

Medicinal Flowers in the Management of Diabetes Mellitus: A Review

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Abstract

Diabetes mellitus is regarded as a noncurable but controllable disease. The disease necessitates constant reassessment of glycaemic control in people with diabetes and appropriate adjustment of therapeutic regimens. For several centuries medical practitioners have long been acknowledged the therapeutic properties of certain flowers. The medicinal properties of flowers are evaluated from the aspect of potential health benefits concerning mainly the influence of color, odour and flavour components in relation to antioxidant activity, and scavenging activity of reactive oxygen radicals. Though many flowers available in our surroundings have medicinal uses and are widely used in indigenous system, there is a scarce data about the medicinal uses of flowers. This review highlights therapeutic utility of medicinal flowers and enriches our knowledge regarding pharmacological aspects of the flowers used in managing diabetes.

Keywords: diabetes, medicinal flowers, hypoglycemic activity.

INTRODUCTION

Diabetes mellitus (DM) is a chronic endocrine disorder resulting from defects in pancreas insulin production and secretion and/or insulin resistance in peripheral tissues, leading to abnormalities in carbohydrate, lipid and protein metabolism. Lifestyle changes in modern society, such as diminished physical activity and increased ingestion of high-energy foods have explained the high incidence of DM, which is reaching epidemic proportions worldwide¹. In 2013, more than 382 million people had diabetes, with estimation to rise to 592 million worldwide by 2035². Progressive nature of the disease necessitates constant reassessment of glycaemic control in people with diabetes and appropriate adjustment of therapeutic regimens³. Thus, the management of diabetes without any side effects is still a challenge.

Diet therapy along with insulin or oral hypoglycemic agent forms an important way of treatment in diabetes and its complications though it has several demerits. To successfully cope with this challenging situation, there is an urgent need to search for more treatment options that are readily available, safe and cost-effective⁴. Especially the antioxidant effects of phytochemicals such as polyphenols or carotenoids have been studied extensively, but less is known about mechanisms linking medicinal flowers to the management of diabetes mellitus.

Flowers the sexual reproductive parts of the plants are matchless ornaments to the nature Queen. They are an integral part of our lives and are associated with the most poignant moments of human experiences like celebrations or grieving. They are used not just for their aesthetic sense but also for nutritive and medicinal properties also. For several centuries medical practitioners have long been acknowledged the therapeutic properties of certain

flowers. The kingdom of flowers is very vast and can categorize them in general into four main classes depending upon the purpose for which they are grown, i.e. ornamental, commercial, medicinal and vegetable or edible flowers⁵.

Out of the total 4, 22,000 flowering plants reported from the world, more than 50,000 plants are used for medicinal purposes. In India, more than 43% of the total flowering plants are reported to be of medicinal importance⁶. India has a very rich flora with nearly 17,500 flowering plants which constitutes 12% of the recorded world flora. Flowers are directly eaten as petals or made as juice decoction, tincture or mixing them with some other ingredients and then administered. Different formulations of flowers are used as Juice, Powder, Syrup, *Arka* (Distilled extract), scents, soups etc⁷.

The medicinal properties of flowers are evaluated from the aspect of potential health benefits concerning mainly the influence of color, odour and flavour components in relation to antioxidant activity, and scavenging activity of reactive oxygen radicals.

In present day concrete jungle life most of the people are suffering with so many lifestyle diseases especially diabetes. There is need of fast and correct method of diagnosis, less expensive treatment with least or no side effects and permanent solution, is the need of the hour to the present day society⁸. Though many flowers available in our surroundings are having medicinal uses and are widely used in indigenous system, there is a scarce data about the medicinal uses of flowers. This review highlights therapeutic utility of medicinal flowers and enriches our knowledge regarding pharmacological aspects of the flowers used in managing diabetes.

Cocos nucifera flowers

Oral administration of *Cocos nucifera* flowers extract to diabetic group of rats reduced the formation of glycosylated haemoglobin by virtue of its normoglycemic activity. It is indicated that *Cocos nucifera* flowers extract possess antidiabetic as well as antioxidant properties. Phytochemical screening indicated the presence of pharmacologically active ingredients in the flowers and nontoxic. The level of glycogen content, the activities of glycogen synthase and glycogen phosphorylase has been shown to be improved upon treatment with the extract⁹. Administration of the methanol extract of coconut inflorescence to the diabetic rats showed dose dependent reduction in hyperglycemia. The cytoprotective property of coconut inflorescence was evidenced from the acute toxicological evaluation. The levels of serum aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase were significantly decreased in the diabetic rats treated with inflorescence when compared with the diabetic control rats¹⁰.

Catharanthus roseus flowers

Oral administration of aqueous extract of *Catharanthus roseus* flowers to diabetic rats resulted in significant reduction in blood glucose, reduction in lipid profile and also prevented a decrease in body weight. Supplementation with *Catharanthus roseus* flowers to diabetic rats significantly reduced the fatty changes and inflammatory cell infiltrates. The aqueous flower extract had synergetic hyperglycemia effect revealed by increased serum insulin levels, decreased serum lipid levels and therefore attribute to therapeutic value of the aqueous flower extract of *Catharanthus roseus* to combat the diabetic condition in rats¹¹.

Psidium guajava flowers

Oral administration of aqueous extract of *Psidium guajava* flowers to diabetic rats resulted in significantly reduction in plasma glucose, creatinine, urea, AST, ALT, ACP, ALP, LPO, glucose-6-phosphatase and fructose 1,6 bisphosphatase and increased level of serum insulin, protein, CAT, SOD, glycogen synthase and hexokinase. Flowers of *Psidium guajava* exhibit hypoglycaemic activity in alloxan induced diabetic rats. The aqueous extract of *Psidium guajava* flower extract possesses good glycaemic control properties in alloxan induced experimental rats¹².

Cassia auriculata flowers

Oral administration of aqueous extract of *Cassia auriculata* flowers extract to alloxan-induced diabetic group of rats showed significant antidiabetic activity as observed from serum glucose level in diabetic rats. It is revealed that, the aqueous extract of *Cassia auriculata* flowers is worthwhile to develop the bioactive principle for diabetes mellitus¹³. Treatment with aqueous extract of *Cassia auriculata* flowers restored the blood glucose and plasma insulin significantly in diabetic animals¹⁴.

Pterospermum acerifolium (L.) Wild flowers

Diabetic animals treated with *Pterospermum acerifolium* (L.) wild flowers reduced the levels of fasting blood glucose, significantly compared to that of diabetic control animals. HPLC analysis of *Pterospermum acerifolium*

(L.) Wild flowers extract revealed the presence of quercetin and apigenin as major constituents and both inhibiting the glycogen phosphorylase enzyme in molecular modelling studies. The study have evidenced strongly that the probable glucose lowering mechanism of action of the *Pterospermum acerifolium* (L.) wild flowers was by increasing the glucose uptake in peripheral tissues and by inhibiting gluconeogenesis¹⁵.

Chamomile recutita flowers

Daily oral consumption of ethanolic extract of *Chamomile recutita* flowers exhibited a pronounced hypoglycemic effect and reduced the lipid peroxidation process with enhanced antioxidant defence system in the diabetic rats¹⁶. chamomile tea possess a glucose lowering effect and able to reduce the fasting and post prandial blood sugar levels progressively and lower the level of hemoglobin A1c (HbA1c) significantly¹⁷.

Citrullus colocynthis Linn. flowers

Oral administration of the Streptozotocin induced diabetic mice with the flower extract of *Citrullus colocynthis* Linn. resulted in significant reduction of blood glucose level, serum cholesterol and increased in liver glycogen. The antidiabetic effect of *Citrullus colocynthis* Linn. flower could be due to the presence of various phytoconstituents detected in the phytochemical screening imparting therapeutic effect¹⁸.

Clitoria ternatea Linn. flowers

The aqueous extract of *Clitoria ternatea* flowers significantly reduced serum glucose, glycosylated hemoglobin and the activities of gluconeogenic enzyme, glucose-6- phosphatase, and increased the serum insulin, liver and skeletal muscle glycogen and the activity of the glycolytic enzyme, glucokinase. Flower extracts of *Clitoria ternatea* are reported to increase insulin secretion and enhance glycogenesis process. The extracts were effective in regulating the glycogen content and the activity of glucokinase and glucose-6-phosphatase¹⁹. The probable mechanism by which *Clitoria ternatea* flower petal extract exerts antiglycation and antioxidant activity may be in association with the phytochemical compounds in the extract. Antiglycation and antioxidant activity of *Clitoria ternatea* flower petal extract may be responsible for their usefulness in the management and prevention of AGE mediated diabetic complication²⁰.

Musa sapientum flowers

Intragastric administration of a fresh flower decoction of *M. sapientum* flowers to hyperglycemic rabbits was reported to significantly decrease the hyperglycemic peak and/or the area under the glucose tolerance curve. Oral administration of various doses of chloroform extract of *M. sapientum* flowers significantly reduced blood glucose and glycosylated hemoglobin and increased total hemoglobin in alloxanized rats²¹.

Punica granatum flowers

The flowers of the plant *Punica granatum* are used as anti-diabetic in Unani medicine called Gulnarfarsi. Oral administration of extract led to significant blood glucose lowering effect in glucose fed hyperglycemic and alloxanized diabetic rats. The methanolic extract of the flowering part of *Punica granatum* in diabetic fatty rats

markedly reduced plasma glucose levels by interfering with transit, digestion or absorption of sugars in the small intestine. *Punica granatum* was shown to inhibit intestinal α -glucosidase activity, leading to hyperglycemic property²². The flower extracts of *Punica granatum* possess significant hypoglycemic activity, which may be partly due to their stimulatory action on insulin release and may in part be due to its antioxidant activity²³.

Tectona grandis flowers

Oral administration of methanolic extract of *Tectona grandis* flowers among streptozotocin-nicotinamide induced diabetic rats significantly improved body weight and reduced blood glucose, in diabetic rats. Methanolic extract of *Tectona grandis* flowers showed the presence of polyphenolic active constituents, such as gallic acid, quercetin, rutin, ellagic acid, ferulic acid, and kaempferol, which was confirmed by HPLC. Polyphenolic active constituents present in methanolic extract of *Tectona grandis* flowers are possibly responsible for the blood glucose-lowering effect in diabetic rats via an insulin-sensitizing action, as well as inhibition of α -amylase and α -glucosidase activity²⁴.

Nymphaea stellata flowers

Administration of *Nymphaea stellata* flower extract to alloxan induced diabetic rats showed more promising results with regard to fasting blood glucose (FBG), plasma insulin levels, haemoglobin counts and urine sugar levels²⁵. *Nymphaea stellata* flowers show therapeutic promise as a protective agent against the development and progression of atherosclerosis and possible related cardiovascular complications in diabetes mellitus²⁶.

Moringa oleifera flowers

Administration of ethanolic extract of *Moringa oleifera* flowers orally exhibited improved lipid metabolism, glucose-lowering potential and beneficial in preventing diabetic complications as a result of lipid peroxidation and oxidative systems in streptozotocin-induced diabetic rats. Oral administration of ethanolic extract of *Moringa oleifera* flower significantly reduced the levels of blood glucose, serum lipids and lipid peroxidation when compared with the controls²⁷. *Moringa oleifera* flower could be employed therapeutically in managing diabetes mellitus.

Caesalpinia pulcherrima flowers

Administration of the *Caesalpinia pulcherrima* flower extract significantly decreased blood glucose levels in diabetic rats confirmed by the histopathological study with better regeneration of β cells²⁸.

Hibiscus tiliaceus flowers

The methanolic *Hibiscus tiliaceus* flower extract showed significant antidiabetic activity with significant improvement in body weight among streptozotocin induced diabetic wistar rats. Daily oral treatment with the extract resulted in significant reduction in blood glucose serum cholesterol and triglycerides. Antidiabetic properties of *Hibiscus tiliaceus* flower extract might be due to antioxidant effect of the plant²⁹.

Borassus flabellifer flowers

Oral administration of *Borassus flabellifer* flower extract significantly decreased blood glucose among the experimental rats. It is conceivable that antioxidant/ free radical scavenging activity of *Borassus flabellifer* flowers ethanol extract is one of the mechanism associated with anti-diabetic effect. The other mechanism is regeneration and moderate expansion of cellular population and size of islet of Langerhans and β cells by ethanol extracts of *Borassus flabellifer* flowers. The anti-diabetic activity of extract may be due to the presence of flavonoids and triterpenoids. It is reported that flavonoids constitute the active biological principles of most medicinal plants with hypoglycemic and anti-diabetic properties³⁰.

Saraca asoca flowers

Administration of aqueous ethanolic extract of *Saraca asoca* to diabetic rats showed a moderate decrease in the levels of blood glucose. The possible may be by increasing either the pancreatic secretion of insulin from the existing beta cells or by its release from the bound form. It is also evidenced by histopathological examination of pancreas showing expansion of islet cells, which cause more insulin secretion³¹.

Nelumbo nucifera flowers

The *Nelumbo nucifera* flower extract has been reported to decrease fasting blood glucose and increase serum insulin and WBC counts in experimental diabetic rats. *Nelumbo nucifera* flower extract possesses immunomodulatory effects and hypoglycemic activities by virtue of flavonoids from flowers. In-vitro studies revealed the improvement of glucose tolerance by increased peripheral glucose utilisation caused by increased sensitivity of skeletal muscle to endogenous insulin³³. Methanol extract from *Nelumbo nucifera* stamens revealed inhibitory activity against rat lens aldose reductase, the key enzyme of the polyol pathway³⁴.

Kigelia pinnata flowers

Oral administration of *Kigelia pinnata* flowers extracts decreased the blood glucose level significantly and showed the hypolipidemic effect. The hypolipidemic effect may be due to inhibition of fatty acid synthesis. The extract also showed improvement in lipid profile and body weight³⁵.

Tabernaemontana divaricata (L.) flowers

Administration of methanolic extract of *Tabernaemontana divaricata* flowers has considerable effect in lowering fasting blood glucose level in alloxan induced diabetic mice. The flowers extract has considerable hypoglycemic activity considering the blood sugar level in standard and diabetic control³⁶.

Combretum lanceolatum flowers

Oral administration of with ethanolic extract of *Combretum lanceolatum* flowers to diabetic rats presented reduction in glycemia, glycosuria and urinary urea levels, and increase in liver glycogen content. HPLC chromatogram showed that quercetin as the major compound in the extract. The extract appears to act through the inhibition of gluconeogenesis, since urinary urea was reduced and skeletal muscle mass was increased³⁷. Antihyperglycaemic effect of flowers is related to the reduction of the hepatic glucose output, and

its reduced production in liver of diabetic rats treated with *Combretum lanceolatum* flowers³⁸.

Calotropis gigantea Linn. flowers

The *Calotropis gigantea* Linn. flowers possess marked hypoglycemic activity that resulted in improvement of oral glucose tolerance and lowering of the serum glucose levels in diabetic rats. The presence of flavonol glycosides may be responsible for the observed anti-diabetic activity, increased glucose uptake, suppression of the gluconeogenic enzymes such as glucose-6-phosphatase³⁹.

Rhododendron arboreum flowers

Ethanol extract of *Rhododendron arboreum* flowers showed maximum antihyperglycemic activity by bringing down the blood glucose levels. Administration of the *Rhododendron arboreum* flower extract to diabetic rats enhanced the hepatic hexokinase activity and promoted glycolysis and glucose utilization for energy production. The increased insulin levels may be due to the significant reduction in the activities of gluconeogenic enzymes. And hence decrease concentration of glucose in blood⁴⁰.

Pterospermum acerifolium flowers

Ethyl acetate fraction of *Pterospermum acerifolium* flowers was found act as the potential α -amylase inhibitor. Inhibition of this enzyme activity in the digestive tract of humans is considered to be effective to control diabetes by diminishing the absorption of glucose decomposed from starch by this enzyme. The probable glucose lowering mechanism of action of active ethyl acetate fraction of *Pterospermum acerifolium* flowers is by increasing the glucose uptake in peripheral tissues and by inhibition of gluconeogenesis⁴¹.

Diplotaxis simplex flowers

The oral administration of *Diplotaxis simplex* flowers extract restored the glycemia, α -amylase activity, and serum lipid profile and antioxidant enzymes. The flowers extract exhibited a renal protective role by decreasing the urea and creatinine levels in diabetic rats' serum. *Diplotaxis simplex* flowers contain bioactive compounds such as rhamnetin, isorhamnetin, quercetin and kaempferol responsible for antioxidant and hypoglycemic properties⁴².

Coreopsis tinctoria flowers

The extract of *Coreopsis tinctoria* flowers lowered blood glucose levels through the inhibition of α -glycosidase activity. The flavonoids from *Coreopsis tinctoria* flowers displayed antioxidant activities and showed to prevent the increase of blood glucose levels. The hypoglycemic effects of the extracts may be exerted through the inhibition of α -glucosidase activity. *Coreopsis tinctoria* flower may be used as a nutraceutical or potential source of drug for diabetes⁴³.

Crocus sativus Linn

The *Crocus sativus* Linn extract ameliorated blood glucose, cognitive deficit, lipid profile, reduced oxidative stress, nitric oxide, and TNF- α in the diabetic rats. The principle mechanisms involved in the antidiabetic and neuroprotective effect of saffron are its strong antioxidant and anti-inflammatory potential. It can be recommended

in diabetic subjects as herbal drug after randomized clinical trials⁴⁴.

Azadirachta indica flowers

Decrease in blood glucose concentration after *Azadirachta indica* flower administration may be produced by several mechanisms including decreased synthesis or release of glucose by the liver or increased release of insulin or increased peripheral glucose utilization. It may be suggested that, the hypoglycemic action of *Azadirachta indica* flower may be due to its direct effect on the tissue. *Azadirachta indica* flower possess active hypoglycemic constituents⁴⁵.

CONCLUSION

Diabetes mellitus is a chronic disease which leads to various complications on long standing. Allopathic medicines are not effective in treating the disease leading to various adverse effects. Flowers which are used as popular remedies are rich source of biologically active secondary metabolites. It is very essential to have a proper documentation of medicinal flowers and their potential for the improvement of health and hygiene through an ecofriendly system. This review enriches our knowledge regarding the chemical constituents and pharmacological properties of flowers. Activity guided fractionation could isolate and characterize many compounds. Hence medicinal flowers are the best alternative for the treatment of diabetes mellitus. Discovery of novel compounds can be developed through extensive research work on bioactivity of various constituents.

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