WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 11, Issue 17, 227-240. Review Article ISSN 2277– 7105

A REVIEW ON: HERBAL DRUG THERAPY FOR DIABETES MELLITUS

Mansi Kalamkar*[1], Ankita Giramkar[2], Pranita Karanjakar[3], Shubhda Khamkar[4], Anjali Gawali[5]

Department of Pharmacognocy, HSBPVT, Group of Institutions, Faculty of Pharmacy, Kashti, Shrigonda, Maharashtra, India. 414701.

Article Received on
27 Oct. 2022,

Revised on 17 Nov. 2022,
Accepted on 07 Dec. 2022

DOI: 10.20959/wjpr202217-26456

***Corresponding Author**
Mansi Kalamkar
Department of Pharmacognocy, HSBPVT, Group of Institutions, Faculty of Pharmacy, Kashti, Shrigonda, Maharashtra, India. 414701.

ABSTRACT

One of the common metabolic diseases, diabetes mellitus affects 2.8% of people worldwide and is expected to reach 5.4% by 2025. Since herbal remedies have long been a highly regarded source of medicine, they are now a growing component of contemporary, high-tech medicine. The current review provides profiles of plants (65 species) with hypoglycaemic properties that are available through literature sources from various databases, with proper categorization according to the parts used, mode of lowering blood glucose (insulinomimetic or activity of insulin secretagogues), and active phytoconstituents with activity of insulin mimetics. According to the review, plants with ability to lower blood sugar primarily come from the families Leguminoseae, Lamiaceae, Liliaceae, Cucurbitaceae, Asteraceae, Moraceae, Rosaceae, and Araliaceae. Allium sativum, Gymnemasylvestre, Citrulluscolocynthis, Trigonellafoenumgreacum, Momordicacharantia, and Ficusbengalensis are the plants that are the most active. These include roseoside, epigallocatechingallate, beta-pyrazol-1-ylalanine, cinchonainIb, leucocyandin 3-O-beta-d-galactosyl cellobioside, leucopelargonidin-3-O-alpha-L rhamnoside, glycyrrhetinic acid, dehydrotrametenolic acid, strictinin, isostrictinAccording to the review, the presence of polyphenols, flavonoids, terpenoids, coumarins, and other compounds that indicate a decrease in blood glucose levels is mostly responsible for the antidiabetic activity of medicinal plants. The management of diabetes mellitus using these plants and their active principles is also covered in the review.

KEYWORDS: Herbal medicine, antidiabetic action, and diabetes.

INTRODUCTION

Diabetes mellitus is a significant medical condition with rising incidence and fatality rates. Elevated plasma glucose levels from either insulin resistance or insufficiency, or both, cause metabolic abnormalities in people with diabetes mellitus. proteins, lipids, and carbs (JA 1997). Reactive oxygen species, which cause many degenerative diseases as diabetes, are minimised by enzymatic and non-enzymatic antioxidative processes in human bodies. (Patel DK 2011) Anti-diabetic medications treat diabetes mellitus by bringing down blood glucose levels. About 60% of people utilise traditional medicines that are made from medicinal plants. This article focuses on Indian herbal medicines and plants that are utilised, particularly in India, to treat diabetes. Diabetes is a serious illness that affects many people worldwide from all areas of life. It is proven to be a serious health issue in India, particularly in the cities. Although there are many ways to lessen the negative consequences of diabetes and its secondary issues, herbal formulations are favoured due to their natural nature, lower cost, and less side effects. Although there are numerous oral hypoglycemic medications and insulin available for the treatment of diabetes, there is a growing demand from patients to employ natural products with anti-diabetic properties. It is a sizeable urine discharge that is typically profuse, has a sweet, violet-flavored aroma, and is accompanied by extreme thirst and general weakness. (T.J and Use n.d.) The two categories listed below can be used to classify various types of reported diabetes mellitus:Diabetes mellitus type 1 (IDDM), in which the body does not manufacture any insulin, is a condition. Young adults and children are most frequently affected by it. 5–10% of people worldwide have type 1 diabetes. Noninsulin-dependent diabetes mellitus (NIDDM) is type 2 and occurs when the body does not produce enough insulin. The most prevalent form of the condition is caused by overusing or misusing secreted insulin, contributing approximatelyabout 90–95% of diabetic cases. Due to an increase in the older population, as well as an increase in obesity and sedentary lifestyles, type 2 diabetes is quickly approaching pandemic levels.

Treatment for diabetes mellitus is based on

- Disease information for.
- Physical activity and nutrition.
- Diabetes medications.

Therefore, medical plants are increasingly being used to cure or control chronic conditions like diabetes mellitus, especially in underdeveloped nations with limited resources. Only

diabetes is accompanied by a number of other illnesses that affect healthy people. The way each is handled of such illness is possible by taking advantage of India's herbal integrity. The plants, in fragments or ascan be used to treat any condition connected to diabetes mellitus. Moreover, occasionally Plant extracts are capable of treating related conditions such polyuria, polydipsia, and Along with treating chronic illnesses like diabetes mellitus, glucosuria, etc. (KLEEN 1900). According to recent estimations, 438 million individuals (7.8%) of the adult population would have diabetes by the year 2030. (Ramachandran A 2010)Due to its natural origin and lower side effects, herbal medicines have gained popularity in recent years in both developing and developed nations for the treatment and control of diabetes. (D. P. Modak M 2007) (Hasani-RanjbarS 2009) (Rahimi R 2005) The majority of plants include compounds that are widely suggested to have antidiabetic effects, such as glycosides, alkaloids, terpenoids, flavonoids, and carotenoids (Malviya N 2010).

Plants used for diabetes treatment

Many of the drugs that are currently on the market have either been directly or indirectly produced from plants, which have historically been a very good source of pharmaceuticals. About 800 plants, according to ethnobotanical data, may have anti-diabetic properties; among them, Momordicacharantia, Pterocarpus marsupium, and Trigonellafoenumgreacum have all been shown to be effective in treating type 2 diabetes (Ponnusamy S 2011) (Jung M 2006). Several of these plants have demonstrated anti-diabetic effects when tested using various experimental methodologies. Alkaloids, glycosides, galactomannan, polysaccharides, peptidoglycans, hypoglycans, guanidine, steroids, carbohydrates, glycopeptides, terpenoids, amino acids, and inorganic ions are just a few of the plant-derived active principles that have demonstrated activity, including the ability to treat diabetes. (Grover JK, Medicinal plant of indian with anti-diabetic potential 2002).

Plants with Antidiabetic Activity

1) AgrimoniapilosaLedeb. (Rosaceae)

Only a secret concoction including this plant has ever been used to cure diabetes. According to clinical studies, some patients' diabetes entirely vanished (J.F.Dong 1994). Experimental evidence suggests that the herb's extract can successfully lower blood glucose levels in both healthy and diabetic mice generated by alloxan (W.L.Li 2002).

2) Alliumsativum (Alliaceae)

The most potent and active ingredient in Allium sativum (garlic), ethyl ether extract, was revealed to have antihyperglycemic effect at 0.25 mg/kg, p.o. This activity was attributed to enhanced insulin-like activity (Ayodhya S 2010). Due to increased hepatic metabolism and increased insulin release from pancreatic beta cells, the sulfur-containing substance allicin has been shown to have considerable hypoglycemic effect. The precursor of allicin and garlic oil, S-allyl cystein sulfoxide (SACS), induced beta cells isolated from healthy rats to secrete insulin in vitro. The antioxidant and secretagogue activities of SACS may be the cause of its positive effects (Bnouham M 2006) (D. P. Modak M 2007). Daily oral administration of 100 mg/kg of garlic extracts enhanced plasma insulin levels while simultaneously lowering plasma glucose levels (Grover JK, Medicinal plants of india with anti-diabetic potential 2002). It has been demonstrated that aqueous garlic extracts (10% v/v) enhance the effects of glucose on insulin secretion in isolated pancreas (Mustafa SSS 2007). Garlic may be insulinotropic rather than hypoglycemic based on its effects on high-fat diet-fed rats for two weeks (Islam MS 2008).

3) Momordicacharantia (Cucurbitaceae)

The plant belongs to the Cucurbitaceae family and is sometimes referred to as kugua, karela, bitter gourd, or bitter melon. It is a well-known herbal remedy and is frequently used to treat diabetes (R .Marles 1995) (R.Arvigo 1993). In streptozocin- or alloxan-induced diabetic rats, mice, and rabbits (M.S.Akhtar and A.M.Athar 2001) (S.Sarkar 1996), in genetically diabetic mice, and in Type 2 diabetic people, Momordicacharantia has been shown to have powerful anti-diabetic effects. has diabetes (Y.Srivastava 1993). Momordicacharantia boosts pancreatic parital cell regeneration or mayallow for partial cell regeneration (I.Ahmed 1998) and increase pancreatic insulin secretion. These could possibly clarify the substantial rise in plasma insulin level when Momordicacharantia was used to treat streptozocin-induced diabetic rats (A.K.Shrma 1995). Momordicacharantia also has insulin-like characteristics (T.B.Ng 1986), which are very stimulating. The liver stores glycogen (G. J.Welihinda 1982). as well as enhancing peripheral glucose absorption (H. J.Welihinda 1986).

4) Aegle marmelos (Bael leaves)

The Rutaceae family includes the medium-sized, armed, deciduous tree known as Beal. It had a more potent antidiabetic impact in addition tothe treatment for oral hypoglycemia. Leafy beal can behigh doses of oral hypoglycemic medications tobring patients' blood glucose

levels back to normalwhose diabetes is not managed by these medications or inthose persons in whom these medications cause negative effects on dosage progression. (Yaheya M 2009)

5) Ficusrecimosa

In the traditional system of medicine, Ficusracemosa (Moraceae) is used to cure a variety of ailments, including diabetes mellitus. Bark ethanolic extractdemonstrated hypolipidemic and antihyperglycemiceffects. in diabetic rats produced by alloxan. dosage of 100–500mg/kg of extract revealed considerably decreased blood pressure.blood glucosepowerful anti-diabetics. (Sophia D 2007).

Adansonniadigitata (Bombacaceae) methanolic stem bark extract was tested for its anti-diabetic ability in streptozotocin-induced diabetic wistar rats. amount of the The dosages of plant extract were 100, 200, and 400 mg/kgthe rats intraperitoneally. Findings indicate that barkextract significantly lowered the hyperglycemia. (Tanko Y 2008).

6) Ipomoiadigitata

On rats with diabetes induced by alloxan, the antidiabetic effects of different fractions of Ipomoiadigitata were examined.100 mg/kg of extract was used, which is a medium dosage. 200 mg/kg for a low dose and 400 mg/kg for a large dose. As a treatment, glibenclamide (10mg/kg body weight). (Kesgari A 2015).

7) Aloe vera (Asphodelaceae)

In streptozotocin-induced diabetic mice and mouse embryonic NIH/3T3 cells, aloe vera extract was tested. (Kumar R 2011). Blood glucose, TG, LDL, and TC significantly decreased after receiving an extract at a dose of 130 mg/kg per day for four weeks. This effect was comparable to that of metformin. Additionally, this research demonstrated that lyophilized aqueous aloe extract (1 mg/mL) increased the synthesis of GLUT-4 mRNA in NIH/3T3 cells. In a more recent study, streptozotocin-induced diabetic rats received 300 mg/kg of aloe vera extract, which improved insulin secretion and pancreatic -cell function by increasing pancreatic islet mass. (M.A 2017)

8) Acacia arabica(Babhul)

By acting as an insulin secretagouge, the plant extract counteracts diabetes. In control rats, it causes hypoglycemia, but not in alloxanized animals. When normal rabbits received 2, 3, and

4 g/kg of powdered Acacia arabica seeds, the release of insulin from the pancreatic beta cells resulted in a hypoglycemic effect. (Rajesham V.V 2012)

9) Azedarach indica(Neem)

In streptozotocin-treated rats, hydroalcoholic extracts of this plant demonstrated anti-hyperglycemic activity. This effect is attributable to an increase in glucose uptake and glycogen deposition in isolated rat hemidiaphragm. In streptozotocin-treated rats, hydroalcoholic extracts of this plant demonstrated anti-hyperglycemic activity. This effect is attributable to an increase in glucose uptake and glycogen deposition in isolated rat hemidiaphragm. (Biswas K 2012)

10) AstragaliseuHedysari (Leguminosae)

Astragalusmembranaceus's roots (Fisch.) Both Astragalusmembranaceus (Fisch.) Bunge and Bunge var. mongholicus (Bunge) Hsiao are used. Nearly every recipe for an anti-diabetic compound contains this medication. Astragalus polysaccharides have a two-dimensional influence on blood sugar regulation, which can raise hypoglycemia individuals' blood sugar levels. Bringing animals' or humans' blood sugar levels back to normal while also The anomalies of myocardial ultra structure are improved by triglycerides and myocardial calcium, andthe metabolic state of diabetic mice and rats (H.Y.Ye 2000) (Z.Y.Zhang 2001), and prevent non-obese diabetic mice from developing type 1 diabetes. According to studies, astragalus membrane aceus has a protective effect on the heart in diabetic nephropathy by preventing lipid peroxidation. Reducing motion nerve conduction velocity as an aldose reductase inhibitor to extend the incubation time of late diabetic neuropathy. (Y.Gao 1998) and reducing renal hypertrophy and microalbuminuria, as well as improving experimental diabetic nephropathy. (Y.J.Q.Y.Xu 1997)

11) Trigonellafoenum-graecum L. (Leguminosae)

Fenugreek, or Trigonellafoenum-graecum, has long been used as a meal or medication to treat diabetes. Fenugreek seeds, leaves, and extracts have been shown to have hypocholesterolemic and anti-diabetic effects in both model animals and people. (M.P.J.Gomez 1998) (X. A.M.M.Khatir 1999) (V.Vats 2002)4-hydroxyisoleucine, an amino acid and insulin secretion is stimulated. (L.Ali 1995) furthermore, the primary alkaloid trigonelline The increased fibre content's influence on delayed stomach emptying and the enzymes that break down carbohydrates were both connected to an anti-hyperglycemic effect. (Y.Sauvaire 1998)

12) Calotropisprocera

In streptozotocin-induced diabetic male wister albino rats, the anti-diabetic effects of Calotropisprocera root extracts were examined. the distinctiveaqueous, methanolic, and ether-based extracts ofRats were used to investigate the antidiabetic potential of roots. (Bhaskar V.H 2009)

13) Abrusprecatorius

In alloxan-induced diabetic rabbits, the anti-diabetic effects of the Abrusprecatorious (Leguminosae) seed extract were investigated. It is anti-diabetic. property was discovered to be comparable tochlopropamide. (IZ. 2008)

14) Syziumcumini (SC)

In India, Syzygiumcumini (Myrtaceae) has long been used in traditional medicine to cure diabetes. SC seed extract has demonstrated antidiabetic effects. action against diabetes caused by streptozotocin (STZ)rats. In India, the herb Syzygiumcumini (Myrtaceae) and the substance "Mycaminose" have long been utilised as a traditional medical system to treat diabetes. Streptozotocin (STZ)-induced diabetic rats were treated with SC seed extract, which demonstrated antidiabetic action. Mycaminose, an extract of ethyl acetate and methanol, was reported to lower blood glucose levels. Blood glucose levels were observed to be reduced by methanol extract. (Chen KK 1957)

15) Ganodermalucidum

In alloxan-induced diabetic wistar rats, anti-diabetic and some haematological benefits of the Ganodermalucidum aqueous extract have been described. a 50 mg/kg dosage of G. lucidum's n-Butanol and ethylacetate fractionsliquid extract. (Invest 2001)

16) Trigonellafoenum-graecim(Fabaceae)

Fenugreek, or Trigonellafoenum-graecum, is a plant whose seeds and leaf extracts are a rich source of anti-diabetic compounds. It has been used extensively in cooking. There is proof that it can lower postprandial glucose levels, but the long-term impact is still unknown. Fenugreek, or Trigonellafoenum-graecum, is a plant whose seeds and leaf extracts are a rich source of anti-diabetic compounds. It has been used extensively in cooking. There is proof that it can lower postprandial glucose levels, but the long-term impact is still unknown. (Baquer N.Z.Kumar P 2011) (R.M 2014)

Orally administered T. foenum-graecum seed powder may have hypoglycaemic and antihyperlipidemic properties similar to insulin, according to preliminary human trials and animal experiments [1076]. Fenugreek significantly decreased both FBG and HbA1c in T2DM patients when compared to control therapies, according to data from clinical trials employing FBG, 2 h GTT, and HbA1c and randomised models. Orally administered T. foenum-graecum seed powder may have hypoglycaemic and antihyperlipidemic properties similar to insulin, according to preliminary human trials and animal experiments [1076]. Fenugreek significantly decreased both FBG and HbA1c in T2DM patients when compared to control therapies, according to data from clinical trials employing FBG, 2 h GTT, and HbA1c and randomised models. (Neelakantan N. 2014) (Bhaskar V.H 2009) (Neeraj A 1993) (Madar Z.Abel R.Samish S 1988) (T.C 1988) (Sharma R.D 1996) (Zargar A.H. 1992)

17) Semen Coicis (Gramineae)

Coixlacryma-jobi L. var. ma-yuen (Roman) Stapf. seeds that have been dried and matured are used medicinally. Coixan A, B, and C polysaccharides are the substances' active ingredients. (M.Takahashi 1986) The dried coix seeds' coixans were purified and extracted, and they had the effect of lowering blood sugar levels in normal rats while raising serum insulin levels. The coixans' anti-diabetic mechanismmaybe to stop pancreatic islet beta cells from becoming injured by alloxan. (Z.H.Xu 2000) (H.L.Huang 1999)

18) Enicostemmalittorale (Gentianaceae)

In alloxan-induced diabetic mice, an aqueous extract of Enicostemmalittorale increased blood insulin levels at 8 hours and promoted glucose-induced insulin release via a K+-ATP channel-dependent route. (Maroo J 2002)

19) Anthocephalusindicus

Root extract of Anthocephalusindicus (Rubiaceae) has been shown to have hypoglycemic, lipid-lowering, and antioxidant effects in alloxan-induced diabetic rats. administration of a root ethanol extract orallySignificantly (500mg/kg body weight) for 21 daysreduced levels of total cholesterol, triglycerides, and blood sugarphospholipids, free fatty acids, and cholesterol. (Kumar V 2009)

20) Ougeiniaoojeinensis

When tested on alloxan-induced hyperglycemia, Ougeiniaoojeinensis (Leguminosae) bark was discovered to have hypoglycemic and hypolipidemicproperties.rats with diabetes A

dosage of bark extract was administered orally. For the hypoglycemic action, 200mg/kg is used. Take out alsolower the heightened biochemical markers, such asLow density lipoprotein, triglycerides, and total cholesterol etc. (Velmurugan C 2011)

CONCLUSION

The entire information about antidiabetic plants used to treat diabetes mellitus is offered in the current review. However, some of these plant-based medications providepossibilities for diabetes management through cost-effectivedietary adjustments, supplementing with nutrients, andIn the near term, combination therapy using synthetic medicines, and for the long time as the only treatment from natural sources, term. The majority of bioactive chemical presences arethe cause of this anti-diabetic effect. But numerous other Plant-based active ingredients have not been very effectivecharacterised. Additional research must be done toanalyse the way that medicinal herbs work with insulin-lowering impact.

REFERENCE

1. A.K.Shrma, I.Ahmed,M.Tadayyon. "Medicinal Chemistry of the Anti-Diabetic Effects of Momordica Charantia:Active Constituents and Modes of Actions." *International Journal of Diabetes*, 1995; 29-38.
2. A.M.M.Khatir, X.L.Ding, T.Fang. "Plants Having Potential Antidiabetic Activity." *Journal of Wuxi University of Light Industry*, 1999; 16-20.
3. A.M.M.Khatir, X.L.Ding,T.Fang. "Plants Having Potential Antidiabetic Activity." *Journal of Wuxi University of Light Industry*, 1999; 16-20.
4. Ayodhya S, Kusum S, Anjali S. "Hypoglycamic activity of different extracts of various herbal plants ." *International Journal Ayurveda Registr Pharmacy*, 2010; 212-224.
5. Baquer N.Z.Kumar P,. Taha A,.Kale R.K,Cowsik S.M, McLean P. "Metabolic and molecular action of trigonella foenum-graecum (fenugreek) and trace metals in expeimental diabetic tissues." *Journal of Biosciences*, 2011; 383-396.
6. Bhaskar V.H, Singh SA. "Antihyperglycemic and Antihyperlipidamic activities of root extracts of Calotropis procera on streptozotocin induced diabetic rats." *Jordan Journal of Biological Sciences*, 2009; 177-180.
7. Biswas K, Chattopadhyay I., Banerjee R.K., Bandyopadhyay I. "Neem (Azadirachta indica A.Juss)-A nature's drug store." *International Research Journal of Biological Sciences*, 2012; 76-90.

8. Bnouham M, Ziyyat A, Mekhfi H, Tahri, Legssyer A. "Medicinal Plants With potential antidiabetic activity-a review of ten yeats of herbal medicine research." *International Journal of Diabetes and Metabolism*, 2006; 1-25.
9. Chen KK, Roberty CA,McCowen MC, Harris PN. "Pharmacoligical action of hypoglycinA and B." *Journal of experimental pharmacology*, 1957; 272-285.
10. Grover JK, Yadav S,Vats V. "Medicinal plant of indian with anti-diabetic potential." *Journal of Ethnopharmacology*, 2002; 81-100.
11. Grover JK, Yadav S,Vats V. "Medicinal plants of india with anti-diabetic potential." *Jouran lof Ethnoohrmacol*, 2002; 81-100.
12. H.L.Huang, F.Li, C.LJiang, Y.C.Shi, L.H.Zhu. "Plants Having Poential Antidiabetic Activity." *Journal of Microbiology*, 1999; 28-31.
13. H.Y.Ye, MH.Yu,LY.Q.Yan,X.F.Yang. "Plants Having Potential Antidiabetic Activity." *Journal of Shanghai Medical University*, 2000; 357-358.
14. Hasani-RanjbarS, Larijani B, Abdollahi M. "A Systemic review of the potential herbal sources of futur drugs effetive in oxidation -related diseases." *Drug Tagets*, 2009; 2-10.
15. I.Ahmed, E.Adeghate, A.K.Sharma, D.J.Pallot, J.Singh. "Studies on the antidiabetic activities of Momordica charantia fruit juice in streptozotocin-induced diabetic rats." *Diabetes Research and Clinical Practice*, 1998; 145-151.
16. Invest, L.A.Witters .J Clin. "The blooming of the French Lilac." 2001; 1105-7.
17. Islam MS, Choi H. "Dietary red chill(Capsicum frutescens L.) IS Insulinotropic rather than hypoglycemic in type 2 diabetes model of rats." *phytother Research*, 2008; 1025-1029.
18. IZ., Abdallah. "Evaluation of Hypoglycemic Activity of Opuntia Dillenii Haw Fruit Juice in Streptozotocin-Induced diabetic rat." *The Egyptiyan Journal of Hospital Medicine*, 2008; 544-558.
19. J.F.Dong. "Lishizhen Medicin and Material Medica Research." *Lishizhen Medicin and Material Medica Research*, 1994; 46-47.
20. J.Welihinda, G.Arvidson, E.Gylfe, B.Hellman, E.Karlsson. "Medicinal chemistry of the anti-diabetic effects of momordica charantia:active constituents and modes of actions." *Acta Boligica et medica Germanica*, 1982; 1229-1240.
21. J.Welihinda, H.E.Karunanayake,. "Plants Having Potential Antidiabetic Activity." *Journal of Ethnopharmacology*, 1986; 247-255.
22. JA, Colwell. "Aspirin Therapy in Diabetes." *Diabetes Care*, 1997; 1767-1997.

23. Jung M, Park M, Lee HC, Kang YH,Kang ES, Kim SK. "Antidiabetic agents from medicinal Plants." *Current Medicinal Chemistry*, 2006; 1203-1218.
24. kardu, avii.
25. Kesgari A, Tripathi PK,Srivastava A,Vishwas R. "Formulation and evaluation of effervecent floating tablets of antidiabetic drug." *Journal of Drug Delivery and Therapeutics*, 2015; 43-55.
26. KLEEN, EMIL. "DIABETES MELLITUS AND GLYCOSURIA." *LANE MEDICAL LIBRARY*, 1900.
27. Kumar R, Sharma B,Tomar N.R Roy P,Gupta A.K .Kumar A. "In vivo evaluation of hypoglycemic activity of Aloe spp. And identification of its mode of action on GLUT-4 gene expression in vitro." *Applied Biochemistry and Biotechnology*, 2011; 1246-1256.
28. Kumar V, Khanna AK,Khan MM,Singh R,Singh S,Chander R et al. "hypoglycemic,lipid lowring and antioxidant activities in root extract of Anthocephalus inidcus in alloxan induced diabetic rats." *Plants with Anti-Diabetes Mellitus Properties*, 2009; 65-69.
29. L.Ali, A.Kalam, A.Khan, Z.Hassan, M.Mosihuzzaman, N.Nhar, T.Nasreen, M.Nur-eAlam,B. "Plants Having Potential Antidiabetic Activity ." *Plant Medica*, 1995; 358-360.
30. M.A, Lakshmi. "Improvement of insulun secretion and pancreatic B-cell function in streptozotocin-induced diabetic rats treated with." *Pharmacognosy Research*, 2017; 99-104.
31. M.P.J.Gomez, G.Bhaskar. "Plants Having Potential Antidiabetic Activity." *Journal of Ecotoxicology and Environmental Monitoring*, 1998; 103-106.
32. M.S.Akhtar, and M.Yaqub. A.M.Athar. "Effect of Momordica charantia ." *Journal of Nutritional Science and Vitaminology*, 2001; 340-344.
33. M.Takahashi, C.Konno, H.Hikino. "Medicinal plants for treatment of diabetes mellitus." *Planta Medica*, 1986; 64-65.
34. Madar Z.Abel R.Samish S,. Aras J. "Glucose-lowering effect of fenugrreek in non-insulin dependent diabeticsl." *European Journal of Clinical Nutrition*, 1988; 51-54.
35. Malviya N, Jain S, Malviya S. "Antidiabetic potential of medicinal plants." *Acta Poloniae Pharmaceutica*, 2010; 113-118.
36. Maroo J, Vasu VT, Aalinkeel R,Gupta S. "Glucose lowering effect of aqueous extract of Enicostemma littorale Blume in diabetes; a possible machanism of action." *Journal Ethnophaemacol*, 2002; 317-320.

37. Modak M, Dixit P,Londhe J,Ghaskadbi S, Paul A,Devasagayam T. "Indian herbs and herbal drugs used for the tretment of diabetes." *Journal of Clinical Biochemistry and Nutrition*, 2007; 163-173.
38. Modak M, Dixit P, Londhe J, Ghaskadbi S, Paul A, Devasagayam T. "Indian herbs and herbal and herbal drugs for treatment of diabetes." *Journal of Clinical Biochemistry and NUTRITION*, 2007; 163-173.
39. Mustafa SSS, Eid NI, Jafri SA, EI-Latif HAA, Ahmed HMS. "Insulinotropic effect of aqueous ginger extract and aqueous garlic extract on the isolated perfused pancreas of streptozotocin induced diabetic rats." *Pakistan Journal of Zoology*, 2007; 279-284.
40. Neelakantan N., Narayanan M., de Suza R..J van Dam R.M. "Effect of fenugreek (Trigonella foenum -graecum L)intak on glycemia:A meta-analiysis of clinical trials." *Nutrition journal*, 2014; 1475-2891-13-7.
41. Neeraj A,. Rajyalakshmi P. "Hypoglycemic efffect of processed femugreek seed in humans." *Journal of Food Science and Technology*, 1993; 427-430.
42. Patel DK, KumarR,Prasad SK, Hemalatha S. "Pedalium murex Linn (Pedaliaceae) fruits.Comparative antioxidant activity of its different fractions." *Asian Pacific Journal of Tropical Biomedicine*, 2011; 395-400.
43. Ponnusamy S, Ravindran R,Zinjarde S,Kumar AR. "Evaluation of traditional Indian antidiabetic medicinal plants for human pancreatic amylase inhibitory effect in vitro." *Evid Based complement Alternat Med.*, 2011; 51-56.
44. R. Marles, N.R. Farnsworth. "Antidiabetic plants and their activ constituents." *Phytomedicine*, 1995; 137-189.
45. R.Arvigo, M.Balick,Rainforest Remedies. "Rainforest Remedies. One hundred healing herbs of Belize." *Rainforest Remedies. One hundred healing herbs of Belize*, 1993; 225.
46. R.M, Neela kantan N.Natayanan M.de Suza R.J van Dam. "Effect of fenugreek (trigonella foenum -gracecum L.) intak on glycemia:A meta-analysis of clinical trials." *Nutrition journal*, 2014; 1475-2891-13-7.
47. Rahimi R, Nikfar S,Larijani B,Abdollahi M. "A review on role of antioxidant in the management of diabetes and its complications." *biomed pharmacother*, 2005; 365-373.
48. Rajesham V.V, Ravindernath A,Bikshapati D.V.R.N. "A review on medicinal plant and herbal drug formulation used I diabetes mellitus;." *Indo American Journal of Pharmaceutical Research*, 2012; 1200-1212.

49. Ramachandran A, Das AK,Joshi SR,Yajinik CS,Shah S ,Prasnna KM. "Current status of Diabetes in india and need for Novel therapeutic agent." *Journal of Association of Physician of India*, 2010; 58: 7-9.
50. S.Sarkar, M.Pranava, P. Marita. "Alternative therapies useful in the mansgement of diabetes:A systematic review." *Pharmacological Research*, 1996; 1-4.
51. Sharma R.D, .Sarkar.A,.Hazra D.K,Mishra B,.Singh J.B,.Sharma S.K,Maheshwaei B.B.,Maheshwari P.K. "Use of fenugreek seed power in the management of non-insulun dependent diabetes mellitus." *Nutrition research*, 1996; 1331-1339.
52. Sophia D, Manoharan S. "Hypolipidemic activity of ficus racemosa linn bark in alloxan induced diabetic rats." *Afr.J.Trad CAM*, 2007; 279-288.
53. T.B.Ng, C.M.Wong,W.W.Li. "Insulin-Like molecules in Momordica charantia Seeds." *Journal of Ethnopharmacology*, 1986; 107-117.
54. T.C, Sharma R.D.Raghuram. "Hypoglycemic effect of fenu greek seed in non -insulin - dependent diabetic subjects." *Nutrition research reviews*, 1988; 731-739.
55. T.J, Graham, and Ayurvedic Materia Medica for Domestic Use. "Ayurvedic Materia Medica for Domestic Use." *Concept Publishing Company*, 516.
56. Tanko Y, Yerima M, Mahdi MA,Yaro AH,Musa KY, Mohammed A. "Hypoglycemic Activity of Methanolic Stem Bark of Adasonnia digitata extract on blood glucose levels of Streptozotocin-induced Diabetic wistar rats." *International Journal of Applied Research in Natural Products*, 2008; 32-36.
57. V.Vats, J.K.Grover,S.S.Rathi. "EVALUATION OF ANTI-HYPERGLYCEMIC AND HYPOGLY CEMIC EFFECT." *Journal of Ethnopharmacology*, 2002; 95-100.
58. Velmurugan C, Sundaram T,Sampeth RK,Vivek B,Sheshadri S,Kumar A. "Anti diabetic and hypolipidemic activity of bark of ethanolic extract of Ougeinia oojenesis." *Medical Journal of Malaysia*, 2011; 22-26.
59. W.L.Li, J.L.Wu, B.R.Ren, R.L Guo,A.L Zhou,H.C.Zheng. "Journal of Plant Resources and Environment." *Journal of Plant Resources and Environment*, 2002; 19-32.
60. Y.Gao, G.X.Wang,X.Yang,S C.He,B.Zhao. "Plants Having Potential Antidiabetic Activity." *Journal of Norman Bethune University of Medical Sciences*, 1998; 372-373.
61. Y.J.Q.Y.Xu, Zhjang,Q.W.Wu. "Plants Having Potential Antidiabetic Activity." *Journal of The Shanghai secondMedical University*, 1997; 357-359.
62. Y.Sauvaire, P.Petit, c.Broca, M.Manteghetti, Y.Baissac, J. Fernandez-Alvareez, R.Groos, M.Roye, A.Leconte, R.Gomis, G. "4-hydroxyisoleucine:a novel amino acid potentiator of insulin secretion." *Diabetes*, 1998; *47:* 206-210.

63. Y.Srivastava, H.Venkatakrishna-Bhatt ,Y.Verma, K.Venkaiah,H.B.Raval. "Plant-Derived Compounds Targeting Pancreatic Beta Cell for the Treatment of Diabetes." *Phytotherapy Research*, 1993; 285-289.
64. Yaheya M, Ismail M. "Clinical Evaluation of Antidiabetic Activity of Bael Leaves." *World applied sciences journal*, 2009; 1518-1520.
65. Z.H.Xu, S.W.Zhou,L.Q.Huang. "Plants Having Potential Antidiabetic Activity." *Chinese Pharmacological Bulletin*, 2000; 639-642.
66. Z.Y.Zhang, H.Y.Ye,M.H.Yu,L.You,Y.Q.Yan,Y.Q.X.F.Yang. "Plants Having Potential Antidiabetic Activity." *Journal of Fudan University*, 2001; 476-477.
67. Zargar A.H., Anjli Nehr B.A.,Laway F.AD. "Effeect of consumption of powdered fenugreek seeds on blood sugar and hbaic levels in patients with type ii diabetes mellitus." *International Journal of Diabetes in Developing Countries*, 1992; 49-55.