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Medicinal and pharmacological action of various herbs on Diabetes mellitus: A review

Priyanka D. Sable[1,2*], Kamlesh A. Kadam[2], Dr. Hemant H. Gangurde[2], Prafulla S. Chavan[2], Priyanka D. Ingle[2,3]

1. *Rajashri Shahu College of Pharmacy, Buldana-443001*
2. *Shri Sant Gajanan Maharaj college of pharmacy, Buldana-443001*
3. *Anuradha College of pharmacy, Chikhali, Buldana- 443112*

Corresponding Author: Name: Priyanka D. Sable
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Abstract: Diabetes is the chronic condition occurs due to incapability of pancreas to synthesis insulin to metabolises excessive sugar present from daily food. Some factors also affect on diabetes occurrence like environmental, genetic, stress, insulin resistance, obesity. As per International Diabetes Federation (IDF), 387 million people worldwide were diagnosed with diabetes in 2014, with that figure expected to rise to 592 million by 2035. many chemically synthesised drugs used management of diabetes like glibenclamide, metformin, glipizide, bromocriptine, but they produce adverse effect on our body. Many more natural drugs are also used for maintain sugar level & sugar metabolism in body. Up to 90% of the population in poor nations uses plants and their products as traditional medicine for basic health care. According to ethnobotanical data, about 800 plants may have anti-diabetic properties. Acacia Arabica, Aegle marmelose, Allium sativum, Allium cepa, Artemisia pallens, Areca catechu, Biophytum sensitivum, Hibiscus rosa sinensis, Trigonella foenum-graecum, Picrorhiza kurroa, Murraya koenigii, Ficus bengalenesis & many other having also antidiabetics activity. herbal drugs are proved to be a better choice over synthetic drugs because of less side effects and adverse effects. herbal formulations are widely available and can be obtained without a prescription.
Keywords: Beta cell damage, Diabetes mellitus, Herbs, Insulin resistance,

I. INTRODUCTION

According to the International Diabetes Federation (IDF), 387 million people worldwide were diagnosed with diabetes in 2014, with that figure expected to rise to 592 million by 2035[1]. Diabetes mellitus (DM) is likely one of society's earliest diseases. It was first written over 3000 years ago in an Egyptian text [2]. DM is a group of metabolic diseases characterized by chronic hyperglycaemias resulting from defects in insulin secretion, insulin action, or both. It is divided into several categories, the most frequent of which being Type 1Diabetes mellitus (T1DM) and type 2 Diabetes mellitus (T2DM) [3]. The distinction between type 1 and type 2 diabetes mellitus was determined in 1936[2]. T1DM is characterised by an inability to produce insulin as a result of beta cell damage caused by autoimmunity. (T2DM), on the other hand, is marked by insulin resistance and a decrease in insulin production. The causes of T1DM are environment, viruses [4], genetic [5]and T2DM are obesity [6], stress [7], life style factors include diet, smoking and alcohol consumption [8] Environmental factors include air pollution, which is a potential mechanism for causing T1DM in susceptible persons through the creation of free radicals. Ozone, for example, produces free oxygen radicals. Because free radicals are known to have a role in beta cell destruction in vitro, a big study of an antioxidant (nicotinamide) to prevent T1DM was conducted in Europe. Through free radicals produced by air pollution, ozone may cause beta cell damage. In the event of a virus Several microorganisms have been suggested as T1DM triggers. Pathogens can cause T1DM by infecting pancreatic beta cells and producing direct cytotoxicity or by generating an autoimmune reaction against beta cells, according to theory [4]. The genetic factors are known as 'susceptibility genes,' since they influence the risk of diabetes, but they are not essential nor sufficient for the illness to develop [5]. Insulin resistance has been linked to obesity and physical inactivity, and many mechanisms that mediate this relationship have been discovered. Adipocytes produce a variety of circulating hormones, cytokines, and metabolic fuels, including non-esterified (free) fatty acids (NEFA), which affect insulin activity. Increased triglyceride storage, particularly in visceral or deep subcutaneous adipose depots, results in big adipocytes that are resistant to insulin's capacity to regulate lipolysis. This results in increased release and circulating levels of NEFA and glycerol, both of which aggravate insulin resistance in skeletal muscle and liver [9]. Stress may play a role in diabetes-related persistent hyperglycemia. Stress has been demonstrated to have a significant impact on metabolic activity for a long time. The fight or flight reaction causes an increase in energy mobilization. Stress causes the release of a variety of hormones, which can lead to an increase in blood sugar levels [10]. The Nurses' Health Study (NHS) found that diet quality is crucial in the development of diabetes, regardless of BMI or several other risk factors. Higher dietary glycemic load and trans-fat intake, in particular, are linked to an increased risk of diabetes, but higher consumption of cereal fiber and polyunsaturated fat is linked to T2DM.Smokers tend to be thinner than non-smokers or former smokers, but smokers tend to gain weight when they quit smoking, and heavier smokers tend to gain more weight than light smokers. Smokers have a higher risk of abdominal obesity than non-smokers, even if their BMI is normal. This is because smoking has an anti-estrogenic effect, which can disrupt hormonal balance and lead to abdominal obesity. Obesity in general and abdominal obesity are both linked to the development of T2DM [8]. Both alcoholism and diabetes impact a huge population worldwide, and DM is recognized clinically because of drinking. Chronic, heavy alcohol drinking, which is an independent risk factor for T2DM, disturbs glucose homeostasis and is linked to insulin resistance development [11]. The most common diabetes symptoms are Frequent urination, Disproportionate thirst, Intense hunger, Weight gain, unusual weight loss, Increased fatigue, Irritability, blurred vision, Cuts, and bruises don't heal properly or quickly, Numbness or tingling, especially in your feet and hands [12].

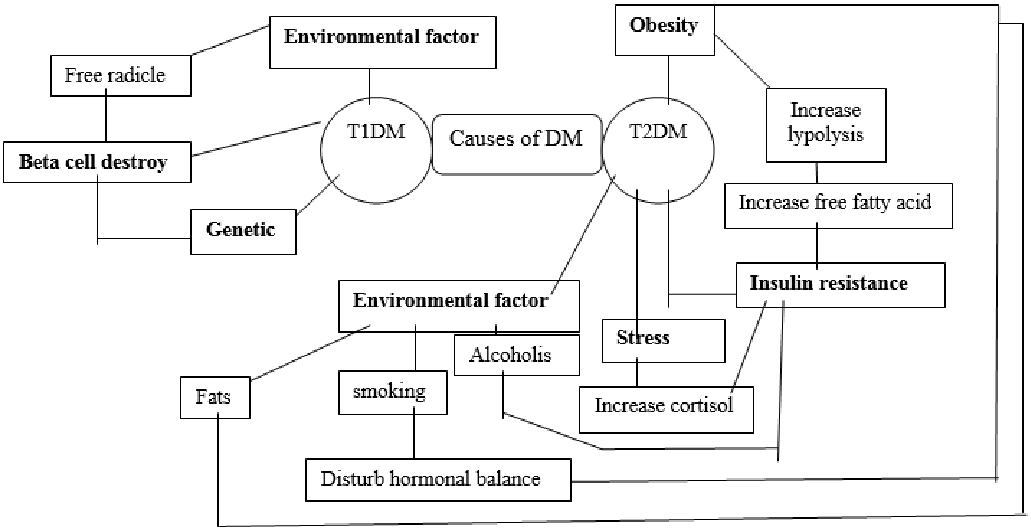

Fig 1: Causes of diabetes mellitus

The use of herbal medicinal products and supplements has increased tremendously over the past three decades with not less than 80% of people worldwide relying on them for some part of primary healthcare. Although therapies involving these agents have shown promising potential with the efficacy of a good number of herbal products clearly established, many of them remain untested and their use are either poorly monitored or not even monitored at all[13].Up to 90% of the population in poor nations uses plants and their products as traditional medicine for basic health care, according to the World Health Organization (WHO)[14].WHO has compiled a list of 21,000 medicinal plants used around the world. India has 2500 species, with 150 of them being used economically on a considerable basis. India is the world's largest producer of medicinal herbs and is known as the world's botanical gardens [15]. According to ethnobotanical data, about 800 plants may have anti-diabetic properties [16]. Herbal drugs are proved to be a better choice over synthetic drugs because of less side effects and adverse effects. Herbal formulations are widely available and can be obtained without a prescription. These herbal medications are used to treat life-threatening illnesses. Herbal formulations are made up of natural herbs, fruits, and vegetable extracts that are effective in the treatment of a variety of disorders while causing no side effects [17].

Plants with anti-diabetic potential

Sr. no	Herbs	Common name	Family	Part used	Antidiabetic and other valuable effects	Reference
1	*Acacia Arabic*	Babul, gum arabic tree	Leguminosae, Fabaceae	Seed, bark	Antimutagenic, Antiproteolytic	18,19
2	*Aegle marmelose*	Bael	Rutaceae	Flower	Antidysenteric, local anesthetics	20
3	*Allium sativum*	Garlic	Amaryllidaceae	Bulbs	Antibacterial, Antifungal, Antioxidant Activity,	21

4	*Allium cepa*	onion	Liliaceae, Amaryllidaceae	Bulbs	Antihyperlipidemic activity	22
5	*Artemisia pallens*	Davana, Davanam	Asteraceae, Compositae	Aerial parts	blood glucose lowering effect	23,24
6	*Areca catechu*	Supari	Arecaceae	seed	antiparasitic, anti-fatigue, antioxidant, antibacterial, suppression of platelet aggregation	25,26
7	*Biophytum sensitivum*	Lajwanti, Lakshmana	Oxalidaceae	Leaves	Antibacterial property, Cardio protection	27
8	*Hibiscus rosa sinensis*	Jassoon, Jasvand	Malvaceae	Leaves, Flowers	Antioxidant, Hepatoprotective, Antiulcer Activity	28
9	*Trigonella foenum-graecum*	Methi	Fenugreek	seeds	Antihyperlipidemic	29
10	*Picrorhiza kurroa*	Picrorhiza, katuka, kutki	Scrophulariaceae	Rhizomes	antioxidant	30, 31
11	*Murraya koenigii*	Curry leaves	Rutaceae	leaves	treating piles, inflammation, itching, fresh cuts, dysentery, and edema	32,33
12	*Ficus bengalenesis*	Banyan tree	Moraceae	bark	Treating dysentery, seminal weakness, menorrhagia, leucorrhoea, erysipelas, nervous disorders and burning sensation	34

Table1: Plants with anti-diabetic potential

1. *Momordica charantia* (*M.charantia*)
Synonyms*:* bitter melon, karela, balsam pear, or bitter ground
Family: Cucurbitacea
Activity: The seed, fruit pulp, leaves, and complete plant of momordica charantia have been proven in several animal tests to have a hypoglycemic impact in normal animals. In rats, *M.charantia* extract enhances insulin sensitivity and suppresses postprandial hyperglycemia, and *M. charantia* improves glucose tolerance and suppresses postprandial hyperglycemia. Some investigations indicated that *M.charantia* hypoglycaemic impact was comparable to those of oral drugs such tolbutamide, chlorpropamide, and glibenclamide. The stimulation of the AMP-activated protein kinase pathway has been a recurring topic in the biochemical evidence for *M. charantia* anti-diabetic actions [35].

2.*Brassica juncea* (*B. juncea*)
Synonyms: Black mustard seed or brown mustard seed, Rai, Mohari, Kadugu, Avalu [36].
Family: Cruciferae
Activity*:* Diabetes was induced in male albino rats by intraperitoneal injection of streptozotocin(STZ), which counteracted the antidiabetic activity of the aqueous seed extract. Normal rats developed diabetes 48 hours after receiving STZ injections. When compared to normal (Placebo) rats, the STZ injected rats' blood glucose levels were much higher (+343%), indicating that they were diabetic (Control). At I hr, II hr, and IV hr of time intervals, diabetic mice fed *B. juncea L* seed extract had significantly reduced blood glucose levels of 291, 185, and 103 mg/dL, respectively [37].

3.*Eucalyptus globulus* (*E. globulus*)
Synonyms: Australian fever tree, Tasmania blue gum, Southern blue gum, blue gum tree, Turpentine gas [38].
Family: Myrtaceae
Activity: In nations such as South America, Africa, India, and China, the plant's leaves, blossoms, and gum are commonly utilised as hypoglycaemic agents. The largest dose of Eucalyptus globulus extract (300 mg/kg) resulted in the most significant reduction in blood glucose levels. After nine days of treatment, blood sugar levels in diabetic rats treated with Eucalyptus globulus leaf extract at 150 and 300 mg/kg were normalised [39]. Traditionally, eucalyptus globulus (also known as eucalyptus) has been used to treat diabetes. By adding eucalyptus to the diet (62.5 g/kg) and water (2.5 g/L) prevented the mice treated with streptozotocin from developing hyperglycemia and the resulting weight loss. In mouse abdominal muscle, an aqueous extract of eucalyptus (AEE) (0.5 g/L) increased 2-deoxy-glucose transport by 50%, glucose oxidation by 60%, and glucose absorption into glycogen by 90%. 0.25-0.5 g AEE/L triggered a progressive 70-160% increase of insulin production from the clonal pancreatic -cell line in acute, 20 min incubations (BRIN-BD11) [40].

4. *Gymnema Sylvestre* (*G. Sylvestre*)

Synonyms: Periploca of the woods (English); Gurmar (Hindi); Meshashringi, madhunashini (Sanskrit); Kavali, kalikardori (Marathi); Dhuleti, mardashingi (Gujrathi); Adigam, cherukurinja (Tamil); Podapatri (Telgu) and Sannagerasehambu (Kannada).

Family: Asclepiadaceae

Activity: The plant is commonly known as Gymnema is derived from the Hindu term "Gurmar," which means "sugar killer," and it is said to neutralise the excess sugar present in the body in Diabetes mellitus. G. Sylvester leaves have been shown to cause hypoglycemia in laboratory animals and to be useful in the treatment of diabetes mellitus in adults in herbal therapy. Some of the ways by which *G. Sylvestre*leaves extract or (Gymnemic acid) exerts its hypoglycemic acid effects include: 1) It promotes islet cell regeneration, 2) It increases insulin secretion, 3) It inhibits glucose absorption from the intestine, and 4) It increases glucose utilisation by increasing the activities of enzymes involved in glucose utilisation by insulin-dependent pathways, such as phosphorylase activity, gluconeogenic enzymes, and sorbitol dehydrogenase [41]. Gymnema has also been shown to enhance glycogen synthesis, glycolysis, gluconeogenesis, and hepatic and muscular absorption of glucose in rabbits. Gymnema may enhance glycemic management by encouraging the release of insulin from the pancreatic islets of Langerhans, according to certain sources. In rats with mild (blood glucose 150-200 mg/dL), severe (blood glucose 250-400 mg/dL), and toxic (blood glucose 400 mg/dL) alloxan-induced diabetes, it was investigated the hypoglycemic and life-prolonging effects of four different single doses (0.2 g, 0.4 g, 0.6 g, and 0.8 g) of an aqueous extract of dried G. sylvestre leaves. The effectiveness of gymnema was found to be inversely related to the severity of diabetes, which was confirmed by a study that used 0.4 g of an aqueous extract of G. sylvestre leaves every day for two weeks. Therefore, it is probable that gymnema has to activate some pancreatic -cells in order to have an anti-diabetic impact [42].

5. *Ocimum sanctum* *(O. sanctum)*

Synonyms: Holy Basil, Tulsi

Family: Labiatae [43]

Activity: Ayurveda and siddha medicine use different parts of plants to prevent and heal a variety of ailments. *O. sanctum* extract promotes insulin production by increasing intracellular calcium in beta islet cells of the pancreas [44]. Extract of *O. sanctum* increases intra cellular calcium of beta islet cells of pancreas and causes insulin secretion [45]. The anti-hyperglycemic effects of tulsi extract are brought on by the chemicals with sulphur and flavonoids. The administration of alloxan (70 mg/kg, i.v.) and the extracts' antidiabetic effects on diabetes patients' fasting blood sugar levels resulted in a threefold increase in fasting blood glucose levels that persisted for 14 days. It was found that giving *O. sanctum* extracts orally to diabetic rats significantly reduced their blood glucose levels. According to the findings of the current study, oral administration of *O. sanctum* extracts daily for 14 days to diabetic rats resulted in a 32.7% decline on the seventh day and a 56% decrease in blood glucose levels after 14 days of treatment. The outcomes amply demonstrated the *O. sanctum* extracts' capacity to lower blood sugar levels [46].

6. *Lantana camara* (*L. camara)*

Synonyms: Unnicceti (Tamil), pulikampa (Telugu), and caturang (Hindi)

Family: Verbenaceae

Activity: In alloxan-induced diabetic rats, oral treatment of the methanol extract of *L. camara* leaves (200 and 400 mg/kg body weight) leaves resulted in a considerable reduction in blood glucose concentration in a dose-dependent manner [47]. In alloxan-induced diabetic rats, oral treatment of the methanol extract of L. camara (400 mg/kg body weight) leaves caused a drop in blood glucose to 121.94 mg/dl. 25 Streptozotocin-induced diabetic rats were used to test the methanol extract of L. camara Linn fruits for hypoglycemic action (Wistar albino rats). In streptozotocin-induced diabetic rats, extract therapy at doses of 100 and 200 mg/kg body weight led to a dose-dependent drop in serum glucose level. Additionally, improvements in HbA1c profile, body weight, and liver cell regeneration were seen after extract administration [48].

7. *Musa sapientum* (*M. sapientum)*

Synonyms: Musa paradisiacal Linn. (kela in Hindi, banana in English)

Family: Musaceae

Activity: The flowers, unripe fruits, and fruit peel of the *M. sapientum syn* plant have all been studied for their anti-diabetic properties. β-Sitosterols, leucocyanidin, sryngin, quercetin, steryl glycosides, amino acids, and other compounds have been found in *M. sapientum*. In experimental animals, β-sitosterols and the dimethoxy derivative of leucocyanidin, leucocyanidin 3-O-beta-D-galactosyl cellobioside, showed hypoglycemic effects. In alloxan-diabetic rats, [49] terpenoids extracted from the fruit pulp of *M. sapientum*. were found to exhibit significant hypoglycemic effects [50]. Musa sapientum flowers exert a significant protection against alloxan induced lipid peroxidation in experimental diabetic rats. Oral administration of 0.15, 0.20 and 0.25 g/kg body weight of the chloroform extract of the flowers for 30 days resulted in a significant reduction in blood glucose and glycosylated haemoglobin and an increase in total haemoglobin [51].

8.*Vinca rosea*
Synonyms: Madagascar periwinkle, Vinca rosea, or Lchnera rosea.
Family: Apocynaceae
Activity: Leaf extracts (hydroalcoholic or dichloromethane-methanol) have been shown to have antihyperglycemic action in laboratory animals. *C. roseus* leaf juice has been shown to lower blood glucose levels in both normal and alloxan diabetic rabbits. Catharanthus roseus leaves and twigs were found to have hypoglycaemic action in streptozotocin-induced diabetic rats. Vinca rosea methanolic extracts exhibit strong anti-diabetic properties. Alcoholic extracts of Vinca rosea significantly reduced blood sugar levels in alloxan-induced hyperglycemic rats without affecting body weight, and they also improved the symptoms of diabetes mellitus as shown by body weight, lipid profile, serum creatinine, urea, and alkaline phosphatase levels. The balance between cell loss and renewal can be seen in the total mass of cells [52].

9. *Salacia oblonga* (*S. reticulata)*
Synonyms: Ponkoranti (Tamil), ekankaya (Kannada)
Family: Hypocrataceae
Activity: The streptozotocin-diabetic Wistar rats were given a hydroalcoholic extract of *S. reticulata* at doses of 50 and 100 mg/kg. Both doses dramatically reduced random blood glucose levels (by about 45 percent) and HbA1c levels while raising serum insulin levels [53]. Blood glucose levels in streptozotocin (STZ)-induced diabetic rats were considerably lower after oral administration of *S. reticulata* root extract, according to a rat study [54]. Increased insulin and decreased Hb1Ac levels were seen in the anti-diabetic tests on albino Wistar rats using S. oblonga root extracts at dosages of 50, 100, and 500 mg/kg bw. Hydroalcoholic root extracts of S. oblonga were used in antidiabetic investigations by Kushwaha et al., who observed comparable benefits in rats. The potentiation of pancreatic islet cells, which results in the release of insulin, is the other potential mechanism for reducing blood glucose levels. This facilitates a synergistic effect with numerous active principles present in the crude extract to improve insulin-mediated cell absorption of glucose [55].

10. *Swertia chirayita* (*S. chirayita)*
Synonyms: chirayata, chirayit
Family: Gentianaceae
Activity: The plant extract contains natural chemicals such as flavonoids and secoiridoids, it is particularly efficient in preventing hyperglycemic problems. Insulin secretion from monolayers of BRIN-BD11 clonal pancreatic cells was studied in the presence of an aquatic bark extract of *S. chirayita* to see if it has antidiabetic characteristics. In the presence of the extract, such cell lines showed stimulated concentration-dependent insulin production and improved insulin action. Inhibition of protein glycation may also help to prevent diabetic complications, according to their findings. Swerchirin, the most powerful xanthone derived from the same plant extract, has remarkable blood sugar reducing activity, which has been proven in experiments using various experimental models. Applying ethanolic leaf extract and pet-ether fraction resulted in improved hypoglycemic qualities by lowering blood glucose levels by roughly 32% and 47.2%, respectively. When reductions in blood glucose level were reached with dichloromethane and methanol fractions after 3 hours of medication administration, 14.1% and 15.9%, respectively, it was determined that the plant extract had a mild to moderate hypoglycemic effect. The existence of mangiferin in plant stem part is mainly responsible for plants antidiabetic activity [56].

11. *Tinospora cordifolia* (*T. cordifolia)*
Synonyms: Giloe, Guduchi
Family: Menispermaceae
Activity: Various studies show improved diabetic neuropathy and gastropathy in rats, reduced blood sugar in alloxan-induced hyperglycemic rats and rabbits, significant reduction in blood glucose and brain lipids, increased glucose tolerance in rodents, increased glucose metabolism, inhibitory effect of pyrrolidine derivative on adrenaline-induced hyperglycemia, and significant hypoglycemic effect in normal and alloxan diabetic rabbits following a pyrrolidine derivative, and significant hypoglycaemic[57]. Aqueous stem extract from another species of 'Tinospora crispa' was similarly found to have antihyperglycemic properties, most likely due to insulin release stimulation via modification of -cell and Ca2+ concentration [58]. By reducing oxidative stress, enhancing insulin secretion, limiting gluconeogenesis, and inhibiting glycogenolysis, the traditional plant Tinospora cordifolia mediates its anti-diabetic potential and controls blood sugar levels [59].

12. Punica granatum (*P. granatum)*

Synonyms: Dalimb (Marathi), Anar (Hindi), Pomograntes (English)

Family: Punicaceae

Activity: Diabetic rats given 0.43 g/kg B.W. of aqueous peel extract for four weeks had significantly reduced blood sugar levels and a higher number of cells, which helped to intensify insulin levels. The extract's anti-diabetic effect is mediated via cell stimulation, regeneration, and increased number, as well as protection of pancreatic tissue and subsequent insulin release. It may also boost insulin receptor stimulation and activity. In alloxan-induced diabetic wistar rats, the methanolic extract of punica peel (75 and 150 mg/kg, daily) lowers glucose levels [60].

13.*Mucuna pruriens (**M. pruriens)*

Synonyms: velvet bean [61]

Family: Fabaceae

Activity: The effect of the crude ethanolic seed extract of *M. pruriens* on the blood glucose level in alloxan-induced diabetic rats was shown to be that the administration of 5, 10, 20, 30, 40, 50, and 100 mg/kg of the crude ethanolic extract of *M. pruriens* seed resulted in 18.6 percent, 24.9 percent, 30.8 percent, 41.4 percent, 49.7%, 53.1 percent, and 55.4 percent reduction in blood glucose of the diabetic rats after 8 hours. Alloxan-induced diabetic rats (plasma glucose > 450 mg/dL) were administered 5, 10, 20, 30, 40, 50, and 100 mg/kg of the crude ethanolic extract of M. pruriens seeds. After 8 hours of treatment, the blood glucose levels of the diabetic rats were reduced by lower to moderate respectively, while glibenclamide (5 mg/kg/day A significant dose-dependent drop in blood glucose level was seen after chronic treatment of the extract. It also demonstrated that the methanolic and ethanolic fractions of the extract are where the antidiabetic properties of M. pruriens seeds are found [62].

14.Pterocarpus marsupium* (P. marsupium)*

Synonyms: Bilava (Marathi), Beeja (Hindi), Indian kina (English)

Family: Leguminosae

Activity: Aqueous extract of *P. marsupium* heart-wood is used in the treatment of diabetes in Ayurveda. Although there are several reports on *P. marsupium* as an anti-diabetic drug, there is no focus on the relevance of its rasayana property and anti-diabetic activity. In albino mice, *P. marsupium* was found to be non-toxic up to 8 g/kg. In rats, the drug's effective dose ranged from 100 to 250 mg/kg. In type 2 diabetic rats, aqueous extract of *P. marsupium* at both dosages, 100 mg/kg, and 200 mg/kg, significantly (P 0.001) reduced fasting blood glucose [63]. revealed that P. marsupium extract enhanced the release of insulin and the absorption of glucose, respectively, in a concentration-dependent way when applied to mice pancreatic and muscle tissues. According to Gairola et al and can prevent both hyperinsulinemia and hypertriglyceridemia [64].

15.*Morus alba*

Synonyms: mulberry [65]

Family: Moraceae [65]

Activity: In STZ-induced rats, an ethanol extract of mulberry leaf is beneficial in curing diabetes. The acetone extract is also effective, but not as effectively as the ethanolic. These studies show that the mulberry extraction procedure is important for diabetes prevention, and that each extract has varied hypoglycemic effects. In diabetic mice induced with streptozotocin (STZ), total alkaloids from mulberry leaf exhibit hypoglycemic effects. In Kunming mice, flavonoids from mulberry leaves exhibit inhibitory effects on a-glucosidase activity in vitro and can lower blood glucose levels after oral administration of starch and sucrose. Mulberry leaf polysaccharides have been demonstrated to lower blood glucose levels, enhance glucose tolerance, and increase hepatic glycogen content in diabetic mice and normal rats, thereby regulating glucose metabolism and increasing insulin production [66]. Although M. alba fruit polysaccharides do not raise insulin secretion, they may boost insulin responsiveness and protect the pancreas. These findings further suggested that the fruit polysaccharides of M. alba induced antihyperglycemic effects through enhancing insulin sensitivity [67].

16.Carissa Carandas

Synonyms: Karvanda (Marathi), Koronda (Hindi)

Family: Apocynaceae

Activity: Carandas Carissa is a climbing shrub with exquisite jasmine-like flowers and tiny berry-shaped fruits. At 4, 8, and 24 hours, C. carandas L. extracts at concentrations of 500 and 100 mg/kg effectively lowered the blood glucose level of alloxan-induced diabetic rats. As compared to the diabetic control group, the methanol extract and its ethyl acetate soluble fraction effectively reduced the increased blood glucose levels at dose levels of 400 mg/kg orally after 24 hours [68]. The effect of the aqueous extract of C. carandas on alloxan induced and normoglycemic wister rats, and found that the doses of 500 and 1000 mg/kg of the extract significantly ($p<0.05$) decreased blood glucose level of alloxan diabetic wister rats at 4,8, and 24 hrs [69].

Reference:

[1]. Joshi SR. Diabetes care in India. Annals of Global health. 2015 Nov 1;81(6):830-8.
[2]. Olokoba AB, Obateru OA, Olokoba LB. Type 2 diabetes mellitus: a review of current trends. Oman medical journal. 2012 Jul;27(4):269.
[3]. Tan SY, Wong JL, Sim YJ, Wong SS, Elhassan SA, Tan SH, Lim GP, Tay NW, Annan NC, Bhattamisra SK, Candasamy M. Type 1 and 2 diabetes mellitus: A review on current treatment approach and gene therapy as potential intervention. Diabetes & metabolic syndrome: clinical research & reviews. 2019 Jan 1;13(1):364-72.
[4]. Butalia S, Kaplan GG, Khokhar B, Rabi DM. Environmental risk factors and type 1 diabetes: past, present, and future. Canadian journal of diabetes. 2016 Dec 1;40(6):586-93.
[5]. Kelly MA, Mijovic CH, Barnett AH. Genetics of type 1 diabetes. Best Practice & Research Clinical Endocrinology & Metabolism. 2001 Sep 1;15(3):279-91.
[6]. Al-Goblan AS, Al-Alfi MA, Khan MZ. Mechanism linking diabetes mellitus and obesity. Diabetes, metabolic syndrome and obesity: targets and therapy. 2014; 7:587.
[7]. Harris ML, Oldmeadow C, Hure A, Luu J, Loxton D, Attia J. Stress increases the risk of type 2 diabetes onset in women: A 12-year longitudinal study using causal modelling. PloS one. 2017 Feb 21;12(2): e0172126.
[8]. Bi Y, Wang T, Xu M, Xu Y, Li M, Lu J, Zhu X, Ning G. Advanced research on risk factors of type 2 diabetes. Diabetes/metabolism research and reviews. 2012 Dec; 28:32-9.
[9]. Stumvoll M, Goldstein BJ, Van Haeften TW. Type 2 diabetes: principles of pathogenesis and therapy. The Lancet. 2005 Apr 9;365(9467):1333-46.
[10]. Surwit RS, Schneider MS, Feinglos MN. Stress and diabetes mellitus. Diabetes care. 1992 Oct 1;15(10):1413-22.
[11]. Kim SJ, Kim DJ. Alcoholism and diabetes mellitus. Diabetes & metabolism journal. 2012 Apr 17;36(2):108-15.
[12]. Lal BS. Diabetes: causes, symptoms, and treatments. Public Health Environment and Social Issues in India. 2016;1.
[13]. Verma S, Gupta M, Popli H, Aggarwal G. Diabetes mellitus treatment using herbal drugs. International Journal of Phytomedicine. 2018;10(1):1-0.
[14]. Rizvi SI, Mishra N. Traditional Indian medicines used for the management of diabetes mellitus. Journal of diabetes research. 2013 Jun 5;2013.
[15]. Modak M, Dixit P, Londhe J, Ghaskadbi S, Devasagayam TP. Indian herbs, and herbal drugs used for the treatment of diabetes. Journal of clinical biochemistry and nutrition. 2007;40(3):163-73.
[16]. Patil R, Patil R, Ahirwar B, Ahirwar D. Current status of Indian medicinal plants with antidiabetic potential: a review. Asian Pacific Journal of Tropical Biomedicine. 2011 Oct 1;1(2): S291-8.
[17]. Ekor M. The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. Frontiers in pharmacology. 2014 Jan 10; 4:177.
[18]. Rajvaidhya S, Nagori BP, Singh GK, Dubey BK, Desai P, Jain S. A review on Acacia Arabica-an Indian medicinal plant. International Journal of pharmaceutical sciences and research. 2012 Jul 1;3(7):1995
[19]. Raj A, Haokip V, Chandrawanshi S. Acacia nilotica: a multipurpose tree and source of Indian gum Arabic. South Indian Journal of Biological Sciences. 2015 Sep 1;1(2):66-9.
[20]. Patkar Atul N, Desai Nilesh V, Ranage Akkatai A, Kalekar Kamlakar S. INTERNATIONAL RESEARCH JOURNAL OF PHARMACY.
[21]. El-Saber Batiha G, Magdy Beshbishy A, G Wasef L, Elewa YH, An Al-Sagan A, El-Hack A, Mohamed E, Taha AE, M Abd-Elhakim Y, Prasad Devkota H. Chemical constituents and pharmacological activities of garlic (Allium sativum L.): A review. Nutrients. 2020 Mar;12(3):872.
[22]. Marrelli M, Amodeo V, Statti G, Conforti F. Biological properties, and bioactive components of Allium cepa L.: Focus on potential benefits in the treatment of obesity and related comorbidities. Molecules. 2019 Jan;24(1):119.
[23]. Suresh J, Elango K, Dhanabal SP, Paramakrishnan N, Suresh B. A comparative pharmacognostical evaluation of two Artemisia species found in Nilgiris biosphere. Ancient science of life. 2007 Oct;27(2):7.
[24]. Subramoniam A, Pushpangadan P, Rajasekharan S, Evans DA, Latha PG, Valsaraj R. Effects of Artemisia pallens Wall. on blood glucose levels in normal and alloxan-induced diabetic rats. Journal of Ethnopharmacology. 1996 Jan 1;50(1):13-7.

[25]. Ansari A, Mahmood T, Bagga P, Ahsan F, Shamim A, Ahmad S, Shariq M, Parveen S. Areca catechu: A phytopharmacological legwork. Food Frontiers. 2021 Jun;2(2):163-83.
[26]. Peng W, Liu YJ, Wu N, Sun T, He XY, Gao YX, Wu CJ. Areca catechu L. (Arecaceae): A review of its traditional uses, botany, phytochemistry, pharmacology and toxicology. Journal of Ethnopharmacology. 2015 Apr 22; 164:340-56.
[27]. Sakthivel KM, Guruvayoorappan C. Biophytum sensitivum: ancient medicine, modern targets. Journal of advanced pharmaceutical technology & research. 2012 Apr;3(2):83.
[28]. Khristi V, Patel VH. Therapeutic potential of Hibiscus rosa sinensis: a review. International journal of nutrition and dietetics. 2016;4(2):105-23.
[29]. Mowl A, Alauddin M, Rahman M, Ahmed K. Antihyperglycemic effect of Trigonella foenum-graecum (fenugreek) seed extract in alloxan-induced diabetic rats and its use in diabetes mellitus: a brief qualitative phytochemical and acute toxicity test on the extract. African Journal of Traditional, Complementary and Alternative Medicines. 2009;6(3).
[30]. Banerjee D, Maity B, Nag SK, Bandyopadhyay SK, Chattopadhyay S. Healing Potential of Picrorhiza kurroa (Scrofulariaceae) rhizomes against indomethacin-induced gastric ulceration: a mechanistic exploration. BMC complementary and alternative medicine. 2008 Dec;8(1):1-4.
[31]. Joy KL, Kuttan R. Anti-diabetic activity of Picrorrhiza kurroa extract. Journal of Ethnopharmacology. 1999 Nov 1;67(2):143-8.
[32]. Balakrishnan R, Vijayraja D, Jo SH, Ganesan P, Su-Kim I, Choi DK. Medicinal profile, phytochemistry, and pharmacological activities of Murraya koenigii and its primary bioactive compounds. Antioxidants. 2020 Feb;9(2):101.
[33]. Arulselvan P, Senthilkumar GP, Sathish Kumar D, Subramanian S. Anti-diabetic effect of Murraya koenigii leaves on streptozotocin induced diabetic rats. Die Pharmazie-An International Journal of Pharmaceutical Sciences. 2006 Oct 1;61(10):874-7.
[34]. Khaliq HA. A review of pharmacognostic, physicochemical, phytochemical, and pharmacological studies on Ficus bengalensis L. J Sci Innov Res. 2017;6(4):151-63.
[35]. Joseph B, Jini D. Antidiabetic effects of Momordica charantia (bitter melon) and its medicinal potency. Asian pacific journal of tropical disease. 2013 Apr 1;3(2):93-102.
[36]. Mishra A, Dash P, Murthy PN, Siddique HH, Kushwaha P, A classical Review on Rajika (Brassica juncea). Research & Reviews.2012;(1):18-22
[37]. Thirumalai T, Therasa SV, Elumalai EK, David E. Hypoglycemic effect of Brassica juncea (seeds) on streptozotocin induced diabetic male albino rat. Asian Pacific journal of tropical biomedicine. 2011 Aug 1;1(4):323-5.
[38]. Hayat U, Jilani MI, Rehman R, Nadeem F. A review on Eucalyptus globulus: a new perspective in therapeutics. Int. J. Chem. Biochem. Sci. 2015; 8:85-91.
[39]. Jouad H, Maghrani M, Hassani RA, Eddouks M. Hypoglycemic activity of aqueous extract of Eucalyptus globulus in normal and streptozotocin-induced diabetic rats. Journal of herbs, spices & medicinal plants. 2004 Mar 1;10(4):19-28.
[40]. Gray AM, Flatt PR. Antihyperglycemic actions of Eucalyptus globulus (Eucalyptus) are associated with pancreatic and extra-pancreatic effects in mice. The journal of nutrition. 1998 Dec 1;128(12):2319-23.
[41]. Saneja A, Sharma C, Aneja KR, Pahwa R. Gymnema sylvestre (Gurmar): A review. Der Pharmacia Lettre. 2010;2(1):275-84.
[42]. Leach MJ. Gymnema sylvestre for diabetes mellitus: a systematic review. The Journal of Alternative and Complementary Medicine. 2007 Nov 1;13(9):977-83.
[43]. Baliga MS, Jimmy R, Thilakchand KR, Sunitha V, Bhat NR, Saldanha E, Rao S, Rao P, Arora R, Palatty PL. Ocimum sanctum L (Holy Basil or Tulsi) and its phytochemicals in the prevention and treatment of cancer. Nutrition and cancer. 2013 Jan 1;65(sup1):26-35.
[44]. Abhilash Rao S, Vijay Y, Deepthi T, Ch SL, Rani V, Rani S, Bhuvaneswara Reddy Y, Ram Swaroop P, Sai Laxmi V, Nikhil Chakravarthy K, Arun P. Anti diabetic effect of ethanolic extract of leaves of Ocimum sanctum in alloxan induced diabetes in rats.
[45]. Abhilash Rao S, Vijay Y, Deepthi T, Ch SL, Rani V, Rani S, Bhuvaneswara Reddy Y, Ram Swaroop P, Sai Laxmi V, Nikhil Chakravarthy K, Arun P. Anti diabetic effect of ethanolic extract of leaves of Ocimum sanctum in alloxan induced diabetes in rats.
[46]. Jayant K.S, Shrivastva N. Effect of ocimum sanctum against alloxan induced diabetes and biochemical alteration in rats. Integr obesity Diabetes. 2016;2(5):2-4.
[47]. Sen S, Chakraborty R. Pharmacognostic and anti-hyperglycemic evaluation of Lantana camara (L.) var. aculeate leaves in alloxan-induced hyperglycemic rats.
[48]. Kalita S, Kumar G, Karthik L, Rao KV. A Review on Medicinal Properties of Lantana camara Linn. Research Journal of Pharmacy and Technology. 2012;5(6):711-5.

[49]. Kumar M, Gautam MK, Singh A, Goel RK. Healing effects of Musa sapientum var. paradisiaca in diabetic rats with co-occurring gastric ulcer: cytokines and growth factor by PCR amplification. BMC complementary and alternative medicine. 2013 Dec;13(1):1-9.
[50]. Dikshit P, Shukla K, Tyagi MK, Garg P, Gambhir JK, Shukla R. Antidiabetic and antihyperlipidemic effects of the stem of Musa sapientum Linn. in streptozotocin- induced diabetic rats. Journal of diabetes. 2012 Dec;4(4):378-85.
[51]. Pari L, Umamaheswari J. Antihyperglycaemic activity of Musa sapientum flowers: effect on lipid peroxidation in alloxan diabetic rats. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2000 Mar;14(2):136-8.
[52]. Ahmed MF, Kazim SM, Ghori SS, Mehjabeen SS, Ahmed SR, Ali SM, Ibrahim M. Antidiabetic activity of Vinca rosea extracts in alloxan-induced diabetic rats. International Journal of Endocrinology. 2010 Jan 1;2010.
[53]. Stohs SJ, Ray S. Anti- diabetic and Anti- hyperlipidemic Effects and Safety of Salacia reticulata and Related Species. Phytotherapy Research. 2015 Jul;29(7):986-95.
[54]. Bhat BM, Raghuveer CV, D'Souza V, Manjrekar PA. Antidiabetic and hypolipidemic effect of Salacia oblonga in streptozotocin induced diabetic rats. Journal of clinical and diagnostic research: JCDR. 2012 Dec;6(10):1685.
[55]. Deepak KG, Challa S, Suhasin G, Nagesewara Rao Reddy N, Elansary HO, El-Ansary DO. Antidiabetic and antilipidemic activity of root extracts of Salacia oblonga against streptozotocin-induced diabetes in Wistar rats. Processes. 2020 Mar 5;8(3):301.
[56]. Dey P, Singh J, Suluvoy JK, Dilip KJ, Nayak J. Utilization of Swertia chirayita Plant Extracts for Management of Diabetes and Associated Disorders: Present Status, Future Prospects and Limitations. Natural Products and Bioprospecting. 2020 Oct 28:1-3.
[57]. Upadhyay AK, Kumar K, Kumar A, Mishra HS. Tinospora cordifolia (Willd.) Hook. f. and Thoms. (Guduchi)–validation of the Ayurvedic pharmacology through experimental and clinical studies. International journal of Ayurveda research. 2010 Apr;1(2):112.
[58]. Sharma R, Amin H, Prajapati PK. Antidiabetic claims of Tinospora cordifolia (Willd.) Miers: critical appraisal and role in therapy. Asian Pacific Journal of Tropical Biomedicine. 2015 Jan 1;5(1):68-78.
[59]. Sangeetha MK, Balaji Raghavendran HR, Gayathri V, Vasanthi HR. Tinospora cordifolia attenuates oxidative stress and distorted carbohydrate metabolism in experimentally induced type 2 diabetes in rats. Journal of natural medicines. 2011 Jul;65(3):544-50.
[60]. Middha SK, Usha T, Pande V. A review on antihyperglycemic and antihepatoprotective activity of eco-friendly Punica granatum peel waste. Evidence-Based Complementary and Alternative Medicine. 2013 Jan 1;2013.
[61]. Lampariello LR, Cortelazzo A, Guerranti R, Sticozzi C, Valacchi G. The magic velvet bean of Mucuna pruriens. Journal of traditional and complementary medicine. 2012 Oct 1;2(4):331-9.
[62]. Majekodunmi SO, Oyagbemi AA, Umukoro S, Odeku OA. Evaluation of the anti–diabetic properties of Mucuna pruriens seed extract. Asian Pacific Journal of Tropical Medicine. 2011 Aug 1;4(8):632-6.
[63]. Halagappa K, Girish HN, Srinivasan BP. The study of aqueous extract of Pterocarpus marsupium Roxb. on cytokine TNF-α in type 2 diabetic rats. Indian Journal of Pharmacology. 2010 Dec;42(6):392.
[64]. Dhayaney V, Sibi G. Pterocarpus Marsupium for the Treatment of Diabetes and Other Disorders. J Complement Med Alt Healthcare. 2019;9(1):555754
[65]. Rodrigues EL, Marcelino G, Silva GT, Figueiredo PS, Garcez WS, Corsino J, Guimarães RD, Freitas KD. Nutraceutical and medicinal potential of the Morus species in metabolic dysfunctions. International journal of molecular sciences. 2019 Jan;20(2):301.
[66]. Tian S, Tang M, Zhao B. Current anti-diabetes mechanisms and clinical trials using Morus alba L. Journal of Traditional Chinese Medical Sciences. 2016 Jan 1;3(1):3-8.
[67]. Jiao Y, Wang X, Jiang X, Kong F, Wang S, Yan C. Antidiabetic effects of Morus alba fruit polysaccharides on high-fat diet-and streptozotocin-induced type 2 diabetes in rats. Journal of ethnopharmacology. 2017 Mar 6; 199:119-27.
[68]. Kadam KA, Patil VR, Gangurde HH, Sable PD, Jagtap PP. Pharmacognostic Investigation of Carissa Carandaslinn: A Review Running Title: Carissa carandasLinn: A Review.
[69]. Singh AK, Uppal GK. A review on carissa carandas ğ phytochemistry, ethnoğpharmacology, and micropropagation as conservation strategy. Asian J Pharm Clin Res. 2015;8(3):26-30.

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