effects of n-hexane fraction from the hydro-methanolic extract of sepals of Salmalia malabarica in streptozotocin-induced diabetic rats, *J Complement Integr Med.*, 21, 9, Article 12.
140. Kulkarni, C. R., Joglekar, M. M., Patil, S. B., & Arvindekar, A. U. (2012). Antihyperglycemic and antihyperlipidemic effect of Santalum album in streptozotocin induced diabetic rats. *Pharmaceutical biology*, *50*(3), 360-365.
141. Datusalia, A. K., Dora, C. P., & Sharma, S. (2012). Acute and Chronic Hypoglycemic activity of Sida tiagii fruits in N5-Streptozotocin diabetic rats.*Acta Pol Pharm*, *69*, 699-706.
142. Balasubramanian, T., Chatterjee, T. K., Senthilkumar, G. P., & Mani, T. (2012). Effect of Potent Ethyl Acetate Fraction of Stereospermum suaveolens Extract in Streptozotocin-Induced Diabetic Rats. *The Scientific World Journal*, Article ID 413196.
143. Stephen Irudayaraj, S., Sunil, C., Duraipandiyan, V., & Ignacimuthu, S. (2012). Antidiabetic and antioxidant activities of Toddalia asiatica (L.) Lam. leaves in Streptozotocin induced diabetic rats. *Journal of Ethnopharmacology*, *143*(2), 515-523.
144. Ramachandran, S., Rajasekaran, A., & Manisenthilkumar, K. T. (2012). Investigation of hypoglycemic, hypolipidemic and antioxidant activities of aqueous extract of Terminalia paniculata bark in diabetic rats. *Asian Pacific journal of tropical biomedicine*, *2*(4), 262-268.
145. Kumar, P., Kale, R. K., McLean, P., & Baquer, N. Z. (2012). Antidiabetic and neuroprotective effects of Trigonella foenum-graecum seed powder in diabetic rat brain. *Prague Med Rep*, *113*(1), 33-43.
146. Adaramoye, O., Amanlou, M., Habibi-Rezaei, M., Pasalar, P., & Ali, M. M. (2012). Methanolic extract of African mistletoe (Viscum album) improves carbohydrate metabolism and hyperlipidemia in streptozotocin-induced diabetic rats. *Asian Pacific journal of tropical medicine*, *5*(6), 427-433.
147. Shukla, K., Dikshit, P., Shukla, R., & Gambhir, J. K. (2012). The aqueous extract of Withania coagulans fruit partially reverses nicotinamide/streptozotocin-induced diabetes mellitus in rats. *Journal of medicinal food*, *15*(8), 718-725.
148. Sarkodie, J. A., Fleischer, T. C., Edoh, D. A., Dickson, R. A., Mensah, M. L. K., Annan, K., ... & Brew-Daniels, H. (2013). Antihyperglycaemic Activity of ethanolic Extract of the Stem of Adenia lobata Engl (Passifloraceae). *International Journal of Pharmaceutical Sciences and Research*, *4*, 1370-1377.
149. Cheng, D., Liang, B., & Li, Y. (2012). Antihyperglycemic Effect of Ginkgo biloba Extract in Streptozotocin-Induced Diabetes in Rats. *BioMed research international*, *2013*, 162724.

