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Herbals and its marketed formulations to treat Diabetes Mellitus (DM): An Overview

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ABSTRACT

Diabetes mellitus is one of the common metabolic disorder characterized by hyperglycemia due to defect in insulin secretion, insulin action or both and 2.8% of the population suffers from this disease throughout the world and it may cross 5.4% by the year 2025. This dreadful disease is found in all parts of the world and is becoming a serious threat to mankind health. It also a very prevalent disease affecting the citizens of both developed and developing countries. There are lots of synthetic chemical agents available in market to control and treat diabetic patients like sulfonylurea, biguanides, etc. but total recovery from diabetes has not been reported up to this date. Alternative to these synthetic agents, many herbal plants with hypoglycaemic properties are known from across the world. Medicinal herbs as potential source of therapeutic aids have attained a significant role in health system all over the world for both humans and animals. India has about 45000 plant species and among them, several thousands have been claimed to possess medicinal properties. Herbal medicines have shown good clinical practice in the therapy of diabetic mellitus. In This present paper aims to review various plant species and their constituents, which have been used in the traditional system of medicine and have shown hypoglycaemic activity and various branded herbal formulations like D-400 tablet, Diasulin powder, Madurisht churna, Diabecon, Dia-care, etc. available in the market as antidiabetic remedies are also discussed.

Keywords: *Diabetes mellitus, hyperglycemia, sulfonylurea, medicinal plants, Diabecon.*

INTRODUCTION

Currently available therapies for diabetes include insulin and various oral antidiabetic agents such as sulfonylureas, biguanides, α-glucosidase inhibitors and glinides [1]. Allopathic drugs used for the treatment of diabetes have their several side effect & adverse effect like hypoglycaemia, nausea and vomiting, hyponatremia, flatulence, diarrhoea or constipation, alcohol flush, headache, weight gain, lactic acidosis, pernicious anaemia, dyspepsia, dizziness, joint pain. So instead of allopathic drugs, herbal drugs are a great choice which is having more or less no side effect & adverse effects. The World Health Organization (WHO) has listed 21,000 plants, which are used for medicinal purposes around the world. Among these 2500 species are in India, out of which 150 species are used commercially on a fairly large scale. India is the largest producer of medicinal herbs and is called as botanical garden of the world [2]. A list of medicinal plants with proven antidiabetic and related beneficial effects and of herbal drugs used in treatment of diabetes is compiled.

Regulation of blood glucose level in body:

In a health condition, Pancreas plays an important role to regulate the glucose level in blood. Pancreas mainly consists four types of cells i.e; alpha cells (secrets Glucagon), beta cells (secrets Insulin), delta cells (secrets Somatostatin) and Gamma cells also called as PP cells (secrets Pancreatic polypeptide) [3]. The increased level of blood glucose stimulates Insulin secretion from the beta cells of the Pancreas while alpha cells' secrets Glucagon in the condition of

low blood glucose level, to maintain the normal blood glucose level in the body [Fig No. 1].

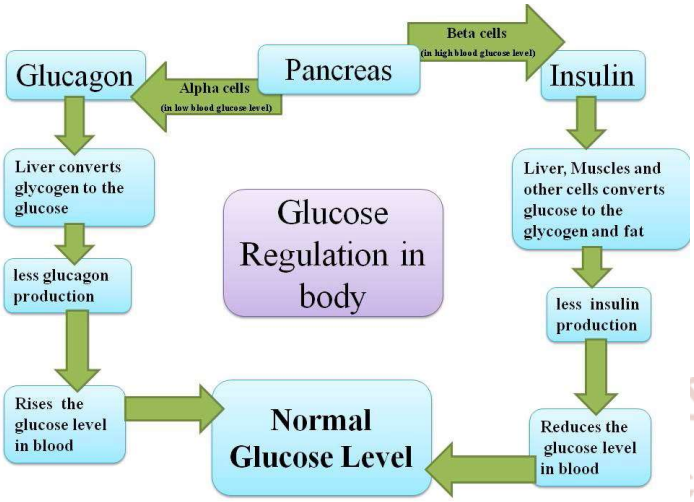

Fig No. 1 Regulation of blood glucose level in body

Diabetes Mellitus:

Diabetes is a state of improperly regulated homeostasis of carbohydrate and lipid metabolism is one of the major health problem in recent time. It is characterised by increased blood glucose level (Hyperglycaemia), glycosuria, hyperlipidaemia, negative nitrogen balance and sometimes ketonaemia [1]. It is often connected with the development of micro and macro vascular diseases which include a long term damage, dysfunction and failure of various organs especially the eye, nerves, heart, kidney and blood vessels. Global increase in diabetes may be related to increased level of obesity. Diabetes can leads to serious medical complications- blindness from retinopathy, renal failure, gangrene and limb amputation, cardiovascular disease and premature death [2]. Diabetes are of two types first, type 1/insulin-dependent diabetes mellitus (IDDM) in which there is a beta-cell destruction in pancreatic islets cause low or very low insulin level in circulation and second, type 2/Noninsulin dependent diabetes mellitus (NIDDM) in which there is reduced sensitivity of peripheral tissue to insulin, reduction in number of insulin receptors cause increase in blood glucose level [1].

Medicinal Plants to Treat Diabetes Mellitus:

India has an officially recorded list of 45,000 plant species and a various estimation of 7500 species of medicinal importance [4]. India is rich source of various potent herbs and herbal components for treating diabetes. Many Indian plants have been examined for their beneficial use in different types of diabetes. In this review, there are 54 plants belonging to 36 families described about their uses in curing diabetes.

S.no	Common name	Botanical name	Family
1.	Yam	Dioscorea opposite	Dioscoreaceae
2.	Madhu nashini	Gymnema sylvestre	Asclepidaceae
3.	Karela, bitter guard	Momordica charentia	Cucurbitaceae
4.	Neem	Azadirachta indica	Meliaceae
5.	Sweet flag	Acorus calamus	Acoraceae
6.	Jelly plum	Sclerocarya birrea	Anacardiaceae
7.	Sugar apple	Annona squamosal	Annonaceae
8.	Ashoka	Polyalthia longifolia	Annonaceae
9.	Hing	Ferula asafetida	Apiaceae
10.	periwinkle	Catharanthus roseus	Apocynaceae
11.	black creeper	Ichnocarpus frutescens	Apocynaceae
12.	Siberian Ginseng	Acanthopanax senticosus	Araliaceae
13.	Makad Shing	Caralluma sinaica	Asclepidaceae
14.	Bahera	Terminalia bellerica	Combretaceae
15.	Keukand	Costus speciosus	Costaceae
16.	Sea bilberry	Vaccinium bracteatum	Ericaceae
17.	physic nut	Jatropha curcas	Euphorbiaceae
18.	Bushweed	Securinega virosa	Euphorbiaceae
19.	Amla	Emblica officinalis	Euphorbiaceae
20.	fenugreek	Trigonella foenum-graecum	Fabaceae
21.	matura tea tree	Senna auriculata	Fabaceae
22.	Sandan	Ougeinia	Fabaceae

		oojeinensis	
23.	Dal chini	Cinnamonum zeylanicum	Lauraceae
24.	Onion	Allium cepa	Liliaceae
25.	clearing-nut tree	Strychonous potatorum	Loganiaceae
26.	Baobab	Adansonnia digitata	Malvaceae
27.	China rose	Hibiscus rosa sinensis	Malvaceae
28.	Banyan	Ficus benghalensis	Moraceae
29.	cluster fig tree	Ficus Glomerata	Moraceae
30.	peepul tree	Ficus religiosa	Moraceae
31.	Guava	Psidium guajava	Myrtaceae
32.	Jamun	Syzygium cumini	Myrtaceae
33.	Lajalu	Biophytum sensitivum	Oxalidaceae
34.	Black-Honey Shrub	Phyllanthus reticulatus	Phyllanthaceae
35.	patience dock	Rumex patientia	Polygonaceae
36.	Neptune grass	Posidonia oceanica	Posidoniaceae
37.	black mangrove	Bruguiera gymnorrhiza	Rhizophoraceae
38.	Bael fruits	Aegle marmelos	Rutaceae
39.	Mithijar, Pilu	Salvadora oleoides	Salvadoraceae
40.	Mithijar, Pilu	Salvadora tamariscina	Selaginellaceae
41.	Wild eggplant	Solanum xanthocarpum	Solanaceae
42.	bay cedar	Guazuma ulmifolia	Sterculiaceae
43.	Sambhalu, mewri	Vitex negundo	Verbanaceae
44.	Babul	Acacia Arabica	Leguminoceae
45.	Aam	Mangifera indica	Anacardiaceae
46.	Garlic	Allium sativum	Liliaceae
47.	Indian black berry	Eugenia jambolana	Myrtaceae
48.	Sugarleaf	Stevia rebaudiana	Asteraceae
49.	Sandalwood	Adenanthera pavonina	Leguminosae
50.	Asian gingseng	Panax ginseng	Araliaceae
51.	apple blossom tree	Cassia javanica	Fabaceae
52.	Tulsi	Ocimum sanctum	Lamiaceae
53.	clove basil	Ocimum Gratissimum	Lamiaceae
54.	waterleaf	Talinum Triangulare	Portulacaceae

Table no.1 Medicinal plants used to treat diabetes.

[1] Dioscorea opposite *(DIOSCOREACEA)*:
Dioscorea opposite is commonly known as Yam belong to family dioscoreaceae. Constitute of yam have a lower glycemic index than costituents of potato, it means yam will provide a more sustained form of energy, and give better protection against obesity and diabetes [5].

[2] Gymnema sylvestre (ASCLEPIDACEAE):
The drugs consist of dried leaves of Gymnema sylvestre belonging to Family Asclepidaceae [6]. According to the horticultural department at Purdue University, it has been used in India for the treatment of diabetes for 2000 years. These drug constituents are useful for the control and treatment of diabetes mellitus.

[3] Momordica charentia (CUCURBITACEAE):
Extracts of fruit pulp, seed, leaves and whole plant was shown to have antidiabetic and antihyperglycemic activity in India as well as other Asian countries. Polypeptide p, isolated from fruit, seeds and tissues of M. charantia showed significant hypoglycemic effect when administered subcutaneously to langurs and humans [7]. Alcoholic extracts of M. charantia (200 mg/kg) showed an antihyperglycemic and also hypoglycemic effect in normal and Straptozotocin induced diabetic rats. This may be because of inhibition of glucose-6-phosphatase besides fructose-1, 6- biphosphatase in the liver and stimulation of hepatic glucose- 6-phosphate dehydrogenase activities [8].

[4] Azadirachta indica (MELIACEAE):
Hydroalcoholic extract of neem shows antihyperglycemic activity in streptozocin induced

diabetic rats and this effect is due to increase in glucose uptake and glycogen deposition in isolated rat hemidiaphragm [9]. Apart from having anti-diabetic activity, this plant also has anti-bacterial, antimalarial, antifertility, hepatoprotective and antioxidant effects.

[5] Acorus calamus (ACORACEAE):
Orally administered methanolic extract of A. calamus rhizome restored the levels of blood glucose in Streptozotocin induced diabetic rats after 21 days. Additional, lipid profile (total cholesterol, LDL and HDL-cholesterol), glucose 6-phosphatase, fructose 1,6 bis phosphatase levels and hepatic markers enzymes (aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase) were decreased [10].

[6] Sclerocarya birrea (ANACARDIACEAE):
The methylene chloride/methanol extract (150 and 300 mg/kg bw) of Sclerocarya birrea stem bark significantly reduced the blood glucose level, plasma cholesterol, triglyceride and urea levels near the normal level and increased plasma insulin level in Straptozotocin induced diabetic rats [11].

[7] Annona squamosa (ANNONACEAE):
Aqueous extract of A. squamosa root (at a dose of 250 mg/kg and 500 mg/kg bw) when administered to Straptozotocin- induced diabetic rats reduced the blood glucose level from 285.52 to 208.81 mg/dl, after 6 hours of oral administration of extract [12].

[8] Polyalthia longifolia (ANNONACEAE):
Methanolic extract of p.longifolia bark when administered orally, reduced the fasting blood glucose. additionally the elevated levels of SGOT, SGPT, ALP, triglycerides and total cholesterol were restored to near normal level in Straptozotocin induced diabetic rats [13].

[9] Ferula asafoetida (APIACEAE):
In traditional medicine system, Oleo-gum-resin obtained from the roots of Ferula asafoetida, is used for the treatment of different diseases like gastrointestinal disorders, epilepsy, influenza and asthma. The hypoglycemic activity of Asafoetida was estimated in streptozotocin induced Male Wistar diabetic rats. The asafoetida extract showed significant hypoglycemic activity at dose of 50 mg/kg for 4 weeks, indicative of the presence of the tannins and phenolic acids (ferulic acid) in the extract [14].

[10] Catharanthus roseus (APOCYNACEAE):
Administration of leaf powder (100 mg/kg bw) of C.roseus reduced the plasma glucose and increased the plasma insulin were obsereved after 15 days in straptozocin induced diabetic rats. The significant enhancement in plasma total cholesterol, triglycerides, LDL and VLDL cholesterol, and the atherogenic index of diabetic rats were normalized in extract treated diabetic rats [15].

[11] Ichnocarpus frutescens (APOCYNACEAE):
Orally administered polyphenolic extract of I. frutescens (150 and 300 mg/kg bw) leaves significantly reduced the fasting blood glucose levels, hepatic HMG-CoA reductase activity decreased the total cholesterol, triglyceride, VLDL, HDL and LDL level in alloxan induced diabetic Rats [16].

[12] Acanthopanax senticosus (ARALIACEAE):
A hot water extract at 85-95°C of A. senticosus stem bark significantly decreased the plasma glucose level without affecting plasma insulin levels and inhibited α-glucosidase activity in diabetic mice. The addition of A. senticosus extract inhibited α-glucosidase activity but not α-amylase activity. Thus it would be useful as an component of functional foods to improve postprandial hyperglycemia and prevent type II diabetes mellitus [17].

[13] Caralluma sinaica (ASCLEPIADACEAE):
Acoholic extract of C. sinaica (200 mg/kg bw) roots and aerial parts significantly reduced blood glucose level in Straptozotocin induced diabetic rat [18].

[14] Terminalia bellerica (COMBRETACEAE):
Crude extracts of T. bellerica with hexane (200mg/kg bw), ethylacetate (300mg/kg bw) and methanol (300 mg/kg bw) fruits significantly reduced the blood glucose level, total cholesterol, triglycerides, LDL cholesterol level, urea, uric acid, creatinine and serum total protein level while it increased the plasma insulin level of Straptozotocin induced diabetic rats [19].

[15] Costus speciosus (COSTACEAE):
Eremanthin is a compound isolated from the plant C. speciosus rhizome. Orally administered Eremanthin decreased the HbA1c, serum total cholesterol, triglyceride, LDL-cholesterol level and at the same time markedly increased plasma insulin, tissue glycogen, HDL-cholesterol and serum protein of Straptozotocin induced diabetic rats. It also restored the plasma enzyme levels to near normal. Thus it possessed asignificant hypoglycemic and hypolipidemic activities and hence it could be used as a drug for treatment of diabetes [20].

[16] Vaccinium bracteatum (ERICACEAE):
Aqueous and ethanolic extract of V. bracteatum leaves significantly ameliorated the body weight,

blood glucose, insulin and plasma lipid levels of Straptozotocin induced diabetic mice when administered intra-gastrically. The effect of V. bracteatum aqueous extract on the diabetic mice was better effective than V. bracteatum ethanolic extract [21].

[17] Jatropha curcas (EUPHORBIACEAE):
Oral administration of ethanolic extract of J. curcas leaves (250 & 500 mg/kg bw) significantly reduced the blood glucose level and can therefore be used as an alternative remedy for the treatment of diabetes mellitus and its complications [22].

[18] Securinega virosa (EUPHORBIACEAE):
Intra-peritoneal administration of (100, 300 and 600 mg/kg bw) methanol extract from S. virosa leaves significantly reduced the blood glucose level of Straptozotocin induced diabetic rats [23].

[19] Emblica officinalis (EUPHORBIACEAE):
Hydro-methanolic (20:80) extract of Emblica officinalis leaves was administered in diabetic rats at different doses to study the anti-diabetic effects using glibenclamid as standard. The extract showed improved blood glucose and serum insulin level at a noteworthy significance and showed significant decrease in biochemical parameters. The extract also improved the free radicals scavenging and antioxidant enzymes; superoxide dismutase, catalase, glutathione peroxidase and glutathione in dose dependent way [24].

[20] Trigonella foenum-graecum (FABACEAE):
Seeds and leaves of the Trigonella foenum-graecum are most frequently used parts of the plant. The antihyperglycemic effect of Trigonella foenum-graecum is due to decrease in somatostatin and high plasma glucagon levels [25] while the antihyperglycemic effect of fenugreek is due to the amino acid 4-hydroxyisoleucine which acts by the improvement of insulin sensitivity and glucose uptake in peripheral tissues [26].

[21] Senna auriculata (FABACEAE):
Ethanolic extract of S. auriculata (at a dose of 150 mg/kg of bw) leaf significantly reduced the blood glucose level, SGOT, SGPT, ALP, total cholesterol, triglyceride and low density lipoprotein-cholesterol levels to the normal level and significantly increased HDL-C and phospholipid level in alloxan induced diabetic rats [27].

[22] Ougeinia oojeinensis (FABACEAE):
The ethanolic extract of O. oojeinensis (200 mg/kg) bark significantly decreased the blood glucose level, triglycerides, LDL, VLDL and total cholesterol and increased high density lipoprotein level in alloxan induced diabetic rats [28].

[23] Cinnamonum zeylanicum (LAURACEAE):
Aquous extract of cinnamonum zeylanicum significantly reduced total cholesterol, triglyceride, LDL-cholesterol and VLDL-cholesterol levels in streptozocin induced diabetic animal and elevated the tissue glycogen and HDL-cholesterol significantly [29]. Extract also showed improvement in glucose homeostatic enzymes indicating the antidiabetic activity of the extract.

[24] Allium cepa (LILIACEAE):
Various ether soluble fractions as well as insoluble fractions of dried onion powder show an hypoglycemic activity in diabetic rabbits. Administration of a sulfur containing amino acid from Allium cepa, S-methyl cysteine sulphoxide (200 mg/kg for 45 days) to alloxan induced diabetic rats significantly controlled blood glucose as well as lipids in serum and tissues and normalized the activities of liver hexokinase, glucose 6-phosphatase and HMG Co A reductase [30]. When diabetic patients were given single oral dose of 50 g of onion juice, it significantly controlled post-prandial glucose levels [31].

[25] Strychonous potatorum (LOGANIACEAE):
Ethanolic extract of S. potatorum plant material significantly decreased the AST, ALT and ALP level along with reduction of blood glucose level in alloxan induced diabetic rats when
Administered Orally[32].

[26] Adansonnia digitata (MALVACEAE):
Methanolic extract of A. digitata stem bark (100 mg/kg bw) significantly decreased the blood glucose level of Straptozotocin-induced diabetic Wistar rats when administered intra-peritoneally [33].

[27] Hibiscus rosa sinensis (MALVACEAE):
Aqueous extract of aerial part of H. rosa sinensis (500 mg kg-1) reduced the blood glucose level, urea, uric acid and creatinine While increased the activities of insulin, C-peptide, albumin, albumin/globulin ratio and restored all marker enzymes to near control levels of Straptozotocin-induced diabetic rats. Thus, it exhibited a hypoglycemic effect and consequently may alleviate liver and renal damage associated with Straptozotocin-induced diabetes mellitus in rats [34].

[28] Ficus benghalensis (MORACEAE):

The aqueous extract of stem bark of F. bengalensis significantly reduced the blood glucose level in Straptozotocin induced diabetic rats [35].

[29] Ficus Glomerata (MORACEAE):
The ethanolic extract of F. Glomerata leaves reduced the blood glucose, serum urea, creatinine and cholesterol level in alloxan induced diabetic rats [36].

[30] Ficus religiosa (MORACEAE):
Aqueous extract of F. religiosa bark significantly reduced the blood glucose level and increased the serum insulin level, glycogen content in liver and skeletal muscle in Straptozotocin-induced diabetic rats when administered orally [37].

[31] Psidium guajava (MYRTACEAE):
A hot aquous extract of P. guajava unripe fruit peel (400 mg/kg) significantly decreased the triglyceride, total cholesterol, alkaline phosphatase, asperate amino transferase, alanine amino transferase and creatinine levels in Straptozotocin induced diabetic rats [38].

[32] Syzygium cumini (MYRTACEAE):
Mycaminose is a compound isolated from the plant S. cumini seed extract. Oral administration of a Mycaminose (50 mg/kg), ethyl acetate (200 mg/kg) and methanol extracts (400 mg/kg) of fruits and leaves of S. cumini reduced the blood glucose level in Straptozotocin-induced diabetic rats [39].

[33] Biophytum sensitivum (OXALIDACEAE):
Ethanolic extract of B. sensitivum whole plant significantly decreased the blood glucose level, serum cholesterol level and increased the total protein level in alloxan induced diabetic rats when administered orally [40].

[34] Phyllanthus reticulatus (PHYLLANTHACEAE):
Ethanolic and petroleum ether extracts of P. reticulatus (1000 mg/kg) leaves significantly reduced the blood glucose level in alloxan induced diabetic rats [41].

[35] Rumex patientia (POLYGONACEAE):
R. patientia showed reduction in serum glucose level, LDL cholesterol level and increased the HDL cholesterol level in Straptozotocin induced diabetic rats when it supplemented with seed powder [42].

[36] Posidonia oceanica (POSIDONIACEAE):
The hydroalcoholic extract of P. oceanica leaves (150 and 250 mg/kg bw) significantly reduced the blood glucose level, ALP, GSH, SOD, GPx, CAT, GPT and nitric oxide level to the normal level in alloxan induced diabetic rats [43].

[37] Bruguiera gymnorrhiza (RHIZOPHORACEAE):
Ethanolic extract of B. gymnorrhiza root (400 mg/kg b.wt) significantly decreased the blood sugar level, total cholesterol, triglycerides, VLDL and LDL and significantly increased the HDL level in Straptozotocin induced diabetic rats when administered orally [44].

[38] Aegle marmelos (RUTACEAE):
Aqueous extract of leaves of aegle marmelos improves digestion and reduces blood sugar and urea, serum cholesterol in alloxan induced diabetic rats as compared to control. Along with exhibiting hypoglycemic activity, this extract also prevented peak rise in blood sugar at 1h in oral glucose tolerance test [45].

[39] Salvadora oleoides (SALVADORACEAE):
Oral administration of ethanolic extract of S. oleoides (1 and 2 g/kg bw) aerial parts significantly reduced the blood glucose level and improves lipid profile in euglycemic as well as alloxan induced diabetic rats [46].

[40] Salvadora tamariscina (SELAGINELLACEAE):
The ethanolic extracts of S. tamariscina whole plant ameliorated the fasting blood glucose level and improved oral glucose tolerance in STRAPTOZOCIN induced diabetic rats [47]. It also significantly down the total cholesterol (TC), triglyceride (TG), LDL-c, free fatty acids (FFA) tumor necrosis factor (TNF), ALT, AST, blood urea nitrogen (BUN) and malondialdehyde (MDA) levels in diabetic rats [47].

[41] Solanum xanthocarpum (SOLANACEAE):
The methanolic extract of the leaves of S. xanthocarpum significantly reduced the blood glucose level, urea, uric acid and creatinine level and increased the serum insulin level in alloxan induced diabetic rats when administered orally [48].

[42] Guazuma ulmifolia (STERCULIACEAE):
Extract of G. ulmifolia bark induced the glucose uptake in insulin-resistant adipocytes. It exerted its anti-diabetic effects by stimulating glucose uptake in both insulin sensitive and insulin resistant adipocytes without inducing adipogenesis [49].

[43] Vitex negundo (VERBANACEAE):
V. negundo contain active component called as Idopyranose. It reduced the blood glucose level, serum urea, and cholesterol level in STRAPTOZOCIN-induced diabetic rats. It helped to regenerate the damaged pancreas and protected the

pancreatic ß cells and hyperglycemic in nature against Straptozotocin-induced diabetic rats [50].

[44] Acacia Arabica (LEGUMINOCEAE):
Plant extract shows an antidiabetic activity by acting as secretagouge to release insulin from pancrease. It induces hypoglycemia in control rats but not in alloxan induced animals. Powdered seeds of Acacia arabica when administered to normal rabbits induced hypoglycemic effect by initiating release of insulin from pancreatic beta cells [51].

[45] Mangifera indica (ANACARDIACEAE):
Aqueous extract given orally did not alter blood glucose level in either normoglycemic or streptozotocin induced diabetic rats. Its antidiabetic activity was seen when the extract and glucose were administered simultaneously and also when the extract was given to the rats one hour before the intake of glucose.The results point out that aqueous extract of Mangifera indica possess hypoglycemic activity. This occur due to reduction in absorption of glucose from intestinal wall [52].

[46] Allium sativum (LILIACEAE):
Allium sativum act as an antidiabetic agent by increasing either the pancreatic secretion of insulin from the β cells or the release of bound insulin [53]. Allicin is a sulfur-containing compound which is responsible for its pungent flavour and significant hypoglycemic activity. Garlic alone and with ginger and turmeric when tested against oxidative stress in streptozotocin-nicotinamide induced diabetic rats showed increment in the signs of hyperglycaemia and dyslipidaemia [54].

[47] Eugenia jambolana (MYRTACEAE):
The hypoglycemic activity of Eugenia jambolana is due to increased secretion of insulin from the pancreas or by inhibition of insulin degradation [55]. In India decoction of kernels of Eugenia jambolana is used as household remedy for diabetes. This also forms a major constituent of many herbal formulations for diabetes. Its aquous and alcoholic extract shows significant hypoglycemic effect. This varies with different level of diabetes. In mild diabetes (plasma sugar >180 mg/dl) it shows 73.51% reduction, whereas in moderate (plasma sugar >280 mg/dl) and severe diabetes (plasma sugar >400 mg/dl) it is reduced to 55.62% and 17.72% respectively.The extract of pulp showed the hypoglycemic activity in streptozotocin induced diabetic mice within 30 min of administration while the seed of the same fruit required 24 h. Extracts also inhibited insulinase activity from liver and kidney [56].

[48] Stevia rebaudiana (ASTERACEAE):
Aqueous extract of Stevia rebaudiana in combination with Momordicha charantia, Tamarindus indica, Gymnema sylvestre, Allium sativum and Murraya koenigii were evaluated for antidiabetic activity in the form of different polyherbal combinations. All combinations were safe and dose of 250 mg/kg was selected as antidiabetics [57].

[49] Adenanthera pavonina (LEGUMINOCEAE):
Antihyperglycaemic and lipid lowering effects of A. pavonina seed aqueous extract was evaluated in the streptozotocin induced diabetic rats. Treatment with Adenanthera pavonina extract showed considerable decrease in plasma glucose, elevated levels of serum triglyceride and cholesterol levels were significantly decreased. Treatment for 30 days showed significant decrease in serum LDL-cholesterol and significant increase in serum HDL cholesterol level and elevated the levels of HbA1c which was significantly increased indicating that extract has the potential to treat diabetes condition and associated lipid disorders [58].

[50] Panax ginseng (ARALIACEAE):
Antidiabetic efficiency of P. ginseng berry extract was evaluated in streptozotocin induced diabetic mice. Hypoglycemic potential of extract in beta-cell deficient mice was evaluated and mechanisms involved were evaluated. Extract showed promising results stimulating increased insulin secretion indicating beta-cell regeneration and improved glycemic control [59].

[51] Cassia javanica (FABACEAE):
Hypoglycemic ability of Cassia javanica wasevaluated in streptozotocin induced diabetic rats. First of all, drug was used to test acute oral toxicity. Formerly, phytochemistry of drug was checked by standard qualitative tests thus detecting antidiabetic compounds. The test drug and standard drug demonstrated considerable fluctuations in the abnormal levels of serum metabolites of diabetic rats [60].

[52] Ocimum sanctum (LAMIACEAE):
Aqueous extract of Ocimum sanctum was evaluated for the antioxidant potential in streptozotocin-induced diabetic rats. Extract decreased the levels of thiobarbituric acid reacting substances in plasma and improved conditions of the antioxidant enzymes; glutathione peroxidase, superoxide dismutase and catalase in essential organs like kidney and liver when administered orally. Results indicated that Ocimum

sanctum might be an important herbal medicine for curing diabetic complications [61].

[53] Ocimum Gratissimum (LAMIACEAE):
O. gratissimum reduces blood sugar level in diabetic rats and improve the cardinal symptoms of diabetes mellitus namely; polyphagia, polydypsia and weight loss when its aquous leaf extract was administered orally in streptozotocin induced diabetic rats [62].

[54] Talinum Triangulare (PORTULACACEAE):
Antihyperglcemic effects of Talinum Triangulare were evaluated in streptozotocin induced diabetic animals. Extract of T. Triangulare significantly reduced the blood glucose levels in diabetic and normal glucose loaded rats. Oral glucose tolerance test showed significant hypoglycemia in rats. The use of glipizide with extract shows significant synergistic effect [63].

S. no	Marketed formulation	Ingredients	Manufacturer
1.	Asanand	Ganasar,Arjuna,Lodhra, Karanja,Kanth, Shirish, Palash	Ayurveda Rasashala Pune.
2.	Alangium salvifolium Tablet	Alangium salvifolium, Gycin max	PSK Herbal S Technology
3.	Ipomea digitata tablet	Ipomea digitata	The Himalaya Drug Company
4.	Bitter gourd tablets	Momordica charantia	Garry and Sun natural Remedies
5.	Diabet capsule	Curcuma longa, Coscinium fenestratum, Strychnos potatorum, Tamarindus indica, Tribulus terrestris, Phyllanthus reticulates	La-medicca private limited
6.	Dihar powder	Syzygium cumini, Momordica charantia, Emblica officinalis, Gymnema sylvestre, Enicostemma littorale, Azadirachta indica, Tinospora cordifolia, Curcuma longa	Rajsha pharmaceuticals
7.	Shilajeet	Shudha shilajeet	Ayurveda Rasashala Pune
8.	Triphala Guggul	Triphala guggul	Ayurveda Rasashala Pune
9.	Gokshuradi Guggul	Gokshuradi guggul	Ayurveda Rasashala Pune
10.	Trivang Bhasma	Trivang bhasma	Ayurveda Rasashala Pune.
11.	Lohasava	Lohabasma	Ayurveda Rasashala Pune
12.	Giloysatva	Giloysatva	Ayurveda Rasashala Pune
13.	Mamajov	Mamajov powder	Ambadas vanaushadhalaya
14.	Diabetic Powder	Proprietary anti diabetic herbs	Rahul Pharmacy Gujarat
15.	Indrajav Churana	Indrajav churana	Universal Pharmacy Pune
16.	Panvli	Karvas,Yashti,Panvelley,Gudmar,Gulvel,Kanth,Haldi,Amla	Panvelly Herbal Product,Rajkot
17.	Madhumehari	Vijaysar,Kutaj,Kulki,Methi,Shilajeet, Trivang-Nag-Suvarnamakshik bhasm	Shrivaidyanah, Jhansi
18.	Karneem	Karela,NeemTulsi,Kulki,Sounth,Sh Udhaguggul	Universal Medicament Pvt.Ltd, Nagpur
19.	Hyponidd	Haldi,Jambuphal, Trivangbhasm,Chirait, Shilajeet, Senna,Amla,Gudmar, Kuaj,Gulvel	Charak Pharma Pvt.Ltd.Mumbai
20.	Adcaps	Haldi,Jambuphal,Amla, Mamajov,Neem,Karela,Vijaysar,Tejbal,Gulvel	Doctors Pharmaceuticals

		Sudha,Guggl, Trivang-Nag-Suvarnamakshik bhasm,Shilajeet,Ashok, Madhunasni	
21.	Diabecon	Gymnema sylvestre, Pterocarpus marsupium, Glycyrrhiza glabra, Casearia esculenta, Syzygium cumini, Asparagus racemosus, Boerhavia diffusa, Sphaeranthus indicus, Tinospora cordifolia, Swertia chirata, Tribulus terrestris, Phyllanthus amarus, Gmelina arborea, Gossypium herbaceum, Berberis aristata, Aloe vera, Triphala, Commiphora wightii, shilajeet, Momordica charantia, Piper nigrum, Ocimum sanctum, Abutilon indicum, Curcuma longa, Rumex maritimus	Himalaya
22.	Pancreatic tonic 180 cp	Pterocarpus marsupium, Gymnema sylvestre, Momordica charantia, Syzygium cumini, Trigonella foenum graceum, Azadirachta indica, Ficus racemosa, Aegle marmelos, Cinnamomum tamala	ayurvedic herbal supplement
23.	Dia-care	Sanjeevan Mool; Himej, Jambu beej, Kadu, Namejav, Neem chal.	Admark Herbals Limited
24.	Diabetes-Daily Care	Alpha Lipoic Acid, Cinnamon 4% Extract, Chromax, Vanadium, Fenugreek 50% extract, Gymnema sylvestre 25% extract Momordica 7% extract, Licorice Root 20% extract	Nature's Health Supply
25.	Gurmar powder	Gurmar (Gymnema sylvestre)	Garry and Sun natural Remedies
26.	Epinsulin	vijaysar (Pterocarpus marsupium)	Swastik Formulations
27.	Diabecure	Juglans regia, Berberis vulgaris, Erytherea centaurium, Millefolium, Taraxacum	Nature beaute santé
28.	Diabeta	Gymnema sylvestre, Vinca rosea (Periwinkle), Curcuma longa (Turmeric), Azadirachta indica (Neem), Pterocarpus marsupium (Kino Tree), Momordica charantia (Bitter Gourd), Syzygium cumini (Black Plum), Acacia arabica (Black Babhul), Tinospora cordifolia , Zingiber officinale (Ginger)	Ayurvedic cure Ayurvedic Herbal Health Products
29.	Syndrex	Germinated Fenugreek seed extract	Plethico Laboretaries
30.	Epinsulin	Pterocarpus marsupium	Swastik Formulations

Table no.2 Marketed formulations and their ingredients used for Diabetes.

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