Asian Journal of Pharmaceutical Technology & Innovation
ISSN: 2347-8810

Review Article

Ayurveda Medicinal Plants for Treatment of Diabetes in Chhattisgarh, Bilaspur Region - A Review

Santosh Kumari Duppala*

Received on: 02-12-2015
Accepted on: 11-12-2015
Published on: 15-12-2015

Corresponding Author:

*** Santosh Kumari Duppala,**

Department of Microbiology,
Bilaspur University,
Bilaspur-495001, Chhattisgarh.
India.

*Email Id-
dsantoshkumari87@gmail.com

ABSTRACT

Diabetes is a chronic disease which is affecting worldwide rapidly and number of people affected increasing gradually. Diabetes is a metabolic disorder where a person has excessive rise in blood glucose level because it may be due to the cells which do not respond to insulin that is produced in the body or body does not produce required insulin so that prevents body to utilise glucose. As diabetes cannot be cured completely with allopathic medicines hence ayurvedic medicinal plants are commonly used for treatment of diabetes which does not have any side effects. There are several plants used for treatment of diabetes, these are nearly about 800 plants that are having medicinal value and show Anti-Diabetic potential. The lists of common medicinal plants which are used in the treatment of diabetes are as follows: *Azadirachta indica, Ficus religiosa*, *Gymnema sylvestre, Allium sativum, Eugenia jambolana, Momordica charantia, Aloevera, Trigonella Foenum-graecum, Cinamomum cassia and Camellia sinesis.* The present article gives detailed information about the various medicinal plants used in the treatment of diabetes which will also help in future studies.

Key-words: Diabetes, Medicinal plants, Chhattisgarh, Disorder, Blood glucose level.

Cite this article as:
Santosh Kumari Duppala, Ayurveda Medicinal Plants for Treatment of Diabetes in Chhattisgarh, Bilaspur Region - A Review, Asian Journal of Pharmaceutical Technology & Innovation, 03 (15); 2015. www.asianpharmtech.com

INTRODUCTION

Diabetes is a major disease and growing health problem in most of the countries. Due to lack of physical activities and change in life style and intake of sugar, fat contents and increase in stress level, hormonal changes effecting insulin levels which causes diabetes. (1)

According to world health organisation recent study tells us about the approximate estimation of diabetic people suffering with Diabetes Type-I & Type-II. Data collected from 2014 has been estimated and shows that adults above 18+ years are more effected with this disease, however 80% death are from developing countries and under developed country among them India is one of the country where 50.8 million people are suffering from this debase. Diabetes is chronic life threatening disease that may lead to millions of death and the number is expected to increase up-to 101.2 million as estimated up-to 2030.

There are three types of diabetes, Type-I, Type-II and Gestational diabetes. Type I diabetes is also called Insulin-Dependent Diabetes or Juvenile onset diabetes. This type of diabetes usually affects children and adults and the need of insulin administration is compulsory for survival. Type-I diabetes is an auto immune disease, studies shows that it may a virus that activates the immune system to attack the insulin produce in β-cells of the pancreas which permanently destroy them which effects the pancreas to stop producing insulin. Type I diabetes accounts for 5% to 10% of all diagnosed cases of diabetes.

Type II diabetes is also called Non-Insulin dependent diabetes mellitus or adult-onset diabetes, about 90% to 95% of all diagnosed cases of diabetes shows type-II. This type of diabetes produce insulin but whereas the cells don't respond to it, which effects the cells to block the glucose and which causes rise in blood sugar level (2).

This type of diabetes is associated with older age, obesity, family history of diabetes, weakened glucose metabolism, physical inactivity and ethnicity.

Gestational diabetes is a temporary type of diabetes in which the body does not produce proper amounts of insulin to regulate sugar during pregnancy. It usually appears during second trimester of pregnancy disappears after birth of the baby. It may also be called glucose intolerance or carbohydrate intolerance. Approximately 2-4% of pregnant women develop gestational diabetes. (3)

Common symptoms of diabetes are frequent urination, sudden weight loss, feeling very thirsty, increased hunger, fatigue, numbness and tingling in the hands & feet. Scientific reports disclose that diabetes cannot be cured completely. Allopathic drugs have not shown any significant effect for the treatment of the disease. Hence traditional system of medicinal plants plays an important role in treatment of diabetes milletus. The various indigenous system of medicine such as Siddha, Ayurveda, Unani and Allopathy use several plant species to treat different diseases. The use of ayurveda medicines is becoming popular due to toxic and side effects of allopathic drugs. (4)

The most common and effective antibiotic medicinal plants of Bilaspur, Chhattisgarh (India) region are : *Babul (Acacia arabica), Bael (Aegle marmelose), Onion (Allium cepa), Garlic (Allium sativum), Ghrita kumari (Aloe vera), Neem (AzadirachtaiIndica), Beetroot (Beta vulgaris), Bitter Apple (Citrullus colocynthis), Ivy Gourd (Coccinia indica), Eucalyptus (Eucalyptus globules), Banyan Tree (Ficus benghalenesis), Gurmar (Gymnema sylvestre), Sweet Potato (Ipomoea batatas), Mango (Mangifera indica), Karela (Momordica charantia), Jamun (Syzygium cumini), Methi (Trigonella foenumgraecum). Cinnamomum cassia (Dalchini) and Camellia sinesis (Green tea)* all these plants are a rich source of phytochemicals. The present article presents the antidiabetic efficiency of some important plants used in ayurvedic system of medicine for the treatment of diabetes. (5)

METHODS AND MATERIALS:

The present investigation is done from Chhattisgarh state, Bilaspur district, Chhattisgarh is rich in forests and it is very famous for its Ayurveda medicinal plants. In Bilaspur Koni region ethnobotanical survey was carried out and plants are collected from different areas of Bilaspur region. The plants are collected with the help of local people who is having good knowledge about the medicinal plants in that region. Ethnobotanical survey conducted to know the medicinal properties of plants in treatment of diabetes various plants parts are collected from different plants like bark, roots, leaf, stem, fruit and they are prepared in aqueous extracts , and some are prepared in powdered form and some are juices and these are carried out for investigation.

Cinnamomum

In Chhattisgarh *Cinnamon* is commonly used in treatment of diabetes and locally it is known as *"Dalchini"* and belongs to family *Lauraceae*. C*innamon bark* and its extracts shows significant improvement in blood glucose level and it acts as an excellent controller of diabetes. *Cinnamon* is good anti-oxidant, anti-inflammatory, antidiabetic and also helps to prevent cancer. (6)

Some studies in urban reason of Chhattisgarh shows that daily intake of small quantity of Cinnamon nearly ½ tea spoon or 3-4g per day significantly reduces blood sugar level. It can also be taken in formulated form. On observation it shows that the *cinnamon* powder is taken with luke warm water in the morning in empty stomach shows good results in decreasing blood glucose level.

As we know that people suffering from diabetes unable to produce insulin properly or β-cells of isolates of Langerhans pancreas produces insufficient insulin. Recently scientists have discovered new compounds in *dalchini* or cinnamon that activate enzymes in the body which stimulates the receptors of the cells and gives response effectively to insulin.

Cinnamon has capacity to potentiate the activity of insulin. It contains large numbers of polyphenols, acts as an anti-oxidant and which prevent free radical problem in diabetic people.

A recent study also shows that *Cinnamon* with protein reactions treats Alzheimer's disease. It plays key role in treatment of type-II diabetes. (7)

Fig 1: *Cinnamon*

Camellia sinesis

Camellia sinesis is also known as Green Tea belongs to family *Theaceae*, it is evergreen shrub or small tree where its leaves are used for preparation of green tea. Green tea is used in treatment of asthama, bronchodilator, peripheral vascular disease, heart disease and also plays major role in treatment of type-II diabetes.

Diabetes is a metabolic disorder and this green tea helps better metabolism in the body. In *camellia sinesis* a compound called EGCG (Epigallacetelin gallate) it is a powerful antioxidant which is present belongs to polyphenol family. Catechins in green tea are widely extolled for prevention of disease anti-agent purpose elements harmful substances like oils and fats from the body, improves digestion, protect brain & liver, prevent cancer and reduce type-II diabetes. *Camellia sinesis* stimulates and boost the immune system improves circulation and protect neurons and brain cells from damage caused by oxidation of glucose and lipid peroxidation. (8)

According to recent studies people who drink more than 5 cups of green tea per day or at least 1 cup per day is less likely to develop diabetes. (9)

Fig 2: *Camellia sinesis*

Azadirachta indica

Azadirachta indica is commonly known as *neem* which belongs to the family *Meliaceae*, used for the treatment of diabetes in Ayurveda based on the ancient belief. The whole tree is used in treating in large number of diseases. Traditional system of medicine "Ayurveda" has been making use of this plant to cure diseases.

The active ingredients of *Neem* herb are seeds and its leaf extracts are taken as effective in treatment of diabetes. *Neem* leaf extracts when taken in juice form improves blood circulation by dilating blood vessels and also used in reducing blood glucose levels. (10)

Fig 3: *Azadirachta indica*

Allium sativum L. (Garlic)

Garlic (Allium sativum) is one of the most common ayurvedic herbs used worldwide to reduce various risk factors related with cardiovascular diseases. *Garlic* is an important medicine from the ancient. *Garlic* is also used in folk medicine for the treatment of Cardiac diseases, cancer, parasitic, fungal diseases, and diabetes. (8) The main bioactive components present in garlic are allicin, (which is very important component having anti-bacterial, anti-viral, anti-fungal and anti-oxidant properties) allixin, ajoene, and other organosulphur compounds. *Garlic* is used for many remedial benefits. Garlic's pungent odour is mostly due to sulphur-containing compounds (e.g. S-allylcysteine sulphoxide), which are believed to responsible for most of its medicinal properties. *Garlic* which have variety of effective compounds that exhibit anticoagulant, antioxidant, anti-diabetic, antibiotic, hypocholesterolaemia, and hypoglycaemic. (11) Oral use of the garlic extract remarkably decreases serum glucose, total cholesterol, triglycerides, urea, uric acid, and creatinine. (12) In Bilaspur Chhattisgarh region it shows that the use of *garlic* significantly decreased fasting blood sugar levels. The best way to take *garlic* is by crushing 2-3 pods in the morning and it is best resultant in empty stomach it can also be taken as paste form.

Fig 4 *Allium sativum*

Ficus religiosa

Ficus religiosa is commonly named as *Peepal* which is most popular member of the genus *Ficus* and belongs to the *Moraceae* family. (3) Different parts of the plant, like bark, fruit, leaves and seeds are widely used in domestic preparation of Ayurveda medicine. *Peepal* shows large range of pharmacological property like, anti-convulsant, anti-helmintic, anti-anxiety, anti-asthmatic, anti-bacterial, antioxidant, anti-inflammatory and anti-ulcer. It has been largely used in ayurvedic medicine for a wide range of disorders. The bark, fruits, leaves, roots, latex and seeds are used in different forms of ayurvdic medicine and also it is used with mix of other herbs. (13) The leaves alone are used to treat constipation and it has also shown remarkable memory enhancing activity. The bark of *Ficus religiosa* is reported to control anti-ulcer and wound healing activities and also used in diabetes, diarrhoea, leucorrhoea, anxiety. The dried fruit, powder and taken with water for a

month cures asthma. The ripe fruit is cold in potency and good for burning sensation. The fruit extract of plant have anti-tumour and anti-bacterial property. (14)
The study shows that the use of 250 mg of aqueous extract of *Ficus* aerial roots effect on blood glucose level of diabetic people and also oral dosing of ethanolic extracts of the fruit, aerial root and bark of *Peepals* for 30 days shows rapid decrease in blood glucose level. Extracts of *Ficus* leaves have resultant in reducing hyperglycaemia in diabetic, hence the plant extract of *Ficus* species can be successfully used for the treatment of diabetes due to their hypoglycaemic activity. (15)

Fig 5 *Ficus religiosa*

Gymnema sylvestre

Gymnema sylvestre belongs to family *Asclepiadaceae,* popularly known as "*gurmar*" for its unique property as sugar controller, is a reputed herb and has a good medicinal value. Plant parts like leaves, roots possess medicinal properties and used for the treatment of various diseases. There are some important phytoconstituents known as gymnemic acids, gymnemasaponins, and a polypeptide, gurmarin. However studies shows that antihyperglycemic action of a crude form of saponin fraction and five triterpene glycosides derived from the methanol extract of levels of *Gymnema sylvestre* was administered in diabetic animal. The results shows that insulin – releasing action of gymnemic acid IV contribute to the anti-hyperglycaemic effect. *Gymnema sylvestre* the herb exhibits a wide range of therapeutic effects as an effective natural remedy for diabetes, besides also used in treatment arthritis, diuretic, anaemia, osteoporosis, hypercholesterolemia, cardio related problems asthma, constipation, microbial infections, indigestion, and anti-inflammatory. (16) The leaves of *Gymnema sylvestre* have great therapeutic value. If a person with diabetic –II is administered to take 300mg the leaf extract per day then the result shows that the body will be able to regenerate beta cells of pancreas and secrete insulin. Caution: when used with other medications it may cause drop down of blood glucose level. (17)
The bioactive compounds of *gurmer* have antimicrobial, anti-inflammatory, and anticancer properties. (18) The leaves of this plant are used for the treatment of obesity, dental problems, antibiotic, in stomach-ache, blood purifier, and in rheumatism. (18)

Fig 6. Gymnema sylvestre

Eugenia jambolana

Eugenia jambolana belongs to *Myrtaceae* family and is commonly known as *Jamun*, *Black berry*. It is used for the treatment of diabetes, and the study shows that the bark, fruits, seeds or leaves of this plant show anti-diabetic properties. Aqueous extracts prepared with hot water and decoctions of *Eugenia jambolana* have been used in Ayurveda medicine for the treatment of diabetes .In *Jamun* there is a vital compound called jamboline which shows anti-diabetic activity the *Eugenia jambolana* seeds contains large number of active substances such as flavonoids, gallic acid, ellagic acid and tannins.. The seeds of *Jamun* contain high quality of alkaloids

which results in hypoglycemic effect. Aqueous extracts of seeds, bark, and leaves show significant decrease in blood glucose level. (19)

In Chhattisgarh region according to studies people who consume *Jamun* daily as fruit form or extract in powder form 2 tea spoons daily 2 times show good control in their blood sugar level and enhance insulin activity. This can be administered for both type-I and type-II diabetic people.by intake of *Jamun* and its extracts impaired fasting glucose is also controlled. (20)

Jamun is rich in anti-oxidants and used for treatment of diarrhoea, asthma, sore throat, healing of wounds, prevents cancer, and boosts immune system.it also has anti-bacterial, anti-diabetic, and anti- diarrhoeal anti-HIV, anti-inflammatory properties

Fig 7 *Eugenia jambolana*

Momordica charantia

Momordica charantia (Bitter Gourd) belongs to family *Cucurbitaceae*. *Momordica charantia* also known as *Karela*, a plant commonly used in Ayurveda medicine as an anti-diabetic agent, it reduces blood glucose level. Fruit as a whole and fruit seeds are mostly used for therapeutic treatment. It is a popular fruit used for the treatment of diabetes, cardiovascular disease. (21)

Bitter gourd contains bioactive substances with antidiabetic property such as vicine, charantin and triterpenoids, momordicin along with some anti-oxidants. Mainly two components charatin and momordicin are the vital compounds in lowering ones blood glucose; it can repair damaged β-cells thereby stimulating insulin levels and also improves sensitivity signalling of insulin. (22)

The seeds of the plant contain plant insulin called polypeptide-p, insulin produced by human pancreas which is reduces blood glucose content, it is also effective in reducing the fat to decrease the weight of epididymal and retroperitoneal white adipose tissues. *Karela* is best advisable as juice form and its seeds are also taken. It is best administered in the empty stomach. (23)

Fig 8 *Momordica charantia*

Aloe barbadensis (Aloevera)

The *Aloe barbadensis* belongs to family *Liliaceae* and is mostly known as *Aloevera* which is a group of plants. *Aloevera* contains mainly two parts 1) leaves containing a high concentration of anti-quinone compounds which have medicinal properties and 2) a clear gel that has been used as a food and to treat burns and other wounds. (24)

It shows that the anti-hyperglycaemic effect of *Aloevera* gel and purified number of compounds from this gel, were recognised as, 24-methyl-lophenol, 24-ethyl-lophenol, cycloartanol, and 24-methylene-cycloartanol. (25)

These five phytosterols were resulted for their anti-hyperglycaemic effects in type 2 diabetes. The studies suggest that *Aloevera* gel and phytosterols extracted from *Aloevera* gel have a long-term blood glucose level control capacity and would be useful for the treatment of type 2 diabetes mellitus. (19) *Aloevera* have multiple biological activities, including anti-tumor activity, anti-acid activity, and antioxidant activity.

Aloevera gel contains polysaccharides, glycoprotein, high fibre, and detoxifying properties. *Aloevera* is administered to diabetic people as one tablespoon of juice taken 2- 3 times daily there is a reduced blood glucose levels and without any adverse reaction. (26)

Fig 9 *Aloe barbadensis*

Trigonella foenum-graecum

Trigonella foenum graecum which is also known as *fenugreek*, it is mostly used for its anti-diabetic properties. *Trigonella foenum-graecum* seeds, a common spice used in Indian homes, have been found to diminish hyperglycaemia. It is very high insoluble fibre which helps lower blood glucose level by slowing down digestion and intake of carbohydrate. It has a very good anti-diabetic benefit (22) and also contain Galactomannan which decrease blood sugar. (27)

In Chhattisgarh region we have found that use of fenugreek seeds or powder in the daily diet of diabetic type-I people gradually reduces fasting blood glucose levels, 75 grams of powder fenugreek seeds is been given to diabetic people that reduces total cholesterol, LDL, triglycerides and glucose levels. For type-II diabetes people by giving 10 grams of powdered form of fenugreek seeds given in the daily diet which reduces the rise in post meal blood glucose level.

Fenugreek seeds are also very beneficial in treatment of Arthritis, skin diseases, constipation, bronchitis and kidney alignments etc. (28)

Fig 10 *Trigonella foenum*

Ocimum sanctum

Ocimum sanctum commonly known as *Tulsi* belongs to the family *Lamiaceae*. Each and every parts of the plants is used as a remedial agent against several diseases. (24) Use of leaf extracts lead to decrease in blood glucose level by 24.6%. *Tulsi* contains vital essential oils such as eugenol, carvacrol, nerol and eugenolmethylether. Leaves have been reported to contain ursolic acid, apigenin, luteolin, apigenin-7-0- glucuronide, luteolin-7-0-glucuronide, and molludistin. (29)

The leaf of *Tulsi* helps to improves the β-cell function in the pancreas which boost immune system and results in secretion of insulin which is very effective in treatment of diabetes, it is also very effective in treatment of cardiovascular disorder. *Tulsi* is having the properties of anti-diabetic, anti-fungal, analgesic, anti-analgesic, anti-inflammatory, antioxidant properties. (30)

For the diabetic people the best use of *Tulsi* is administered as 3 grams of tulsi leaf in powdered form or it can be taken orally in the morning every day. It can also be advisable to taken as *Tulsi* tea at least twice or thrice in a day.

Fig 11 *Ocimum sanctum*

Table 1 : Ayurvedic Medicinal Plants for treatment of Diabetes

Sl No.	Common Name	Botanical Name	Family	Parts Used	Mode of Utilization	References
1	Bael	Aegle mamelos	Rutaceae	Fruit & Leaf	Juice & powder with water	[31]
2	Garlic	Allium sativum	Lilaceae	Bulb	Extract & Raw	[32]
3	Bhui Neem	Andrographis paniculata	Acanthaceae	Whole plant	Aqueous extract of whole plant	[33]
4	Sitafal	Annona squamosa	Annonaceae	Leaf	Extract	[34]
5	Amla	Emblica offlcinalls gaeth	Euphorbiaceae	Fruit & Bark	Fruit juice & powder with water	[35]
6	Jamun	Eugenia jambolina	Myrtaceae	Fruit, Seed & Bark	Fruit & seed orally, bark with water	[36]
7	Bargad	Ficus bengalensis	Ficaceae	Stem, Bark	Aqueous extract of bark	[37]
8	Aam / Mango	Mangifera indica	Anacardiaceae	Leaf, seed	Extract	[38]
9	Karela	Momordica charantia	Cucurbiataceae	Fruit & seeds	Raw & powder	[39, 40]
10	Tulsi	Ocimum sanctum	Lamiaceae	Leaf	Orally & powder taken with water	[29,30]
11	Anar	Punica granatum	Puniaceae	Fruit	Juice	[41,42]
12	Methi	Trigonella foenum	Fabaceae	Leaf, Seed	Extract	[43]
13	Adarak	Zinziber officinale	Zingiberaceae	Rhizome	Juice	[44]
14	Ber	Zizyphus mauritiana	Rhmnaceae	Leaf	Powder with water	[45]
15	Babul	Acacia nilotica	Fabaceae	Stem & bark	As tooth brush & powder form	[46]
16	Neem	Azadirachta indica	Meliaceae	Leaf, Stem & Seeds	Extract, Juice & As tooth brush	[47]
17	Palas	Butea monospema	Fabaceae	Stem	Decoction gargle	[48]
18	Munga	Moringa oleiferalam	Moringaceae	Fruit, leaf & Bark	Extract & powder	[49,50]
19	Giloye	Tinospora cordifolia	Menispermiaceae	Whole plant	Extract	[51]
20	Sadabhar	Catharanthus roseus	Apocynaceae	Leaf	Oral	[52]
21	Kamal	Nelumbo nucifera	Nymphaceae	Rhizome	Extract	[53]

Hence several medicinal plants has good effect on the human system in control and cure of several diseases [54, 55]

CONCLUSION

In the present analysis there are variety of medicinal plants used for treatment of diabetes were reported but only few species are mentioned very important and most preferably used by Chhattisgarh Bilaspur region *Cinamomum Cassia, Camellia sinesis, Azadirachta indica, Ficus religiosa*, , *Gymnema sylvestre, Allium sativum, Eugenia jambolana, Momordica charantia, Aloevera, Trigonella foenum-graecum.* Diabetes is chronic disease which leads to many complications. Allopathic medicines are not so effective in treating the disease hence medicinal plants play important role and used as best alternative for treatment of diabetes. Hence, these medicinal plants are having both pharmacological and clinical value and it may be further used for formulation of drugs for various ailments.

References:

1. World health organization .Global health estimates. Deaths by cause, age ,and country 2000-2012 geneva WHO-2014.
2. Global status report on non communicable disease 2014, Geneva ,WHO 2012.
3. Grover JK , et.al J. ethnopharmacol 2002.
4. Traditional medicines for modern times; anti-diabetic plants (Google e-books) Amala soumyanath CRC-2006.
5. L. K Keter and P. C Mutiso, " Ethnobotanical studies of medicinal plants used by Traditional Health Practitioners in the management of diabetes in Lower Eastern Province, Kenya," Journal of Ethno Pharmacology, vol. 139, no. 1, pp. 74-80, 2012.
6. Khan A, Khattak, K. N. Safdar M. ct.al cinnamon improve glucose and lipids of people with type-II diabetes.
7. Manisha Modak, Priyanjali Dixit , Jayant Londhe , Saroj Ghaskadbi & Thomas Paul A Devasagayam , Indian Herbs and Herbal Drug Used for the Treatment of Diabetes, *J Clin* Biochem Nutr, 40 (2007) 163-173.
8. Botanics "history of tea" 10 Aug 2003,Georg Jeoseph kamel,whose name is latin was camellus.
9. M. Simmonds and M. Howes, "Plants Used in the treatment of diabetes," in Traditional Medicines for Modern Time-Antidiabetic Plants, A. Soumyanath, Ed., vol.6th, pp. 19-82, CRC Press/ Taylor and Francis Group,2006.
10. Alam , et al 1989
11. Sheela CG, Kumud K, Augusti KT. " Anti- diabetic effects of onion and garlic sulfoxide amino acids in rats", *Planta Med*. 1995; 61(4): 356-357.
12. Sheela CG, Augusti KT. " Antidiabetic effects of S-allyl cysteine sulphoxide isolated from garlic Allium Sativum Linn". *Indian J. Exp. Biol*.1992; 30(6): 523-526.
13. S. Ambika and M. Rao, " Studies on a phytosterolin from the bark of Ficus religiosa," The Indian Journal of Pharmancey, vol.29,pp,91-94,1967
14. Vatsa V, Yadava SP, Biswasb NR, Grovera JK." Anti – cataract activity of Pterocarpus marsupium bark and Triggonella foenum-graecum seeds extract in alloxan diabetic rats". *J. Ethnopharmacol* . 2003; 84: 163-168.
15. D. Singh, B Singh, and R. K. Goel, " Traditional uses, phytochemistry and pharmacology of Ficus religiosa: a review," Journal of Ethnopharmacology vol.134, no.3, pp . 565-583, 2011.
16. S. Ayodhya, S. Kusum , and S. Anjali, " Hypoglycemic activity of different extracts of various herbal plants Singh," International Journal of Ayurveda and Research in Pharmacy , vol . 1, pp. 212-224,2010.
17. Sathyavathi GV, Gupta AK, Tandon N. Medicinal plants of India. New Delhi, India: Indian Council of Medical Research; 1987.
18. Sugihara Y, Nojima H, Matsuda H, Murakami T,Yoshikawa M, Kimura I. "Antihyperglycemic effects of gymnemic acid IV, a compound derived from Gymnema sylvestre leaves in streptozotocin- diabetic mice". *J. Asian Nat Prod. Res.* 2000; 2(4); 321-327.
19. Acherekar S;kaklij S.M, hypoglycemic activity of Eugenia jambolana and ficus bengalense , mechanism of action ;1991
20. Rave K, Sivagnanam K, Subramanian S. " Anti- Diabetic Activity of Eugenia jambolana Seed Kernels on STZ- diabetic rats". *J. Med. Food.* 2004; 7 (2): 187-191.
21. Krawinkel et.al, Bitter Gourd (Momordica charantia); A Dietary approach to Hyperglycaemia, Nutrition Reviews. Volume -6 u, July -2006.
22. Chaturvedi P, George S, Momordica charantiana on lipid profile and oral glucose tolerance in diabetic rate.
23. Welihinda J, Kurunanayake EH, Sheriff MH, Jaysinghe KS. " Effect of Momordica charantia on the glucose tolerance in maturity onset diabetes", *J. Ethnopharmacol* . 1986: 17 (3): 277-282.
24. Rajasekaran, S., Sivananam, K., Ravi, K., Subramanian, S., Hypoglycemic effect of Aloe Vera gel on streptozotocin-induced diabetes in experimental rats. Journal of Medicinal Food.2004; 7: 61-66.
25. Boudreau MD, Be land FA (Apr-2006). "An evaluation of the biological and toxicological properties of Aloe barbadenisis" Journal of environmental Science and health. Part 'C", Environmental Carcinogenesis & ecotoxicology services.
26. Okyar A, Can A, Akev N, Baktir G, Sutlupinar N. "Effect of Aloe Vera Leaves on blood glucose level in type I and type II diabetic rat models". *Phytother. Res.* 2001;15(2): 157-161.

27. Gupta A, Gutpa R, Lal B, Effect of Trigonella foemen-graecum (fenugreek) seeds on glycamic control and insulin resistance in type -II diabetes mellitus a double blind placebo controlled study. The journal of Association of Physicians of India 2001.
28. Abdel- Berry JA, Abdel- Hassan IA, Ai – Hakiem MH. Hypoglycaemic andantihyperglycaemic effects of Trigonella foenum-graecum leaf in normal and alloxan induced diabetic rats. Department of Chemistry, College of Science, Univesrity of Basrah, Iraq. 1997: 58(3): 149-55.
29. Rai V, Iyer U, Mani UV Effect of Tulsi (Ocimum sanctum) leaf power supplementation on blood sugar levels, serum lipids and tissue lipids in diadetic rats. Plant Foods and Human Nutrition 1997; 50: 9-16.
30. Chattopadhyay RR "Hypoglycemic effect of Ocimum sanctum leaf extract in normal and streptozotocin diabetic rats.". *Indian J. Exp. Biol*. 1993; 31 (11): 891-893.
31. Kamalakkaman N, Princs PS. The effect of Aegle extract of Aegle marmelos fruit extract in Streptozotocin diabetes. A histopythological study. J Herb pharmocother 2005.
32. Jain RC, Vyas, CR, Garlic in Alloxan- induced diabetic rabbits. American .Journal of Clinical Nutrition 1975;28: 684-685.
33. Din N, Dibong SD, Mopondo Mopondo E, Priso RJ, Kwin NF et al., Inventory and Identification of plants Used in the Treatment of Diabetes in Doula Town (Cameroon) *Eur J* Med Plants, 1(3) (2011) 60-73,
Morton, Julia *(1987).* "Annona squamosa". *Fruits of warm climates. p. 69*. Retrieved 6 March 2013.
34. Babu PS, Stanely Mainzen Prince P. Antihyperglycaemic and antioxidant effect of hyponidd, an ayurvedic herbomineral formulation in streptozotocin-induced diabetic rats. J Pharm Pharmacol . 2004;56(11):1435-1442.
35. Rave K, Sivagnanam K, Subramanian S. " Anti- Diabetic Activity of Eugenia jambolana Seed Kernels on STZ- diabetic rats". *J. Med. Food.* 2004; 7 (2): 187-191.
36. Sathyavathi GV, Gupta AK, Tandon N. Medicinal plants of India. New Delhi, India: Indian Council of Medical Research; 1987.
37. Miura T, Ichiki H, Iwamoto N, Kato M, Kubo M, Sasaki H, et al. Antidiabetic activity of the rhizome of Anemarrhena asphodloides and active components, mangiferin and its glucoside. Biol Pharm Bull. 2001;24:1009–11.
38. Ooi CP, Yassin Z, Hamid TA. Momordica charantia for type 2 diabetes mellitus. Cochrane Database Syst Rev. 2010;2:CD007845.
39. Srivastava Y, Venkatakrishna – Bhatt H, Verma Y, et al Antidiabetic and adaptogenic properties of Memordica charantia Extract. An Experimental and clinical evaluation.
40. Das AK, Mandal SC, Banerjee SK, Sinha S, Das J, Saha BP, Pal M:Studies on antidiarrheal activity of Punica granatum seedextract in rats. Journal of Ethnopharmacology 1999; 68: 205-208.2.
41. Jafri MA, Aslam M, Javed K, Singh S: Effect of Punica granatum Linn. (flowers) on blood glucose level in normal and alloxaninduced diabetic ats.Journal of Ethnopharmacology 2000; 70:309-314.
42. Puri D, Prabhu KM, Murthy PS, Mechanism of action of hypoglycaemic principal isolated from fenugreek seeds.
43. Kumar PJ, Clark M. Textbook of Clinical Medicine. Pub: Saunders (London), pp 1099-1121,2002.
44. Adzu B, Amos S, Dzarma S, Wambebe C, and Gamaniel K. Effect of Zizyphus spina-christi wild aqueous extract on the Central nervous system in mice. J Ethnopharmacol. 2002; 79:13–16
45. Narendhirakannam RT , Subramanian S, Kandaswamy M. " Mineral content of some medicinal plants used in the treatment of diabetes mellitus ", *Biol. Trace Elem. Res.*2005; 103(2): 109-115.
46. Halim EM. " Lowering of blood sugar by water extract of Azadirachta indica and Abroma augusta in diabetes rats". *Indian J. Exp. Biol*. 2003; 41 (6) : 636-640.
47. Burlia DA, Khadeb AB. A comprehensive review on *Butea monosperma* (Lam.) kuntze. Pharmacogn Rev. 2007;1:333–7.
48. Dangi SY, Jolly CI, Narayanan S. 2002. Antihypertensive activity of the total alkaloids from the leaves of Moringa oleifera J.pharmaceutical biology 40(2):144-148.
49. Anwar F., Latif S., Ashraf M., Gilani A. H. (2007). *Moringa oleifera*: a food plant with multiple medicinal uses. Phytother. Res. 21, 17–25
50. Rana V, Thakur K, Sood R, Sharma V, Sharma TR. Genetic diversity analysis of *Tinospora cordifolia* germplasm collected from northwestern Himalayan region of India. J Genet. 2012;91:99–103. [PubMed]
51. Sahelian R. Alkaloid substances in plants, information on vinca, ergot and ephedra alkaloid compounds. [Cited on 2011 Jul 9];
52. Mukheerjee PK, Saha K, Das J, Pal M, Saha BP. Studies on the anti-inflammatory activity of rhizomes of Nelumbo nucifera, Plant Med 1997.
53. Mukheerjee PK, Saha K, Saha BP, Effect of Nelumbo nucifcea rhizome extract on blood sugar level in rats.
54. DSVGK Kaladhar, Traditional and Ayurvedic medicinal plants from India: Practices and Treatment for human diseases, Lambert Academic publishing,2012
55. DSVGK Kaladhar, Govinda Rao Duddukuri and Nagendra Sastry Yarla. Phytochemical Analysis, Antioxidant And Antimicrobial Activities From Raw Fruit Peel Crude Extracts Of Annona squamosa Linn. WJPPS, 4(1), 1373-1380, 2015.