Indian medicinal plants with hypoglycemic potentials: Review Part I

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Abstract: Blood glucose lowering activity of aqueous extract in normal and glucose loaded rats. Antihyperglycemic activity of the extract in streptozotocin-diabetic rats along with reduction in the increased plasma thiobarbituric acid reactive substance and blood urea. Exhibits significant reduction in blood glucose level, a decrease in the activities of glucose-6-phosphatase and fructose-1,6-bishophatase and an increase in the activity of liver hexokinase, resulting in potent hypoglycemic activity.

Keywords: Plant, Hypoglccemia, Blood level, Glucose, Family

Introduction: Indian medicinal plants with hypoglycemic activity:

1. Acacia Arabica

Common name: Indian Gum Arabic tree

Family: Leguminosae

Activity with route of administration/dosage:

i. Hypoglycaemic activity of 94% seed diet in normal rats orally with no blood sugar lowering activity in alloxanized rats at the same dose level.1

ii. Hypoglycemic effect of powdered seeds in normal rabbits (2, 3 and 4 mg/kg) administered orally.2
Reported mechanism of action:

Acts through release of insulin from pancreatic beta cells, which accounts for the hypoglycemic activity.\(^1,2\)

2. **Aegle marmelos (L.)**

**Common name:** Holy Fruit Tree

**Family:** Rutaceae

**Activity with route of administration/dosage:**

i. Hypoglycemic effect of aqueous decoction of the plant root bark (1 ml/100 mg) in normal fasted rats.\(^3\)

ii. Antihyperglycemic activity of aqueous leaf extract in alloxanized rats.\(^4\)

iii. Antihyperglycemic activity of aqueous leaf extract in streptozotocin induced diabetic rats.\(^5,6\)

iv. Hypoglycemic and antioxidant activity of leaves in diabetic male albino rats.\(^7\)

v. Antihyperglycemic and antioxidant activity of the plant in alloxanized rats.\(^8\)

vi. Antihyperglycemic activity of the leaves in glucose induced hyperglycemic rat at an oral dose equivalent to 250 mg/kg.\(^9\)

vii. Antihyperglycemic activity of aqueous fruit extract (250 mg/kg, twice daily for 1 month) in streptozotocin induced female albino Wistar diabetic rats.\(^10\)

viii. Hypoglycaemic activity of water extract of fruits in streptozotocin-induced diabetic Wistar rats (125 and 250 mg/kg) twice a day for 4 weeks, orally.\(^11\)

ix. Antioxidant activity of the aqueous extract of fruits in streptozotocin diabetic rats (125 and 250 mg/kg), orally for 30 days.\(^12\)

Reported mechanism of action:

Increases utilization of glucose; either by direct stimulation of glucose uptake or via the mediation of enhanced insulin secretion\(^9\) and also decreases the elevated glucose and glycosylated hemoglobin levels.\(^10\)

3. **Allium cepa L.**

**Common name:** Onion
Family: Liliaceae

Activity with route of administration/dosage:

i. Hypoglycemic activity of ether soluble fraction of onion (0.25 mg/kg p.o.) in normal rabbits.\textsuperscript{13}

ii. Hypoglycemic activity of the bulb in rabbits in an oral glucose tolerance test at 2 g/kg.\textsuperscript{14}

iii. Antihyperglycemic, antioxidant and hypolipidemic activity of a diet containing 3\% freeze dried onion powder upon prolonged administration in STZ diabetic rats.\textsuperscript{15}

Reported mechanism of action:

Lowers blood glucose level and has potent antioxidant activity, which may account for the hypoglycemic potential.\textsuperscript{13}

4. Allium sativum L.

Common name: Garlic

Family: Alliaceae

Activity with route of administration/dosage:

i. Antihyperglycemic activity of ethanol, petroleum ether and ethyl acetate extract in alloxanized rabbits at a dose of 0.25 mg/kg, orally.\textsuperscript{16}

ii. Antioxidant activity of allicin, isolated from garlic.\textsuperscript{17}

Reported mechanism of action:

Has strong antioxidant activity and rapid reactivity with thiol containing proteins responsible for the hypoglycemic property.\textsuperscript{17}

5. Aloe vera (L.)

Common name: Aloe

Family: Aloaceae

Activity with route of administration/dosage:

i. Hypoglycemic activity of the plant (200 and 300 mg/kg p.o.) on normal fasted rats, oral glucose-loaded rats and streptozotocin-induced diabetic rats.\textsuperscript{18}

ii. Hypoglycaemic activity of leaf pulp extracts in type I and type II diabetic rats.\textsuperscript{19}
iii. Hypoglycemic effect of aloe and its bitter principle in alloxanized mice.²⁰

iv. Antihyperglycemic activity of dried sap in five non-insulin-dependent diabetic patients and in alloxanized Swiss albino mice.²¹

Reported mechanism of action:
Maintains glucose homeostasis by controlling the carbohydrate metabolizing enzymes 18 and stimulates insulin release from pancreatic beta cells.²⁰

6. Artemisia pallens

Common name: Davana

Family: Compositae

Activity with route of administration/dosage:

i. Antihyperglycemic activity of aerial parts (100 mg/kg, orally) in glucose-fed hyperglycaemic and alloxan-induced diabetic rats. Moderate hypoglycaemic effect (1000 mg/kg) in fasted normal rats.²²

7. Annona squamosa L.

Common name: Sugar apple

Family: Annonaceae

Activity with route of administration/dosage:

i. Hypoglycemic activity of aqueous leaf extracts in streptozotocin-nicotinamide induced diabetic rats.²³

ii. Hypoglycemic and antihyperglycemic activities of ethanolic leaf-extract (350 mg/kg, orally) in normal, streptozotocin (STZ)-diabetic rats and alloxanized rabbit.²⁴

Reported mechanism of action:
Lowers blood glucose level.²³

8. Andrographis paniculata

Common name: King of Bitter

Family: Acanthaceae

Activity with route of administration/dosage:

Inhibits glucose re-absorption or increase in peripheral glucose utilization.²²
i. Hypoglycemic and antihyperglycemic activity of Andrographis paniculata and andrographolide in normal and streptozotocin induced diabetic rats, orally.  

Reported mechanism of action:

Prevents glucose absorption from gut.  

9. Azadirachta indica

Common name: Neem

Family: Meliaceae

Activity with route of administration/dosage:

i. Hypoglycemic activity of hydro alcoholic plant extract in normal rats and hypoglycemic activity in glucose fed and streptozotocin induced diabetic rats.  

Reported mechanism of action:

Inhibits action of epinephrine on glucose metabolism, resulting in increased utilization of peripheral glucose and exhibits hypoglycaemic activity without altering the serum cortisol concentration.  

10. Biophytum sensitivum (L.)

Common name: Life Plant

Family: Oxalidaceae

Activity with route of administration/dosage:

i. Hypoglycemic activity of the plant leaf extract in alloxan diabetic male rabbits.  

ii. Hypoglycemic activity of the plant on glucose homeostasis in rabbits.  

Reported mechanism of action:

Stimulates pancreatic beta cells to release insulin.  

11. Beta vulgaris L.

Common name: Garden beet

Family: Chenopodiaceae
Activity with route of administration/dosage:

i. Hypoglycemic activity of Betavulgarosides II–IV, isolated from the root of Beta vulgaris L. in an oral glucose tolerance test in rats.\(^{31}\)

Reported mechanism of action:

Lowers blood glucose level.\(^{31}\)

12. Brassica juncea (L.)

Common name: Brown Mustard

Family: Brassicaceae

Activity with route of administration/dosage:

i. Hypoglycemic activity of Brassica juncea diet (10%, w/w) in normal rats upon oral administration for 60 days.\(^{32}\)

Reported mechanism of action:

Increases the concentration of hepatic glycogen and glycogenesis and suppressed the activity of glycogen phosphorylase and gluconeogenic enzymes, lead to reduction in glycogenolysis and gluconeogenesis.\(^{32}\)

13. Boerhavia diffusa L.

Common name: Tar vine

Family: Nyctaginaceae

Activity with route of administration/dosage:

i. Hypoglycemic activity of aqueous leaf extract at a dose of 100, 200 and 400 mg/kg in alloxan induced diabetic rats.\(^{33}\)

ii. Hypoglycemic and antihyperglycemic activity of aqueous leaf extract (200 mg/kg p.o., daily for 4 weeks) in normal and alloxan induced diabetic rats.\(^{34,35}\)

Reported mechanism of action:

Increases plasma insulin levels and improves glucosentolerance, produced significant antioxidant activity.\(^{34,35}\)

14. Cassia auriculata L.

Common name: Tanner’s
Family: Leguminosae

Activity with route of administration/dosage:

i. Antihyperglycemic and antihyperlipidemic activity of aqueous flower extract in streptozotocin-induced diabetic rats upon oral administration at different doses for 30 days.\(^{36,37}\)

ii. Antioxidant activity of aqueous flower extract in the brain of streptozotocin diabetic rats.\(^{38,39}\)

Reported mechanism of action:
Suppresses enhanced gluconeogenesis during diabetes and enhance utilization of glucose through increased glycolysis\(^{36,37}\) in addition to pronounced alpha-glucosidase inhibitory actions resulting in a significant and potent lowering of blood glycemic response.\(^{38,39}\)

15. *Caesalpinia bonducella* (L.)

Common name: Chinese Cinnamon

Family: Caesalpiniaceae

Activity with route of administration/dosage:

i. Hypoglycemic and antihyperglycemic activities of the aqueous and 50% ethanolic seed extracts in normal and streptozotocin-diabetic rats.\(^{40}\)

ii. Antihyperglycemic activity of the seed extracts in type II diabetic Long Evans rat.\(^{41}\)

iii. Hypoglycemic activity of aqueous and ethanolic extracts in chronic type II diabetic model with an increase in secretion of insulin from isolated islets.\(^{42}\)

Reported mechanism of action:
Increases the release of insulin from pancreatic cells.\(^{40}\)

16. *Cajanus cajan* (L.)

Common name: Pigeon pea

Family: Fabaceae

Activity with route of administration/dosage:
i. Glucose tolerance enhancing activity of aqueous leaf and stem extract in oral glucose tolerance test.\textsuperscript{43}

ii. Hypoglycemic activity of cooked diet in healthy human volunteers.\textsuperscript{44}

**Reported mechanism of action:**

Lower plasma glucose level.\textsuperscript{45}

17. *Citrullus colocynthis* (L.)

**Common name:** Bitter apple

**Family:** Cucurbitaceae

**Activity with route of administration/dosage:**

i. Hypoglycemic activity of alcoholic leaf extract in normoglycemic guinea pig.\textsuperscript{49}

ii. Hypoglycemic activity of the leaves in alloxanized dogs upon oral administration.\textsuperscript{50}

iii. Hypoglycemic and antihyperglycemic activity of the ethanolic root extract in fasted and glucose-loaded animal models.\textsuperscript{51}

iv. Hypoglycemic effect of 95% ethanol extract of the leaves in normal fed and 48 h starved rats.\textsuperscript{52}

v. Blood glucose lowering activity of 60% ethanol leaf extract (200 mg/kg, orally).\textsuperscript{53}

18. *Coccinia indica*

**Common name:** Ivy gourd

**Family:** Cucurbitaceae

**Activity with route of administration/dosage:**

i. Hypoglycemic activity of aqueous extract (300 mg/kg), glycosidic and saponin extract (50 mg/kg), orally in normal rabbits.\textsuperscript{46,47}

**Reported mechanism of action:**

Exerts an insulinotropic effect.\textsuperscript{46,47}
vi. Hypoglycemic activity of the leaf extract in a double blind control trial in human subjects.$^{54, 55}$

vii. Antihyperglycemic activity of dried extract (500 mg/kg p.o., for 6 weeks) in 30 diabetic patients.$^{56}$

**Reported mechanism of action:**

Suppresses glucose synthesis, through depression of the key gluconeogenic enzymes glucose-6-phosphatase and fructose-1,6-bisphosphatase and enhances glucose oxidation by shunt pathway through activation of its principal enzyme glucose-6-phosphate dehydrogenase.$^{52}$ Also has an insulin secretagogue effect$^{54, 55}$ and acts like insulin by correcting elevated enzymes in glycolytic pathway and restoring LPL activity in lypolytic pathway with control of hyperglycemia in diabetes.$^{56}$


**Common name:** Carilla

**Family:** Flacourtiaceae

**Activity with route of administration/dosage:**

i. Antihyperglycaemic activity of root extract (300 mg/kg p.o. for 45 days) in normal and streptozotocin-induced diabetic rats.$^{57}$

ii. Blood glucose lowering activity of aqueous extract in normal and glucose loaded rats. Antihyperglycemic activity of the extract in streptozotocin-diabetic rats along with reduction in the increased plasma thiobarbituric acid reactive substance and blood urea.$^{58}$

**Reported mechanism of action:**

Exhibits significant reduction in blood glucose level, a decrease in the activities of glucose-6-phosphatase and fructose-1,6-bisphosphatase and an increase in the activity of liver hexokinase, resulting in potent hypoglycemic activity.$^{57}$

20. *Catharanthus roseus* (L.)

**Common name:** Madagascar periwinkle

**Family:** Apocynaceae
Activity with route of administration/dosage:

i. Hypoglycemic activity of ethanolic leaf extract in normal rats upon oral administration at graded dose. Hypoglycemic activity of the extract (500 mg/kg) in streptozotocin rats and in oral glucose tolerance test.  

ii. The hypoglycemic activity of dichloromethane: methanol extract of leaves and twigs in streptozotocin (STZ) induced diabetic rat (500 mg/kg p.o., for 7 and 15 days).  

iii. Hypoglycemic and antihyperglycemic activity of leaf juice or water decoction of the plant in normal and alloxan-induced diabetic rabbits.  

Reported mechanism of action:

Increases metabolism of glucose and enhances secretion of insulin either from the beta cells of Langerhans or through extrapancreatic mechanism.

21. Camellia sinensis

Common name: Green tea

Family: Theaceae

Activity with route of administration/dosage:

i. Antihyperglycemic activity of hot water extract of green tea in streptozotocin (STZ)-diabetic rats.

Reported mechanism of action:

Epigallocatechin gallate, present in tea increases insulin activity and prevent oxidative damages, responsible for the hypoglycemic activity.

Conclusion:

From the above work it is clear that number of medicinal plants used to treat hyperglycemia.

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Reference:

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