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Review Article

A Review on Different Herb's used In Management of Diabetes

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Abstract

As we know that many drugs are available in market for the management of diabetes. In India 60% of population is suffering from this disease and taking the allopathic medicines which has tremendous side effect and creates complications in human life. This review highlights the chemical constituents, uses and the microscopical property of some of the important herbal drugs for the treatment of Diabetes. This work also provides the basic information to the Researcher who is doing the research to discover new chemical entity for the management of Diabetes. In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. . This article emphasis on Indian Herbal drugs and plants used in the management of diabetes, especially in India. A list of medicinal plants with proven antidiabetic and related favorable effects and of herbal drugs used in treatment of diabetes is hoarded

Keywords: Herbal drugs, Anti diabetic's herbs, Biological activity. Type I and II diabetes.

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Introduction

Old fashioned Medicines derived from medicinal plants are used by about 60% of the world's people. This article emphasis on Indian Herbal drugs and plants used in the management of diabetes, especially in India. Diabetes is an important human sickness afflicting many from various walks of life in different kingdoms. In India it is proving to be a major strength problem, especially in the urban areas. Though there are various slants to reduce the ill effects of diabetes and its secondary obstacles, herbal formulations are preferred due to lesser side effects and low cost. A list of medicinal plants with proven antidiabetic and related favorable effects and of herbal drugs used in treatment of diabetes is hoarded. These include Allium Sativum, Eugenia Jambolana, Momordica Charantia, Ocimum Sanctum, Phyllanthus Amarus, Pterocarpus Marsupium, Tinospora Cordifolia, Trigonella Foenum Graecum and Withania Somnifera. One of the etiologic factors involved in the development of diabetes and its worries is the damage induced by free radicals and hence antidiabetic drugs with antioxidant properties would be more constructive. Consequently information on antioxidant effects of these medicinal plants is also included. In the last few years there has been an exponential evolution in the field of herbal remedy and these drugs are gaining reputation both in developing and developed countries because of their natural source and less side effects.[1-4]

Classification of Diabetes Mellitus

Two major types of diabetes mellitus are there;

1] Type I [Insulin dependent diabetes mellitus [IDDM] juvenile onset diabetes mellitus] There is B cell demolition in pancreatic islets majority of cases are autoimmune [type1A] antibodies that destroy B cell are noticeable in blood, but some are idiopathic [type2B] no B cell antibody is found .In all type 1 cases circulating insulin levels are low or very low, and patients are more prone to ketosis. This type is less common and has a low degree of genetic tendency.

2] Type II [Non-insulin dependent diabetes mellitus [NIDDM], maturity onset diabetes mellitus] There is no loss or enough reduction in B cell mass; insulin circulation is low, normal or even high degree of genetic predisposition ; generally has a late inception over90% cases are type 2 DM. Causes may be;

- Idiosyncrasy in gluco-receptor of B cell so that they return at higher glucose concentration.
- Reduced compassion of peripheral tissues to insulin: reduction in number of insulin receptors, down regulation of insulin receptors. Many hypertensives are hyper insulinemic but normogltcaemic; exhibit insulin resistance. Hyperinsulinemia per se has been implicated in causing angiopathy.
- Excess of hyperglycemic hormones obesity; because relative insulin deficiency-the B cell lag behind.

Classification of Antidiabetic Drugs

Insulin preparation

1] Rapid & short acting

- Regular soluble insulin
- Insulin lispro
- Insulin aspart
- Insulin glulisine
- semilente[prompt insulin zinc suspension]

2] Intermediate acting

- NPH[Neutral protamine Hagedorn]insulin
- Lente [insulin zinc suspension]

3] Slow and long acting

- protamine zinc insulin
- ultralente
- insulin glargine*insulin detemir

Mode of Action

Insulin acts on specific receptor situated on the cell membrane of virtually all cell but their compactness depends on the cell type. The insulin receptor has been isolated and found to be hetero tetrameric glycoprotein consisting of 2 extracellular alpha and 2 transmembrane B subunits link together by disulphide bonds.

The alpha subunits carry insulin binding site while the beta subunits have tyrosine protein kinase activity. Binding of insulin to alpha subunits induces aggregation and internalization of receptor along with the bond insulin molecules. This activates tyrosine kinase activity of the beta subunits tyrosine recedues of the beta subunits get auto-phosphorelated so that the activity of these subunits to phosphorelate tyrosine residue of insulin receptor substrates protein is increased.

Certain second messengers like phosphatidyl inositol glycan and DAG which are generated through activation of specific phospholipase C also mediate the action of insulin on metabolic enzymes. Insulin stimulates glucose transport across cell membrane by ATP dependent translocation of glucose transporters GLUT4 and GLUT1 to the plasma membrane as well as by increasing their activity. Over a period of time it also encourages expression of the genes directing synthesis of genes for large number of enzyme and carrier have been shown to be regulated by insulin primarily through MAP kinases. [5-6]

Different Herbs Used In Management of Diabetes

There are many drugs used in the management of Diabetes, some important drugs are discuss below to know the chemistry behind the treatment of disease.

1. Bitter Melon [7]

Fig. 1: Herbal plant Bitter Melon used for Antidiabetic

Biological source
It is obtained from edible fruit of **Momordica charantia**, belonging to the family **Cucurbitaceae.**

Chemical constituents
The plant contains several biologically active compounds

a) Chiefly momordicin I & momordicin II, cucurbitacin B.
b) Glycosides (momordin, charantin, charantosides, goyaglycosides)
c) Terpenoid compounds- momordicinin, momordicilin, momordol
d) Cytotoxic (ribosome inactivating) proteins such as momorcharin & momordin.

Uses
Bitter melon is used as anti-diabetic. It contains lectin that has insulin like activity due to its nonprotein specific linking together to insulin receptors. This lectin lowers blood glucose level by acting on peripheral tissues. Lectin is a major contributor to hypoglycaemic effect.

Scientific work done- Triterpenoids Isolated from **Bitter Melon** has showed antidiabetic activity**.**

Dosage form
It is used as fresh juice, tincture, juice extract & powered leaf.

Dose: Fresh juice- 57-113 gm daily**,** Tincture- 1.3 ml/ twice/ daily, Juice extract- 300-600 mg, Powered leaf- 1-2 gm

2. Fiery Costus [8]

Fig. 2: Herbal plant Fiery Costus used for antidiabetic

Biological Source
It is obtained from the leaves of the plant Costus igneus, belonging to the family Costaceae.

Chemical Constituents- The main chemical constituents are Beta-carotene, deoxyribose, Phenol, flavonoids, insulin precursors.

Uses
The leaves of insulin plant reduced the fasting and postprandial blood sugar levels, bringing them down towards normal. Reduction in the fasting and the postprandial blood sugar levels with leaves of insulin plant was comparable with that obtained with Glibenclamide 500 µg/kg at 250 mg/kg/day and 500 mg/kg/day of powdered leaves of the insulin plant. The hypoglycemic action can be due to release of insulin, insulin-sensitizing action or a combination of both. Hence further studies need to be undertaken to determine the mechanism of action by measurement of either insulin or 'C' peptide level.
Scientific work done Costus igneus has showed effect on hyperglycemia.

Dosage Forms- It is used as oral hypoglycaemic agent, or as i.v. injection Dose- Tablet- 1 tablet/ day

3. Dandelion [9]

Fig. 3: Herbal plant Dandelion used for antidiabetic

Biological Source
It is obtained from the leaves of **Taraxacum officinale**, belonging to the family **Asteraceae.**

Chemical Constituents
4. Sesquiterpene lactones (bitters): taraxinic acid (taraxacin), tetrahydroridentin B
5. Triterpenoids and sterols: taraxasterol, taraxerol, cycloartenol, beta-sitosterol
6. Other: Vitamin A, Vitamin C, tannins, alkaloids, pectin, inulin, starch, potassium, betacarotene, caffeic acid, flavonoids (apigenin)

Uses
It is a good antidiabetic drug. It can lower the blood glucose level .Tests on diabetic mice show that dandelion extract may help regulate blood sugar and keep cholesterol in check.
Scientific work done
Dandelion has showed antihyperglycemic effect.
Dosage forms
Capsules, tinctures, and teas containing dandelion leaves, roots, flowers, or the entire plant are used.

Doses
Capsules- taken after each meal

Adult doses: There is disagreement on the optimal form and dose of dandelion. Reputable physicians and herbalists recommend a range of doses
Fresh leaves: 4-10 grams daily Dried leaves: 4-10 grams daily
Fresh leaf juice: 1 tsp (4-8 ml) twice daily
Fluid extract: 1-2 teaspoons daily

Fresh roots: 2-8 grams daily
Dried powdered extract: 250-1000mg three to four times daily.
Tea: Pour 2 cups boiling water over one ounce of fresh leaves and steep for 10 minutes.
Or, boil 1 cup of water with 2-3 tsp of dried, cut root for 15 minutes. Cool. Pediatric dosages: Unknown.

4. French Lilac [10]

Fig. 4: Herbal plant French Lilac used for antidiabetic

Biological Source
It consists of the aerial parts of the plant, flowers, leaf, stem, seeds of the plant **Galega officinalis**, belonging to the family **Fabaceae.**

Chemical Constituents
Oleanane & ursane type triterpinoids like sophoradiol, soyasapogenol b, & 9-sitosterol, Sophorediol, galactogil, galegine, peganine, hydroxyl galegine,vasicinone, alkaloids like lutein, penta hydroxyflavone 5 glucoside, luteoline, galuteoline, luteoline 5 glucosides,flavonoids, saponines etc.

Uses
It has been known since the middle Ages for relieving the symptoms of diabetes mellitus. Upon analysis, it turned out to contain compounds related to guanidine, a substance that decreases blood sugar by mechanisms including a decrease in insulin resistance, but were too toxic for human use. Georges Tanret identified an alkaloid from this plant (galegine) that was less toxic, and this was evaluated in clinical trials in patients with diabetes in the 1920s and 1930s. Other related compounds were being investigated clinically at this time, including biguanide derivatives. This work led ultimately to the discovery of metformin (Glucophage), currently recommended in international guidelines for diabetes management as the first choice for antidiabetic pharmacotherapy alongside diet and exercise and the older agent phenformin, which has been withdrawn in most countries due to an unacceptable risk of lactic acidosis (the risk of lactic acidosis with metformin is no higher than with other antidiabetic therapies when it is prescribed according to its label)The study of galegine and related molecules in the first half of the 20th century is regarded as an important Milestone in the development of oral antidiabetic pharmacotherapy.

Dosage form
It is used as herbal infusion, tincture & leaves.
Doses- Herbal infusion- twice daily, Tincturethri Daily.

5. Gurmar [11,12]

Fig. 5: Herbal plant Gurmar used for antidiabetic

Biological source
It is obtained from leaves & roots of **Gymnema sylvestre**, belonging to the family **Asclepiadaceae.**

Chemical constituents
The principal active ingredient is gymnemic acid. The other compounds found are calcium oxalate, anthraquinone compound, tartaric acid, cellulose but no tannin is present**.**

Uses
1) This is one of the main herbs used for healing diabetes mellitus.
2) Gymnema removes sugar from pancreas, restores pancreatic function.
3) Gymnema stimulates circulatory system, increases urine secretion.

Scientific works done
1. **Gymnema sylvestre** has shown Enzyme changes and glucose utilization.
2. **Gymnema sylvestre** has showed effect in controlling blood glucose level.

Dosage forms: It is used as water soluble acidic solution & as powered leaf.
Doses: Power leaf- 2-4 mg/daily, Water soluble acidic solution- 400 mg/day

6. Turmeric [13]

Fig. 6: Herbal plant curcuma Longa used for antidiabetic

Biological Source
It consists of dried fresh rhizomes of the plant Curcuma longa belonging to the family
Zingiberaceae.
Chemical Constituents
Turmeric contains 5% of volatile oil, resin; zingiberaceous starch grains & yellow coloured curcuminoids. The chief components of curcuminoids are known as curcumin. Volatile oil is Composed of mono and sesquiterpens such as alpha & beta pinene, alpha-phellandrene, camphor, camphene, zingiberene, alpha & beta curcumenes.
Use- It is used as anti- diabetic drug.

Scientific works done
1. Turmeric has showed hypoglycaemic, hypolipidemic & antioxidant activity
2. Turmeric has shown effect in diabetes.
Dosage form Powdered form of turmeric is used.
Dose Powdered turmeric- 500-8000 mg/ day.

7. **GULVEL** [14]

Fig. 7: Herbal plant Tinospora Cordifolia used for antidiabetic

Biological source
It is obtained from the stems and roots of Tinospora cordifolia, belonging to the family Menispermaceae.

Chemical Constituents
The active adaptogenic constituents are diterpene compounds including tinosporone, tinosporic acid, cordifolisides A to E, syringen, the yellow alkaloid, berberine, Giloin, crude Giloininand, a glucosidal bitter principle as well as polysaccharides, including arabinogalactan polysaccharide (TSP). Picrotene and bergenin were also found in the plant. The active principles of Tinospora cordifolia a traditional Indian medicinal plant were found to possess anticomplementary and immunomodulatory activities.
Use
It is used as antidiabetic. Scientific work done Tinospora cordifolia has showed Anti-diabetic activity.
Dosage form Aqueous extract of roots is used.
Dose Aqueous extract of root- 2.5g, 5 g/ kg body weight

8. **Bael** [15]

Fig. 8: Herbal plant Aegle Marmelos used for *antidiabetic*

Biological source
It consists of unripe or half ripe fruits of the plant known as **Aegle marmelos,** belonging to the family **Rutaceae.**

Chemical constituents
The chief constituent of the drug is marmelosinn (0.5%) which is a furocoumarin. Other coumarins are marmesin, psoralin, umbelliferone. The drug also contains carbohydrate, protein, volatile oil & tannins. The pulp also contains good amount of vitamin A & C. Two alkaloids, Omethylhalfordinol & isopentylhalfordinol have been isolated from fruits.

Use
It is used as anti-diabetic drug. Leaf & callus extract of **Aegle marmelos** has shown antidiabetic activity.
Dosage forms It is used as aqueous decoction & aqueous leaf extract.
Doses Aqueous decoction- 1 ml/ 100 mg**,** aqueous leaf extract- 1 gm/ kg

9. **AMLA** [16]

Fig. 9: Herbal Plant Emblica *Officinalis Used For* Antidiabetic

Biological Source
It is obtained from the dried as well as fresh fruits of Emblica officinalis, belonging to the family Euphorbiaceae.

Chemical Constituents
Amla is a rich natural source of vitamin C. It contains 0.5% fat, phyllemblin, 5% tannin. It also contains phosphorus, iron & calcium. It contains pectin & 75% moisture**.**

Use- It is used as anti-diabetic**.**
Scientific work done
Emblica officinalis has shown Anti-diabetic activity in animal models.
Dosage form It is used as amalaki capsules.
Dose Capsule- 1 capsule/ twice a day before meal.

10. Fenugreek [17]

Fig. 10: Herbal plant Fenugreek used for antidiabetic

Biological source
It is obtained from the leaves and seeds of Trigonella foenum- graecum, belonging to the family Fabaceae.

Chemical constituents
The nicotinic acid, alkaloid trogonelline, and coumarin contained by defatted section of the seed of fenugreek proves to be the responsible active ingredient for its anti-diabetic properties.
Uses- It is used as anti-diabetic. The fiber-rich fraction of fenugreek seeds can lower blood sugar levels in people with type II diabetes.

Scientific works done-
Metabolic and molecular action of Trigonella foenum-graecum (fenugreek) and trace metals has been shown in experimental diabetic tissues.
2. Fenugreek Seed has shown the postprandial hypoglycaemic activity**.**
Dosage forms
The leaves & seeds of fenugreek are used in therapeutic purpose.
Doses Leaves- 5-30 gm/ thrice daily with meal, Seeds- 3 ½ ounces/ daily.

11. Indian Kino Tree [18]

Fig. 11: Herbal plant Pterocarpus M. used for antidiabetic

Biological source
It is obtained from the dried juice of the plant Pterocarpus marsupium & obtained by making vertical incisions to the stem bark & it belongs to the family Leguminaceae.

Chemical constituents
It contains about 70%- 80% of kinotannic acid, kino- red, k- pyrocatechin (catechol), resin & gallic acid. Kinotannic acid is glucosidal tannin, while kino- red is anhydride of kinoin. Kinoin is an insoluble phlobaphene & is produced by action of oxydase enzyme. It is darker in colour than kinotannic acid. If the juice is boiled during drying, enzyme gets destroyed & thus in solubilisation & darkening is prevented.

Uses
The heartwood of the plant is used in treatment of diabetes. The gum resin is the only herbal product ever found to regenerate B cells that make insulin in the pancreas.

Scientific works done
1. Phenolics from **Pterocarpus marsupium** have shown antihyperglycemic activity.
2. Hypoglycaemic activity of **Pterocarpus marsupium** has been seen.
Dosage forms: The wood extracts & bark decoction is used.
Doses Wood extract (pterostilbene) – 10 mg/ kg, Bark decoction- 1 gm/ 100 mg body weight for 10 days

12. Nayantara [19,20]

Fig. 12: Herbal plant Catharanthus Roseus used for *antidiabetic*

Biological source
It is obtained from the dried whole plant of Catharanthus roseus, belonging to the family Apocynaceae.

Chemical constituents
The main active compounds here are alkaloids & tannins. The major alkaloid is vincamine. Aclosely related semi-synthetic derivative of vincamine is vinpocetin. There are over 130 constituents with an indole or dihydroindole structure, including the principal component vindoline, vinblastine, vincristine, learocristine, vinine, ajmalicine, leurocine, vinomine etc.
Use- It is used as antihyperglycemic agent.

Scientific works done

1. Effect of an antidiabetic extract of **Catharanthus roseus** has been seen.

2. The juice of fresh leaves of Catharanthus roseus has shown reduction blood glucose.

Dosage forms

It is used as tincture & infusion.

Doses

Tincture- 1-2 ml/ 3 times daily, Infusion- 2-3 cups daily

13. Onion [21,22]

Fig. 13: Herbal plant Allium Cepa used for antidiabetic

Biological source- It is obtained from the bulb of the plant Allium cepa, belonging to the family Liliaceae.

Chemical constituents- It contains essential amino acid composition of arginine, histidine, lysine, tryptophan, phenylalanine, methionine, threonine, leucine & isoleucine. The bulb on steam distillation yields an essential oil known as onion oil. The bulb contains several phenolic acid, such as protocatechuic acid, p-hydroxybenzoic acid, vanillic acid, caffeic acid, & o & p-coumaric acids. Citric, abietic, oxalic and mialic acids are also present. It also contains several oligosaccharides.

Uses- Onion consists of an active ingredient called APDS (allyl propyl disulphide). APDS has been shown to block the breakdown of insulin by the liver and possibly to stimulate insulin production by the pancreas, thus increasing the amount of insulin and reducing sugar levels in the blood. It is found to lower lipid levels, inhibit platelet aggregation and are antihypertensive. So, liberal use of onion is recommended for diabetes patients.

Scientific work done

Clinical Hypoglycemic effect of Allium cepa (Red onion) has been seen.

Dosage forms

Raw & boiled onion extracts are used. APDS can also be administered orally.

Dose: APDS- 125 mg/ kg to fasting humans.

14. Opuntia [23]

Fig. 15: Herbal plant Opuntia used for antidiabetic

Biological source

It is obtained from the stems of Opuntia ficusindica belonging to the family Cactaceae.

Chemical constituents

The main chemical constitutes are 3- methoxytyramine, candicine, hordinine, Nmethyltyramine**,** tyramine etc.

Use- It is used in the treatment of type II diabetes.

Scientific work done

Polysaccharides from Opuntia have shown antidiabetic effects.

Dosage form

Boiled stems are used. Dose oiled stem- 100-500/ daily.

Chemical constituents

The main chemical constituents are· flavonoids (hyperoside, isoquercitrin, quercitrin, Astragaline),· anthocyanosides (myrtillin, malvidin, cyanidin, delphinidin and others), catechin tannins (2-10%), others (carbohydrates including invertose, organic acids, pectins, alkaloids)

Uses- Blueberry is a natural herb of controlling or lowering blood sugar levels when they are slightly elevated. It contains an active agent known as myrtillin which is an anthocyanoside. It is weaker and less toxic than insulin.

Scientific works done

1. Vaccinium myrtillus has shown antidiabetic activity.
2. Vaccinium myrtillus has shown hypoglycaemic effect.

Dosage form- Leaf extracts are used.

Dose- Leaf extract- 3 cups/ day

15. Blueberry [24]

Fig. 14: Herbal plant Vaccinium Myrtillus used for antidiabetic

Biological source

It is obtained from the leaves of Vaccinium myrtillus, belonging to the family Ericaceae.

16. Blackberry [25,26]

Fig. 16: Herbal plant Rubus Fruticosus used for antidiabetic

Biological Source

It is obtained from the edible fruits of the plant Rubus fruticosus belonging to the family Rosaceae.

Chemical Constituents

The principal compounds isolated from red blackberry leaves are hydrolysable tannins. Simple compounds such as 1,2,6-tri-O-galloyl-glucoseand penta-O-galloyl glucose are oxidatively coupled through galloyl groups to form more complex compounds such as casuarictin, pendunculagin, sanguin H-6 and lambertianin A, with as many as 15 galloyl groups coupled to 3 glucose units. Common flavonoids have also been isolated from the leaves. Rutin was isolated, as were kaempferol, quercitin, quijaverin, and kaempferol-3-O-β-D-glucurono pyranoside.Major leaf volatiles studied by GC-MS include the monoterpenes geraniol and linalool as well as 1- octane-3-ol and decanal. Phenolic acids common to the Rosaceae family have also been identified.

Use- It is used as anti-diabetic.

Dosage form- It is used as fruit powder.

Dose- Dried fruit powder- 20 mg/day.

17. Abrus Precatorius l. (Fabaceae) [27]

Fig. 17: Herbal plant Kundumani used for antidiabetic

Local Name: Kundumani

The plant is a climber commonly known as Wild Liquorice and found through the plains of India. Leaf of this plant is mixed with the leaves of Andrographis paniculata, Gymnema sylvestre and seeds of Syzygium cumini. The mixture is shade dried and ground into powder and taken orally along with cow's milk. Dosage: About 50 ml of mixture is taken twice a day before food for 120 days.

18. Trigonella Foenum Graecum: (Fenugreek) [28]

Figure 18: Trigonella Foenum Graecum

Herbal plant Fenugreek used for antidiabetic. It is found all over India and the fenugreek seeds are usually used as one of the major constituents of Indian spices. 4-hydroxyleucine, a novel amino acid from fenugreek seeds increased glucose stimulated insulin release by isolated islet cells in both rats and humans. Oral administration of 2 and 8 g/kg of plant extract produced dose dependent decrease in the blood glucose levels in both normal as well as diabetic rats. Administration of fenugreek seeds also improved glucose metabolism and normalized creatinine kinases activity in heart, skeletal muscle and liver of diabetic rats. It also reduced hepatic and renal glucose-6-phosphatase and fructose –1, 6-biphosphatase activity. This plant also shows antioxidant activity.

19. Wattakaka Volubilis (L.F.) STAPF. (ASCLEPIADACEAE)[29]

Fig. 19: Herbal plant Perun Kurinjan used for antidiabetic

Local Name: Perun-kurinjan

The plant is a fleshy and very large climber found throughout the plains with papery leaves. Leaf powder is taken orally along with cow's milk. Dosage: 50-75 ml of mixture is taken twice a day after food for 90 days.

20. Ginseng [30]

Figure 20: Herbal plant Panax Ginseng used for antidiabetic

Biological Source
It is obtained from the dried roots of **Panax ginseng**, belonging to the family **Araliaceae.**

Chemical Constituents
Ginseng contains a mixture of several saponin glycosides, belonging to triterpenoid group. They are grouped as follows-

1) Ginsenosides
2) Panaxosides
3) Chikusetsusaponin
Ginsenosides contain aglycone dammarol while panaxosides have oleanolic acid as aglycone.
About 13 Ginsenosides have been identified. Panaxosides give oleanolic acid, panaxadiol & panaxatriol on decomposition.

Use It is used as hypoglycaemic agent.

Scientific works done
1. Use of Ginseng in diabetes.
2. Ginseng has shown hypoglycaemic effect.

Dosage forms
Dried root and tincture are used.
Doses Dried root- 0.5- 9 gm/ daily, Tincture- 0.2- 3/ one to three times daily.

21. Mangifera Indica: (MANGO) [31]

Fig. 21: Herbal plant Mangifera Indiaca used for antidiabetic

Biological source:
Amra consist of dried stem bark of mangifera indica linn belonging to family anacardiaceae.
Mature bark has a white cork consisting of tangentially elongated cell, few outer layers brown and inner lighter in colour. At few places lenticels secondary cortex absent; secondary phloem wide, consisting of sieve elements, parenchyma and phloem fibers, traversed by medullary rays.
Chemical constituents:
It contain 10 to 20% tennins namely protocatachuic acid and catechin it also contain mangiferin, alanine, glycine.
Adulterants:
Calcium carbide use to ripen mangoes rampant. Camouflaging Adulterants,
Uses: It is use as astringent, antioxidant, and also in treatment of diarrhoea, dysentery and rheumatism. The leaves of this plant are used as an antidiabetic agent in Nigerian folk medicine, although when aqueous extract given orally did not alter blood glucose level in either normoglycemic or streptozotocin induced diabetic rats. However, antidiabetic activity was seen when the extract and glucose were administered simultaneously and also when the extract was given to the rats 60 min before the

22. Garlic [32-33]

Fig. 22: Herbal plant Garlic used for antidiabetic

Microscopy:
Colour: Greyish to dark brown externally and yellowish white to reddish internally.
Odour: Pleasant
Taste: Astringent
Size and shape: Drug occurs in pieces of variable size and thickness.
Microscopy:
The results indicate that aqueous extract of Mangifera indica possess hypoglycemic activity. This may be due to an intestinal reduction of the absorption of glucose.

Biological source: Consist of bulb of plant known as Allium sativum linn belonging to family liliaceae.
Physical and chemical properties
The physical parameter results showed that the garlic geometric and arithmetic mean diameters ranged from 2.53 to 4.93, and 2.53 to 5.02 cm, respectively according to the bulb categories.
Morphology
Colour: bulbs are white to pink in colour
Odour: characteristic and aromatic.
Taste: aromatic and pungent
Size-1.5to2.5 cm

Chemical constituents:
Garlic bulb contain 29% of carbohydrate, about 56% of protein, 0.1% of fat, mucilage, and 0.06% to 0.1% of volatile oil. it also contain phosphorus iron copper.

Uses of Garlic: Garlic is used as anti-diabetic, carminative, aphrodiciac, expectorant, stimulant, and disinfectant in the treatment of pulmonary condition.oil of garlic is used as anthelmentic and rubefacient.

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23. Neem[34-35]

Fig. 23: Herbal plant Neem used for antidiabetic

Biological source:
It consist of arial part of plant known as Azadirachta indica belonging to family Meliaceae
Morphology:
Leaves: Alternate estipulate impapripinnate leaflet 22 to 25 cm in length lanceolate closely cluster towards the end of branches serrate margin, green, bitter.
Bark: moderately thick rough brown in colour longitudinally obliquely furrowed. Internally starchy white laminated with characteristic smell of Neem bitter in taste.
Chemical constituents:
The Neem oil contain 2% of bitter, which are sulphur containing compound nimbin, nimbidin, nimbinine and nimbidol.Azadiractin-k new tetraterpenoid has been isolated from seed kernels of Neem along with other compounds such as nimbolide, olichinonide B , nimbin, 6-deacetyl nimbin, salanin and azadiaradione.
Uses: Recently it has been studied scientifically and reported that is contain different chemicals which have insect repellent, insecticide, anti-feedant, nematicide and antimicrobial properties. The seed oil has spermicidal activity.

24. Indian Gum [36-37]

Fig. 24: Herbal plant Indian Gum used for antidiabetic

Biological source: Indian gum is dried gummy exudation obtained from the stem and branches of acacia Arabica wild belonging to family leguminosae
Morphology: Colour -tears are cream brown to red, white powder is light brown in colour. Odour- odourless. Taste-bland and mucilaginous. Size and shape-irregular brown tears of varying size

Physical property:
Solubility: it is soluble in water; the watery solution is viscous and acidic. It is soluble in alcohol
Satandard: it should contain no more than 15%of moisture and5% of ash Indian gum should not contain tannin, starch and dextrin.
Chemical constituents:
It consist principally of Arabian, which is complex mixture of calcium, magnesium and potassium salts of Arabic acid. Arabic acid on hydrolysis gives l-arabinose, l-rhamnose, d-galactose and d-glucuronic acid.

Adulterants: Indian gum is adulterated with gum ghatti, obtained from Anogeissus latifolia.
Uses: Acacia is demulcent. It is also administered intravenously in haemolysis. It is used as suspending agent.

25. Tulsi [38-39]

Fig. 25: Herbal plant Tulsi used for antidiabetic

Biological source: it consist of fresh and dried leaves of ocimum sanctum belonging to family lamiaceae
Microscopy:
It is much branched small herb and 30 to 75 cm in height.laeves is oblong, acute with entire and serrate margin. The leaves are green in colour with aromatic flavour with slightly pungent taste
Chemical constituents:
Tulsi contain bright, coloured and pleasant volatile oil [0.1to0.9%] they also approximately 70%eugenal, carvacrol [3%] and eugenal –methyl-ether [20%].it also contain s caryophyllin.seed contain fixed oil with good drying properties.
Adulterants: Ethnobotany and Ocimum sanctum (Tulsi).
Uses
The fresh leaves, its juice and volatile oil are used for various purposes. The oil is antibacterial and insecticidal. The leaves are as stimulant. The leaves are used as stimulant, aromatic, anticatarrhal, spasmolytic, and

diaphoretic. Infusion of the leaves is used as stomachic. The drug is a good immune-modulatory agent.

26. Guduchi [40-41]

Fig. 26: Herbal plant Guduchi used for antidiabetic

Biological source: Tinospora cordifolia, which is known by the common name Guduchi, is an herbaceous vine of the family Menispermaceae indigenous to the tropical areas of India, Myanmar and Sri Lanka**.**

Chemical constituents: The active adaptogenic constituents are diterpene compounds, polyphenols, and polysaccharides, including arabinogalactan polysaccharide. The bio-chemicals that have been isolated from Guduchi include tinosporide, furanolactone, diterpene, furanolactone clerodane diterpene, furanoid diterpene, tinosporaside, ecdysterone makisterone, poly acetate, phenylpropane disaccharides cordifolioside A, cordifolioside B, cordifolioside C, cordifolioside D, cordifolioside E, tinocordioside, cordioside, palmatosides C and palmatosides F, sesquiterpene glucoside tinocordifolioside and sesquiterpene tinocordifolin.

Uses: Immune booster - Modern research shows that Guduchi is strong immunostimulant with very good anti-cytotoxic (drugs used in treating cancer) effects. The helps to reduce effects of these toxic cancer-Figurehting drugs, and with its immune-promoting qualities, could even prevent cancer. Another study shoes it to be effective in reducing rheumatic complications. Guduchi is an excellent herb to take as an immune booster and general tonic. Other uses are Fever, Upper respiratory Tract Infections, tonsillitis, pharyngitis, hoarseness of voice and cough and cold. Guduchi extract shows an efficacy in relieving the problems of Arthritis because of its anti-inflammatory property.

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