Research Article
ISSN: 0976-1209

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Antihyperglycemic activity of *Boerhaavia diffusa* in streptozotocin induced diabetic rats

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Received on: 15-11-2013; Revised on: 18-11-2013; Accepted on:21-12-2013

ABSTRACT

Background: Many Indian medicinal plants were investigated in streptozotocin induced diabetic rat model and provided scientific validation to prove their antihyperglycemic activity. In view of alleged antidiabetic potential, effect of the aqueous and methanol extracts of *Boerhaavia diffusa* (Nyctaginaceae) roots, was observed on fasting blood sugar levels in streptozotocin induced diabetic rats. **Methods:** Fasting plasma glucose levels were determined by an enzymatic method using a kit. **Results:** Results show that both the extracts significantly reduced the blood glucose level in STZ induced diabetic rats. **Conclusion:** A plausible mechanism of action is that the extracts might have stimulated the residual pancreatic beta-cell function or produced the hypoglycaemia.

Key words: Antihyperglycemic activity, *Boerhaavia diffusa*, Streptozotocin.

1. INTRODUCTION

Diabetes mellitus is a metabolic disorder in the body[1] .The ß-cells secrete less amount of insulin so that glucose cannot be converted into the source of energy and its level rises in the blood. Currently available synthetic antidiabetic agents produce serious side effects like hypoglycemic coma and hepatorenal disturbances[2]. Diabetes may be insulin dependent or non-insulin dependent. In insulin dependent diabetes mellitus, the ß-cells of Islets of langerhans of pancreas of patients are either malfunctioning or destroyed. In noninsulin dependent diabetes mellitus, the patient exhibits insulin resistance and then concomitantly develops insulin secretory defect[3]. Type 1 diabetes is treated with exogenous insulin and type 2 diabetes is treated with oral hypoglycemic agent (sulphonylureas, biguanides) [4]. Diabetes mellitus is a condition in which the pancreas no longer produces enough insulin or when cells stop responding to the insulin that is produced, so that glucose in the blood cannot be absorbed into the cells of the body. The body will attempt to dilute the high level of glucose in the blood, a condition called hyperglycemia.

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2. EXPERIMENTAL

2.1 Materials and methods

2.1.1 Plant material

The roots of *Boerhaavia diffusa* were collected from local trader, Dehradun (Uttarakhand) and specimen was identified and authenticated at the Botanical Survey of India, Northern Zone, Dehradun with Accession No. 114549 and a sample deposited in the herbarium of BSI, Dehradun, U.K.

2.1.2 Preparation of extract

Plants were air dried at room temperature for 3 weeks to get consistent weight. The dried plants were later ground to crude powder. Two hundred grams of crude powder plant material were shaken separately in methanol and aqueous medium respectively for 24 hrs on an orbital shaker at room temperature. Extracts were filtered using a Buckner funnel and Whatman No 1 filter paper. Each filtrate was concentrated to dryness under reduced pressure at 40°C through evaporator. The extract was resuspended in the respective solvent for further estimation[6].

The extractive yields were found to be 10.5% and 8.45% for aqueous and methanolic extract of *Boerhaavia diffusa*, respectively.

2.2 Induction of diabetes

Male albino rats, weighing about 180-200 g were purchased from IVRI,

Bareilly,were conditioned to animal house environment prior to the experiment. The protocol of the study was approved by the animal ethical committee of the institution. The rats were given pelleted rat chow and water ad libitum.The animals were starved overnight and then diabetes was induced by a single intravenous injection of a freshly prepared streptozotocin (STZ) solution (50 mg/kg body wt). Streptozotocin was dissolved in 10mM freshly prepared citrate buffer solution (pH 4.5).The animals were allowed to drink 5% glucose solution overnight[5]. After 5 days, streptozotocin administration, rats showing diabetes average plasma glucose level of =251 mg/dl were classified as diabetic and included in the present investigation.Control rats were injected with citrate buffer alone. The root extract in aqueous and methanolic solution respectively was administered orally through gastric intubation at a concentration of 200 mg/kg body weight/rat, twice a day for 16 weeks.

2.3 Experimental design

The animals were divided into four groups for the analysis of biochemical parameter.

Each group has 6 animals.
Group I: Normal control rats.
Group II: Diabetic control rats.
Group III: Diabetic rats treated with *Boerhaavia diffusa* aqueous root extract 200 mg/kg body wt orally.
Group IV: Diabetic rats treated with *Boerhaavia diffusa* methanolic root extract 200 mg/kg body wt orally.

2.4 Measurement of glucose

Fasting plasma glucose levels were determined by an enzymatic method using a kit from Autospan, New Delhi.

2.5 Statistical Analysis

This was done by employing two-tailed Student t-test as described by Bennet and Franklin (1967)[7]. P value less than 0.02 were considered significant.

3. RESULTS AND DISCUSSION

3.1 Effect of *Boerhaavia diffusa* extract on body weight in Streptozotocin induced diabetic rats

In the antidiabetic activity, the effects of *Boerhaavia diffusa* aqueous and methanolic root extract on body weight is of post induction and were compared with normal and diabetic control groups. The values are shown in Table1. Streptozotocin induced diabetic rats showed a significant decrease in body weight compared to normal rats. Oral administration of both the root extracts of *Boerhaavia diffusa* at the dose of 200mg/kg showed a significant increase in body weight when compared to diabetic control rats. The methanolic extract showed higher increase in weight compared to aqueous extract.The diabetic control rats showed significant decrease in body weight as observed for diabetes patients.

Table 1: Effect of *Boerhaavia diffusa* extract on body weight in Streptozotocin induced diabetic rats

Sample	Weight in g (Before treatment)	Weight in g (After treatment)	Percentage change in weight
Normal control	167.2±3.25	181±3.34	+8.14%
Diabetic control	163.8±3.34	125.3±2.39	-23.33%
Aqueous extract	164.3±1.98	175.8±1.47	+6.6%
Methanolic extract	165.1±2.77	178.5±2.37	+7.74%

Values are expressed as Mean ± S.E. n=6.

3.2 Effect of *Boerhaavia diffusa* extract on average diet consumption in Streptozotocin induced diabetic rats

Table2 depicts the values for effect of *Boerhaavia diffusa* extract on average diet consumption in Streptozotocin induced diabetic rats .The average food intake for aqueous and methanol extract treated groups was significantly higher that the control groups. The average water intake during study period was significantly higher in experimental groups compared to normal control**.**

Table2: Effect of *Boerhaavia diffusa* extract on average diet consumption in Streptozotocin induced diabetic rats

Sample	Average food consumption /group/day (g) (Before treatment)	(After treatment)	Average water intake/ group/day (ml) (Before treatment)	(After treatment)
Normal control	185±4.00	191.64±9.40 +3.58%	160±21.9	163±25.8
Diabetic control	175±5.12	170±4.12 -2.85%	267±20.1	283±15.7
Aqueous extract	191.23±6.62	201.64±3.66 +5.45%	262±15.4	264±16.4
Methanolic extract	191.23±6.62	220±10.11 +15.04%	260±27.4	264±18.2

Values are expressed as Mean ± S.E. n=6.

3.3 Blood glucose level in Streptozotocin induced diabetic rats

In the present work, we have described the antidiabetic activity of the aqueous and methanolic extracts of the *Boerhaavia diffusa* in STZ induced diabetic rats. As shown in Table 3, the methanolic and aqueous extracts significantly reduced the blood glucose level in STZ induced diabetic rats. The antidiabetic activity of methanolic extract observed was better compared to same dose of aqueous extract. In diabetic albino rats, maximum percentage reduction was found to be 18.88% and 9.91%, respectively for methanolic and aqueous extracts. Barik *et al.*,2008 have discovered the antidiabetic activity of root extract of *Ichnocarpus frutescens*[8]. They have observed maintenance of blood glucose level in normal and streptozotocin induced diabetic rats. Chaurasia *et al.*, 2011 studied the effect of the methanol and aqueous extracts of *Morus alba* (Moraceae) leaves on fasting blood sugar levels in streptozotocin induced diabetic rats.Their result draws similar conclusion of methanolic extract being more effective to reduce blood glucose level that the aqueous extract of *Morus alba*[9].

Table 3: Blood glucose level in Streptozotocin induced diabetic rats

Sample	Blood glucose level (Before treatment)	Blood glucose level (After treatment)	Percentage reduction in blood glucose level
Normal control	62.2±1.22	60.47±1.16	0.22%
Diabetic control	268.67 ± 5.13	267.67 ± 6.89	0.37 %
Aqueous extract	263.34 ± 4.33	237.23 ± 6.89	9.91 %
Methanolic extract	264.17 ± 9.60	214.33 ± 5.33	18.88 %

Values are expressed as Mean ± S.E. n=6.

From the study, it is suggested that the possible mechanism by which the plant extract decreases the blood glucose level may be by potentiation of insulin effect either by increase in pancreatic secretion of insulin from beta cells of islets of langerhans or by increase in peripheral glucose uptake. From the phytochemical analysis it was found that the major chemical constituents of the root extract were phenols, flavonoids and glycosides. On the basis of above evidence it is possible that the presence of phenols and flavonoids may be responsible for the observed antidiabetic activity.

4. CONCLUSION

In the present study we can conclude that a plausible mechanism of action is that the extracts might have stimulated the residual pancreatic beta-cell function or produced the hypoglycaemia through an extra-pancreatic mechanism, probably increasing peripheral utilization of glucose. The hypoglycemic effect produced by the extract of *B. diffusa* roots may be due to the glycosides, flavonoids, tannins and saponins present in the extract. Further investigation is expected to characterize the active hypoglycemic principles and to elucidate the mechanism of action.

CONFLICTS OF INTEREST

All authors have none to declare.

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Source of support: Nil, Conflict of interest: None Declared