



A PEER REVIEW ON HERBAL DRUGS USED FOR THE TREATMENT OF DIABETES

Madhu Sahu^{1*}, Prerana Sahu² and Neha Dubey³

¹RKDF College of Pharmacy, SRK University, Bhopal.

²Rungta Institute of Pharmaceutical Sciences, Bhilai.

³Shri Rawatpura Sarkar Institute of Pharmacy, Kumhari.

***Corresponding Author: Madhu Sahu**

RKDF College of Pharmacy, SRK University, Bhopal.

Article Received on 15/04/2021

Article Revised on 05/05/2021

Article Accepted on 25/05/2021

ABSTRACT

Diabetes mellitus is a dreadful disease found in all parts of the world and is becoming a serious threat to mankind health. Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels that result from defects in insulin secretion, or action, or both. There are lots of chemical agents available to control and to treat diabetic patients, but total recovery from diabetes has not been reported up to this date. Alternative to these synthetic agents, many herbal plants with hypoglycaemic properties are known from across the world. Alternative to synthetic agents, plants provide a potential source of hypoglycemic drugs and are widely used to prevent diabetes. In the present review, an attempt has been made to summarize some of the herbal plants having anti-diabetic activity which are beneficial for the mankind.

KEYWORDS: Diabetes mellitus, herbal drugs, garlic, aloe vera.

1. INTRODUCTION

Diabetes is a group of metabolic disorders characterized by abnormal metabolism, which results most naturally in hyperglycaemia, due to defect in insulin secretion, insulination or both diabetes mellitus is characterized by chronic hyperglycaemia glycosuria disturbance of carbohydrate, fat and protein metabolic resulting cause changes in multiple organism. According to WHO, reports, India had 32 million diabetic people in the year 2001 the International Diabetes Federation (IDF) estimates the total number of diabetic subjects to be around 40.9 million in India and this to further set to rise to 69.9 million by the year 2025.^[1]

Hyperglycemia, hyperlipemia, hyperaminoacidemia, and hypoinsulinemia are all symptoms of diabetes mellitus, a systemic metabolic condition.^[2] Insulin, insulin absorption, and insulin action both decline as a result. Insulin and other oral antidiabetic agents such as sulfonylureas, biguanides, -glucosidase inhibitors, and glinides are currently available therapies for diabetes.^[3] The use of any plant's seeds, berries, stems, leaves, bark, or flowers for medicinal purposes is known as herbal medicine, also known as botanical medicine^[4] or phytomedicine. Herbalism, which has long been practised outside of traditional medicine, is becoming more common as new studies and study prove its importance in the treatment and prevention of diseases.^[5]

Medicinal herbs, minerals, and organic matter are used in many common remedies. In herbal preparations used in Indian traditional health care schemes &^[6], a variety of medicinal plants known as rasayana have been used for over 1000 years. In Indian medicine, the majority of practitioners create and administer their own formulas.^[7] The World Health Organization (WHO) has compiled a list of 21 diseases. 21,000 plants, which are used for medicinal purposes around the world.^[8] An herbal formulation is a dosage medium that contains one or more herbs or refined herb(s) in particular amounts to provide various medicinal, cosmetic, and/or other advantages for use in diagnosing, treating, or mitigating diseases in humans or animals, as well as to change the structure or physiology of humans or animals.^[10] Many ingredients are included in whole herbs, and they are likely to work together to achieve the desired therapeutic result. The type of condition in which a plant grew (climate, pests, soil quality), as well as how and where it was harvested and processed, would have an impact on its components.^[11] The aggregation of glycated proteins, glucose oxidation, and elevated free fatty acids are all factors that contribute to hyperglycemia-related injury.^[13] Furthermore, Recent research suggests that reactive oxygen species (including free radicals) can play a role in the onset and progression of diabetic vascular complications.^[14]

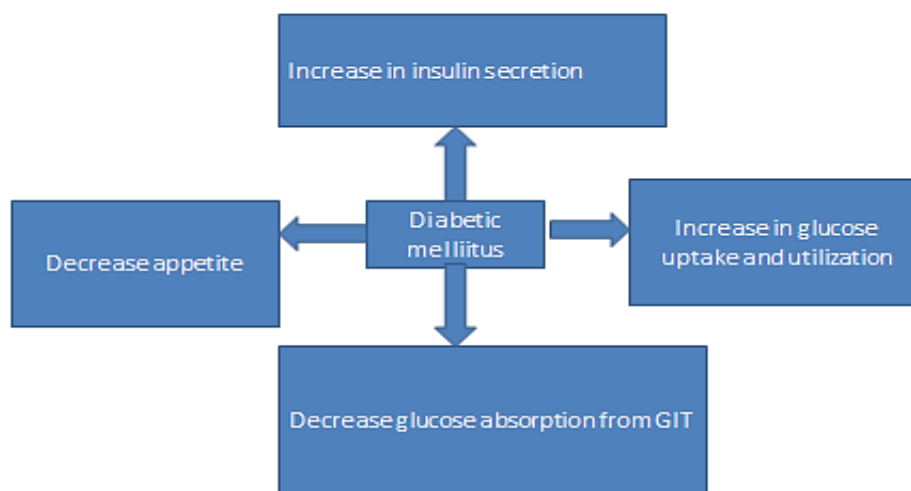


Fig 1.1: Effects of Diabetes mellitus.

1.1 Herbal Drug

The term herbal drug denotes plants or plant parts that have been converted into phyto-pharmaceuticals by means of simple processes.^[15] Involving harvesting, drying and storage, it is also called herbalism, traditional medical or full medicine practice based on the use of plant and plant extracts.^[16]

1.2 Mechanism of Herbal Drugs

Herbal drug treat many disease like asthma, eczema, chronic fatigue, diabetics mellitus, rheumatoid arthritis, migraine.^[17] among other herbal drug are best taken under the guidance of a profession and be sure to consult with your physician and herbalist some herbal drugs which is used in diabetes give below.^[18] Herbalists tend to use whole plants rather than removing single components from them for the reasons mentioned in the

previous section. There are several components in whole plant extracts.^[19] These elements function together to achieve therapeutic benefits while also reducing the risk of side effects from any one of them. Several herbs are often combined to increase potency and synergistic effects.^[20]

1.3 Various Herbal drugs with anti-diabetic properties

1.3.1 Allium Sativum (Lahsun)

Synonyms: Garlic (eng), Lasun (Hindi).

Family: *Liliaceae*.

Parts used: Ripe Bulbs.

Chemical constituents: allicin (yellow liquid), alin, mucilage, albumin, alpha glutamyl peptides, amino acid (methionine, lucine cysteine).



Fig 1.2: Allium Sativum (Lahsun).

Pharmacological use: S-allyl cystein sulfoxide (SACS), a sulfur-containing amino acid that regulated lipid peroxidation better than glibenclamide and insulin, is the precursor of Allicin and garlic oil.^[21] It also helped

diabetic patients. SACS also increased insulin secretion in beta cells isolated from normal rats in vitro. In addition, Allium sativum has antimicrobial, anticancer, and cardioprotective properties.^[22]

1.3.2 Aloe vera

Synonyms: ghirtkumari.

Family: Liliaceae.

Part used: leaf.

Chemical constituent: aloe emodin, aloin, aloesin, emodin.



Fig 1.3: Aloevera.

Pharmacological used

Aloevera has been used by mankind for thousands of years in folk medicine for therapeutic properties especially on skin.^[23] Aloevera is a cactus-like plant, although is related to the onion, garlic and asparagus. It is stemless with triangular, fleshy leaves ranging in color from grey-green to bright green and in the margin of the leaves has small white teeth. The polysaccharides found in Aloe vera can play an important role in its anti-diabetic properties. In diabetics, this plant has been related to lower blood glucose levels, as well as lower

blood lipid levels or cholesterol (approximately 30% lower) 40 in hyperlipidaemic patients.^[24] Aloe vera and its bitter philosophy work by stimulating the development and/or release of insulin.

1.3.3 Trigonella foenum graecum (fenugreek)

Synonyms: alholva.

Family: fabaceae.

Part used: seed.

Chemical constituent: dioscin, stolone, 4-hydroxy isoleucine.



Fig 1.4: Trigonella foenum graecum.

Pharmacological activity

In both rats and humans, 4-hydroxyisoleucine, a novel amino acid derived from fenugreek seeds, enhanced glucose-stimulated insulin release by isolated islet cells.^[25] In both normal and diabetic rats, oral administration of 2 and 8 g/kg of plant extract resulted in dose-dependent reductions in blood glucose levels.^[26]

1.3.4 Azadirachta indica

Synonyms: Neem.

Family: meliaceae.

Parts used: leaf, stem, seed.

Chemical constituents: azadirachtin, nimbin, gedunin.



Fig 1.5: *Azadirachta indica*.

Pharmacological use

In streptozotocin-treated rats, hydroalcoholic extracts of this plant exhibited anti-hyperglycemic action^[27], which was due to an improvement in glucose absorption and glycogen deposition in isolated rat hemidiaphragm. Apart from its anti-diabetic properties, it shows anti-bacterial properties, anti-fungal property, anti-malarial and anti-fertility.^[28]

1.3.5 *Momordica charantia*

Synonyms: Bitter ground.

Family: Cucurbitaceae.

Parts used: fruit.

Chemical constituent: vincine, siogresin.



Fig 1.6: *Momordica charantia*.

Pharmacological use

In India and other Asian countries, *Momordica charantia* is widely used as an antidiabetic and antihyperglycemic agent. In different animal models, extracts of fruit pulp, seed, leaves, and the whole plant were shown to have a hypoglycemic effect.^[29] When polypeptide p, derived from the berries, seeds, and tissues of *M. charantia*, was administered subcutaneously to langurs, rat and human it had a major hypoglycemic impact.^[30] In normal and STZ diabetic rats, ethanolic extracts of *M. charantia* (200

mg/kg) had an antihyperglycemic and hypoglycemic impact. This may be due to inhibition of glucose-6-phosphatase in the liver, in addition to fructose-1, 6-biphosphatase, and activation of hepatic glucose-6-phosphate dehydrogenase activities.^[31]

1.3.6 *Syzygium cumini*

Family: myrtaceae.

Parts used: fruit, seed, leaf.

Chemical constituent: gallic acid, myricitrin, myricetin.



Fig 1.7: Syzygium cumini.

Pharmacological use

A great number of herbal medicinal products worldwide have been identified as hypoglycemic. Jamun is one of the old fruits commonly performed by the doctors.^[32] A diabetologist is a person who specialises in the treatment of diabetes.^[33] Similarly, jamun seeds have been shown to have anti-diabetic properties. Jamun, botanically known as *Syzygium cumini*, is a member of the Myrtaceae family. Its fruit is widely accepted to be of very high quality for its curative role, most notably against diabetes due to its impact on the pancreas.

Because of the existence of bioactive ingredients, jamun has antihypercholesterolemic properties and aids in the regulation of blood lipid profiles.^[34] Several studies conducted over the last two decades have shown that jamun contains a rich complex of naturally occurring antioxidant compounds.^[35]

1.3.7 Mangifera indica

Family: myrtaceae.

Parts used: fruit, seed, leaf.

Chemical constituent: gallic acid, myricitrin, myricetin.



Fig 1.8: Mangifera Indica.

Pharmacological use

Leaves of this plant in Nigerian Folk Medicine are used as an antidiabetic agent^[36], however, in normalglycemic or streptozotocin-induced diabetes rats, when the aqueous extract was given orally^[37], the glucose level was not altered.^[38] Antidiabetic activity was nevertheless noted when extract and glucose were concurrently administered and again when the extract was administered to rats 60 minutes before glucose.^[39] The

findings show the hypoglycemic activity of the aqueous extract of *Mangifera indica*.^[40] This may be because glucose synthesis has been reduced intestinally.^[41]

1.3.8 Coccinia indica

Synonyms: kundru, tindora.

Family: Cucurbitaceae.

Parts used: Leaves.



Fig 1.9: *Coccinia indica*.

Pharmacological study

Studying Dry extracts (500 mg/kg body weight) of *Coccinia indica* were administered for 6 weeks in diabetic patients.^[42] These extracts restored the decreased activities and glucose-6-phosphatase and dehydrate lactate dehydratease of the lipoprotein lipase (LPL) enzyme which have been increased in untreated diabetics.^[43] The 500 mg/kg oral administration of *C.*

indica leaves demonstrated severe hypoglycemia and improved glucose resistance in mild and diabetic dogs with alloxanized diabetic dogs.^[44]

1.3.9 *Hibiscus rosa-sinesis*

Synonyms: Chinese hibiscus, China rose.

Family: Malvaceae.

Parts used: flowers.



Fig. 1.10: *Rosa sinesis*.

Pharmacological study

In a glucose-loaded rat, *Hibiscus rosa-sinesis* caused mild but severe hypoglycemia after 120 minutes.^[45] A significant hypoglycemic effect was observed at 30, 90 and 120 minutes after glucose loading in normal rats daily with the same dose for 7 days.^[46]

1.3.10 *Acacia arabica*

Synonyms: bulbul.

Family: Fabaceae.

Parts used: Leaves, stem.



Fig 1.11: Acacia Arabica.

Pharmacological study

It is primarily found in the wild in India.^[47] The plant extract functions as an antidiabetic agent to produce insulin.^[48] It leads to hypoglycemia, but not in alloxanized animals, in control rats.^[49] Acacia arabica

powdered seeds is caused hypoglycemic effect by the initiation of the release of insulin from pancreatic beta cells, when administered (2, 3 and 4g/kg body weight) to normal rabbits.^[50]

Table 1.1: Different herbal drugs used for diabetes along with their family.

S.no	Biological source	Synonyms	Family
1	<i>Aloe vera</i> Mill.	Aloe	<i>Liliaceae</i>
2	<i>Allium cepa</i> L.	Onion	<i>Liliaceae</i>
3	<i>Allium sativum</i> L.	Garlic	<i>Liliaceae</i>
4	<i>Adhatoda vasica</i> Nees	Vasaka	<i>Acanthaceae</i>
5	<i>Alocasia indica</i> schott	Giant Taro	<i>Araceae</i>
6	<i>Aloevera tournex</i> .Linn	Barbados Aloe	<i>Liliaceae</i>
7	<i>Anana scomosus</i> (L) merr	Pineapple	<i>Bromeliaceae</i>
8	<i>Andrographis paniculata</i> Nees	Green chirayta	<i>Acanthaceae</i>
9	<i>Annona reticulata</i> Linn	Custard apple	<i>Annonaceae</i>
10	<i>Annona reticulata</i> L.	Bullock's heart	<i>Annonaceae</i>
11	<i>Antidesma acidum</i> Retz	Devil's tree	<i>Euphorbiaceae</i>
12	<i>Areca catechu</i> Linn	Betel palm	<i>Areaceae</i>
13	<i>Argyrea speciosa</i> Linn. F.	Elephant creeper	<i>Convolvulaceae</i>
14	<i>Boenninghausenia albiflora</i>	Tooth-ache plant	<i>Rutaceae</i>
15	<i>Bombax malabaricum</i> DC	Red cotton tree	<i>Bombacaceae</i>
16	<i>Brassica juncea</i> (L) Czern.	Mustard greens	<i>Brassicaceae</i>
17	<i>Caesalpinia crista</i> Linn.	Fever nut	<i>Caesalpinaceae</i>
18	<i>Caesalpinia pulcherrima</i>	Pride of Barbados	<i>Caesalpinaceae</i>
19	<i>Cajanus cajan</i> Mill	Pigeon pea	<i>Papilionaceae</i>
20	<i>Cassia fistula</i> L.	Golden shower cassia	<i>Caesalpinaceae</i>
21	<i>Cassia occidentalis</i> Linn.	Coffee-senna	<i>Caesalpinaceae</i>
22	<i>Cassia sophera</i> Linn	Senna sophera	<i>Caesalpinaceae</i>
23	<i>Catharanthus roseus</i> L.	Periwinkle	<i>Apocynaceae</i>
24	<i>Cajanus cajan</i> (L.)	Millsp. Pigeon pea	<i>Papilionaceae</i>
25	<i>Cicer arietinum</i> L.	Gram	<i>Papilionaceae</i>
26	<i>Cichorium intybus</i> L.	Chicory	<i>Asteraceae</i>
27	<i>Cyperus rotundus</i> L.	Nutgrass	<i>Cyperaceae</i>
28	<i>Daucus carota</i> L.	Carrot	<i>Apiaceae</i>
29	<i>Dodonaea viscosa</i> (L) Jacq.	Switch sorrel	<i>Sapindaceae</i>
30	<i>Elettaria cardamomum</i> Maton	Cardamon	<i>Zingiberaceae</i>
31	<i>Equisetum debile</i> Roxb.	Horse Tail	<i>Equisetaceae</i>
32	<i>Fagonia indica</i> L.	Fagonia	<i>Euphorbiaceae</i>

33	<i>Ficus bengalensis L.</i>	Banyan	<i>Moraceae</i>
34	<i>Glycine max Merr</i>	Glycine	<i>Papilionaceae</i>
35	<i>Gmelina arborea Roxb</i>	Beechwood	<i>Verbenaceae</i>
36	<i>Grewia abutilifolia Juss</i>	Phalsa berries.	<i>Tiliaceae</i>
37	<i>Ichnocarpus frutescent R. Bn.</i>	Ichnocarpus frutescence	<i>Apocyanaceae</i>
38	<i>Imperata cylindrical Beauv</i>	Kunai grass	<i>Poaceae</i>
39	<i>Ipomoea aquatica Forssk.</i>	Water spinach	<i>Convolvaceae</i>
40	<i>Ipomoea batata (L) Lam.</i>	Sweet Potato	<i>Convolvaceae</i>
41	<i>Jatropha curcus Linn.</i>	Physic nut	<i>Euphorbiaceae</i>
42	<i>Hordeum vulgare L.</i>	Barley	<i>Poaceae</i>
43	<i>Kickxia ramosissima (Wall.)</i>	Janchen Kichxia	<i>Scrophulariaceae</i>
44	<i>Melia azedarach L.</i>	Barbados lilac	<i>Meliaceae</i>
45	<i>Momordica charantia L.</i>	Bitter gourd	<i>Cucurbitaceae</i>
46	<i>Ocimum album L.</i>	White basil	<i>Lamiaceae</i>

2. CONCLUSION

Diabetes mellitus is a most common endocrine disorder, affecting millions of people worldwide. It is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The increase in resistance and populations of patients at some risk, in conjunction with the restricted number of commercially available drugs for diabetes that still present have many side effects and also problems like unwanted hypoglycemic effect are the cause to shift the research towards traditionally available medicine which have low side effect and wide range of bio activity and do not require laborious pharmaceutical synthesis seems highly attractive. From this review article, it may be useful to the health professionals, scientists and scholars to develop evidence-based alternative medicine to cure different kinds of diabetes problem using herbal preparation. Substances and extracts isolated from different natural resources play very important role to design medicine and treat hyperglycemic problem in diabetes mellitus.

3. REFERENCES

- Manisha Modak, Priyanjali Dixit, Jayant Londhe, Saroj Ghaskadbi, and Thomas Paul A. Indian Herbs and Herbal Drugs Used for the Treatment of Diabetes., J. Clin. Biochem. Nutr, 2007; 40: 163–173.
- Pritesh Patel, Pinal Harde, Jagath Pillai, Nilesh Darji And Bhagirath Patel Sat Kaival College Of Pharmacy Pharmacophore (An International Research Journal Antidiabetic Herbal Drugs A Review Available Online At Review Article Pharmacophore, 2012; 3: 18-29.
- M. Ayyanar, K. Sankarasivaraman and S. Ignacimuthu Traditional Herbal Medicines Used for the Treatment of Diabetes among Two Major Tribal Groups in South Tamil Nadu, Ethnobotanical Leaflets, 2008; 12: 276-280.
- Prof. Dr. Basavaraj K. Nanjwade Polyherbal Formulations for Diabetes. 7th September 2011 in 14th Asian Chemical Congress.
- Zohreh Bakhtiary. Herbal Medicines in Diabetes. Iranan journal of diabetes and obesity, 2011; 2: 3, 1-10.
- www.diabetes-herbs.com.
- C. K. Kokate, A. P. Purohit Pharmacognosy, Published By Nirali Prakashan, Vol 1&2, 47th Edition, 2008.
- Prof. Dr. Basavaraj K. Nanjwade Polyherbal Formulations for Diabetes. 7th September 2011 in 14th Asian Chemical Congress.
- Gerstein HC, Santaguida P, Raina P, Morrison KM, Balion C, Hunt D, et al. Annual incidence and relative risk of diabetes in people with various categories of dysglycemia: a systematic overview and meta-analysis of prospective studies. Diabetes Res Clin Pract, 2007; 78: 305–12.
- McCarty P, Zimmet P. Diabetes 1994-2010: global estimate and projections. Diabetes Care, 1997; 20: 1785-90.
- Hunt LM, Arar NH, Akana LL. Herbs, prayer, and insulin: Use of medical and alternative treatments by a group of Mexican-American diabetic patients. J Fam Pract, 2000; 49: 216-223.
- Cleary PD. Chiropractic use: A test of several hypothesis. Am J Public Health, 1982; 72: 727-730.
- Cleary PD. Chiropractic use: A test of several hypothesis. Am J Public Health, 1982; 72: 727-730.
- Dahanukar SA, Kulkarni RA, Rege NN. Pharmacology of Medicinal Plants and Natural Products (1994–98), Indian J Pharmacol, 2000; 32: S81–S118.
- Ranjan C, Ramanujam R. Diabetes and insulin resistance associated disorders: Disease and the therapy. Curr Sci, 2002; (83): 1533-38.
- Pulok KM, Kuntal M, Kakali M, Peter JH. Leads from Indian medicinal plants with hypoglycemic potentials. J Ethnopharmacol, 2006; 106: 1–28.
- Mohamed B, Abderrahim Z, Hassane M, Abdelhafid T, Abdelkhaleq L. Medicinal plants with potential antidiabetic activity-A review of ten years of herbal medicine research (1990-2000). Int J Diabetes Metabol, 2006; 14: 1-25.
- Manisha Modak, Priyanjali Dixit, Jayant Londhe, Saroj Ghaskadbi, and Thomas Paul A. Indian Herbs and Herbal Drugs Used for the Treatment of Diabetes., J. Clin. Biochem. Nutr, 2007; 40: 163–173.

19. Pritesh Patel, Pinal Harde, Jagath Pillai, Nilesh Darji And Bhagirath Patel Sat Kaival Pharmacophore, 2012; 3: 18-29.
20. Bhattacharya A, Chatterjee A, Ghosal S, Bhattacharya SK. Indian J Exp Biol, 1999; 37: 676–680.
21. Genuth, S (2006), “Insights from the diabetes control and complications trial/epidemiology of diabetes interventions and complications study on the use of intensive glycemic treatment to reduce the risk of complications of type 1 diabetes”, *Endocr Pract*, 12(Suppl 1): 34-41.
22. Gangan, VD; Pradhan, P; Sipahimalani, AT; Banerji (1994), “A. Cordifoliosides A, B, C: Norditerpene furan glycosides from *Tinospora cordifolia*”, *Phytochemistry*, 37: 781-6.
23. LM, Tierney; SJ, McPhee and MA, Papadakis (2002), “Current medical Diagnosis & Treatment”, International Edition, New York, Lange Medical Books/McGraw-Hill, 1203-1215.
24. Maroo, J Vasy and VT, Gupta (2003), “Dose Dependent Hypoglycemic effect of aqueous extract induced diabetic rats. *Phytomedicine*, International Journal of Phytotherapy & Phytopharmacology.
25. Piyush M, Patel; Natvarlal M, Patel and Ramesh K, Goyal (2006) “Holistic classification of herbal antidiabetic: A review”, *Pharma Times*, Vol-38.
26. Sivarajan, VV and Indira, Balachandran (2004) “*Ayurvedic Drugs & their plant Source*”, 1st Edition Reprint-Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.
27. Sniderman, AD; Bhopal, R; Prabhakaran, D and Sarrafzadegan, N (2007), “Why might South Asians be so susceptible to central obesity and its atherogenic consequences? The adipose tissue overflow hypothesis”, *International Journal of Epidemiology*, 36(1): 220-225.
28. TK, Biswas; S, Bandyopadhyay; Biswapati, Mukherjee and BR, Sengupta (1997), “Oral Hypoglycemic effect of *Caesalpinia bonducella*”, *International Journal of Pharmacognosy*, 35(4): 261-264.
29. Trivedi, NA; Saxena, NS; Mazumdar, B; Bhatt, JD and Hemavathi, KG(2001), “Effect of Shilajit on blood glucose, lipid profile and vascular preparation in alloxan induced diabetic rats”, *Indian Journal of Pharmacology*, 143.
30. Vinod D, Rangari (2007) “*Pharmacognosy Phytochemistry*”, Vol. 2, 1st Edition, Career Publication, Nashik, 184.
31. M. Upendra Rao, M. Sreenivasulu, B. Chengaiah, K. Jaganmohan Reddy, C. Madhusudhana Chetty. Herbal Medicines for Diabetes Mellitus: A Review, *International Journal of PharmTech Research*, 2010; 2(3): 1883-1892.
32. Abesundara KJ, Matsui T M, K. Alpha-glucosidase inhibitory activity of some Sri Lanka plant extracts one of which *Cassia auriculata* exerts a strong antihyperglycemic effect in rats comparable to the therapeutic drug acarbose. *Journal of Agricultural and Food Chemistry*, 2004; 52: 2541–2545.
33. Khan BA, Abraham A, Leelamma S. Hypoglycemic action of *Murraya koeingii* (curry leaf) and *Brassica juncea* (mustard): mechanism of action. *Indian Journal of Biochemistry and Biophysics*, 1995; 32: 106–108.
34. Nugroho AE, Andrie M, Warditiani NK, Siswanto E, Pramono S, Lukitaningsih E. Antidiabetic and antihyperlipidemic effect of *Andrographis paniculata* (Burm. f.) Nees and andrographolide in high-fructose-fat-fed rats. *Indian journal of pharmacology*, 2012; 44(3): 377–381.
35. Gupta R. Bajpai KG, Johri S, Saxenaa M. An overview of indian novel traditional medicinal plants with antidiabetic potentials. *Complementary and Alternative. Medicines*, 2008; 5: 1–17.
36. Tabatabaeimalazy O. Iarijani B, Abdollahi M. Targeting metabolic disorders by natural products. *Journal of diabetes & metabolic disorder*, 2015: 14–57.
37. Reddy VS. Sahay RK, Bhadada SK, Agrawal JK, Agrawal NK. Newer Oral Antidiabetic Agents. *Journal Indian. Academy of Clinical Medicine*, 2000; 1(3).
38. Prabhakar PK, Doble M. Mechanism of action of natural products used in the treatment of diabetes mellitus. *Chin J integr med*, 2011(17).
39. Kumar K, Fateh V, Verma B, Pandey S. Some herbal drugs used for treatment of diabetes: review article. *International*, 2014.
40. Galor SW. Benzie IF. FHerbal medicine: an introduction to its history, usage, regulation, current trends and; Research needs, 2011.
41. Gupta R. Bajpai KG, Johri S, Saxenaa M. An overview of indian novel traditional medicinal plants with antidiabetic potentials. *Complementary and Alternative. Medicines*, 2008; 5: 1–17.
42. Gebreyohannes G, Gebreyohannes M. Medicinal values of garlic: A review. *International. Journal of Medicine and Medical Sciences*, 2013; 5: 401–408.
43. Lakshmi MS. Rani KSS, Reddy UKT. A review on diabetes mellitus and the herbal plants used for its treatment. *Asian. journal of pharmaceutical and clinical research*, 2012; 5: 15–21.
44. Mishra R, Shuaib M, Shravan M, S P. A review on herbal antidiabetic drugs. *Journal of Applied Pharmaceutical Science*, 2011; 1(6): 235–237.
45. Arumugam G, Manjula P, Paari N. A review: Antidiabetic medicinal plants used for diabetes mellitus. *Journal of acute diseases*, 2013.
46. Giovannini P, Jayne MR, Howes E, E S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: a review. *Journal of. Ethnopharmacology*, 2016; 2.
47. Dwivedi CP, Dasgaul S. Antidiabetic herbal drugs and polyherbal formulation used for diabetes: A review. *The journal of phytopharmacology*, 2013; 2: 44–51.

48. Rao MU, Sreenivasulu M, Chengaiah B, Reddy KJ, Chetty CM. Herbal Medicines for Diabetes Mellitus. A Review. *International Journal of Pharm Tech Research*, 2010; 2: 1883–1892.
49. Bordoloi R, Dutta KN. A Review on Herbs Used in the Treatment of Diabetes mellitus. *Journal of Pharmaceutical, Chemical and Biological Sciences*, 2014; 2: 86–92.
50. Wannes WA, Marzouk B. Research progress of Tunisian medicinal plants used for acute diabetes. *Journal of Acute Disease*, 2016; 5(5): 357–363.