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## A REVIEW- PHYTOMEDICINES USED IN TREATMENT OF DIABETES

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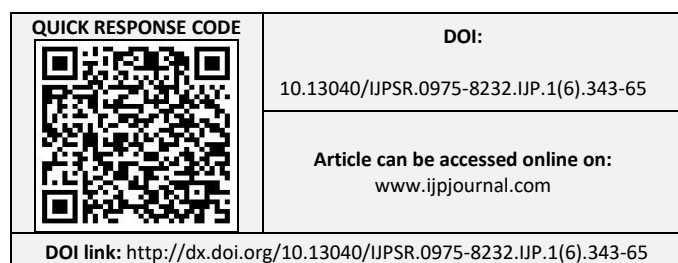
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**ABSTRACT:** Diabetes mellitus (DM), both insulin-dependent DM (IDDM) and non-insulin dependent DM (NIDDM) is a common and serious metabolic disorder throughout the world. Traditional plant treatments have been used throughout the world for the therapy of diabetes mellitus. Among many medications and other alternative medicines, several herbs have been known to cure and control diabetes; additionally, they have no side effects. The present paper is an attempt to list the plants with anti-diabetic and related beneficial effects originating from different parts of the world. History showed that medicinal plants had been used in traditional healing around the world for a long time to treat diabetes; this is because such herbal plants have hypoglycemic properties and other beneficial properties, as reported in scientific literature. The medicinal plants, besides having natural therapeutic values against various diseases and considerable works have been done on these plants to treat diabetes mellitus, describes that the anti-diabetic activity of medicinal plants is due to the presence of phenolic compounds, flavonoids, terpenoids, coumarins and other constituents which show a reduction in blood glucose levels. Some of these herbal plants and their active chemical constituents which have a role in the management of diabetes mellitus are compiled here and discussed in this review.

**INTRODUCTION:** Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels that result from defects in insulin secretion, or action, or both. Diabetes mellitus, commonly referred to as diabetes (as it will be in this article) was first identified as a disease associated with "sweet urine," and excessive muscle loss in the ancient world.

Elevated levels of blood glucose (hyperglycemia) lead to spillage of glucose into the urine, hence the term sweet urine. Normally, blood glucose levels are tightly controlled by insulin, a hormone produced by the pancreas. Insulin lowers the blood glucose level. When the blood glucose elevates (for example, after eating food), insulin is released from the pancreas to normalize the glucose level. In patients with diabetes, the absence or insufficient production of insulin causes hyperglycemia. Diabetes is a chronic medical condition, meaning that although it can be controlled, it lasts a lifetime <sup>1</sup>.

**Causes of Diabetes:** Insufficient production of insulin (either absolutely or relative to the body's needs), production of defective insulin (which is



uncommon), or the inability of cells to use insulin properly and efficiently leads to hyperglycemia and diabetes. This latter condition affects mostly the

cells of muscle and fat tissues, and results in a condition known as "insulin resistance." This is the primary problem in type 2 diabetes.

**TABLE 1: BLOOD SUGAR LEVEL IN NORMAL & DIABETIC PATIENTS**

Category of a person	Fasting Value		Post- Prandial
	Minimum Value	Maximum Value	Value 2 h after consuming glucose
Normal	70	100	Less than 140
Early Diabetes	101	126	140 to 200
Established Diabetes	More than 126	-	More than 200

\* All values are in mg/100 ml

The absolute lack of insulin, usually secondary to a destructive process affecting the insulin-producing beta cells in the pancreas, is the main disorder in type 1 diabetes. In type 2 diabetes, there also is a steady decline of beta cells that adds to the process of elevated blood sugars. Essentially, if someone is resistant to insulin, the body can, to some degree, increase production of insulin and overcome the level of resistance. After a time, if production decreases and insulin cannot be released as vigorously, hyperglycemia develops.

Glucose is a simple sugar found in food. Glucose is an essential nutrient that provides energy for the proper functioning of the body cells. Carbohydrates are broken down in the small intestine, and the glucose in digested food is then absorbed by the intestinal cells into the bloodstream and is carried by the bloodstream to all the cells in the body where it is utilized. However, glucose cannot enter the cells alone and needs insulin to aid in its transport into the cells. Without insulin, the cells become starved of glucose energy despite the presence of abundant glucose in the bloodstream.

In certain types of diabetes, the cells' inability to utilize glucose gives rise to the ironic situation of "starvation in the midst of plenty." The abundant, unutilized glucose is wastefully excreted in the urine. Insulin is a hormone that is produced by specialized cells (beta cells) of the pancreas. (The pancreas is a deep-seated organ in the abdomen located behind the stomach.) In addition to helping glucose enter the cells, insulin is also important in tightly regulating the level of glucose in the blood. After a meal, the blood glucose level rises.

In response to the increased glucose level, the pancreas normally releases more insulin into the bloodstream to help glucose enter the cells and

lower blood glucose levels after a meal. When the blood glucose levels are lowered, the insulin release from the pancreas is turned down. It is important to note that even in the fasting state there is a low steady release of insulin that fluctuates a bit and helps to maintain a steady blood sugar level during fasting. In normal individuals, such a regulatory system helps to keep blood glucose levels in a tightly controlled range. As outlined above, in patients with diabetes, the insulin is either absent, relatively insufficient for the body's needs, or not used properly by the body. All of these factors cause elevated levels of blood glucose (hyperglycemia) <sup>2</sup>.

### Herbal Treatment of Diabetes Mellitus: Bitter Melon:



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

**Chemical constituents:** The plant contains several biologically active compounds-

- Chiefly momordicin I & momordicin II, cucurbitacin B
- Glycosides (momordin, charantin, charantosides, goyaglycosides)

- Terpenoid compounds- momordicinin, momordicin, momordol
- Cytotoxic (ribosome inactivating) proteins such as momorcharin & momordin<sup>3</sup>.

**Uses:** Bitter melon is used as anti-diabetic. It contains a lectin that has insulin-like activity due to its non-protein specific linking together to insulin receptors. This lectin lowers blood glucose level by acting on peripheral tissues. Lectin is a major contributor to hypoglycemic effect<sup>4</sup>.

**Scientific Work is Done:** Triterpenoids isolated from bitter melon has shown anti-diabetic activity<sup>5</sup>.

**Dosage Form:** It is used as fresh juice, tincture, juice extract & powdered leaf.

**Dose:** Fresh juice- 57-113 gm daily, tincture- 1.3 ml/twice/daily, juice extract 300-600 mg, powdered leaf- 1-2 gm.

#### Fiery Costus:



**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, and 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 the 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<sup>6</sup>.

**Scientific Work is Done:** *Costus igneus* has shown the effect on hyperglycemia.<sup>7</sup>

**Dosage Forms:** It is used as an oral hypoglycemic agent, or as i.v. injection.

**Dose:** Tablet- 1 tablet/ day.

#### Dandelion:



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

#### Chemical Constituents:

- Sesquiterpene lactones (bitters): taraxinic acid (taraxacin), tetrahydridentin B
- Triterpenoids and sterols: taraxasterol, taraxerol, cycloartenol, beta-sitosterol
- Other: Vitamin A, Vitamin C, tannins, alkaloids, pectin, inulin, starch, potassium, beta carotene, caffeic acid, flavonoids (apigenin)<sup>8</sup>

**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<sup>9</sup>.

**Scientific Work is Done:** Dandelion has shown antihyperglycemic effect<sup>10</sup>.

**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: 250-1000 mg 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 min cool.
- Pediatric dosages: Unknown

**French Lilac:**



**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 triterpenoids like sophoradiol, soyasapogenol b, & 9-sitosterol, sophorediol, galactogil, galegine, paganini, hydroxygalegine, vasicinone, alkaloids like lutein, pentahydroxyflavone 5 glucoside, luteoline, galuteoline, luteoline 5 glucosides, flavonoids, saponins etc.<sup>11</sup>

**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 was 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<sup>12</sup> 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 anti-diabetic therapies when it is prescribed according to its label)<sup>13</sup>. The study of galegine and related molecules in the first half of the 20<sup>th</sup> century is regarded as an important milestone in the development of oral anti-diabetic pharmacotherapy<sup>14</sup>.

**Dosage Form:** It is used as herbal infusion, tincture & leaves.

**Doses:** Herbal infusion- twice daily, tincture- thrice daily.

**Gulvel:**



**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 anti-complementary and immunomodulatory activities<sup>15</sup>.

**Use:** It is used as antidiabetic<sup>16</sup>.

**Scientific Work is Done:** *Tinospora cordifolia* has shown Anti-diabetic activity<sup>17</sup>.

**Dosage Form:** Aqueous extract of roots is used.

**Dose:** Aqueous extract of root- 2.5g, 5 g/ kg body weight.

#### **Turmeric:**



**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 colored curcuminoids. The chief component of curcuminoids is known as curcumin.

The volatile oil is composed of mono and sesquiterpenes such as alpha & beta pinene, alpha-phellandrene, camphor, camphene, zingiberene, alpha & beta curcumins<sup>18</sup>.

**Use:** It is used as anti-diabetic drug<sup>19</sup>.

#### **Scientific Works Did:**

- Turmeric has shown hypoglycemic, hypolipidemic & antioxidant activity<sup>20</sup>.
- Turmeric has shown an effect in diabetes<sup>21</sup>.

**Dosage Form:** The powdered form of turmeric is used.

**Dose:** Powdered turmeric- 500-8000 mg/ day.

#### **Gurmar:**



**Biological Source:** It is obtained from the 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, an anthraquinone compound, tartaric acid, cellulose but no tannin is present<sup>22</sup>.

#### **Uses:**

- This is one of the main herbs used for healing diabetes mellitus.
- *Gymnema* removes sugar from the pancreas, restores pancreatic function.
- *Gymnema* stimulates the circulatory system, increases urine secretion<sup>23</sup>.

#### **Scientific Works Did:**

- *Gymnema Sylvestre* has shown Enzyme changes and glucose utilization<sup>24</sup>.
- *Gymnema Sylvestre* has shown an effect in controlling blood glucose level<sup>25</sup>.



**Dosage Forms:** It is used as a water-soluble acidic solution & as a powdered leaf.

**Doses:** Power leaf- 2-4 mg/daily, Water soluble acidic solution- 400 mg/day.

**Bael:**



**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 marmalizing (0.5%) which is a furocoumarin. Other coumarins are marmesin, psoralen, umbelliferone. The drug also contains carbohydrate, protein, volatile oil & tannins. The pulp also contains a good amount of vitamin A & C. Two alkaloids, Omethylhalfordinol and isopentylhalfordinol has been isolated from fruits<sup>26</sup>.

**Use:** It is used as anti-diabetic drug<sup>27</sup>.

**Scientific Work is Done:** Leaf & callus extract of *Aegle marmelos* has shown anti-diabetic activity<sup>28</sup>.

**Dosage forms:** It is used as aqueous decoction & aqueous leaf extract.

**Doses:** Aqueous decoction- 1 ml/ 100 mg, aqueous leaf extract- 1 gm/ kg.

**Amla:**

**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, phyllembin, 5% tannin. It also contains

phosphorus, iron & calcium. It contains pectin & 75% moisture<sup>29</sup>.



**Use:** It is used as anti-diabetic<sup>30</sup>.

**Scientific Work is Done:** *Emblica officinalis* has shown Anti-diabetic activity in animal models<sup>31</sup>.

**Dosage Form:** It is used as amalaki capsules.

**Dose:** Capsule- 1 capsule/ twice a day before a meal.

**Fenugreek:**



**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 trigonelline, and coumarin contained by a defatted section of the seed of fenugreek prove to be the responsible, active ingredient for its anti-diabetic properties<sup>32</sup>.

**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<sup>33</sup>.

### Scientific Works Did:

- Metabolic and molecular action of *Trigonella foenum-graecum* (fenugreek) and trace metals has been shown in experimental diabetic tissues<sup>34</sup>.
- Fenugreek seed has shown the postprandial hypoglycemic activity<sup>35</sup>.

**Dosage Forms:** The leaves & seeds of fenugreek are used in therapeutic purpose.

**Doses:** Leaves- 5-30 gm/ thrice daily with a meal, Seeds- 3 ½ ounces/ daily.

### Ginseng:



**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 the triterpenoid group. They are grouped as follows-

- Ginsenosides
- Panaxosides
- Chikusetsusaponin

Ginsenosides contain aglycone dammarol while panaxosides have oleanolic acid as an aglycone. About 13 ginsenosides have been identified. Panaxosides give oleanolic acid, panaxadiol & panaxatriol on decomposition.<sup>36</sup>

**Use:** It is used as hypoglycemic agent.<sup>37</sup>

### Scientific Works have Done:

- Use of Ginseng in diabetes<sup>38</sup>.

- Ginseng has shown hypoglycemic effect<sup>39</sup>.

**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.

### Indian Kino Tree:



**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 kino-tannic acid, kino- red, k- pyrocatechin (catechol), resin & gallic acid. kinotannic acid is glucosidal tannin, while kino- red is an anhydride of kinoin. Kinoin is an insoluble phlobaphene & is produced by the action of oxidase enzyme. It is darker in color than kinotannic acid.

If the juice is boiled during drying, enzyme gets destroyed & thus insolubilisation & darkening is prevented.<sup>40</sup>

**Uses:** The heartwood of the plant is used in the treatment of diabetes. The gum resin is the only herbal product ever found to regenerate B cells that make insulin in the pancreas.<sup>41</sup>

### Scientific Works have Done:

- Phenolics from *Pterocarpus marsupium* has shown antihyperglycemic activity.<sup>42</sup>
- Hypoglycaemic activity of *Pterocarpus marsupium* has been seen.<sup>43</sup>

**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.

**Nayantara:**



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

**Chemical Constituents:** The main active compounds here are alkaloids & tannins. The major alkaloid is vincamine. An aclosely related semi-synthetic derivative of vincamine is vinpocetine. There are over 130 constituents with an indole or dihydroindole structure, including the principal component vindoline, vinblastine, vincristine, leurocristine, vinine, ajmalicine, leurocine, vincamine etc.<sup>44</sup>

**Use:** It is used as anti-hyperglycemic agent<sup>45</sup>.

**Scientific Works Have Done:**

- Effect of an antidiabetic extract of *Catharanthus roseus* has been seen.<sup>46</sup>
- The juice of fresh leaves of *Catharanthus roseus* has shown reduced blood glucose.<sup>47</sup>

**Dosage forms:** It is used as tincture & infusion.

**Doses:** Tincture- 1-2 ml/ 3 times daily, infusion- 2-3 cups daily.

**Neem:**

**Biological Source:** It is obtained from the leaves of *Azadirachta indica*, belonging to the family Meliaceae.

**Chemical constituents:** It contains glycerides of saturated & unsaturated fatty acids. The main fatty

acids are oleic (50%) & stearic (20%) acids. The oil contains 2.0% of bitters, which are sulpher containing compounds, nimbodin, nimbin, nimbinin, nimbidol. The unsaponifiable part contains nimboesterol (0.03%). The main limonoid that it contains is azadirachtin, but it also contains azadiradione, fraxinellone, nimbin, salannin, salannol, vepinin, vilasinin.<sup>48</sup>



**Use:** It is used in diabetes<sup>49</sup>.

**Scientific Work is Done:** *Azadirachta indica* leaf extract has shown anti-hyperglycemic and anti-dyslipidemic activity<sup>50</sup>.

**Dosage Form:** Capsules are used.

**Dose:** Capsule- 1-2 capsules/ twice daily.

**Cinnamon:**



**Biological Source:** It consists of the dried inner bark of shoots of coppiced trees of *Cinnamomum zeylanicum*, belonging to the family Lauraceae.

**Chemical constituents:** Cinnamon bark contains volatile oil, tannins, mucilage, calcium oxalate, starch & mannitol. Cinnamon oil contains



cinnamaldehyde, other terpenes like phellandrene, pinene, cymene, caryophyllene<sup>51</sup>.

**Uses:** Cinnamon is used in the treatment of type II diabetes mellitus & insulin resistance<sup>52</sup>.

#### Scientific Works Did:

- Alcoholic extract of *Cinnamomum zeylanicum* leaves has shown anti-diabetic activity.<sup>53</sup>
- Cinnamon improves glucose and lipid of people<sup>54</sup>.

**Dosage Form:** It is mostly used as a powdered form.

**Dose:** Powder- ½ teaspoon daily

#### Saptrangi:



**Biological Source:** It is obtained from the stem, root & leaves of *Salacia oblonga*, belonging to the family Hippocrateaceae.

**Chemical Constituents:** It contains 2 potent alpha-glucosidase inhibitors- salicinol, kotalanol, sesquiterpene (salasol A & B), triterpenes (salasones A-E, salaquinones A & B)<sup>55</sup>.

**Uses:** It is used as anti-diabetic. It binds to intestinal enzymes alpha- -glucosidases that break down carbohydrate into glucose in body<sup>56</sup>.

**Scientific Work is Done:** *Salacia oblonga* has shown antidiabetic potential<sup>57</sup>.

**Dosage Form:** Aqueous extract of the root bark is used.

**Dose:** Aqueous extract of root bark- 250 ml/ kg

#### Onion:



**Biological Source:** It is obtained from the bulb of the plant *Allium cepa*, belonging to the family Liliaceae.

#### Chemical Constituents:

- It contains the 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 acids, such as protocatechuic acid, p-hydroxybenzoic acid, vanillic acid, caffeic acid, & o & p- coumaric acids. Citric, abietic, oxalic and maleic acids are also present. It also contains several oligosaccharides<sup>58</sup>.

**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<sup>59</sup>.

**Scientific Work is Done:** Clinical hypoglycemic effect of *Allium cepa* (Red onion) has been seen<sup>60</sup>.

**Dosage Forms:** Raw & boiled onion extracts are used. APDS can also be administered orally.

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

### Garlic:



**Biological Source:** It consists of bulbs of the plant known as *Allium sativum*, belonging to the Liliaceae.

#### Chemical Constituents:

- Garlic bulbs contain 29% of carbohydrate, about 56% of proteins (albumin), 0.1% of fat, mucilage, and 0.06- 0.1% of volatile oil. It also contains phosphorus, iron & copper.
- Volatile oil of the drug is the chief active constituent and contains allyl propyl disulphide, diallyl disulphide, alliin, and allicin.
- Alliin by the action of enzyme allinlyase is converted into allicin. Garlic oil is yellow in colour<sup>61</sup>.

**Uses:** Garlic cloves lower blood sugar significantly. Subsequently, scientific studies have proven that the presence of disulfides in garlic such as allyl propyl and diallyl sulfide have played a role in the decrease of blood glucose levels.

They have been seen to have actions similar to Tolbutamide, a sulfonylurea drug of the first generation. They act on the pancreas and stimulate the production of insulin to control the sugar levels in the blood. It is those patients with type 2 diabetes who benefit the most out of this.<sup>62</sup>

**Scientific Work is Done:** Anti-diabetic and hypolipidaemic properties of garlic have been seen<sup>63</sup>.

**Dosage Form:** Juice extract of it is used.

**Dose:** Juice extract- 50 ml/daily

### Opuntia:



**Biological Source:** It is obtained from the stems of *Opuntia ficusindica*, belonging to the family Cactaceae.

**Chemical Constituents:** The main chemical constituents are 3- methoxytyramine<sup>64</sup>, candicine<sup>65</sup>, hordinine<sup>66</sup>, N- methyltyramine<sup>67</sup>, tyramine<sup>68</sup> etc.

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

**Scientific Work is Done:** Polysaccharides from *Opuntia* have shown anti-diabetic effects.<sup>69</sup>

**Dosage Form:** Boiled stems are used.

**Dose:** Oiled stem- 100-500/daily

### Blueberry:



**Biological Source:** It is obtained from the leaves of *Vaccinium myrtillus*, belonging to the family Ericaceae.

**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)<sup>70</sup>.

**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.<sup>71</sup>

#### Scientific Works Did:

- *Vaccinium myrtillus* has shown antidiabetic activity<sup>72</sup>.
- *Vaccinium myrtillus* has shown hypoglycaemic effect<sup>73</sup>.

**Dosage Form:** Leaf extracts are used.

**Dose:** Leaf extract- 3 cups/ day.

#### Blackberry:



**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 hydrolyzable tannins. Simple compounds such as 1,2,6-tri-O-galloyl-glucose<sup>74</sup> and penta-O-galloyl glucose are oxidatively coupled through galloyl groups to form more complex compounds such as casuarictin, pedunculagin, sanguine H-6<sup>75</sup>, and lambertianin A<sup>76</sup>, with as many as 15 galloyl groups coupled to 3 glucose units<sup>77</sup>.

Common flavonoids have also been isolated from the leaves. Rutin was isolated<sup>78</sup>, as were kaempferol, quercetin, quivering, and kaempferol-3-O-β-D-glucuronopyranoside<sup>79</sup>. Major leaf

volatiles studied by GC-MS includes the monoterpenes geraniol and linalool as well as 1-octane-3-ol and decanal<sup>80</sup>. Phenolic acids common to the Rosaceae family have also been identified<sup>81</sup>.

**Use:** It is used as anti-diabetic.

**Dosage form:** It is used as fruit powder.

**Dose:** Dried fruit powder- 20 mg/day.

**Blond Psyllium (Blond Plantago):** Blond psyllium seed husk orally seems to significantly reduce postprandial serum glucose, insulin levels, total serum cholesterol, and low-density lipoprotein (LDL) cholesterol levels in patients with Type II diabetes and hypercholesterolemia. Blond psyllium seems to reduce postprandial blood glucose levels by about 14% to 20%, total cholesterol by about 9%, and LDL cholesterol by 13%. Blonde psyllium also seems to lower postprandial glucose levels in patients with Type I diabetes. Blond psyllium's maximum effect on glucose levels occurs when psyllium is mixed and consumed with foods. Blond psyllium does not lower postprandial glucose in people who do not have diabetes.

**Devil's Claw:** Devil's Claw is native to south and central Africa. Its medicinal value lies in its fleshy roots, which are sliced, chopped, or pulverized while fresh. Some evidence shows that this herb might decrease blood glucose and have additive effects with medication used in diabetes.

**Ginger (*Zingiber officinale*):** Preliminary research suggests ginger might increase insulin levels. Theoretically, it could have an additive effect with medication used to treat diabetes and cause hypoglycemia.

**Glucomannan (Konnyaku Root):** A member of the yam family, this herb is high in fiber and can help normalize blood sugar, relieve stress on the pancreas.

**Holy Basil (Hot Basil):** Preliminary evidence suggests that holy leaf extract may decrease fasting (17.6%) and postprandial blood glucose in patients with Type II diabetes.

**Jambolan (*Syzygium cumini*):** A close relative of the clove tree *Syzygium aromaticum*, jambolan is native to East India and the Malay Peninsula, but



has spread as far as China and Australia and is grown in the Caribbean. Only the bark of the jambolan has proven medicinal value, although the seeds are often used as well. In Asian medicine, it is used for diabetes, diarrhoea, sore throat, and diseases of the spleen.

**Kudzu:** Kudzu is native to Japan and China, however, it grows extremely well in the Southern United States. This vine, when left uncontrolled, will eventually grow over almost any fixed object or other vegetation. Kudzu or its constituents might have hypoglycemic, hypocholesterolemic, and antioxidant activity.

**Prickly Pear Cactus (Nopal):** There is some preliminary clinical evidence that prickly pear cactus used orally can decrease blood glucose levels in patients with Type II diabetes. Single doses can decrease blood glucose levels by 17% to 46% in some patients. However, it is not known if extended daily use can consistently lower blood glucose levels and decrease HbA1c levels. Only the broiled stems of the specific species *Opuntia streptacantha* seem to be beneficial and raw or crude stems do not seem to decrease glucose levels. Other prickly pear cactus species do not seem to lower blood glucose levels significantly.

**Red Sandalwood (*Pterocarpus marsupium*):** Like *Gymnema Sylvestre*, this is a traditional herb used in India to help rejuvenate the insulin-producing pancreatic beta cells. One group of researchers investigating diabetic rats compared *Pterocarpus*' observed effects on blood glucose levels to those of metformin, a drug familiar to many people with diabetes.

**Stevia (Sweet Herb):** *Stevia* is a non-caloric herb, native to Paraguay, which has been used as a sweetener and flavor enhancer for centuries. Clinical research suggests that stevioside, a constituent of *Stevia*, might reduce postprandial glucose levels by 18% in people with Type II diabetes.

**Herbal Home Remedies for Diabetes:**<sup>82</sup> Diabetes has been referred to as 'Madhumeh' by Ayurveda. This disease is caused by an imbalance of the hormone insulin (which controls the sugar level of blood) that has to be taken externally by a diabetes patient regularly. Ayurvedic therapies recommend

many Indian herbs and general practices to improve the secretion of insulin through natural ways. Some of the home and herbal remedies prescribed by Ayurveda are described below.

- Include turmeric and cinnamon in your diets. You can even take one teaspoon of cinnamon powder daily.
- Soak one teaspoon of fenugreek seeds in 1 cup of water overnight. Drink this water in the morning on an empty stomach and eat the seeds.
- Take a bitter gourd, remove the seeds and saturate in a cup of water. Drain this preparation and drink every morning.
- Boil around fifteen mango leaves in one cup of water. Keep it overnight and filter in the morning. Drink every morning on an empty stomach.
- Avoid oily, fried and starchy foodstuffs.
- Avoid coffee, sugar, refined flour and alcohol.
- Eat smaller meals (low-fat diet) five to six times a day instead of having three large meals.
- Increase intake of vegetables like spinach, cucumber, tomatoes, onion, sprouts, beans, garlic, etc.
- Refrain from taking the stress.
- Do regular exercise. Walk for at least 40 minutes a day.
- Avoid red meat and excessive salt in your meals. Fish and soy can be taken due to their good protein value.
- Bitter herbs like *Azadirachta Indica* (Neem), bitter gourd and fenugreek are like miracle drugs for diabetics. Take them in any form you can.
- Avoid white bread, rice, potatoes, sweet and sugary foods.
- Chew 8-10 curry leaves (Meetha Neem) on an empty stomach. It is very effective for bringing the urine and blood sugar to their normal levels, even in hereditary diabetic patients.
- *Emblica Officinalis* or Indian gooseberry (Amla) is very beneficial for diabetic patients.

Prepare a fine powder of dry amala and put this powder in water. Allow it to stand for some time. Then filter the solution and mix some lemon juice in it. Take this early in the morning. You can even use the extract of amla easily available in the market.

- *Syzygium cumini* or Indian plum (Jamun) is considered a panacea for diabetes. Eating this fruit is very beneficial for patients of diabetes. More than fruit, the seeds of jamun fruit is beneficial when taken in powdered form mixed with some water.
- The holy fruit of India- the bel fruit or the *Aegle marmelos* has anti-diabetic properties. The

herbal extract of its leaves should be taken preferably with a pinch of black pepper.

- Garlic contains allicin that helps in reducing sugar level in blood.
- The leaves of *Butea monosperma* (Palas) tree are very useful in diabetes. They reduce blood sugar and are useful in glycosuria- the presence of a large amount of glucose in urine.
- Tenner's cassia (Tarwar) is an effective remedy for diabetes. A decoction of the whole plant or bubs is used to treat diabetes. The powder of the herb, mixed with honey, is very effective. Seeds can also be used similarly as flowers.

**TABLE 2: SOME MARKETED ANTIDIABETIC POLYHERBAL FORMULATIONS** <sup>83</sup>

Name	Company	Ingredients
Diabecon	Himalaya	<i>Gymnema Sylvestre</i> , <i>Pterocarpus marsupium</i> , <i>Glycyrrhiza glabra</i> , <i>Casearia esculenta</i> , <i>Syzygium cumini</i> , <i>Asparagus racemosus</i> , <i>Boerhavia diffusa</i> , <i>Sphaeranthus indicus</i> , <i>Tinospora cordifolia</i> , <i>Swertia chirata</i> , <i>Tribulus Terrestris</i> , <i>Phyllanthus amarus</i> , <i>Gmelina arborea</i> , <i>Gossypium herbaceum</i> , <i>Berberis aristata</i> , <i>Aloe vera</i> , <i>Triphala</i> , <i>Commiphora wightii</i> , <i>shilajeet</i> , <i>Momordica charantia</i> , <i>Piper nigrum</i> , <i>Ocimum sanctum</i> , <i>Abutilon indicum</i> , <i>Curcuma longa</i> , <i>Rumex maritimus</i>
Diasulin	Tobbest Busindo	<i>Cassia auriculata</i> , <i>Coccinia indica</i> , <i>Curcuma longa</i> , <i>Emblica officinalis</i> , <i>Gymnema sylvestre</i> , <i>Momordica charantia</i> , <i>Scoparia dulcis</i> , <i>Syzygium cumini</i> , <i>Tinospora cordifolia</i> , <i>Trigonella foenum graecum</i> .
Bitter gourd Powder Dia-care	Garry and Sun natural remedies Admark Herbals Limited	<i>Momordica charantia</i> Sanjeevan Mool; Himej, Jambu beej, Kadu, Namejav, Neem chal.
Diabetes- Daily Care	Nature's Health Supply	Alpha Lipoic Acid, Cinnamon 4% Extract, Chromax, Vanadium, Fenugreek 50% extract, <i>Gymnema sylvestre</i> 25% extract <i>Momordica charantia</i> 7% extract, Licorice Root 20% extract
Gurmar powder	Garry and Sun natural Remedies	<i>Gymnema sylvestre</i>
Epinsulin	Swastik Formulations	<i>Pterocarpus marsupium</i>
Diabecure	Nature beaute sante	<i>Juglans regia</i> , <i>Berberis vulgaris</i> , <i>Erythrea centaurium</i> , <i>Millefolium</i> , <i>Taraxacum</i>
Diabeta	Ayurvedic cure Ayurvedic Herbal Health Products	<i>Gymnema sylvestre</i> , <i>Vinca rosea</i> , <i>Curcuma longa</i> , <i>Azadirachta indica</i> , <i>Pterocarpus marsupium</i> , <i>Momordica charantia</i> , <i>Syzygium cumini</i> , <i>Acacia arabica</i> , <i>Tinospora cordifolia</i> , <i>Zingiber officinale</i>
Syndrex	Plethico Laboratories	Germinated Fenugreek seed extract

Experimental and epidemiological evidence now indicates that chromium levels are a major determinant of insulin sensitivity, as it functions as a cofactor in all insulin- regulating activities <sup>84</sup>. Chromium facilitates insulin binding and subsequent uptake of glucose into the cell. Supplemental chromium has been shown to

decrease fasting glucose levels, improve glucose tolerance, lower insulin levels, and decrease total cholesterol and triglycerides while increasing HDL cholesterol in normal, elderly, and type 2 diabetic subjects. <sup>85, 86</sup> Without chromium, insulin's action is blocked, and glucose levels are elevated <sup>87</sup>.

Chromium picolinate, trivalent chromium (Cr<sup>3+</sup>), is one of the forms of chromium that exhibits biological activity.<sup>88</sup> A large clinical study on 180 diabetic patients documents the benefit of chromium picolinate for type 2 diabetic patients. In the study, while patients continued their normal medication, they were placed in one of three groups: placebo group, 100 mcg chromium picolinate twice daily, or 500 mcg chromium picolinate twice daily. There were significant dose- and time-dependent decreases in glycosylated hemoglobin, fasting glucose, two-hour postprandial glucose levels, fasting and two-hour postprandial insulin values, and total cholesterol, particularly in the 500 mcg twice daily group<sup>89</sup>. However, not all studies on chromium have yielded positive results. In a controlled six-month study to determine the effect of 200 mcg/day chromium picolinate on individuals with type 2 diabetes, Lee and Reasner reported a decrease in triglycerides but no statistical difference between control and chromium-treated subjects concerning measured parameters of glucose control<sup>90</sup>. This dosage is considerably smaller than that found effective at lowering glucose in other studies so may explain the disparate findings among studies.

Although no recommended daily allowance (RDA) has been established for chromium, over 200mcg/day appears necessary for optimal blood sugar regulation. Supplemental chromium<sup>91</sup> assures a good supply of chromium in addition to dietary sources. Good dietary sources are brewer's yeast<sup>63</sup> and barley flour,<sup>92</sup> while refined sugars, white flour products, and lack of exercise can deplete chromium levels. Trivalent chromium has long been considered to be a safe nutritional supplement<sup>93</sup>. Although, the hexavalent form of chromium is a known human respiratory tract carcinogen when inhaled in high-exposure industrial settings, there is no evidence of any carcinogenesis in humans from the trivalent form of chromium found in chromium supplements<sup>94, 95</sup>. Further evaluation of the safety and efficacy of trivalent chromium in diabetes treatment may be warranted.

**Vanadium:** Before the discovery of insulin in 1922, vanadium was used for the control of blood sugar. Two small studies (one with six types 2 diabetic patients, one with seven type 2 diabetic

patients) have confirmed the effectiveness of vanadyl sulfate at a dose of 100 mg/day in improving insulin sensitivity<sup>96, 97</sup>.

**Magnesium:** A deficiency of magnesium is significantly more common in Type 2 diabetics than in the general population<sup>98</sup>. Magnesium deficiency has been associated with complications of diabetes, retinopathy in particular. One study found patients with the most severe retinopathy were also lowest in magnesium<sup>99</sup>.

**Physical Interventions: Acupuncture and Hydrotherapy:** Acupuncture is best known in the United States as an alternative therapy for chronic pain. However, it has been used for the treatment of diabetes and related complications during the past several decades. There are numerous Chinese publications on the use of acupuncture for diabetes, but only those published in English will be cited here.

Acupuncture may be effective in treating not only diabetes but also in preventing and managing complications of the disease<sup>100</sup>. The effects of acupuncture on diabetes have been observed experimentally and clinically<sup>101, 102</sup>. Animal experiments have shown that acupuncture can activate glucose-6- phosphatase (an important enzyme in carbohydrate metabolism) and affect the hypothalamus<sup>103</sup>. Acupuncture can act on the pancreas to enhance insulin synthesis, increase the number of receptors on target cells, and accelerate the utilization of glucose, resulting in the lowering of blood sugar<sup>104</sup>. Data from other studies have shown the beneficial anti-obesity effect of acupuncture,<sup>105</sup> which is the most modifiable risk factor for type 2 diabetes. It appears that the therapeutic effect of acupuncture on diabetes is not the result of its action on one single organ, but multiple systems. Four commonly used points are:

- Zusanli point, located three inches below the lateral knee depression, one finger width from the lateral side of the anterior crest of the tibia;
- Sanyinjiao point, located three inches above the tip of the inner ankle, on the posterior margin of the metatarsal bone;
- Feishu point, located 1.5 inches lateral and inferior to the spinous process of the third thoracic vertebra in a prone position;



- Shenshu point, located 1.5 inches lateral to the posterior midline, lateral and inferior to the spinous process of the second lumbar vertebra in a prone position. These acupuncture points were selected based on traditional Chinese medicine theory. During the treatment, other points can be added according to symptoms and signs<sup>106</sup>. Other methods have also been employed such as point injection with normal saline, small dose insulin, and Chinese herbal medicine extracts. Treatment is generally given once daily or once every other day as a course of 14-21 treatments. It is believed that the longer the course of treatment, the more marked will be the effect. Acupuncture can be effective in treating complications of diabetes, often with marked improvement in clinical symptoms. Better therapeutic results are obtained in patients with dietary control than in those without it. Physical exercise, breathing exercises, & massage can help improve the therapeutic effect.

Although, acupuncture shows some effectiveness in treating diabetes, its mechanisms of action are still obscure. Since hot-tub therapy can increase blood flow to skeletal muscles, it has been recommended for patients with type 2 diabetes who are unable to exercise<sup>107</sup>. A study reported that eight patients were asked to sit in a hot tub for 30 min daily for three weeks. During the study period, patients' weight, mean plasma glucose level and mean glycosylated hemoglobin decreased<sup>107</sup>.

Caution should be taken that the water is not too hot as neuropathy may prevent the patient from noticing they are burning themselves. Also, poor circulation can result in increased metabolic demands when feet become heated demands that cannot be met by the diabetic patient. Proper water sanitation and appropriate guidance should be considered when prescribing hot-tub therapy for diabetic patients<sup>108</sup>.

**TABLE 3: MEDICINAL PLANTS WITH ANTIDIABETIC AND THEIR REPORTED EFFECT ON EXPERIMENTAL MODELS**

Botanical Name	Family	Antidiabetic and other beneficial effects	References
<i>Achillea santolina</i> L.	Asteraceae	Hypoglycemic, antioxidant	109
<i>Artemisia patterns</i>	Asteraceae	Hypoglycemic, increases peripheral glucose utilization	110
<i>Areca catechu</i> L.	Arecaceae	Hypoglycemic	111
<i>Beta vulgaris</i> L.	Chenopodiaceae	Increases glucose tolerance in OGTT	112
<i>Boerhaavia diffusa</i> L.	Nyctaginaceae	Decreases blood glucose level and increases plasma insulin levels, antioxidant	113
<i>Bombax ceiba</i> L.	Malvaceae	Hypoglycemic	114
<i>Butea manasperma</i> (Lam)	Caesalpinaceae	Anti-hyperglycemic	115
<i>Carum carvi</i> L.	Apiaceae	Potent anti-hyperglycemic	116
<i>Cogniauxia podoleana</i> Baillon	Cucurbitaceae	Hypoglycemic and antihyperglycemic	117
<i>Commelina communis</i> L.	Conimelinaceae	Anti-hyperglycemic, management of non-insulin-dependent diabetes.	118
<i>Croton cajucara</i> Benth	Euphorbiaceae	Anti-hyperglycemic	119, 120
<i>Curcuma longa</i> L.	Zingiberaceae	Hypoglycemic, plays a role in PPAR-gamma activation	121
<i>Cynodon dactylon</i> Pers	Poaceae	Anti-hyperglycemic	122
<i>Ericostemma littorale</i> Blume	Gentianaceae	Decreases plasma glucose level, glycosylated hemoglobin and glucose-6-phosphatase activity in liver	123
<i>Eriobotrya japonica</i> Lindl.	Rosaceae	Hypoglycemic	124
<i>Gentiana olivieri</i> L.	Gentianaceae	Hypoglycemic, anti-hyperlipidemic	125
<i>Ginkgo biloba</i> L.	Ginkgoaceae	Hypoglycemic, increases pancreatic beta-cell in NIDDM	126, 127
<i>Globularia alypum</i> L.	Globulariaceae	Hypoglycemic, increases plasma insulin levels	128
<i>Glycyrrhiza uralensis</i> Fish.	Papilionaceae	PPAR-gamma ligand-binding activity, decreases the blood glucose levels	129
<i>Gymnema nwtanum</i> Hook	Asclepiadaceae	Anti-peroxidative, antioxidant, may prevent the cholinergic neural and retinal complications of hyperglycemia in diabetes	130
<i>Gymnema Sylvestre</i> R. Br.	Asclepiadaceae	Hypoglycemic. Hypolipidemic	131
<i>Hintonia standleyana</i>	Rubiaceae	Anti-hyperglycemic	132
<i>Ibervillea sonora</i> S.	Cucurbitaceae	Acute and chronic hypoglycemic	133
<i>Ipomoea aquatic</i> Forsk.	Convolvulaceae	Decreases serum glucose concentration by 29.4%	134

<i>Kalopanax pictus</i> Thumb.	Araliaceae	in Type II diabetic patients. hypoglycemic Anti-diabetic activity, hypocholesterolemic and hypolipidemic	135
<i>Lagerstroemia speciosa</i> L.	Lythraceae	Insulin-like actions, glucose uptake, anti- adipogenesis	136,137
<i>Medicago saliva</i> L.	Fabaceae	Anti-hyperglycemic, insulin-releasing and insulin- like activity	138
<i>Morus alba</i> L.	Moraceae	Protects pancreatic beta cells from degeneration and diminishes lipid peroxidation	139
<i>Morus indica</i> L.	Moraceae	Hypoglycemic	140, 141
<i>Morus inignis</i> L.	Moraceae	Hypoglycemic	142
<i>Murraya koenigii</i> L.	Rutaceae	Hypoglycemic, increases glycogenesis, decreases gluconeogenesis and glycogenolysis	143
<i>Nelumbo nucifera</i> L.	Nelumbonaceae	Improves glucose tolerance and potentiates the action of exogenously injected insulin	144
<i>Nigella saliva</i> Gaertn.	Ranunculaceae	Decreases oxidative stress and preserves pancreatic beta-cell integrity.	145
<i>Ocimum gratissimum</i> L. Var.	Lamiaceae	Hypoglycemic	146
<i>Pandanus odors</i> Ridl.	Pandanaceae	Hypoglycemic, increases serum insulin levels and liver glycogen	147
<i>Parmentiera edulis</i> A. DC	Bignoniaceae	Hypoglycemic	148
<i>P. sellowianus</i> Mull. Arg.	Euphorbiaceae	Hypoglycemic	149
<i>Psacalium decompositum</i> (Gray)H.	Asteraceae	Hypoglycemic	150
<i>Psacalium peltatum</i> (Kunth)	Asteraceae	Anti-hyperglycemic	151
<i>Punica granatum</i> L.	Punicaceae	Improves postprandial hyperglycemia in type 2 diabetes and obesity by inhibiting intestinal alpha-glucosidase activity	152
<i>Solaria oblonga</i>	Celastraceae	Hypoglycemic and possess anti-oxidant activity	153
<i>Sambucus nigra</i> L.	Adoxaceae	Insulin-releasing and insulin-like activity	154
<i>Sanguis draxonis</i>	Apocynaceae	Increase insulin sensitivity and improve the development of insulin resistance in rats	155
<i>Sclerocarya birea</i> (A. Rich)	Anacardiaceae	Hypoglycemic	156
<i>Scoparia dulcis</i> L.	Scrophulariaceae	Hypoglycemic, antihyperlipidemic, antidiabetic	157, 158
<i>Swertia chirayita</i> (Roxb)	Gentianaceae	Stimulates insulin release from islets	159
<i>Syzygium alternifolium</i> (Wt) Walp.	Myrtaceae	Hypoglycemic, antihyperglycemic and antihyperlipidemic	160, 161
<i>Terminalia bellirica</i> (Gaertn)	Combretaceae	Stimulates insulin secretion. Enhances insulin action and inhibits both protein glycation and starch digestion	162
<i>Terminalia chebula</i> Retz.	Combretaceae	Dose-dependent glucose lowering effect, antidiabetic and renoprotective, decreases hepatic and skeletal muscle glycogen content increases insulin release from the pancreatic islets	163, 164
<i>Teucrium polium</i>	Lamiaceae	Increases insulin release, antioxidant and hypoglycemic	165
<i>Tinospora cordifolia</i> Miers..	Menispermaceae	Hypoglycemic	166
<i>Tinospora crispa</i> (L) Hook.	Menispermaceae	Anti-hyperglycemic stimulates insulin release from islets	167
<i>Urtica dioica</i> L.	Urticaceae	Anti-hyperglycemic	168
<i>Urtica pilulifera</i> L.	Urticaceae	Hypoglycemic	169
<i>Vinca rosea</i> L.	Apocynaceae	Anti-hyperglycemic	170
<i>Withania soimifera</i> (L) Dunal	Solanaceae	Hypoglycemic, antioxidant, diuretic and hypocholesterolemic	171, 172
<i>Withania coagulans</i> Dunal	Solanaceae	Anti-hyperglycemic, anti-hyperlipidemic and hypoglycemic	173,174
<i>Zizyphus sativa</i> Gaertn	Rhamnaceae	Hypoglycemic	175
<i>Zizyphus spina-christi</i> L.	Rhamnaceae	Insulinotropic, the hypoglycemic antidepressant effect on the central nervous system	176
<i>Zygophyllum gaetulum</i> Emb	Zygophyllaceae	Hypoglycemic, increases plasma insulin levels	177

### Traditional Phytotherapies:

#### Anti-diabetic Extracts: *Adhatoda vasica* Nees:

Extract obtained from the fresh leaves of plant mixed with water. About 10 ml of the extract is used a day thrice to treat sugar.

#### *Aloe vera* Nill + *Fagonia indica* L. + *Tylophora*

*hirsuta* L.: Equal quantity of extract obtained from the fresh aerial parts of *Fagonia indica*, fresh leaves and stem of *Aloe vera* and fresh branches of *Tylophora hirsuta* L. Then these three extracts are

mixed and used small teaspoon thrice a day. According to the rural inhabitants of the area, this formula is very old and 100% effective to lower the blood glucose level of diabetics.

***Ficus bengalensis* L.:** The latex obtained from the aerial parts of the plant (leaves and young branches) and mixed with honey and used orally to control high blood glucose level.

***Psidium guajava* L.:** Hot water extract made from the dried leaves of the plant is used to reduce blood glucose level of people with diabetes. This hot tea was very common among the local people in the area.

***Momordica charantia* L.:** The juice of fresh fruits, used, one small cup daily. This juice exhibits an anti-diabetic property.

***Cajanus cajan* and *Vigna mungo* (Burm. f.) Walp:** The pulse obtained from the seeds of these plants is cooked and is recommended to people with diabetes.

***Allium cepa* L.:** The juice obtained from the underground bulb is used, one teaspoon thrice a day. This is given for the control of blood sugar and high blood pressure amongst the people with diabetes.

***Caralluma edulis* (L.) Benth ex Hook. f.:** The aerial parts are cooked as vegetables by the local people for diabetes mellitus.

#### **Antidiabetic Leaves:**

***Zizyphus jujuba* Mill:** 4-5 fresh leaves are chewed daily to lower blood glucose level.

***D. viscosa* (L.) Jacq:** 2-3 Fresh leaves of the plant are masticated twice a day with a glass of water.

#### **Antidiabetic Powder (Safoof):**

***Ocimum sanctum* L. + *Ocimum album* L.:** Leaves of these plant species are dried under shade, then ground to make a powder (Safoof). One gm power is given with water twice a day for prophylactic and the treatment of diabetes.

***Momordica charantia* L.:** The fruits of the plant are dried under shade, then ground to obtain a powder. One table spoon is administered twice a day to lower blood glucose level.

***Syzygium cumini* Skeels:** Seeds of the plant are dried under shade, then ground to make powder. About 25 gm powder is used a day thrice with water. This decreases blood glucose level very significantly.

***Kickxia ramosissima* (Wall) Janchen:** The whole plant is dried under shade and is ground to make powder. This powder is prescribed for the treatment of diabetes by the inhabitants of the study area.

***Cichorium intybus* L.:** The roots are dried under shade and then ground to obtain a powder. About 15 gm of this powder is taken with a glass of water twice a day before a meal to lower blood glucose level.

***Melia azedarach* L.:** The dried fruits of the plant are ground to make powder. An about half small teaspoon is given with a glass of water before breakfast daily for a month. The inhabitants claim that it is an effective therapy for the treatment of diabetes.

***Hordeum vulgare* L. + *Cicer arietinum* L. + *Elettaria cardamomum* Maton:** Seeds of *Hordeum vulgare* 125 gm are roasted and mixed with each of 50 gm of *Cicer arietinum* and *Elettaria cardamomum* and used @ half teaspoon with water thrice a day to control blood glucose level.

**Antidiabetic Bread:** Equal quantity of *Cicer arietinum* (Seeds), *Daucus carota* ((Dried form), *Hordeum vulgare* (Seeds), *Oryza sativa* (Seeds), *Triticum aestivum* (Seeds) and *Zea mays* (yellow variety) are ground and made into powder. The bread is cooked from this mixed flour and taken as breakfast with fresh butter of cow for 2-month. This remedy is used as a dietary supplement to control diabetes.

#### **Antidiabetic Seeds:**

***Trigonella foenum-graecum* L.:** Twenty five gm seeds are given daily for 21 days with water. The inhabitants claimed that it is one of the effective treatments to reduce blood glucose in diabetic patients.

***Withania coagulants* (L.) Dunal.:** Fifteen gm seeds of the plant are soaked in water for the whole night. This is given early morning before breakfast to diabetic patients.



### **Antidiabetic Potherbs/Vegetables:**

***Solanum nigrum* L.:** Fresh aerial parts of the plant are cooked as a vegetable and are recommended to control diabetes.

***Taraxacum Officinale* Weber:** Fresh leaves are cooked as a vegetable (locally-called Saag).

***Cajanus cajan* & *Vigna mungo* (Burm. F.) Walp.:** The pulses obtained from the seeds of these plants are cooked and is recommended to diabetic patients.

***Allium sativum* L.:** The underground bulb is cooked or uncooked is used for diabetes and hypertension amongst diabetics.

***Caralluma edulis* (L.) Bth. ex Hk. F.:** The aerial parts are cooked as vegetables by local people for diabetes mellitus.

### **Antidiabetic Fruits:**

***Vigna sinensis* (L.) Savi ex Hassk:** The immature pods of the plant are used to reduce blood glucose level.

***Syzygium cuminii* Skeels:** The fresh fruits are used for diabetes.

***Olea ferruginea* Royle:** Fruit fresh in summer season is collected, dried and recommended to diabetics in winter season for reducing blood glucose level.

**Antidiabetic Herbal Mixtures:** The seeds in 25 gm of *Syzygium cumini*, *Momordica charantia*, 12 gm of *Cyperus rotundus* and *Rosa alba* are made into powder. This compound is given successfully for lowering blood glucose by the inhabitants of an area. The equal quantity of *Tylophlra hirsuta* (leaves), *Trigonella foenum-graecum* (seeds) and aerial parts of *Fumaria indica* is ground and made into powder. This mixture is claimed a significant therapy to reduce the blood sugar of diabetic patients.

**Clinical Research of CAM Supplements in Diabetes:** Currently, there is not yet sufficient evaluation of herbs, vitamins, and mineral supplements for glucose control in diabetes. Aside from relatively poor study methodological quality, this area of supplement research has been fraught with several complications. First, the multiple

constituent natures of botanical products have made standardization a challenging task. Proponents of herbal remedies caution that in standardizing to one constituent, resulting extracts may have lost a proportion of benefit as compared with the whole plant<sup>178</sup>. Precise considerations of purity, chemical composition, and potency of derivatives may be grossly influenced by the age of the plant (especially of roots), the source location, the season of harvest, the method of drying and crude preparation, etc. In the literature, we examined several herb studies used “homemade” or otherwise unspecified preparations. Although individual companies have begun to standardize supplements, there is a general lack of consistency across the market.

With vitamin and mineral supplements, these issues are less relevant. Also, the development of proper supplement regulation and safety codes has been slow. Currently, all dietary supplements (including herbal products) are regulated under the Dietary Supplement Health and Education Act of 1994 (DSHEA), which specifically differentiates supplements from drugs. Consequently, DSHEA does not require the extensive premarket approval that the Food and Drug Administration requires for a prescription drug, and although it calls for “good manufacturing practices [GMP],” the burden of proof that a supplement is unsafe lies with the government, leaving manufacturers to operate unchecked. This has contributed to skepticism among clinicians and makes it especially difficult for physicians to recommend supplements to patients responsibly. In the absence of external regulation, the industry has taken steps to police itself.

For example, the National Nutritional Foods Association (NNFA), representing about one-third to one-half of retailers and manufacturers of natural products in the U.S., has encouraged the adoption of strict, self-imposed GMP standards, as well as initiatives such as the TruLabel program (in which products are subjected to random laboratory testing by independent third-party auditors to verify contents)<sup>179</sup>. Research of vitamin and mineral supplements has also been hindered by a lack of accurate and meaningful assays that detect functional micronutrient deficiencies. In the case of chromium, for example, it is postulated that

supplementation of targeted individuals might be more beneficial. Some speculate that positive results seen in large studies in diabetic patients in China may be due to the population's relative chromium deficiency. However, without reliable assays, these theories have remained difficult to test<sup>180</sup>. Finally, the existing literature in this area includes a considerable amount of study population heterogeneity. Future research may need to more precisely define targeted diabetic populations about disease classification, severity, optimal adjunctive interventions, and perhaps nutrient deficiencies. It will also be important to elucidate mechanisms of action further so that applicability to type 1 or Type 2 diabetes can be clarified.

**CONCLUSION:** Diabetes mellitus is the most common endocrine disorder, affecting more than 300 million people worldwide. For this, therapies developed along the principles of western medicine (allopathic) are often limited in efficacy, carry the risk of adverse effects & are often too costly, especially for the developing world. Therefore, treating diabetes mellitus with plant-derived compounds which are accessible & do not require laborious pharmaceutical synthesis seems highly attractive. All the herbal drugs discussed in the review exhibit significant clinical & pharmacological activity.

The potency of herbal drugs is significant & they have negligible side effects than synthetic antidiabetic drugs. In this review article, an attempt has been made to focus on hypoglycemic plants & may be useful to the health professionals, scientists and scholars working in the field of pharmacology & therapeutics to develop evidence-based alternative medicine to cure different kinds of diabetes in man & animals. Isolation & identification of active constituents from these plants, preparation of standardized dose & dosage regimen can play a significant role in improving the hypoglycemic action.

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