Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/10705
DOI URL: http://dx.doi.org/10.21474/IJAR01/10705

*REVIEW ARTICLE*

# A REVIEW ON MEDICINAL PLANTS WITH ANTI-DIABETIC ACTIVITY

**Syed Ahad Hussain[1], Master Greeshma Namilikonda[1], Thota Karan Chandra[1] and Md. Arif Pasha[2]**

1. Bpharmacy, Vaageswari College of Pharmacy, Karimnagar-505001.
2. Department of Pharmaceutical Chemistry, Vaageswari College of Pharmacy, Karimnagar-505001.

## *Manuscript Info*

***Manuscript History***
Received: 20 January 2020
Final Accepted: 22 February 2020
Published: March 2020

## *Abstract*

Diabetes mellitus is a metabolic disorder which is characterised by hyperglycaemia due to increase in hepatic glucose production ,decreased insulin secretion and impaired insulin action. About 60%of the world's population uses traditional medicines which are derived from the medicinal plants. In India it is proving to be a severe health issue majorly in the urban areas. Though there are various approaches to reduce the ill effects of diabetes and its secondary complications, herbal formulations are being preferred due to lesser side effects ,less toxic ,low cost and effectiveness .The present review focuses on various herbal plants which are proved to be containing anti-hyperglycaemic activity. Although many plants are recommended, further pharmacological and chemical research should be done to elucidate the exact mechanism of hypoglycaemic activity.



## Introduction:-

According to W.H.O.-Diabetes is defined as a metabolic disorder which is characterised by chronic hyper glycemia with disturbances in metabolism of fat, protein and carbohydrate which results in insulin secretion, insulin action or both. Diabetes mellitus is associated with long term damage, failure of organs and dysfunction. Diabetes mellitus include symptoms like thirst, polyurea, blurred vision and loss of weight [1]. Indian council of medical research has identified that it is one of the refractive diseases for which an alternate medicine is required for the treatment. In this ultra-modern era it has become one of the most rising problem in the world [2]. It is one of the most serious metabolic disorder in the endocrine system which leads to several manifestations [3].According to an estimate, people who are suffering from diabetes has marked to 246 million and now it kills people more when compared to AIDS [4]. Every 5sec in the world a person is detected with diabetes while some dies of it every 10 sec [5]. Increased stress, obesity and lack of physical activity has been ensnared in the prevalence of diabetes in the past two decades [6].

**Types of diabetes mellitus:**

1. Insulin dependent diabetes mellitus (IDDM)
2. Non-Insulin dependent diabetes mellitus (NIDDM)
3. Gestational diabetes

**Prominent plant-based medicines:**

It has been predicted that near about 80-85% of the population both in developed and developing countries confide on the traditional medicine for the primarily health care requirements and it is pretended that major part involves in

**Corresponding Author:- Md. Arif Pasha**
Address:- Department of Pharmaceutical Chemistry, Vaageswari College of Pharmacy, Karimnagar-505001.

traditional therapy of the plant extracts or their active principles [7,8]. This is exclusively true for the countries like India and China which fairly organises the traditional therapy [9]. Abundant traditional plants are used for the treatment of diabetes all over the world [10]. Before the discovery of insulin in 1922, the only choice for the treatment of diabetes were based on the traditional medicine practices [11].

**Gigantic research has been attracted to natural drugs:**
Marles and Farnsworth approximated that besides 1000 variety of plant species are being used as a community medicine for diabetes [12]. Since mid 1950s the concentration of the investigators attracted to research in medicinal plants. Highly compelling research is going on medicinal plants while some are being investigated in clinical setting [13].

**Potency:**
The potency and safety of some plants have been sufficiently proved by clinical use over thousands of years [14]. Literature research has shown that many of the plants analysed for ant diabetic potentials have been used since ages in the traditional settings and scientific investigation later validated the claims [15,16]. Many of the plants have been found to be quite potential in the control of diabetes and its stumbling both in experimental animals and in clinical studies.

**Safety-Less Side Effects:**
Some of the natural products mainly plants have been used as food since years and are considered safe. Plant drugs and medicinal formulations are considered to be less toxic and free from side effects. [17,18]. Herbal plants are prescribed largely even when their active constituents are unknown, because of their safety, efficacy and availability [19].

**W.H.O reinforce herbal medicines:**
The World Health Organization (WHO) reinforces and promotes the usage of herbal drugs for the management of various diseases including diabetes [20]. WHO appraises plant treatments to be the most effective, non-poisonous, with less adverse effects [21]. WHO monograph on selected medicinal plants and publications are those which will support the plant based medicines[22].

**Mechanism of action of medicinal anti diabetics [23,24]:**
The ant diabetic activity of medicinal plants depends on several mechanisms. The mechanism of action can be grouped as-

1. Pancreatic beta cell potassium channel blocking, cAMP (secondary messenger) stimulation
2. PInhibition of renal glucose reabsorption
3. Stimulation of insulin secretion from beta cells of islets of Langerhans/inhibition of insulindegradative processes
4. Reduction of insulin resistance
5. Providing few necessary elements like calcium, zinc, magnesium, manganese andcopper for the beta-cells
6. Regenerating /repairing pancreatic beta cells
7. Stimulation of insulin secretion
8. Stimulation of glycolysis.

**Plants On Diabetes Mellitus:**
Natural products are the major sources for discovering propitious dominance candidates, which play an important role in future drug development programs. Ease of availability, least side effects and low cost make the herbal preparations favourable for all available therapies, mostly in rural areas. The aim of this review is to mention some of the anti-diabetic plantsand shed light on the most relevant data related to these popular plants.

**Azadirachtaindica(Meliaceae):**
This is also known as Neem and is a tree native to India, Burma, Bangladesh, Sri Lanka, Malaysia and Pakistan and tropical and semi-tropical regions. A low (0.5g TID) and high (2g TID) doses of powdered leaves&bark, aq. extract and alcoholic extract of *Azadirachtaindica*showed significant hypoglycaemic activity in high dose and can be successfully combined with oral hypoglycaemic agents[25].

**Bruguieragymnorrhiza(Rhizophoraceae):**
The oral administration of ethanolic extract of B. gymnorrhiza root (400 mg/kg b.wt) reduced the blood sugar level, triglycerides, total cholesterol and increased the HDL level of STZ induced diabetic rats.[26].

**Biophytumsensitivum(Oxalidaceae):**
The oral administration of the ethanolic extract of B. sensitivumwhole plant has shown the decrease in blood glucose level, serum cholesterol level and increase in the total protein level of induced diabetic rats [27].

**HelicteresisoraL(Malvaceae):**
The hot water extract of fruit of H. isorahas shown moderate anti-diabetic activity at 200 mg/mL doses&glucose-up take activity. It was found to have activity comparable to insulin and metformin. The ethanolic extract has insulin-sensitizing and hypolipidemic activity used in the treatment of type-2 diabetes mellitus [28].

**Lantana camaraL. (Verbenaceae):**
Ondaily administration of L. camaraleaf juice (1500 mg/kg/day for 14 days) has shown significant hypoglycaemic effect in rats [29].

**MurrayakoenigiiLinn (Rutaceae):**
In normal and alloxan diabetes the aq. extract of the leaves of M. koenigiihasproduced hypoglycaemic effect. It suppressed blood glucose level and was found to be having beneficial effect on carbohydrate metabolism [30].

**Ossimumgratissium(Labiatae):**
The hypoglycaemic effect of aq. Leaf extract of Opium gratisimumwas investigated in streptozotocin induced diabetic rats. The aqueous extract at the dose of 500 mg/kg has shown the lowered blood glucose level of the diabetic rats by 81.3% after 24 hr of administration [31].

**Polyalthialongifolia(Annonaceae):**
The oral administration of the methanolic extract of P. longifoliabark (200 and 300 mg/kg b.w.) has lowered the fasting blood glucose levels, further the elevated levels of SGOT, SGPT, ALP, triglycerides and total cholesterol were restored to near normal level in STZ induced diabetic rats [32].

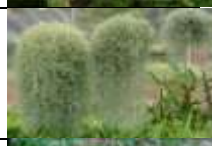
**Tectonagrandis(Verbenaceae):**
Administration of methanolic extract of Tectonagrandisroots has induced antidiabetic activity which was performed on alloxan induced diabetic albino rats. Its hypoglycaemic activity was compared with glibenclamide and hypoglycaemic activity and reported at the dose of 500mg/kg [33].

**Terminalia chebula(Combretaceae):**
Anti diabetic activity of the chloroform extract of T. chebulaRetz seeds in STZ -induced diabetic rats was proved [34].

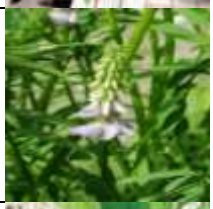
| S.no. | Plant | Family | Plant part | Reference |
|---|---|---|---|---|
| 1. | Azadirachtaindica | Meliaceae | Leaves & bark | 35 |
| 2. | Bruguieragymnorrhiza | Rhizophoraceae | root | 36 |
| 3. | Biophytumsensitivum | Oxalidaceae | Whole plant | 37 |
| 4. | Helicteresisora L. | Malvaceae | fruit | 38 |
| 5. | Lantana camara | Verbenaceae | Leaf juice | 39 |
| 6. | Murray koenigii Linn. | Rutaceae | leaves | 40 |
| 7. | Ossimumgratissium | Labiatae | leaves | 41 |
| 8. | Polyalthialongifolia | Annonaceae | bark | 42 |
| 9. | Tectonagrandis | Verbenaceae | roots | 43 |
| 10. | Terminalia chebula | Combretaceae | seeds | 44 |

**Other Plants Containing Anti-Diabetic Activity:**

| S.n | Plant | Family | Plant part/main constituent | Referen | Images |
|---|---|---|---|---|---|

| o | | | | ce | |
|---|---|---|---|---|---|
| 1. | Abelmoschus moschatusMedik | Malvaceae | Myricelin | 45 |  |
| 2. | Zizyphus spina-christiL | Rhamnaceae | Christinin-A, (saponin glycoside) | 46 |  |
| 3. | Acanthopanaxsenticosus | Araliaceae | Saponin/leaves | 47 |  |
| 4. | Xanthocerciszambesiaca | Leguminaceae | Leaves&roots | 48 |  |
| 5. | Bryonia alba | Cucurbitaceae | trihydroxyoctadecadienoic acids/roots | 49 |  |
| 6. | Trigonellafoenum graecum L. | Leguminosea | Steroidal saponins | 50 |  |
| 7. | Chamaemelumnobile | Compositae | 3 hydroxy-3-methylglutaric acid (HMG) containing flavonoids, glucoside chamaemeloside | 51 |  |
| 8. | Tillandsia usneoidesL. | Bromeliaceae | 3-Hydroxy-3-methyl-glutaric acid (HMG) | 52 |  |
| 9. | Citrullus colocynthisL. | Cucurbitaceae | Beta-pyrazol-1 yl alanine/seeds; Saponin glycosides/rind | 53,54 |  |
| 10. | Swertia japonica Blum | Gentianaceae | Bellidifolin | 55 |  |

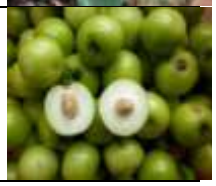
| | | | | | |
|---|---|---|---|---|---|
| 11. | Coccinaindica | Cucurbitaceae | Pectin/fruit | 56 |  |
| 12. | Swertiachirayita | Gentianaceae | Swerchirin(1,8-dihydroxy-3,5-dimethoxyxanthone) | 57,58 |  |
| 13. | Croton cajucaraBenth | Euphorbiaceae | Trans dehydro-crotonin (t-DCTN)/bark | 59 |  |
| 14. | Securigera securidacaL. | Fabaceae | seeds | 60 |  |
| 15. | Cuminum nigrum | Apiaceae | Flavonoid/seeds | 61 |  |
| 16. | Salacia oblonga Wall | Hippocrateaceae | Two biologically active fractions have been isolated | 62 |  |
| 17. | Equisetum myriochaetum | Equisetaceae | 3 kaempferol glucosides and 1 caffeoyl glucoside | 63 |  |
| 18. | Rhodiolasachalinensis | Crassulaceae | Polysaccharides | 64 |  |
| 19. | Eriobotrya japonica Lindl. | Rosaceae | Sesquiterpene glycoside &polyhydroxylated triterpenoids | 65 |  |

| | | | | | |
|---|---|---|---|---|---|
| 20. | Pterocarpus marsupium | Leguminosea | Marsupsin, pterosupin&pterostilbene&Epicatecin | 66 |  |
| 21. | FicusbenghalensisL. | Moraceae | A dimethoxy derivative of perlargonidin 3-O-alpha-L rhamnoside, Glycoside of leucopelargonidin and dimethoxy ether of leucopelargonidin-3-O-alpha-L rhamnoside /bark | 67,68 |  |
| 22. | Pandanus odorusRidl. | Pandanaceae | 4-hydro47xybenzoic acid | 69 |  |
| 23. | Galega officinalis L. | Leguminosea | Galegine | 70 |  |
| 24. | Panax ginseng | Araliaceae | GPP/roots | 71,72 |  |
| 25. | KalopanaxpictusThumb | Araliaceae | Hederagenin glycosides and phenolic Glycosides/stem bark | 73 |  |
| 26. | Paeonia lactifloraPall. | Ranunculaceae | Paeoniflorin and 8-debenzoylpaeoniflorin (glycosides)/root | 74 |  |
| 27. | Kochia scoparia | Chenopodiaceae | Momordin IC and its 2'-O-beta-D-glucopyranoside together with three saponins named scoparianosides A, B and C | 75 |  |

| | | | | | |
|---|---|---|---|---|---|
| 28. | Otholobiumpubescens | Fabaceae | Bakuchiol | 76 |  |
| 29. | Lagerstroemia speciosaPers. | Lythraceae | colosolic acid and maslinic acid | 77 |  |
| 30. | Olea europaeaL. | Oleaceae | Oleuropeoside/leaf | 78 |  |
| 31. | Larrea tridentata | Zygophyllaceae | Masoprocol | 79 |  |
| 32. | Myrcia multiflora DC | Myrtaceae | myrciacitrins I and IIandmyrciaphenones A and B | 80 |  |
| 33. | Malva verticillata | Malvacées | Polysaccharide/seeds | 81 |  |
| 34. | Morus insignis L. | Moraceae | mulberrofuran U and moracin (M-3-O-β-D glucopyranoside) together with 6 known compounds | 82 |  |
| 35. | Acacia auriculiformis | Leguminosae | bark | 83 |  |

| | | | | | |
|---|---|---|---|---|---|
| 36. | Amaranthus viridis | Amaranthaceae | Whole plant | 84 |  |
| 37. | Acacia arabica | Leguminosae | bark | 85 |  |
| 38. | Aegle marmelos | Rutaceae | Whole plant | 86 |  |
| 39. | Agrimoniaeupatoria | Rosaceae | Whole plant | 87 |  |
| 40. | Alangiumsalvifolium | Alangiacea | leaves | 88 |  |
| 41. | Allium sativum | Alliacea | garlic | 89 |  |
| 42. | Aloe barbadensis | Liliaceae/ Aspodelaceae | leaves | 90 |  |
| 43. | Annona squamosa | Annonaceae | leaves | 91 |  |

| | | | | | |
|---|---|---|---|---|---|
| 44. | Camellia sinensis | Theaceae | Green tea | 92 |  |
| 45. | Capsicum frutescens | Solanaceae | Red chilli | 93 |  |
| 46. | Catharanthus roseus | Apocynacea | Leaves&twigs | 94 |  |
| 47. | Ephedra distachya | Ephedraceae | Crude drug | 95 |  |
| 48. | Eucalyptus globulus L. | Myrtaceae | leaves | 96 |  |
| 49. | Eucalyptus citriodori | Myrtaceae | leaves | 97 |  |
| 50. | Nigella sativa | Ranunculacea e | Plant oil | 98 |  |
| 51. | Rehmanniaglutinos a | Scrophulariac eae | rhizome | 99 |  |

| | | | | | |
|---|---|---|---|---|---|
| 52. | Solanum xanthocarpum | Solanaceae | Leaves | 100 |  |
| 53. | Semen coicis | Gramineae | seeds | 101 |  |
| 54. | Solanum nigrum | Solanaceae | Leaves | 102 |  |
| 55. | Sphenostylisstenocarp | Leguminosae | Seeds | 103 |  |
| 56. | Tribulus terrestris | Zygophyllaceae | Saponin from decoction of plant | 104 |  |
| 57. | Terminalia superba | Combretaceae | Stem bark | 105 |  |
| 58. | Vernonia amygdalina | Asteraceae | Leaves | 106 |  |
| 59. | Ziziphusmauritiana | Rhamnaceae | seed | 107 |  |

| | | | | | |
|---|---|---|---|---|---|
| 60. | Withaniasomnifera | solanaceae | roots | 107 |  |
| 61. | Symplocospaniculata | Symplocaceae | Leaves,stem | 107 |  |
| 62. | Musa sapientum Kuntz | Musaceae | Fruits,flower | 107 |  |
| 63. | Garcinia cola | Clusiaceae | seed | 107 |  |
| 64. | Ficuscarica L. | Moraceae | leaves | 107 |  |

## Conclusion:-

In this present review work, we have listed out the medicinal plants containing anti-diabetic activity along with the advantages of herbal drugs over synthetic drugs as these considered to be less toxic with less side-effects, more potential, less- expensive and widely available.Diabetes has become a critical and swiftly extending health problem through outthe world in both developed and developing countries. Despite development of various types of drugs and continuous research on different fronts both number of cases and prevalence is increasing. Based on WHO recommendations, hypoglycaemic agents of plant origin used in medicine are important.The attributed anti hyperglycaemic effects of these plants are due to their ability to restore the function of pancreatic tissues by causing an increase in insulin output or a decrease in intestinal absorption of glucose. Hence treatment with herbal drugs has effect in protecting cells and smoothing out fluctuations in glucose level.

## Reference:-


1. Rakesh K. Joshi, William N. Setzer, Valdir F. DaVeiga Junior. Aromatic and Medicinal Plants with Anti-Diabetic Potential from India: A Review. American Journal of Essential Oils and Natural Products. 2015,2(4),22-28
2. Kokate C K, Purohit A P. Pharmacognosy,Published By NiraliPrakashan ,Vol 1&2, 47th Edition, 2008.
3. Soon YY, Tan BKH. Evaluation of the hypoglycemic and anti- oxidant activities of Morinda officinalis in streptozotocin-induced diabetic rats. Singapore Medical Journal. 2002,43(2),77-85.
4. WHO Experts Committee on Diabetes Mellitus. Technical Report Series, World Health Organization, Geneva. 1980.
5. Colagiuri R. Diabetes: A pandemic, a development issue or both? Expert Review of Cardiovascular Therapy.2010,8,305–309.
6. Hill JO and Peters JC. Biomarkers and functional foods for obesity and diabetes. British Journal of Nutrition. 2002,88,S213- S218.

7. Bekelee T. Antidiabetic activity and phytochemical screening of crude extracts of Stevia rebaudianaBertoni and Ajuga remotaBenth grown in Ethiopia on alloxan- induced diabetic mice. MSc Thesis, Addis Ababa University; 2008.
8. Tomlinson TR, Akerele O. Medicinal plants: Their role in health and biodiversity. Philadelphia: University of Pennsylvania Press; 1998.
9. Sukh D. Prime Ayurvedic Plants Drugs A Modern Scientific Appraisal. 2nd ed. India: Ane Books Pvt. Ltd.; 2012.
10. Koski RR. Practical review of oral antihyperglycemic agents for Type 2 diabetes mellitus. The Diabetes Educator. 2006,32,869-876.
11. Ribnicky DM, Poulev A, Watford M, Cefalu WT, Raskin I. Antihyperglycemic activity of Tarralin, an ethanolic extract of Artemisia dracunculus L. Phytomedicine. 2006,13,550–557.
12. Marles R, Farnsworth NR. Plants as sources of antidiabetic agents. In: Wagner H, Farmsworth NR, editors. Economic and Medicinal Plant Research. UK: Academic Press Ltd; 1994.
13. Sukh D. Prime Ayurvedic Plants Drugs A Modern Scientific Appraisal. 2nd ed. India: Ane Books Pvt. Ltd.; 2012.
14. Chopra A, Saluja M, Tillu G. Ayurveda-modern medicine interface: A critical appraisal of studies of Ayurvedic medicines to treat osteoarthritis and rheumatoid arthritis.Journal of Ayurveda and Integrative Medicine. 2010,1(3),190-198.
15. Bnouham M, Ziyyat A, Mekhfi H, Tahri A, Legssyer A. Medicinal plants with potential antidiabetic activity - A review of ten years of herbal medicine research (1990-2000).International Journal of Diabetes & Metabolism. 2006,14,1-25.
16. Kavishankar GB, Lakshmidevi N, Murthy SM, Prakash HS, Niranjana SR. Diabetes and medicinal plants-A review. InternationalJournal of Pharmacy and Biomedical Sciences. 2011,2(3),65-80
17. Neelesh M, Sanjay J, Sapna M. Antidiabetic Potential of Medicinal Plants. Acta PoloniaePharmaceutica -Drug Research. 2010,67(2),113-118.
18. Verspohl EJ. Recommended testing in diabetes research. PlantaMedica. 2002,68,581–590.
19. Dewanjee S, Das AK, Sahu R, Gangopadhyay M. Anti-diabetic activity of Diospyros peregrina fruit: effect on hyperglycemia, hyperlipidemia and augmented oxidative stress in experimental type 2 diabetes. Food and Chemical Toxicology. 2009,47(10),2679-2685.
20. Bailey CJ, Day C. Traditional plant medicines as treatments for diabetes. Diabetes Care. 1989,12,553–564.
21. Shokeen P, Anand P, Murali YK, Tandon V. Antidiabetic activity of 50% ethanolic extract of Ricinus communis and its purified fractions. Food and Chemical Toxicology. 2008,46(11),3458-3466.
22. WHO website: http://www.who.int/medicines/organization/trm/orgtrmstrat.htm. Retrieved on August 12, 2013.
23. Ghosh MN. Fundamentals of experimental Pharmacology. 3rd ed. Hilton and Company; 2005. P. 190 – 7.
24. Dwivedi Chandraprakash, DaspaulSwarnali, Antidiabetic Herbal Drugs and Polyherbal Formulation Used For Diabetes: A Review, The Journal of Phytopharmacology. 2013,2 (3),1-7
25. Rawat Mukesh & Parmar Namita. Medicinal Plants with Anti diabetic Potential A Review, American-Eurasian Journal ofAgricultural& Environmental Science.2013,13(1),81-94.
26. Elavarasi S., Saravanan K. & Renuka C. A Review on Medicinal Plants Used to treat Diabetes Mellitus.International Journal of Pharmaceutical, Chemical & Biological Sciences.2013,3(3),984-986.
27. Elavarasi S., Saravanan K. & Renuka C. A Review on Medicinal Plants Used to treat Diabetes Mellitus, International Journal of Pharmaceutical, Chemical & Biological Sciences.2013,3(3),984-986.
28. Rakesh K. Joshi, William N. Setzer, Valdir F. DaVeiga Junior. Aromatic and Medicinal Plants with Anti-Diabetic Potential from India: A Review.American Journal of Essential Oils and Natural Products.2015,2(4),22-28.
29. Rakesh K. Joshi, William N. Setzer, Valdir F. DaVeiga Junior. Aromatic and Medicinal Plants with Anti-Diabetic Potential from India: A Review.American Journal of Essential Oils and Natural Products.2015,2(4),22-28
30. Abdel Nasser Singab, Fadia S Youssef and Mohamed L Ashour. Medicinal Plants with Potential Antidiabetic activity & their Assesment. Medicinal & Aromatic Plants.2014,3(1),151.
31. ReeteshMalvi, Sonam Jain, Shareya Khatri, Arti Patel, Smita Mishra. A Review on Anti-diabetic Medicinal Plants and Marketed Herbal Formulations.International Journal of Pharmaceutical and Biological Archives 2011, 2(5),1346.
32. Elavarasi S., Saravanan K. & Renuka C. A Review on Medicinal Plants Used to treat Diabetes Mellitus.International Journal of Pharmaceutical, Chemical & Biological Sciences.2013,3(3),984-986.

33. Gurjar Himanshu P.S, Irchharya Raghuveer, Verma Amita. Review on Some Medicinal Plants with Anti-diabetic Activity, Journal of Drug Delivory and Therapeutics.2016, 6(2),45-51.
34. Abdel Nasser Singab, Fadia S Youssef and Mohamed L Ashour. Medicinal Plants with Potential Antidiabetic activity & their Assessment. Medicinal & Aromatic Plants.2014,3(1),151.
35. Rawat Mukesh & Parmar Namita. Medicinal Plants with Anti diabetic Potential A Review.American-Eurasian Journal of Agricultural& Environmental Science. 2013,13(1),81-94.
36. Elavarasi S., Saravanan K. & Renuka C. A Review on Medicinal Plants Used to treat Diabetes Mellitus.International Journal of Pharmaceutical, Chemical & Biological Sciences.2013,3(3),984-986.
37. Elavarasi S., Saravanan K. & Renuka C. A Review on Medicinal Plants Used to treat Diabetes Mellitus.International Journal of Pharmaceutical, Chemical & Biological Sciences.2013,3(3),984-986.
38. Rakesh K. Joshi, William N. Setzer, Valdir F. DaVeiga Junior. Aromatic and Medicinal Plants with Anti-Diabetic Potential from India: A Review.American Journal of Essential Oils and Natural Products 2015, 2(4),22-28
39. Rakesh K. Joshi, William N. Setzer, Valdir F. DaVeiga Junior. Aromatic and Medicinal Plants with Anti-Diabetic Potential from India: A Review.American Journal of Essential Oils and Natural Products 2015, 2(4),22-28
40. Abdel Nasser Singab, Fadia S Youssef and Mohamed L Ashour. Medicinal Plants with Potential Antidiabetic activity & their Assessment. Medicinal & Aromatic Plants.2014,3(1),151.
41. ReeteshMalvi, Sonam Jain, Shareya Khatri, Arti Patel, Smita Mishra. A Review on Anti-diabetic Medicinal Plants and Marketed Herbal Formulations.International Journal of Pharmaceutical and Biological Archives.2011, 2(5),1346.
42. Elavarasi S., Saravanan K. & Renuka C. A Review on Medicinal Plants Used to treat Diabetes Mellitus.International Journal of Pharmaceutical, Chemical & Biological Sciences.2013,3(3),984-986.
43. Gurjar Himanshu P.S, Irchharya Raghuveer, Verma Amita. Review on Some Medicinal Plants with Anti-diabetic Activity, Journal of Drug Delivory and Therapeutics.2016, 6(2),45-51.
44. Nasser Singab, Fadia S Youssef and Mohamed L Ashour. Medicinal Plants with Potential Antidiabetic activity & their Assessment. Medicinal & Aromatic Plants.2014,3(1),151.
45. Liu IM, Tzeng TF, Liou SS, Lan TW. Improvement of insulin sensitivity in obese Zucker rats by myricetin extracted from Abelmoschus moschatus. Planta Medica. 2007,73,1054-1060.
46. Glombitza KW, Mahran GH, Mirhom YW, Michel KG, Motawi TK. Hypoglycaemic and antihyperglycaemic effects of Zizyphus spina-christi in rats. Planta Medica. 1994,60,244-247.
47. Sui DY, Lu ZZ, Li SH, Cai Y. Hypoglycaemic effect of Saponin isolated from leaves of Acanthopanaxsenticosus (Rupr. Et Maxin.) [Harms]. Chung Kuo Chung Yao TsaChih. 1994,19,683-685.
48. Nojima H, Kimura I, Chen FJ, Sugihara Y, Haruno M, Kato A, et al. Antihyperglycaemic effects of N-containing sugars from Xanthoceciszambesiaca, Morusbombycis, Aglaenematreubii and Castanospermumautrale in streptozotocin- diabetic mice. Journal of Natural Products. 1998,61,397-400.
49. Karagenzyan KG, Vartanyan GS, Agadjanov MI, et al. Restoration of the disordered glucose fatty acid cycle in alloxan-diabetic rats by trihydroxyoctadecadienoic acids from Bryonia alba, a native Armenian medicinal plant. Planta Medica. 1998,64,417-422.
50. Petit PR, Sauvaire YD, Hillaire-Buys DM, Leconte OM, Baissac YG, Ponsin GR, et al. Steroid saponins from fenugreek seeds: extraction, purification, and pharmacological investigation on feeding behavior and plasma cholesterol. Steroids. 1995,60,674-680.
51. König GM, Wright AD, Keller WJ, Judd RL, Bates S, Day C. Hypoglycaemic activity of HMG-Containing flavonoid glucoside, chamaenmeloside, from Chamaemelumnobile. Planta Medica. 1998,64,612-614.
52. Witherup KM, McLaughlin JL, Judd RL, Ziegler MH, Medon PJ, Keller WJ. Identification of 3-hydroxy-3-methyl glutaric acid (HMG) as hypoglycaemic principle of spanish moss (Tillandsia usneoïdes). Journal of Natural Products. 1995,58,1285-1290.
53. Nmila R, Gross R, Rchid H, Roye M, Manteghetti M, Petit P, et al. Insulinotropic effect of Citrullus colocynthis fruit extracts. Planta Medica. 2000,66,418-423.
54. Abdel-Hassan IA, Abdel-Barry JA, Tariq Mohammeda S. The hypoglycaemic and antihyperglycaemic effect of Citrullus colocynthis fruit aqueous extract in normal and alloxan diabetic rabbits. Journal of Ethnopharmacology. 2000,71,325-330.
55. Basnet P, Kadota S, Shimizu M, Takata Y, Kobayashi M, Namba T. Bellidifolin stimulates glucose uptake in rat 1 fibroblasts and ameliorates hyperglycaemia in streptozotocin (STZ)- induced diabetic rats. Planta Medica. 1995,61,402-405.

56. Kumar GP, Sudheesh S, Vijayalakshmi NR. Hypoglycaemic effect of Coccinaindica: Mechanism of action. PlantaMedica. 1993,59,330-332.
57. Bajpai MB, Asthana RK, Sharma NK, Chatterjee SK, Mukherjee SK. Hypoglycaemic effect of Swerchirin from the hexane fraction Swertiachirayita. Planta Medica. 1991,57,102-104.
58. Saxena AM, Bajpai MB, Murthy PS, Mukherjee SK. Mechanism of blood sugar lowering by a Swerchirin containing hexane fraction (SWI) Swertiachirayita. Indian Journal of Experimental Biology.1993,31(2),178-181.
59. Farias RA, Rao VS, Viana GS, Silveira ER, Maciel MA, Pinto AC. Hypoglycaemic effect of trans-dehydrocrotocin, a nor-clerodane diterpene from Croton cajucara. Planta Medica. 1997,63,558-560.
60. Ali AA, Mohamed MH, Kamel MS, Fouad MA, Spring O. Studies on Securigerasecuridacea (L.) Deg. et Dorfl. (Fabaceae) seeds, an antidiabetic Egyptian folk medicine. Pharmazie. 1998,53,710-715.
61. Ahmad M, Akhtar MS, Malik T, Gilani AH. Hypoglycaemic action of the flavonoid fraction of Cuminum nigrum seeds. Phytotherapy Research. 2000,14,103-106.
62. Augusti KT, Joseph P, Babu TD. Biologically active principles isolated from Salacia oblonga wall. Indian Journal of Physiology and Pharmacology. 1995,39,415-417.
63. Andrade CA, Wiedenfeld H, Revilla MC, Sergio IA. Hypoglycaemic effect of Equisetum myriochaetum aerial parts on streptozotocin diabetic rats. Journal of Ethnopharmacology. 2000,72,129-133.
64. Gao D, Li Q, Liu Z, Feng J, Han Z, Duan Y. Antidiabetic potential of Rhdiolasachalinensis root extract in streptozotocin-induced diabetic rats. Methods and Findings in Experimental and Clinical Pharmacology. 2009,31(6),375-381.
65. De Tommasi N, De Simone F, Cirino G, Cicala C, Pizza C. Hypoglycaemic effects of sesquiterpene glycosides and polyhydroxylated triterpenoids of Eriobotrya japonica. Planta Medica. 1991,57,414-416.
66. Manickam M, Ramanathan M, Jahromi MA, Chansouria JP, Ray AB. Antihyperglycaemic activity of phenolics from Pterocarpus marsupium. JournalofNatural Products. 1997,60,609-610.
67. Cherian S, Kumar RV, Augusti KT, Kidwai JR. Antidiabetic effects of glycoside of pelargonidin isolated from the bark of Ficusbengalensis Linn. Indian Journal of Experimental Biology.1992,29,380-382.
68. Cherian S, Augusti KT. Antidiabetic effects of glycoside of leucopelargonidin isolated from Ficusbengalensis Linn. Indian Journal of Experimental Biology. 1993,31,26-29.
69. Pengvicha P, Thirawapan SS, Watanabe H. Possible mechanism of hypoglycaemic effect of 4-hydroxybenzoic acid, a constituent of Pandanus odorus root. Japanese Journal of Pharmacology. 1998,78,395-398.
70. Guang-Yan Tang, Xue-Juan Li, Hong-Yu Zhang. Antidiabetic Components Contained in Vegetables and Legumes. Molecules. 2008,13,1189-1194.
71. Yang M, Wang BX, Jin YL, Wang Y, Cui ZY. Effects of ginseng polysaccharides on reducing blood glucose and liver glycogen. Chung Kuo Yao Li Hsueh Pao. 1990,11,520-524.
72. Wang BX, Yang M, Jin YL, Cui ZY, Wang Y. Studies on the hypoglycaemic effect of ginseng polypeptide. Yao Hsueh Hsueh Pao. 1990,25,401-405.
73. Park HJ, Kim DH, Choi JW, Park JH, Han YN. A potent antidiabetic agent from Kalopanaxpictus. Archives ofPharmacal Research. 1998,21,24-29.
74. Hsu FL, Lai CW, Cheng JT. Antihyperglycaemic effects of paeoniflorin and 8- debenzoylpaeniflorin, glucosides from the root of Paeonia lactiflora. Planta Medica. 1997,63,323-325.
75. Yoshikawa M, Shimada H, Morikawa T, Yoshizumi S, Matsumura N, Murakami T, et al. Medicinal foodstuffs. VII. On the saponin constituents with glucose and alcohol absorption-inhibitory activity from a food garnish "Tonburi", the fruit of Japanese Kochia scoparia (L.) Schard: Structures of scoparianosides A, B, and C. Chemical and Pharmaceutical Bulletin. 1997,45,1300-1305.
76. Krenisky JM, Luo J, Reed MJ, Carney JR. Isolation and antihyperglycaemic activity of bakuchiol from Otholobiumpubescens (Fabaceae), a Peruvian medicinal plant used for the treatment of diabetes. Biological and Pharmaceutical Bulletin. 1999,22,1137-1140.
77. Murakami C, Myoga K, Kasai R, Ohtani K, Kurokawa T, Ishibashi S, et al. Screening of plant constituents for effect on glucose transport activity in Ehrlich ascites tumour cells. Chemical and Pharmaceutical Bulletin. 1993,41,2129-2131.
78. Gonzalez M, Zarzuelo A, Gamez MJ, Utrilla MP, Jimenez J, Osuna I. Hypoglycaemic activity of olive leaf. Planta Medica. 1992,58,513-515.
79. Luo J, Chuang T, Cheung J, Quan J, Tsai J, Sullivan C, et al. Masoprocol (nordihydroguaiaretic acid): A new antihyperglycaemic agent isolated from the creosote bush (Larreatridentata). European Journal of Pharmacology. 1998,346,77-79.

80. Yoshikawa M, Shimada H, Nishida N, Li Y, Toguchida I, Yamahara J, et al. Antidiabetic principles of natural medicines. II. Aldose reductase and alpha- glucosidase inhibitors from Brazilian natural medicine, the leaves of Myrcia multiflora DC. (Myrtaceae): structures of myrciacitrins I and II and myrciaphenones A and B. Chemical and Pharmaceutical Bulletin. 1998,46,113-192.
81. Tomoda M, Shimizu N, Gonda R, Kanari M, Yamada H, Hikino H. Anticomplementary and hypoglycaemic activities of the glycans from the seeds of Malva verticillata. Planta Medica. 1990,56,168-170.
82. Basnet P, Kadota S, Terashima S, ShimizuM, Namba T. Two new 2- arylbenzofuran derivatives from hypoglycaemic activity-bearing fractions of Morus insignis. Chemical and Pharmaceutical Bulletin. 1993,41,1238-1243.
83. Arumugam sathy, Perumal Siddhuraju, Protetive effect of bark and empty pod extracts from acacia auriculiformis against paracetamol intoxicated liver injury and alloxan induced type II diabetes.Food and chemical toxicology. 2013,56, 162-170.
84. B,S,Ashok Kumar, Antidiabetic, antihyperlipidemic and antioxidant activities of methanolic extract of amaranthusviridis Linn in alloxan induced diabetic rats.Experimental and toxicologic pathology, 2012,64, 75-779.
85. Patil RN, Patil RY, Ahirwar A, Ahirwar D, Evaluation of antidiabetic and related actions of some Indian medicinal plants in diabetic rats. Asian Pacific Journal of Tropical Medicine. 2011,4, 20-23.
86. Ayodhya S, Kusum S, Anjali S, Hypoglycemic activity of different extracts of various herbal plants.International Journal of research in Ayurveda and Pharmacy. 2010,1(1), 212-224.
87. Bnouham M, Ziyyat A, Mekhfi H, Tahri A, Legsyer A, Medicinal plants with potential antidiabetic activity- a review of ten years of herbal medicine research, (1990-2000). International Journal of Diabetes and metabolism. 2006,14, 1- 25.
88. K shirsagar RP, Darade SS, Takale V, Effect of Alangiumsalvifolium (Alangiaceae) on dexamethasone induced insulin resistance in rats.Journal of Pharmacy Research. 2010,3(11), 271-276.
89. Chauhan A, Sharma PK, Srinivastava P, Kumar N, Duehe R, Plants having potential antidiabetic activity, A review.Derpharmacialettre. 2010, 2(3), 369-387.
90. Singh LW, Traditional medicinal plants of Manipur as antidiabetics.Journal of Medical Plants Research. 2011,5(5),677-687.
91. Malviya N, Jain S, Malviya S, Antidiabetic potential of medicinal plants.ActaPoloniaePharmaceutica. 2010,67(2), 113-118.
92. Islam MS, Choi H, Green tea, anti- diabetic or diabetogenic, a dose response study.Biofactors. 2007, 29(1), 45-53.
93. Islam S, Choi H, Dietary red chilli (Capsicum frutescns L) is insulinotropic rather than hypoglycemic in type 2 diabetes model of rats. Phototherapy Research. 2008,22(8), 1025-1029.
94. Dallak M, Al- khateeb M, abbas M, Elessa R, al- hashem F, basher N, Et al, In vivo, acute, normo – hypoglycemic, antihyperglycemic, insulinotropic actions of orally administered ethanol extract of citrulluscolocynthis(L) Scharbpulp.American Journal of Biochemistry and Biotechnology. 2009, 5(3), 119-126.
95. Chauhan A, Sharma PK, Srinivastava P, Kumar N, Duehe R, Plants having potential antidiabetic activity, A review.Derpharmacialetter. 2010, 2(3), 369-387.
96. Arjyun P, Shivesh J, Sahu An, Antidiabetic activity of aqueous extract of Eucalyptus citriodora hook in alloxan induced diabetic rats.Pharmacognosy Magzine.2009,5, 51-54.
97. Arjyun P, Shivesh J, Sahu An, Antidiabetic activity of aqueous extract of Eucalyptus citriodora hook in alloxan induced diabetic rats.PharmacognosyMagzine. 2009,5, 51-54.
98. Fararh KM, Atoji Y, shmizu Y, takewaki T, Insulintropic properties of Nigella sativa oil in streptozotocin plus nicotinamide diabetic hamster.Research in Veterinary Science. 2002,73(3), 279-282.
99. Chauhan A, Sharma PK, Srinivastava P, Kumar N, Duehe R, Plants having potential antidiabetic activity, A review.Derpharmacialettre. 2010, 2(3), 369-387.
100. Poongothai K, Ponmurugan P, Ahmed K S Z, Kumar S B & Sheriff S A, Antihyperglycemic and antioxidant effects of Solanum xanthocarpum leaves (field grown & in vitro raised) extracts on alloxan induced diabetic rats.Asian Pacific Journal of Tropical Medicine. 2011,4, 778.
101. Malviya N, Jain S, Malviya S, Antidiabetic potential of medicinal plants.ActaPoloniaePharmaceutica. 2010,67(2), 113-118.
102. Chauhan A, Sharma PK, Srinivastava P, Kumar N, Duehe R, Plants having potential antidiabetic activity, A review.Der pharmacialettre.2010, 2(3), 369-387.
103. Chauhan A, Sharma PK, Srinivastava P, Kumar N, Duehe R, Plants having potential antidiabetic activity, A review.Derpharmacialettre. 2010, 2(3), 369-387.

104. Chauhan A, Sharma PK, Srinivastava P, Kumar N, Duehe R, Plants having potential antidiabetic activity, A review.Derpharmacialettre. 2010, 2(3), 369-387.
105. Fararh KM, Atoji Y, shmizu Y, takewaki T, Insulintropic properties of Nigella sativa oil in streptozotocin plus nicotinamide diabetic hamster.Research in Veterinary Science. 73(3), 2002, 279-282.
106. Meenakshi P, Bhuvaneshwari R, Rathi MA, Thiruoorthi L, Guravaiah DC, Jiji MJ, et al, Antidiabetic activity of ethanolic extract of Zaleyadecandra in alloxan- induced diabetic rats.Applied Biochemistry Biotechnology. 2010,162, 1153-1159.
107. Abdl- zaherAo, Salim SY, Assaf MH, Abdel- Hady RH, Teucrium polium antidiabetic activity and toxicity of Zizyphus spina – Christi leaves.Journal Ethnopharmocolgy.2005, 101(1-3), 129-138.