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Review Article

INDIGENOUS REMEDIES FOR DIABETES MELLITUS

KASHIKAR V.S.* KOTKAR TEJASWITA

Modern College of Pharmacy (Ladies), Moshi Pune, (M.H.) India. Email: vrushalipharma@indiatimes.com

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ABSTRACT

Diabetes mellitus (DM), a global public health problem, is now emerging as an epidemic world over. According to a widely accepted estimation, the number of diabetic patients would reach 366 million by the year 2030. India now has the world's largest diabetic population, encompassing an estimated 35 million people out of an overall population of 1 billion. In just over 20 years (i.e. 2025) the country will have almost 200 million people (approximately 15% of the population) affected by diabetes or its precursor. In India, indigenous remedies have been used in the treatment of DM since the time of Charaka and Sushruta (6th century BC). The ethnobotanical information reports about 800 plants that may possess anti-diabetic potential. Several such herbs have shown anti-diabetic activity when assessed using presently available experimental techniques. The present review, deals with some selective Indian medicinal plants having pharmacologically established hypoglycemic potential.

Keywords: Diabetes mellitus, indigenous remedies

INTRODUCTION

Diabetes mellitus (DM), a global public health problem, is now emerging as an epidemic world over. According to a widely accepted estimation, the number of diabetic patients would reach 366 million by the year 2030. India now has the world's largest diabetic population, encompassing an estimated 35 million people out of an overall population of 1 billion. In just over 20 years (i.e. 2025) the country will have almost 200 million people (approximately 15% of the population) affected by diabetes or its precursor[1]. Diabetes mellitus is group of syndrome characterized by hyperglycemia altered metabolism of lipids, carbohydrates and proteins with an increase risk complications from vascular disease[2]. It was reported that there is a higher incidence of retinopathy, neuropathy, nephropathy etc. together with diabetes. A wide spread pathological change is thickening of capillary membrane, increase in vessel wall matrix and cellular proliferation resulting in vascular complication like lumen narrowing, early atherosclerosis, sclerosis of glomerular capillaries, retinopathy, neuropathy and vascular insufficiency.

It may affect the disruption of carbohydrate and fat metabolism[3]. Diabetes is a metabolic disorder where in human body does not produce or properly uses insulin, a hormone that is required to convert sugar, starches, and other food into energy[4]. Human body has to maintain the blood glucose level at a very narrow range, which is done with insulin and glucagon. The function of glucagon is causing the liver to release glucose from its cells into the blood, for the production of energy. The condition may be multifactorial origin in which heredity, age, sex, pregnancy, obesity, autoimmune, infections and emotional disturbances may be important. It may precipitated by pancreatic disorders, hormonal disorders (e.g. acromegely and cushing syndrome), or by administration of drugs (corticosteroids or diuretic, especially thiazides)[5]. There are mainly two types of diabetes—Type 1 and Type 2. In Type 1 diabetes, in the absence of pancreatic b-cells the hormone insulin is not produced while Type 2 diabetes mellitus (T2DM), is characterized by a progressive impairment of insulin secretion by pancreatic b-cells and by a relative decreased sensitivity of target tissues to the action of this hormone[6]. Gestation diabetes mellitus (GDM) is glucose intolerance being recognized during pregnancy. It can complicate pregnancy leading to prenatal morbidity and mortality, so clinical detection important. In India, indigenous remedies have been used in the treatment of DM since the time of Charaka and Sushruta (6th century BC). Plants have always been an exemplary source of drugs and many of the currently available drugs have been derived directly or indirectly from them. The ethnobotanical information reports about 800 plants that may possess anti-diabetic potential[7]. Several such herbs have shown anti-diabetic activity when assessed using presently available experimental techniques[8]. Although, oral hypoglycemic agents/insulin is the mainstay of treatment of diabetes and is effective in controlling hyperglycemia, they have prominent side effects and fail to significantly alter the course of diabetic complications[9]. As the knowledge of heterogeneity of this disorder increases, there is needed to look for more efficacious agents with lesser side effects. Though development of modern medicine resulted in the advent of modern pharmacotherapeutics including insulin, biguanides, sulfonylureas and thiazolidinediones, there is still a need to look for new drugs as no drug (except strict glycemic control with insulin) has been shown to modify the course of diabetic complications[10]. Apart from currently available therapeutic options, many herbal medicines have been recommended for the treatment of diabetes. Traditional plant medicines are used throughout the world for a range of diabetic presentations. Herbal drugs are prescribed widely because of their effectiveness, less side effects and relatively low cost. Therefore, investigation on such agents from traditional medicinal plants has become more important. India has a rich history of using various potent herbs and herbal components for treating diabetes. Many Indian plants have been investigated for their beneficial use in different types of diabetes and reported in numerous scientific journals. The present review, deals with some selective Indian medicinal plants having pharmacologically established hypoglycemic potential[11].

Table 1: Selected Indian Medicinal Plants With Hypoglycemic Potential [10,11]

Sr. No	Name Of Plant	Part Used	Model Used	Reported Mechanism of Action	Reference
1	*Acacia arabica* (Lam.) Muhl. ex Willd. **Common name:** Indian Gum Arabic tree [Family: Leguminosae]	Seed, powdered seed (2, 3 and 4 mg/kg)	Normal rats, alloxan rats, rabbits	Acts through release of insulin from pancreatic beta cells.	12,13
2	*Aegle marmelos (L.) Correa ex Roxb.* **Common name:** Holy Fruit Tree [Family:Rutaceae]	root bark (1 ml/100mg), aqueous leaf extract	Normal fasted rats,	Increases utilization of glucose	14-16

3	*Allium cepa L.* **Common name:** Onion [Family:Liliaceae]	ether soluble fraction of onion (0.25 mg/kg p.o.),	STZ rats	Lowers blood glucose level	17-19
4	*Allium sativum L.* **Commonname:** Garlic [Family: Alliaceae]	ethanol, petroleum ether and ethyl acetate extract (0.25 mg/kg)	Alloxan rabbits	Has strong antioxidant activity and rapid reactivity with thiol containing proteins responsible for the hypoglycemic property.	20-21
5	*Aloe vera (L.) Burm.f.* **Common name:** Aloe [Family: Aloaceae]	leaf pulp extracts	STZ rats	Maintains glucose homeostasis by controlling the carbohydrate metabolizing enzymes and stimulates insulin release from pancreatic beta cells.	22-24
6	*Artemisia pallens Wall* **Common Name:** Davana [Family:Compositae]	aerial parts (100 mg/kg, orally)	Alloxan rats	Inhibits glucose re-absorption or increase in peripheral glucose utilization	25
7	*Annona squamosa L.* **Common name:** Sugar apple [Family:Annonaceae]	ethanolic leaf-extract (350 mg/kg, orally)	STZ rats and alloxan rabbits	Lowers blood glucose level	26-27
8	*Andrographis paniculata Nees* **Common name:** King of Bitter [Family:Acanthaceae]	Andrographis paniculata extract	STZ rats	Prevents glucose absorption from gut.	28-30
9	*Azadirachta indica A.Juss.* **Common name:** Neem [Family: Meliaceae]	Hydro alcoholic plant extract, crude ethanolic extract of the plant	STZ rats, alloxan albino rats	Inhibits action of epinephrine on glucose metabolism, resulting in increased utilization of peripheral glucose	31-34
10	*Amaranthus esculents* [Family: Amaranthaceae]	whole plant , oil fraction	STZ rats	↓Glucose; ↑insulin	35
11	*Biophytum sensitivum (L.)* **Common name:** Life Plant [Family: Oxalidaceae]	plant leaf extract	Alloxan rabbits	Stimulates pancreatic beta cells to release insulin	36
12	*Boerhavia diffusa L.* **Common name:** Tar vine [Family:Nyctaginaceae]	aqueous leaf extract (100, 200 and 400 mg/kg)	Alloxan rats	Increases plasma insulin levels and improves glucose tolerance	37-38
13	*Cassia auriculata L.* **Common name:** Tanner's Cassia [Family:Leguminosae]	aqueous flower extract	STZ rats	Suppresses enhanced gluconeogenesis during diabetes and enhance utilization of glucose through increased glycolysis. in addition to pronounced alpha-glucosidase inhibitory actions resulting in a significant and potent lowering of blood glycemic response	39
14	*Caesalpinia bonducella (L.)Roxb.* **Common name:** Chinese Cinnamon [Family: Caesalpiniaceae]	aqueous and 50% ethanolic seed extracts	STZ rats	Increases the release of insulin from pancreatic cells	40
15	*Citrullus colocynthis (L.)Schrad.* **Common name:** Bitter apple [Family: Cucurbitaceae]	aqueous extract (300 mg/kg)	Normal rabbits, STZ rats	Exerts an insulinotropic effect	41-42
16	*Coccinia indica Wight & Arn.* **Common name:** Ivy gourd [Family: Cucurbitaceae]	alcoholic leaf extract	Guinea pig, Alloxan dogs	Suppresses glucose synthesis, through depression of the key gluconeogenic enzymes glucose-6-phosphatase and fructose-1,6-bisphosphatase and enhances glucose oxidation by shunt pathway through activation of its principal enzyme glucose-6-phosphate dehydrogenase. Also has an insulin secretagogue effect and acts like insulin by correcting elevated enzymes in glycolytic pathway and restoring LPL activity in lypolytic pathway with control of hyperglycemia in diabetes	43-48
17	*Casearia esculenta Roxb.* **Common name:** Carilla Fruit [Family:Flacourtiaceae]	root extracts (300 mg/kg p.o.)	STZ rats	Exhibits significant reduction in blood glucose level, a decrease in the activities of glucose-6-phosphatase and fructose-1,6-bishosphatase and an increase in the activity of liver hexokinase, resulting in potent hypoglycemic activity	49
18	*Catharanthus roseus (L.) G.*	ethanolic leaf	STZ rats	Increases metabolization of glucose and	50-52

	Don **Common name:** Madagascarperiwinkle [Family: Apocynaceae]	extract (500mg/kg), dichloromethane: methanol extract of leaves and twigs((500 mg/kg p.o., for 7 and 15 days)		enhances secretion of insulin either from the beta cells of Langerhans or through extrapancreatic mechanism	
19	*Camellia sinensis Kuntze* **Common name:** Green tea [Family: Theaceae]	hot water extract of green tea	STZ rats	increases insulin activity	53-54
20	*Chamaemelum nobile* [Family: Asteraceae]	aqueous extract of leaves	STZ rats	↓Glucose	55
21	*Coscinium fenestratum* [Family: Menispermaceae]	alcoholic extract/steam barks	STZ rats	↓Glucose, ↓glycosylated hemoglobin, ↓glycogen, ↓lipids, ↓oxidative stress	56
22	*Enicostemma littorale Blume* [Family: Gentiaceae]	aqueous extract of plant	Alloxan rats	Enhances glucose-induced insulin release from isolated rat pancreatic islets, mediated through K (+)-ATP channel-dependent pathway	57-58
23	*Eugenia jambolana Lam.* **Common name:** Indian black berry [Family: Myrtaceae]	pulp extract of the fruits, alcoholic extract (100 mg/kg p.o.)	STZ rats, alloxan rats	May be mediated through an insulin release mechanism or due to alteration in hepatic and skeletal muscle glycogen content and hepatic glucokinase, hexokinase, glucose-6-phosphate and phosphofructokinase levels in diabetic mice. It also enhances serum insulin act and exhibits normoglycemia and better glucose tolerance	59-64
24	*Egyptian Morus alba* [Family: Moraceae]	alcoholic extract	STZ rat	↓Glucose, ↓lipid peroxidation, ↑insulin	65
25	*Ficus bengalensis L.* **Common name:** Banyan tree [Family: Moraceae]	bark extract	STZ rats, alloxan rats	Stimulates insulin secretion from beta cells of islets of Langerhans and inhibits insulin degradative process.	66-70
26	*Hibiscus rosa sinensis L.* **Common name:** China Rose [Family: Malvaceae]	ethanol extract of the plant, alcoholic leaf extract (250 mg/kg p.o. for seven days consecutive)	STZ rats	Stimulates insulin secretion from pancreatic beta cells and increases utilization of glucose, either by direct stimulation of glucose uptake or via the mediation of enhanced insulin secretion	71-72
27	*Helicteres isora L.* **Common name:** Screw tree [Family: Sterculiaceae]	ethanolic root extract (300 mg/kg, after 9 days of administration	Mice	Acts through insulin-sensitizing activity	73-74
28	*Hintonia standleyan* [Family: Rubiaceae]	methanolic extract	STZ rat	↓Glucose	75-76
29	*Hypoxis hemerocallidea* [Family: Hypoxodaceae]	Aqueous extract/fruits	STZ mice , rat	↓Glucose	77
30	*Leonotis leonurus* [Family: Lamiaceae]	Aqueous extract/leaves	STZ mice , rat	↓Glucose	78
31	*Lepidum sativum* [Family: Brassiaceae]	Aqueous extract/leaves	STZ rat	↓Glucose	79
32	*Lycium barbarum* [Family: Solanaceae]	Isolated compounds /fruits	STZ rat	↓Glucose, ↓oxidative stress, ↑GLUT4, ↑insulin	80-81
33	*Mangifera indica L.* **Common name:**Mango [Family:Anacardiaceae]	Aqueous leaf extracts (1 g/kg p.o.)	STZ rats	Possibly acts through intestinal reduction of the absorption of glucose as well as pancreatic and extrapancreatic mechanisms	82-83
34	*Momordica cymbalaria Fenzl* [Family: Cucurbitaceae]	fruit powder, aqueous fruit extract (0.5 g/kg dose for 6 weeks)	Alloxan rats	May act by increasing hepatic glycogen	84-85
35	*Mucuna pruriens (L.)* **Common name:** Velvet bean [Family: Leguminosae]	powdered seeds (0.5, 1 and 2 g/kg), plant extract (200 mg/kg), alcohol extract of the plant (100, 200 and 400	Alloxan rabbits, STZ mice	Possibly acts through stimulation of the release of insulin and/or by a direct insulin-like action due to the presence of trace elements like manganese, zinc, etc.	86-88

		mg/kg/day)			
36	*Morus alba L.* **Common name:** White mulberry [Family: Moraceae]	aqueous extract of leaves(200mg/kg)	Mice	Acts by increasing glucose uptake	89
37	*Murraya koenigii (L.) Spreng.* **Common name:** curry-leaf tree [Family: Rutaceae]	leaf-powder	Normal rats	Increases glycogenesis and decreases glycogenolysis and gluconeogenesis	90-91
38	*Malmea depressa* [Family: Annonaceae]	aqueous extract, ethanolic extract , n-butenol fraction/roots	STZ rats	↓Glucose	92
39	*Mangifera indica* [Family: Anacardiaceae]	aqueous extract/stem barks	STZ rats	↓Glucose	93
40	*Momordica charnitia* [Family: Cucurbitaceae]	methanolic extract, isolated compounds /gourd Aqueous extract/leaves	STZ rats, STZ mice Alloxan-rat	↓Glucose	94-95
41	*Ocimum sanctum L.* **Common name:** Holy Basil [Family: Lamiaceae]	ethanolic leaf extract, plant extract (200 mg/kg for 30 days)	STZ rat	Acts by cortisol inhibiting potency	96-98
42	*Punica granatum L.* **Common name:** Pomegranate [Family: Punicaceae]	ethanolic flower extract, plant extract (200 mg/kg for 30 days)	STZ rat	Inhibits intestinal alpha-glucosidase activity, leading to antihyperglycemic property	99-100
43	*Piper betle* [Family: Piperaceae]	aqueous extract, ethanolic extract/leaves	STZ rat	↓Glucose, ↓glycosylated hemoglobin	101-102
44	*Psidium guajava Linn.* [Family: Myrtaceae]	aqueous extract/whole plant	STZ rat	↓Glucose, ↓lipids, ↓insulin	103
45	*Raphanus sativus* (Brassicaceae)	aqueous extract /whole plant	STZ rat, mice	↓Glucose, ↓lipids, ↓insulin	104
46	*Retama raetam* [Family: Fabaceae]	aqueous extract/whole plant	STZ rat	↓Glucose	105
47	*Strobilanthes crispus* [Family: Acanthaceae]	aqueous extract/leaves	STZ rat	↓Glucose	106
48	*Syzygium cordatum* [Family: Myrtaceae]	aqueous extract/leaves	STZ rat	↓Glucose, ↓hepatic glycogen	107
49	*Salacia reticulata Wight.* **Common name:** Salacia [Family: Celastaceae]	aqueous decoction	STZ rat	Inhibits alpha-glucosidase activity	108
50	*Salacia Oblonga Wall.* [Family: Celastaceae]	aqueous methanolic extract, aqueous methanolic extract	Zucker rat (OZR)	Acts through inhibition of alpha-glucosidase activity	109
51	*Sida cordifolia L.* [Family: Malvaceae]	methanolic extract/root	STZ rat	↓Glucose	110
52	*Swertia chirayita (Roxb. Ex Fleming) H. Karst.* **Common name:** Indian Gentian [Family: Gentianaceae]	ethanol extract (250 mg/kg)	STZ rat	Stimulates insulin release from islets of Langerhans by depleting aldehyde-fuchsin stained beta-granules and immunostained insulin	111-112
53	*Syzygium alternifolium Walp.* [Family: Myrtaceae]	Aqueous Extract/seed	Alloxan rats	↓Glucose	113
54	*Scoparia dulcis L.* **Common name:** Sweet Broomweed [Family: Scrophulariaceae]	aqueous leaf extract (0.15, 0.30 and 0.45 g/kg body weight for 45	STZ rat , mice	Suppresses glucose influx into the polyol pathway leading to increased activities of antioxidant enzymes and plasma insulin and decreases activity of sorbitol dehydrogenase	114-115

		days p.o.), plant extracts		Also potentiates insulin release from Blood glucose, sorbitol dehydrogenase, glycosylated pancreatic islets.	
55	*Taxus yunnanensis* [Family: Taxaceae]	aqueous extract, methenolic extract, isolated compounds/ woods	STZ rat	↓Glucose	116
56	*Terminalia catappa L.* [Family: Combretaceae]	Pet-ether, Methanol, aqueous extract/fruit	Alloxan rats	↓Glucose	117
57	*Terminalia chebula* [Family: Combretaceae]	chloroform exreacr /seeds	STZ rat	↓Glucose	118
58	*Terminalia superb* [Family: Combretaceae]	methenolic extract, methylene chloride extract/steam barks	STZ rat	↓Glucose	119
59	*Trema orientalis* [Family: Ulmaceae]	aqueous extract/steam bark	STZ rat	↓Glucose	120
60	*Tremella mesenteric* [Family: Combretaceae]	isolated compounds/fruits	STZ rat	↓Glucose	121
61	*Triticum repens* P.Beauv. [Family: Gramineae]	aqueous extract/rhizomes	STZ rat	↓Glucose	122
62	*Viscum album L.* [Family: Llorenthaceae]	aqueous extract, ethanolic extract/whole plant	STZ rat	↓Glucose, ↓lipidic Peroxidation	123
63	*Zizyphus spina-christi* [Family: Rhamnaceae]	n-butenol fraction, isolated compounds/l eaves	STZ rat	↓Glucose, ↑insulin	124
64	*Smilax chinensis (L.)* [Family:Liliaceae]	ethanolic extract, dried rhizomes	Alloxan rats	Reduces blood glucose level	125
65	*Abelmoschus esculentus Linn* [Family: Malvaceae]	aqueous extract, fruit	Alloxan mice	Reduces blood glucose level	126

CONCLUSION

The incidences of modern lifestyle diseases like Type 2 diabetes widely prevalent in industrialized countries are on the rise in developing countries. The burden of T2DM is enormous when the costs of diagnosis and treatment are considered. Due to economic constraints, providing modern medical healthcare in developing countries such as India is still a far-reaching goal. Out of an estimated 250000 higher plants, less than 1% has been screened pharmacologically and very few in regard to DM. Therefore, it is prudent to look for options in herbal medicine for diabetes as well. The goals of medicine no matter to which group it belongs, are the same i.e. the welfare of the patient. One can look towards a future of integrated medicine and hope that research in alternative medicine will help identify what is safe and effective rather than marginalizing, unorthodox medical claims and findings.

REFERENCES

1. Geetanjali Kaushik et.al., Commonly consumed Indian plant food materials in the management of diabetes mellitus, Diabetes & Metabolic Syndrome: Clinical Research & Reviews 4 (2010) 21–40
2. Goodman and Gilman's, 'The Pharmacological Basis of Therapeutics', McGraw-Hill, 5th Edition, New York, 1996, 1286-89.
3. Tripathi K. D., 'An Essentials of Medical Pharmacology', Jaypee Publication, 5th Edition, New Delhi, 2006, 235-236.
4. Liggett P., David T., Choudhari N., 'Diabetic Retinopathy' Enlarged Text New England Retina, Vol. 12(2), 2006,52-62.
5. Harman R., 'Health Care Disease and Patient Advice' The Pharmaceutical Press, Vol. 17, 1990, 45-49.
6. Burcelin R, Rolland E, Dolci W, Germain S, Carrel V, Thorens B. Encapsulated, genetically engineered cells, secreting glucagon-like peptide-1 for the treatment of non-insulin-dependent diabetes mellitus. Ann N Y Acad Sci 1999; 875(June (18)):277–85.
7. Alarcon-Aguilara, F.J., Roman-Ramos, R., Perez-Gutierrez, S., Aguilar- Contreras, A., Contreras-Weber, C.C., Flores-Saenz, J.L. 1998. Study of the anti-hyperglycemic effect of plants used as antidiabetics. Journal of Ethnopharmacology 61 (2), 101-/110.
8. Saifi, A.Q., Shinde, S., Kavishwar, W.K., Gupta, S.R. 1971. Some aspects of phytochemistry and hypoglycemic actions of Pterocarpus marsupium. Journal of Research in Indian Medicine 6 (2), 205-207.
9. Rang, H.P., Dale, M.M. 1991. The Endocrine System Pharmacology, Second ed. Longman Group Ltd, UK, pp. 504-508.
10. J.K. Grover, S. Yadav, V. Vats., Medicinal plants of India with anti-diabetic potential, Journal of Ethnopharmacology 81 (2002) 81-100
11. Pulok K. Mukherjee, Kuntal Maiti , Kakali Mukherjee , Peter J. Houghton., Leads from Indian medicinal plants with hypoglycemic potentials Journal of Ethnopharmacology 106 (2006) 1–28
12. Singh, K.N., Chandra, V., Barthwal, K.C., 1975. Letter to the editor: hypoglycemic

13. activity of Acacia arabica, Acacia benthami and Acacia modest leguminous seed diets in normal young albino rats. Indian Journal of Physiology and Pharmacology 19, 167–168.
14. Wadood, A., Wadood, N., Shah, S.A., 1989. Effects of Acacia arabica and Caralluma edulis on blood glucose levels of normal and alloxan diabetic rabbits. Journal of Pakistan Medical Association 39, 208–212.
15. Karunanayake, E.H., Welihinda, J., Sirimanne, S.R., Sinnadorai, G., 1984. Oral hypoglycemic activity of some medicinal plants of Sri Lanka. Journal of Ethnopharmacology 11, 223–231.
16. Ponnachan, P.T., Paulose, C.S., Panikkar, K.R., 1993. Effect of leaf extract of Aegle marmelose in diabetic rats. Indian Journal of Experimental Biology 31, 345–347.
17. Kamalakkanan, N., Rajadurai, M., Prince, P.S., 2003. Effect of Aegle marmelos fruits on normal and streptozotocin-diabetic Wistar rats. Journal of Medicinal Food 6, 93–98.
18. Augusti, K.T., 1973. Studies on the effects of a hypoglycemic principle from Allium Cepa Linn. Indian Journal of Medical Research 61, 1066–1071.
19. Gupta, R.K., Gupta, S., Samuel, K.C., 1977. Blood sugar lowering effect of various fractions of onion. Indian Journal of Experimental Biology 15, 313–314.
20. Babu, P.S., Srinivasan, K., 1997. Influence of dietary capsaicin and onion on the metabolic abnormalities associated with streptozotocin induced diabetes mellitus. Molecular and Cellular Biochemistry 175, 49–57.
21. Jain, R.C., Vyas, C.R., 1975. Garlic in alloxan-induced diabetic rabbits. American Journal of Clinical Nutrition 28, 684–685.
22. Rabinkov, A., Miron, T., Konstantinovski, L., Wilchek, M., Mirelman, D., Weiner, L., 1998. The mode of action of allicin: trapping of radicals and interaction with thiol containing proteins. Biochimica et Biophysica Acta 1379, 233–244.
23. Rajasekaran, S., Sivagnanam, K., Ravi, K., Subramanian, S., 2004. Hypoglycemic effect of Aloe vera gel on streptozotocin-induced diabetes in experimental rats. Journal of Medicinal Food 7, 61–66.
24. Okyar, A., Can, A., Akev, N., Baktir, G., Sutlupinar, N., 2001. Effect of Aloe vera leaves on blood glucose level in type I and type II diabetic rat models. Phytotherapy Research 15, 157–161.
25. Ajabnoor, M.A., 1990. Effect of aloes on blood glucose levels in normal and alloxan diabetic mice. Journal of Ethnopharmacology 28, 215–220.
26. Subramoniam, A., Pushpangadan, P., Rajasekharan, S., Evans, D.A., Latha, P.G., Valsaraj, R., 1996. Effects of Artemisia pallens Wall. on blood glucose levels in normal and alloxan-induced diabetic rats. Journal of Ethnopharmacology 50, 13–17.
27. Shirwaikar, A., Rajendran, K., Dinesh Kumar, C., Bodla, R., 2004. Hypoglycemic activity of aqueous leaf extracts of Annona squamosa in streptozotocin-nicotinamide type 2 diabetic rats. Journal of Ethnopharmacology 91, 171–175.
28. Gupta, R.K., Kesari, A.N., Murthy, P.S., Chandra, R., Tandon, V., Watal, G., 2005. Hypoglycemic and hypoglycemic effect of ethanolic extract of leaves of Annona squamosa L. in experimental animals. Journal of Ethnopharmacology 99, 75–81.
29. Borhanuddin, M., Shamsuzzoha, M., Hussain, A.H., 1994. Hypoglycaemic effects of Andrographis paniculata Nees on non-diabetic rabbits. Bangladesh Medical Research Council Bulletin 20, 24–26.
30. Yu, B.C., Hung, C.R., Chen, W.C., Cheng, J.T., 2003. Antihyperglycemic effect of andrographolide in streptozotocin-induced diabetic rats. Planta Medica 69, 1075–1079.
31. Zhang, X.F., Tan, B.K., 2000a. Anti-diabetic property of ethanolic extract of Andrographis paniculata in streptozotocin-diabetic rats. Acta Pharmacologica Sinica 21, 1157–1164.
32. Chattopadhyay, R.R., Chattopadhyay, R.N., Nandy, A.K., Poddar, G., Maitra, S.K., 1987a. Preliminary report on antihyperglycemic effect of a fraction of fresh leaves of Azadirachta indica (Beng. Neem). Bulletin of the Calcutta School of Tropical Medicine 35, 29–33.
33. Chattopadhyay, R.R., 1996. Possible mechanism of antihyperglycemic effect of Azadirachta indica leaf extract, part IV. General Pharmacology 27, 431–434.
34. Chattopadhyay, R.R., 1999. A comparative evaluation of some blood sugar lowering agents of plant origin. Journal of Ethnopharmacology 67, 367–372.
35. Gholap, S., Kar, A., 2004. Hypoglycaemic effects of some plant extracts are possibly mediated through inhibition in corticosteroid concentration. Pharmazie 59, 876–878.
36. Kim, H.K., Kim, M.J., et.al, 2006, Antioxidative and anti-diabetic effects of amaranth **(**Amaranthus esculents) in streptozotocin-diabetic rats.Cell Biochemistry and function 24,195-199.
37. Puri, D., Baral, N., 1998. Hypoglycemic effect of Biophytum sensitivum in the alloxan diabetic rabbits. Indian Journal of Physiology and Pharmacology 42, 401–406
38. Chude, M.A., Orisakwe, O.E., Afonne, O.J., Gamaniel, K.S., Vongtau, O.H., Obi, E., 2001. Hypoglycaemic effect of the aqueous extract of Boerhavia diffusa leaves. Indian Journal of Pharmacology 33, 215–216.
39. Pari, L., Amarnath Satheesh, M., 2004. Hypoglycemic activity of Boerhaavia diffusa L.: effect on hepatic key enzymes in experimental diabetes. Journal of Ethnopharmacology 91, 109–113
40. Pari, L., Latha, M., 2002. Effect of Cassia auriculata flowers on blood sugar levels, serum and tissue lipids in streptozotocin diabetic rats. Singapore Medical Journal 43, 617- 621.
41. Sharma**,** S.R., Dwivedi, S.K., Swarup, D., 1997. Hypoglycemic, antihyperglycemic and hypolipidemic activities of Caesalpinia bonducella seeds in rats. Journal of Ethnopharmacology 58, 39–44.
42. Abdel-Hassan, I.A., Abdel-Barry, J.A., Tariq Mohammeda, S., 2000. The hypoglycemic and antihyperglycemic effect of Citrullus colocynthis fruit aqueous extract in normal and alloxan diabetic rabbits. Journal of Ethnopharmacology 71, 325–330.
43. Al-Ghaithi, F., El-Ridi, M.R., Adeghate, E., Amiri, M.H., 2004. Biochemical effects of Citrullus colocynthis in normal and diabetic rats. Molecular and Cellular Biochemistry 261, 143–149.
44. Mukherjee, K., Ghosh, N.C., Datta, T., 1972. Coccinia indica Linn. as potential hypoglycemic agent. Indian Journal of Experimental Biology 10, 347–349.
45. Singh, N., Singh, S.P., Vrat, S., Misra, N., Dixit, K.S., Kohli, R.P., 1985. A study on the anti-diabetic activity of Coccinia indica in dogs. Indian Journal of Medical Science 39, 27–29.
46. Shibib, B.A., Khan, L.A., Rahman, R., 1993. Hypoglycemic activity of Coccinia indica and Momordica charantia in diabetic rats: depression of the hepatic gluconeogenic enzymes glucose-6-phosphatase and fructose-1,6- bisphosphatase and elevation of both liver and red-cell shunt enzyme glucose-6-phosphate dehydrogenase. Biochemistry Journal 292, 267– 270
47. Azad Khan, A.K., Akhtar, S., Mahtab, H., 1979. Coccinia indica in the treatment of patients with diabetes mellitus. Bangladesh Medical Research Council Bulletin 5, 60–66.
48. Babu, P.S., Srinivasan, K., 1997. Influence of dietary capsaicin and onion on the metabolic abnormalities associated with streptozotocin induced diabetes mellitus. Molecular and Cellular Biochemistry 175, 49–57.
49. Kamble, S.M., Kamlakar, P.L., Vaidya, S., Bambole, V.D., 1998. Influence of Coccinia indica on certain enzymes in glycolytic and lipolytic pathway in human diabetes. Indian Journal of Medical Science 52, 143–146.
50. Prakasam, A., Sethupathy, S., Pugalendi, K.V., 2002. Antihyperglycaemic effect of Casearia esculenta root extracts in streptozotocin-induced diabetic rats. Pharmazie 57, 758–760.
51. Chattopadhyay, R.R., Sarkar, S.K., Ganguly, S., Banerjee, R.N., Basu, T.K., 1991. Hypoglycemic and antihyperglycemic effect of leaves of Vinca rosea Linn. Indian Journal of Physiology and Pharmacology 35, 145– 151.
52. Singh, S.N., Vats, P., Suri, S., Shyam, R., Kumria, M.M., Ranganathan, S., Sridharan, K., 2001. Effect of a hypoglycemic extract of Catharanthus roseus on enzymic activities in streptozotocin induced diabetic rats. Journal of Ethnopharmacology 76, 269–277.
53. Nammi, S., Boini, M.K., Lodagala, S.D., Behara, R.B., 2003. The juice of fresh leaves of Catharanthus roseus Linn. reduces blood glucose in normal and alloxan diabetic rabbits. BMC Complementary and Alternative Medicine 3, 4.
54. Gomes, A., Vedasiromoni, J.R., Das, M., Sharma, R.M., Ganguly, D.K., 1995. Anti-hyperglycemic effect of black tea (Camellia sinensis) in rat. Journal of Ethnopharmacology 45, 223–226.

55. Anderson, R.A., Polansky, M.M., 2002. Tea enhances insulin activity. Journal
56. of Agricultural and Food Chemistry 50, 7182–7186
57. Eddouks, M., Lemhadri, A., Zeggwagh, N.A., Michel, J.B., 2005a. Potent hypoglycemic activity of the aqueous extract of Chamaemelum nobile in normal and streptozotocin-induced diabetic rats. Diabetes Research and Clinical Practices 67, 189 195
58. Shirwaikar, A., Rajendran, K., Punitha, I.S., 2005. Antidiabetic activity of alcoholic stem extract of Coscinium fenestratum in streptozotocin-nicotinamide induced type 2 diabetic rats. Journal of Ethnopharmacology 97, 369–374.
59. Vijayvargia, R., Kumar, M., Gupta, S., 2000. Hypoglycemic effect of aqueous extract of Enicostemma littorale Blume (chhota chirayata) on alloxan induced diabetes mellitus in rats. Indian Journal of Experimental Biology 38, 781–784
60. Maroo, J., Vasu, V.T., Aalinkeel, R., Gupta, S., 2002. Glucose lowering effect of aqueous extract of Enicostemma littorale Blume in diabetes: a possible mechanism of action. Journal of Ethnopharmacology 81, 317– 320.
61. Achrekar, S., Kaklij, G.S., Pote, M.S., Kelkar, S.M., 1991. Hypoglycemic activity of Eugenia jambolana and Ficus bengalenesis: mechanism of action. In Vivo 5, 143–147
62. Prince, P.S., Menon, V.P., Pari, L., 1998. Hypoglycemic activity of Syzigium cumini seeds: effect on lipid peroxidation in alloxan diabetic rats. Journal of Ethnopharmacology 61, 1–7.
63. Prince, P.S., Kamalakkannan, N., Menon, V.P., 2004a. Hypoglycemic and antihyperlipidaemic effect of alcoholic Syzigium cumini seeds in alloxan induced diabetic albino rats. Journal of Ethnopharmacology 91, 209–213.
64. Grover, J.K., Vats, V., Rathi, S.S., 2000. Anti-hyperglycemic effect of Eugenia jambolana and Tinospora cordifolia in experimental diabetes and their effects on key metabolic enzymes involved in carbohydrate metabolism. Journal of Ethnopharmacology 73, 461–470.
65. Sharma, S.B., Nasir, A., Prabhu, K.M., Murthy, P.S., Dev, G., 2003. Hypoglycaemic and hypolipidemic effect of ethanolic extract of seeds of Eugenia jambolana in alloxan-induced diabetic rabbits. Journal of Ethnopharmacology 85, 201–206.
66. Ravi, K., Ramachandran, B., Subramanian, S., 2004a. Protective effect of Eugenia jambolana seed kernel on tissue antioxidants in streptozotocininduced diabetic rats. Biological and Pharmaceutical Bulletin 27, 1212–1217.
67. Singap, A.N., 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, 333–338.
68. Augusti, K.T., 1975. Hypoglycemic action of bengalenoside, a glucoside isolated from Ficus bengalenesis Linn. in normal and alloxan diabetic rabbits. Indian Journal of Physiology and Pharmacology 19, 218– 220
69. Achrekar, S., Kaklij, G.S., Pote, M.S., Kelkar, S.M., 1991. Hypoglycemic activity of Eugenia jambolana and Ficus bengalenesis: mechanism of action. In Vivo 5, 143–147.
70. Cherian, S., Kumar, R.V., Augusti, K.T., Kidwai, J.R., 1992. Hypoglycemic effect of a glycoside of pelargonidin isolated from the bark of Ficus bengalenesis Linn. Indian Journal of Biochemistry and Biophysics 29, 380–382.
71. Augusti, K.T., Daniel, R.S., Cherian, S., Sheela, C.G., Nair, C.R., 1994. Effect of leucopelargonin derivative from Ficus bengalenesis Linn. on diabetic dogs. Indian Journal of Medical Research 99, 82–86
72. Kumar, R.V., Augusti, K.T., 1989. Hypoglycemic effect of a leucocyanidin derivative isolated from the bark of Ficus bengalensis Linn. Indian Journal of Biochemistry and Biophysics 26, 400–404.
73. Sachdewa, A., Khemani, L.D., 1999. A preliminary investigation of the possible hypoglycemic activity of Hibiscus rosa-sinensis. Biomedical and Environmental Sciences 12, 222–226.
74. Sachdewa, A., Raina, D., Srivastava, A.K., Khemani, L.D., 2001a. Effect of Aegle marmelos and Hibiscus rosa sinensis leaf extract on glucose tolerance in glucose induced hyperglycemic rats (Charles foster). Journal of Environmental Biology 22, 53–57.
75. Chakrabarti, R., Vikramadithyan, R.K., Mullangi, R., Sharma, V.M., Jagadheshan, H., Rao, Y.N., Sairam, P., Rajagopalan, R., 2002. Hypoglycemic and hypolipidemic activity of Helicteres isora in animal models. Journal of Ethnopharmacology 81, 343–349.
76. Venkatesh, S., Dayanand Reddy, G., Reddy, Y.S., Sathyavathy, D., Madhava Reddy, B., 2004. Effect of Helicteres isora root extracts on glucose tolerance in glucose-induced hyperglycemic rats. Fitoterapia 75, 364– 367.
77. Guerrero-Analco, J.A., Hersch-Martinez, P., Pedraza-Chaverri, J., Navarrete, A., Mata, R., 2005. Antihyperglycemic effect of constituents from Hintonia standleyana in streptozotocin-induced diabetic rats. Planta Medica 71, 1099–1105
78. Navarrete, A., Mata, R., 2005. Antihyperglycemic effect of constituents from Hintonia standleyana in streptozotocin-induced diabetic rats. Planta Medica 71, 1099–1105
79. Ojewole, J.A., 2006. Antinociceptive, anti-inflammatory and antidiabetic properties of Hypoxis hemerocallidea Fisch. and C.A.Mey. (Hypoxidaceae) corm ['African Potato'] aqueous extract in mice and rats. Journal of Ethnopharmacology 103, 126–134.
80. Ojewole, J.A., 2005b. Antinociceptive, antiinflammatory and antidiabetic effects of Leonotis leonurus (L.) R. BR. [Lamiaceae] leaf aqueous extract in mice and rats. Methods and Findings in Experimental and Clinical Pharmacology 27, 257–264
81. Eddouks, M., Maghrani, M., Zeggwagh, N.A., Michel, J.B., 2005c. Study of the hypoglycaemic activity of Lepidium sativum L. aqueous extract in normal and diabetic rats. Journal of Ethnopharmacology 97, 391–395.
82. Zhao, Y.F., Keating, D.J., Hernandez, M., Feng, D.D., Zhu, Y., Chen, C., 2005a. Long-term inhibition of protein tyrosine kinase impairs electrophysiologic activity and a rapid component of exocytosis in pancreatic βcells. Journal of Molecular Endocrinology 35, 49–59.
83. Wu, H., Guo, H., Zhao, R., 2006. Effect of Lycium barbarum polysaccharide on the improvement of antioxidant ability and DNA damage in NIDDM rats. Yakugaku Zasshi: Journal of the Pharmaceutical Society of Japan 126, 365–3671
84. Aderibigbe, A.O., Emudianughe, T.S., Lawal, B.A., 1999. Antihyperglycaemic effect of Mangifera indica in rat. Phytotherapy Research 13, 504–507
85. Muruganandan, S., Srinivasan, K., Gupta, S., Gupta, P.K., Lal, J., 2005. Effect of mangiferin on hyperglycemia and atherogenicity in streptozotocin diabetic rats. Journal of Ethnopharmacology 97, 497–501.
86. Rao, B.K., Kesavulu, M.M., Giri, R., Appa Rao, C., 1999. Hypoglycemic and hypolipidemic effects of Momordica cymbalaria Hook. fruit powder in alloxan-diabetic rats. Journal of Ethnopharmacology 67, 103–109
87. Kameswara Rao, B., Kesavulu,.M., Apparao, C., 2003a. Evaluation of hypoglycemic effect of Momordica cymbalaria fruit in alloxan-diabetic rats. Fitoterapia 74, 7–13.
88. Akhtar, M.S., Qureshi, A.Q., Iqbal, J., 1990. Hypoglycemic evaluation of Mucuna pruriens Linn. Seeds. Journal of Pakistan Medical Association 40, 147–150.
89. Grover, J.K., Vats, V., Rathi, S.S., Dawar, R., 2001. Traditional Indian antidiabetic plants attenuate renal hypertrophy, urine volume and albuminuria in streptozotocin induced diabetic mice. Journal of Ethnopharmacology 76, 233–238.
90. Rathi, S.S., Grover, J.K., Vats, V., 2002. The effect of Momordica charantia and Mucuna pruriens in experimental diabetes and their effect on key metabolic enzymes involved in carbohydrate metabolism. Phytotherapy Research 16, 236–243.
91. Chen, F., Nakashima, N., Kimura, I., Kimura, M., 1995. Hypoglycemic activity and mechanisms of extracts from mulberry leaves (Folium mori) and cortex mori radicis in streptozotocin-induced diabetic mice. Yakugaku Zasshi 115, 476–482.
92. Iyer, U.M., Mani, U.V., 1990. Studies on the effect of curry leaves supplementation (Murraya koeingii) on lipid profile, glycated proteins and amino acids in non-insulin-dependent diabetic patients. Plant Foods and Human Nutrition 40, 275–282.
93. Khan, B.A., Abraham, A., Leelamma, S., 1995. Hypoglycemic action of Murraya koeingii (curry leaf) and Brassica juncea (mustard): mechanism of action. Indian Journal of Biochemistry and Biophysics 32, 106–108.
94. Andrade-Cetto, A., Martinez-Zurita, E., Wiedenfeld, H., 2005. Hypoglycemic effect of Malmea depressa root on

streptozotocin diabetic rats. Journal of Ethnopharmacology 100, 319–322

95. Ojewole, J.A., 2005c. Antiinflammatory, analgesic and hypoglycemic effects of Mangifera indica Linn. (Anacardiaceae) stem-bark aqueous extract. Methods and Findings in Experimental and Clinical Pharmacology 27, 547–554
96. Shetty, A.K., Kumar, G.S., Sambaiah, K., Salimath, P.V., 2005. Effect of bitter gourd (Momordica charantia) on glycaemic status in streptozotocin induced diabetic rats. Plant Foods for Human Nutrition 60, 109– 112.
97. Harinantenaina, L., Tanaka, M., Takaoka, S., Oda, M., Mogami, O., Uchida, M., Asakawa, Y., 2006. Momordica charantia constituents and antidiabetic screening of the isolated major compounds. Chemical and Pharmaceutical Bulletin 54, 1017–1021. 100
98. Chattopadhyay, R.R., 1993. Hypoglycemic effect of Ocimum sanctum leaf extract in normal and streptozotocin diabetic rats. Indian Journal of Experimental Biology 31, 891–893.
99. Vats, V., Yadav, S.P., Grover, J.K., 2004a. Ethanolic extract of Ocimum sanctum leaves partially attenuates streptozotocin-induced alterations in glycogen content and carbohydrate metabolism in rats. Journal of Ethnopharmacology 90, 155–160.
100. Gholap, S., Kar, A., 2004. Hypoglycaemic effects of some plant extractsare possibly mediated through inhibition in corticosteroid concentration. Pharmazie 59, 876–878.
101. Jafri, M.A., Aslam, M., Javed, K., Singh, S., 2000. Effect of Punica granatum Linn. (Flowers) on blood glucose level in normal and alloxan-induced diabetic rats. Journal of Ethnopharmacology 70, 309–314.
102. Das, A.K., Mandal, S.C., Banerjee, S.K., Sinha, S., Saha, B.P., Pal, M., 2001. Studies on the hypoglycaemic activity of Punica granatum seed in streptozotocin induced diabetic rats. Phytotherapy Research 15, 628–629.
103. Arambewela, L.S., Arawwawala, L.D., Ratnasooriya,W.D., 2005. An antidiabetic activity of aqueous and ethanolic extracts of Piper betle leaves in rats. Journal of Ethnopharmacology 102, 239–245.
104. Santhakumari, P., Prakasam, A., Pugalendi, K.V., 2006. Antihyperglycemic activity of Piper betle leaf on streptozotocin-induced diabetic rats. Journal of Medicinal Food 9,108–112.
105. Ojewole, J.A., 2005d. Hypoglycemic and hypotensive effects of Psidium guajava Linn. (Myrtaceae) leaf aqueous extract. Methods and Findings in Experimental and Clinical Pharmacology 27, 689–695.
106. Taniguchi, H., Kobayashi-Hattori, K., Tenmyo, C., Kamei, T., Uda, Y., Sugita- Konishi, Y., Oishi, Y., Takita, T., 2006. Effect of Japanese radish (Raphanus sativus) sprout (Kaiware-daikon) on carbohydrate and lipid metabolisms in normal and streptozotocin-induced diabetic rats. Phytotherapy Research 20, 274–278.
107. Maghrani, M., Michel, J.B., Eddouks, M., 2005. Hypoglycaemic activity of Retama raetam in rats. Phytotherapy Research 19, 125–128.
108. Fadzelly, A.B., Asmah, R., Fauziah, O., 2006. Effects of Strobilanthes crispus tea aqueous extracts on glucose and lipid profile in normal and streptozotocininduced hyperglycemic rats. Plant Foods for Human Nutrition 61, 7–12
109. Musabayane, C.T., Mahlalela, N., Shode, F.O., Ojewole, J.A., 2005. Effects of Syzygium cordatum (Hochst.) [Myrtaceae] leaf extract on plasma glucose and hepatic glycogen in streptozotocin-induced diabetic rats. Journal of Ethnopharmacology 97, 485–490.
110. Yoshikawa, M., Murakami, T., Yashiro, K., Matsuda, H., 1998. Kotalanol, a potent alpha-glucosidase inhibitor with thiosugar sulfonium sulfate structure, from hypoglycemic Ayurvedic medicine Salacia reticulata. Chemical and Pharmaceutical Bulletin (Tokyo) 46, 1339–1340
111. Li, Y., Peng, G., Li, Q., Wen, S., Huang, T.H., Roufogalis, B.D., Yamahara, J., 2004. Salacia oblonga improves cardiac fibrosis and inhibits postprandial hyperglycemia in obese Zucker rats. Life Science 75, 1735–1746.
112. Kanth, V.R., Diwan, P.V., 1999. Analgesic, antiinflammatory and hypoglycaemic
113. activities of Sida cordifolia. Phytotherapy Research 13, 75–77.
114. Sekar, B.C., Mukherjee, B., Chakravarti, R.B., Mukherjee, S.K., 1987. Effect of different fractions of Swertia chirayita on the blood sugar level of albino rats. Journal of Ethnopharmacology 21, 175–181.
115. Saxena, A.M., Bajpai, M.B., Murthy, P.S., Mukherjee, S.K., 1993. Mechanism of blood sugar lowering by a Swerchirin-containing hexane fraction (SWI) of Swertia chirayita. Indian Journal of Experimental Biology 31, 178–181
116. Rao, B.K., Rao, C.H., 2001. Hypoglycemic and antihyperglycemic activity of Syzygium alternifolium (Wt.) Walp. seed extracts in normal and diabetic rats. Phytomedicine 8, 88–93.
117. Pari, L., Venkateswaran, S., 2002. Hypoglycaemic activity of Scoparia dulcis L. extract in alloxan induced hyperglycaemic rats. Phytotherapy Research 16, 662–664.
118. Latha, M., Pari, L., Sitasawad, S., Bhonde, R., 2004b. Scoparia dulcis, a traditional hypoglycemic plant, protects against streptozotocin induced oxidative stress and apoptosis in vitro and in vivo. Journal of Biochemical and Molecular Toxicology 18, 261–272.
119. Banskota, N.T., Nguyen, Y., Tezuka, T., Nobukawa, S., Kadota, S., 2006. Hypoglycemic effects of the wood of Taxus yunnanensis on streptozotocininduced diabetic rats and its active components. Phytomedicine 13, 109–114
120. Nagappa, A.N., Thakurdesai, P.A., Venkat Rao, N., Singh, J., 2003. Hypoglycemic activity of Terminalia catappa Linn. fruits. Journal of Ethnopharmacology 88, 45–50.
121. Rao, N.K., Nammi, S., 2006. Antidiabetic and renoprotective effects of the chloroform extract of Terminalia chebula Retz seeds in streptozotocin-induced diabetic rats. BMC Complementary and Alternative Medicine 6, 17.
122. Kamtchouing, P., Kahpui, S.M., Dzeufiet, P.D., Tedong, L., Asongalem, E.A., Dimo, T., 2005. Anti-diabetic activity of methanol/methylene chloridestem bark extracts of Terminalia superba and Canarium schweinfurthii on streptozotocin-induced diabetic rats. Journal of Ethnopharmacology 104, 306–309
123. Dimo, T., Ngueguim, F.T., Kamtchouing, P., Dongo, E., Tan, P.V., 2006. Glucose lowering efficacy of the aqueous stem bark extracts of Trema orientalis (Linn) Blume in normal and streptozotocin diabetic rats. Die Pharmazie 61, 233–236
124. Lo, H.C., Tsai, F.A., Wasser, S.P., Yang, J.G., Huang, B.M., 2006. Effects of ingested fruiting bodies, submerged culture biomass, and acidic polysaccharide lucuronoxylomannan of Tremella mesenterica Retz: Fr. on glycemic responses in normal and diabetic rats. Journal of Life Science 78, 1957–1966.
125. Eddouks, M., Maghrani, M., Michel, J.B., 2005b. Hypoglycaemic effect of Triticum repens P. Beauv in normal and diabetic rats. Journal of Ethnopharmacology 102, 228–232.
126. Orhan, D.D., Aslan, M., Sendogdu, N., Ergun, F., Yesilada, E., 2005. Evaluation of the hypoglycemic effect and antioxidant activity of three Viscum album subspecies (European mistletoe) in streptozotocin-diabetic rats. Journal of Ethnopharmacology 98, 95–102.
127. 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, 129–138
128. 125 Venkidesh R., Subhash C. Mandal, Dilipkumar Pal, Mohana Lakshmi S., SaravanakumarA., Antidiabetic Activity Of Smilax Chinensis (L.) In Alloxan Induced Diabetic Rats, International Journal of Pharmacy and Pharmaceutical Sciences, Vol 2, Suppl 2, 2010,51-54
129. Dibyajyoti Saha, Bindu Jain, Vibhor K. Jain., Phytochemical Evaluation And Characterization of Hypoglycemic Activity Of Various Extracts Of Abelmoschus Esculentus Linn. Fruit. International Journal of Pharmacy and Pharmaceutical Sciences., Vol 3, Suppl 2, 2011,183-185.