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Indian medicinal plants with hypoglycemic potentials: Review Part II

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Abstract: Antihyperglycemic activity of whole plant aqueous extract in alloxan induced diabetic rats along with reduction of glycosylated haemoglobin and glucose-6-phosphatase activity in liver. Mechanism may be mediated through an insulin release mechanism¹ or due to alteration in hepatic and skeletal muscle glycogen content and hepatic glucokinase, hexokinase, glucose-6-phosphate and phosphofructokinase levels in diabetic mice.

Keywords: Plant, Hypoglycemic activity, Family, Alloxan

Introduction: Indian medicinal plants with hypoglycemic activity:

1. Eugenia jambolana Lam.

Common name: Indian black berry

Family: Myrtaceae

Activity with route of administration/dosage:

- i. Hypoglycemic activity of pulp extract of the fruits in normal as

well as STZ diabetic rats upon oral administration.¹

- ii. Blood glucose lowering activity of aqueous seed extract (2.5 and 5.0 g/kg body weight p.o. for 6 weeks) along with an increase in total haemoglobin and antioxidant activity in diabetic rats.²

- iii. The blood glucose lowering activity of alcoholic extract (100 mg/kg p.o.) in alloxan diabetic

- rats along with reduction in urine sugar and lipids in serum and tissues.³
- iv. Hypoglycemic effect of aqueous, alcoholic extracts and lyophilized powder (200 mg/kg per day) of the plant in hyperglycemic animals.⁴
 - v. Antihyperglycemic and antihyperinsulinemic activity of aqueous extracts (400 mg per day) in fructose fed rats.⁵
 - vi. Reduction in plasma glucose concentration by the extract (200 mg/kg) upon administration for 50 days in STZ induced diabetic mice.⁶
 - vii. Hypoglycemic activity of ethanolic seed extract in alloxan-induced diabetic rabbits along with hypolipidemic effect.⁷
 - viii. Hypoglycemic activity of ethanolic whole seeds, kernel (100 mg/kg of body weight) and seed coat extracts in streptozotocin-induced diabetic rats.⁸
 - ix. Hypoglycemic activity of inorganic trace elements, obtained from the seeds in streptozotocin-induced diabetic rats.⁹
 - x. Antioxidant activity of ethanolic seed kernel extract in streptozotocin-induced diabetic rats upon oral administration.¹⁰
 - xi. Blood glucose lowering activity of seed powder in streptozotocin diabetic female albino Wistar rats at a dose of 250, 500 or 1000 mg/kg, orally.¹¹

Reported mechanism of action:

May be mediated through an insulin release mechanism¹ or due to alteration in hepatic and skeletal muscle glycogen content and hepatic glucokinase, hexokinase, glucose-6-phosphate and phosphofructokinase levels in diabetic mice.⁴ It also enhances serum insulin activity⁷ and exhibits normoglycemia and better glucose tolerance.⁸

2. Enicostemma littorale

Common name: Blume

Family: Gentiaceae

Activity with route of administration/dosage:

- i. Antihyperglycemic activity of whole plant aqueous extract in alloxan induced diabetic rats along with reduction of glycosylated haemoglobin and glucose-6-phosphatase activity in liver.¹²
- ii. Insulin enhancing activity of a single dose of aqueous extract of plant (15 g dry plant equivalent extract per kg) in alloxan-induced diabetic rats.¹³
- iii. Glucose lowering activity of aqueous extract (2 g/kg p.o.) daily for 6 weeks in neonatal non-insulin-dependent diabetes mellitus (NIDDM) rats along with a decrease in the elevated cholesterol, triglyceride and creatinine levels.¹⁴
- iv. Reduction in glycosylated haemoglobin, liver glucose-6-phosphatase activity and significant increase in serum insulin levels of the diabetic rats by aqueous extract.¹⁵

- v. Antioxidant activity of the whole plant aqueous extract (1 and 2 g/kg) in alloxanized rats upon oral administration for 45 days.¹⁶

Reported mechanism of action:

Enhances glucose-induced insulin release from isolated rat pancreatic islets, mediated through K (+)-ATP channel-dependent pathway.¹³

3. Ficus bengalensis L.

Common name: Banyan tree

Family: Moraceae

Activity with route of administration/dosage:

- i. Hypoglycemic activity of ethanolic bark extract and a glucoside isolated from the plant in normal and alloxan diabetic rabbits.¹⁷
- ii. Blood glucose lowering activity of bark extract in processes (Kumar and Augusti, 1989) streptozotocin-induced diabetic animals upon oral administration

- and enhancement of serum insulin levels in normoglycemic and diabetic rats.18
- iii. Blood sugar lowering activity of a dimethoxy derivative of leucocyandin 3-O-beta-d-galactosyl cellobioside isolated from the bark in normal and moderately diabetic rats along with an increase in serum insulin in the diabetic rats at a dosage of 250 mg/kg for a 2 h period upon oral administration.19
 - iv. Antihyperglycemic activity of dimethoxy derivative of perlargonidin 3-O-alpha-l rhamnoside (250 mg/kg, single dose study and 100 mg/kg/day long term study) in moderately diabetic rats. Hypoglycemic and serum insulin raising activity in normal and moderately diabetic dogs during a period of two hours.20, 21
 - v. Hypoglycemic, hypolipidemic and serum insulin raising effects of glycoside of leucopelargonidin isolated from the bark in moderately diabetic rats.22

- vi. Hypoglycemic activity of Leucodelphinidin derivative in normal and alloxan diabetic rats at a dosage of 250 mg/kg.23

Reported mechanism of action:

Stimulates insulin secretion from beta cells of islets of langerhans 18, 20, 21 and inhibits insulin degradative processes. 19

4. Hibiscus rosa sinensis L.

Common name: China Rose

Family: Malvaceae

Activity with route of administration/dosage:

- i. Hypoglycemic activity of single dose of ethanol extract of the plant in glucose-loaded rats at 120 min and blood glucose lowering effect after repeated administration for seven consecutive days at 30, 90 and 120 min after glucose loading.24
- ii. Hypoglycemic activity of alcoholic leaf extract (250 mg/kg p.o. for seven consecutive days)

- in glucose induced hyperglycemia model in rats.²⁵
- iii. Blood glucose lowering activity of ethanol flower extract in streptozotocin induced diabetic rats along with a reduction in total cholesterol and serum triglycerides.²⁶

Reported mechanism of action:

Stimulates insulin secretion from pancreatic beta cells²⁴ and increases utilization of glucose, either by direct stimulation of glucose uptake or via the mediation of enhanced insulin secretion.²⁵

5. Helicteres isora L.

Common name: Screw tree

Family: Sterculiaceae

Activity with route of administration/dosage:

- i. Plasma glucose lowering activity of ethanolic root extract (300 mg/kg, after 9 days of

administration) in insulin resistant and diabetic C57BL/KsJdb/db mice associated with a reduction in plasma triglyceride level.²⁷

- ii. Antihyperglycemic activity of butanol root extracts (250 mg/kg) in glucose loaded rats.²⁸

Reported mechanism of action:

Acts through insulin-sensitizing activity.²⁷

6. Ipomoea batatas (L.)

Common name: Sweet potato

Family: Convolvulaceae

Activity with route of administration/dosage:

- i. Hypoglycemic effect of the plant against diabetic Zucker fatty rats and inhibition of the increased blood glucose level in a glucose tolerance test in rats.²⁹
- ii. Postprandial glucose suppression effect (reduced blood glucose level by 16.5% at 30 min) of

Peonidin 3-O-[2-O-(6-O-E-feruloyl-beta-d-glucopyranosyl)-6-O-Ecaffeyl-beta-d-glucopyranoside]-5-O-beta-d-glucopyranoside, a diacylated anthocyanin, isolated from storage roots in male 8-week-old Sprague-Dawley rats upon single oral administration.³⁰

Reported mechanism of action:

Reduces insulin resistance²⁹ and possibly acts by maltase inhibition, not by sucrase or glucose transport inhibition at the intestinal membrane.³⁰

7. Mangifera indica L.

Common name: Mango

Family: Anacardiaceae

Activity with route of administration/dosage:

- i. Hypoglycemic activity of aqueous leaf extract (1 g/kg p.o.), given along with as well as 60 min before glucose administration in streptozotocin-induced diabetic rats.³¹

- ii. Hypoglycemic activity of Mangiferin (10 and 20 mg/kg, i.p. once daily for 28 days) in STZ induced diabetic rats and improvement in oral glucose tolerance in glucose-loaded normal rats upon chronic administration (10 and 20 mg/kg, i.p.) for 14 days.³²

Reported mechanism of action:

Possibly acts through intestinal reduction of the absorption of glucose³¹ as well as pancreatic and extrapancreatic mechanisms.³²

8. Momordica cymbalaria

Common name: Hook

Family: Cucurbitaceae

Activity with route of administration/dosage:

- i. Blood glucose level reducing activity of fruit powder in fasted alloxan-induced diabetic rats after a treatment for 15 days.³³

- ii. Blood glucose lowering effect of aqueous fruit extract in alloxan diabetic rats.³⁴
- iii. Antihyperglycemic activity of aqueous fruit extract (0.5 g/kg dose for 6 weeks) in alloxan-induced diabetic rats upon oral administration.³⁵

Reported mechanism of action:

May act by increasing hepatic glycogen.³³

9. Mucuna pruriens

Common name: Velvet bean

Family: Leguminosae

Activity with route of administration/dosage:

- i. Blood glucose lowering activity of powdered seeds (0.5, 1 and 2 g/kg) in normal rabbits and hypoglycemic activity of the seed (1 and 2 g/kg body weight) in alloxan-diabetic rabbits.³⁶
- ii. Blood glucose lowering activity of plant extract (200 mg/kg)

upon daily oral feeding for 40 days in STZ-diabetic mice.³⁷

- iii. Antihyperglycaemic effect of alcohol extract of the plant (100, 200 and 400 mg/kg/day) in alloxanized rats and insignificant glucose lowering effect in streptozotocin (STZ) diabetic mice.³⁸

Reported mechanism of action:

Possibly acts through stimulation of the release of insulin and/or by a direct insulin-like action due to the presence of trace elements like manganese, zinc, etc.³⁶

10. Morus alba L.

Common name: White mulberry

Family: Moraceae

Activity with route of administration/dosage:

- i. Hypoglycemic activity of hot water extract of leaves in fasted and non-fasted streptozotocin

- induced diabetic mice at a dose of 200 mg/kg, i.p.³⁹
- ii. Degranulation effect of leaf-extract on the beta cells of islets of langerhans of rabbits upon chronic subcutaneous administration.⁴⁰

Reported mechanism of action:

Acts by increasing glucose uptake.³⁹

11. Acacia Arabica

Common name: Curry-leaf tree

Family: Rutaceae

Activity with route of administration/dosage:

- i. Fasting as well as post-prandial blood sugar lowering effect of leaf-powder in Type II diabetic patients upon administration for a period of 1 month.⁴¹
- ii. Blood sugar lowering effect of the leaves in normal rats when administered as a diet (10%, v/v) for 60 days.⁴²

Reported mechanism of action:

Increases glycogenesis and decreases glycogenolysis and gluconeogenesis.⁴²

12. Ocimum sanctum L.

Common name: Holy Basil

Family: Lamiaceae

Activity with route of administration/dosage:

- i. Hypoglycemic activity of 70% ethanolic leaf extract in normal, glucose fed and STZ diabetic rats, orally. The extract also potentiated the action of exogenous insulin in normal rats.⁴³
- ii. Fasting blood glucose level reducing activity of the leaf powder, given along with food for 1 month, in normal and diabetic rats.⁴⁴
- iii. Plasma glucose lowering activity of plant extract (200 mg/kg for 30 days) in STZ induced diabetic animals revealing the effect of the extract on three important

- enzymes of carbohydrate metabolism, namely glucokinase, hexokinase and phosphofructokinase.⁴⁵
- iv. Glucose and cortisol lowering activity of the plant in male mice.⁴⁶

Reported mechanism of action:

Acts by cortisol inhibiting potency.⁴⁶

13. Punica granatum L.

Common name: Pomegranate

Family: Punicaceae

Activity with route of administration/dosage:

- i. Blood glucose lowering activity of a 50% (v/v) ethanolic flower extract in glucose fed and alloxanized hyperglycemic rats.⁴⁷
- ii. Hypoglycemic activities of methanolic seed extract (150, 300 and 600 mg/kg p.o.) in streptozotocin diabetic rats at the end of 12 h.⁴⁸

- iii. Plasma glucose lowering activity of methanolic extract of the flowering part in non-fasted Zucker diabetic fatty rats.⁴⁹

Reported mechanism of action:

Inhibits intestinal alpha-glucosidase activity, leading to antihyperglycemic property.⁴⁹

14. Salacia reticulata Wight.

Common name: Salacia

Family: Celastaceae

Activity with route of administration/dosage:

- i. Blood glucose lowering effect of aqueous decoction in fasted animals with improved glucose tolerance in laboratory animals.^{50, 51}
- ii. Hypoglycemic activity of plant tea in type II diabetic patients in a randomised single centre double blind cross over clinical trial.⁵²

Reported mechanism of action:

Inhibits alpha-glucosidase activity.^{50, 51}

15. Salacia Oblonga Wall.

Common name: Salacia

Family: Celastaceae

Activity with route of administration/dosage:

- i. Serum glucose lowering activity of aqueous methanolic extract of the roots in sucrose and maltose loaded rats and alpha-glucosidase and aldose reductase inhibitory activities of water soluble and ethyl acetate soluble fractions of the aqueous methanolic extract in same animal model.⁵³
- ii. Antihyperglycemic, antihypoinsulinemic and antioxidant activity of petroleum ether extract of the root bark in streptozotocin diabetic rats.⁵⁴
- iii. Antihyperglycemic effect of water extract in the obese Zucker rat (OZR) (genetic model of Type II diabetes) along with the effect on cardiac fibrosis upon chronic administration.⁵⁵
- iv. Plasma glucose and serum insulin reducing activity of the extract (1000 mg/kg) along with

an alpha glucosidase inhibitory activity in a double-masked randomized cross over clinical study in healthy adults.⁵⁶

Reported mechanism of action:

Acts through inhibition of alpha-glucosidase activity.⁵³

16. Swertia chiravita

Common name: Indian Gentian

Family: Gentianaceae

Activity with route of administration/dosage:

- i. Blood glucose lowering activity of hexane fraction of 95% ethanol extract (250 mg/kg) in fed, glucose loaded and tolbutamide pretreated animals.⁵⁷
- ii. Insulin releasing effect of the hexane fraction of the plant (250 mg/kg body weight p.o. per day for 28 days) in albino rats along with a significant rise in liver glycogen.⁵⁸

- iii. Blood sugar lowering activity of swerchirin, (1,8-dihydroxy-3,5-dimethoxyxanthone), isolated from hexane fraction of the plant in fasted, fed, glucose loaded and tolbutamide pretreated albino rats.59
- iv. Blood sugar lowering effect of Swerchirin (50 mg/kg p.o.) in healthy and streptozotocin treated (35 mg/kg i.v.) Charles Foster strain albino rats.60

Reported mechanism of action:

Stimulates insulin release from islets of Langerhans by depleting aldehyde-fuchsin stained beta-granules and immunostained insulin.60

17. Scoparia dulcis L.

Common name: Sweet Broomweed

Family: Scrophulariaceae

Activity with route of administration/dosage:

- i. Hypoglycemic activity of aqueous leaf extract (0.15, 0.30 and 0.45 g/kg body weight for 45

days p.o.) in experimental diabetic rats along with a reduction in glycosylated haemoglobin and an increase in total haemoglobin.61

- ii. Blood glucose, sorbitol dehydrogenase, glycosylated pancreatic islets (Latha et al., 2004a) hemoglobin, thiobarbituric acid reactive substances, hydroperoxides reducing and plasma insulin, glutathion peroxidase, glutathion S-transferase enhancing activities of aqueous plant extract (200 mg/kg) in the liver of streptozotocin adult diabetic male albino Wistar rats.62
- iii. Plasma insulin and plasma antioxidants enhancing activity of aqueous extract for 6 weeks at a dose of 200 mg/kg p.o. in diabetic rats.63
- iv. The insulin secretagogue activity of the plant extracts in isolated mice pancreatic islets at a dose of 10 mg/ml.64
- v. In vitro insulin secretagogue activity of the extract of this plant in rat insulinoma cell lines

(RINm5F cells) treated with streptozotocin.⁶⁵

Reported mechanism of action:

Suppresses glucose influx into the polyol pathway leading to increased activities of antioxidant enzymes and plasma insulin and decreases activity of sorbitol dehydrogenase.⁶² Also potentiates insulin release from pancreatic islets.⁶⁴

Conclusion:

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