Hypoglycemic effect of Methanolic extract of *Feronia elephantum* fruits in Streptozotocin diabetic rat

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**ABSTRACT**

The objective of the present investigation is to elucidate hypoglycemic activity of Methanolic fruit extract of *Feronia elephantum* in streptozotocin induced diabetes in Wistar rats. Diabetes was produced by streptozotocin (50mg/kg,i.p.) in 0.1 M citrate buffer. The Plant extract (400mg/kg, p.o.) was administered once daily for thirty days, while standard group received glibenclamide (0.9 mg/kg). At the end of the study the blood glucose level was analyzed. The methanolic extract showed significant hypoglycemic activity and efficacy of extract was almost comparable to that of glibenclamide.

**Key words:** *Feronia elephantum*; hypoglycemic activity.

**INTRODUCTION**

Diabetes mellitus (DM) is a group of metabolic disorders characterized by hyperglycemia and abnormalities in carbohydrate, fat, and protein metabolism. It results from defects in insulin secretion, insulin sensitivity, or both. The prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030. The total number of peoples with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. Although, oral hypoglycemic agents (OHA) / insulin are the mainstay of treatment of diabetes and are effective in controlling hyperglycemia, they have prominent side effects and fail to significantly alter course of diabetic complications. Though there are various approaches to reduce the ill effects of diabetes and its secondary complications, herbal formulations are preferred due to lesser side effects and low cost. These include, *Ficus bengalensis*, *Ipomoea batatas*, *Aegle marmalos*, *Tinospora crispata* & *Vincia rosea*.

**MATERIALS AND METHODS**

**Plant material and Extraction**

The fresh fruits of *Feronia elephantum*, were collected in month of November from Sangli district, Maharashtra, India, identified and authenticated by Prof. R S Goudar, Selection grade lecturer, Head of Dept of Botany, with the reference no. RLSI/AUG/BOT/1.

Fruit pulp of *Feronia elephantum*, were dried in shade and powdered mechanically. The powder was subjected to extraction in Soxhlet extractor, was defatted with petroleum ether (40-60) and later extracted with methanol (40-60) at controlled temperature. The collected extract was concentrated under reduced pressure below 45°C using vacuum pump and rotatory evaporator ensuring complete removal of the solvent and the dry extract was used for all experimental studies.

**Experimental animals**

Male albino rats (180-200 gm) of Wistar train were used throughout the studies. Animals had ad libitum access to standard laboratory diet, except during the day of blood sampling when animals were used after an overnight fast. The animals were acclimatized under standard condition of temperature (23±2°C), relative humidity (55±10%) with 12 h each of day and light cycle in the departmental animal house.

**Induction of diabetes in rats**

Diabetes was induced by single intraperitoneal injection of freshly prepared streptozotocin (50 mg/Kg) dissolved in 0.1 M citrate buffer (pH 4.5) after overnight fasting of 12 hr. The diabetes was assessed by determining the blood glucose concentration after 48 hrs of streptozotocin injection. The rats with blood glucose level above 200 mg/dL were selected for the experimental studies.

**Experimental design**

In the experiment a total number of 24 rats (18 diabetic rats, 6 normal rats) were used. The rats were divided into 4 groups of six each.

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Control group (Vehicle treated)</td>
</tr>
<tr>
<td>II</td>
<td>Diabetic control (streptozotocin 50mg/kg b.w i.p)</td>
</tr>
<tr>
<td>III</td>
<td>Diabetic rats receiving “FE fruit extract” (400mg/kg b.w orally)</td>
</tr>
<tr>
<td>IV</td>
<td>Diabetic rats receiving Glibenclamide (900 μg/kg b.w orally)</td>
</tr>
</tbody>
</table>

The blood glucose of all the rats were measured at weekly interval for 30 days. On 31st day blood glucose was measured in autoanalyser by using standard glucose kits, then all animals were sacrificed by cervical dislocation and pancreas was removed for histological examination.

**Statistical Analysis**

Statistical analysis was performed using one way analysis of variance (ANOVA) followed by Bonferroni’s multiple comparison test. Results were expressed as

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mean±S.E.M. from six rats in each group. P-values <0.05 were considered significant.

RESULTS

Antidiabetic effect of fruit extract:
Table 1 shows the level of blood glucose in control and experimental animals in each group. The level of blood glucose was significantly increased in streptozotocin alone treated rats (Group II) as compared to control animals (Group I). However, the chronic administration of fruit extracts(400mg/kg) and Glibenclamide for 30 days significantly reduces the blood glucose level of the diabetics. “FE extract” showed comparable effect to that of Glibenclamide.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Groups</th>
<th>Dose (mg/kg)</th>
<th>Days of Feronia elephantum supplement</th>
<th>0</th>
<th>14</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Control (Normal Saline)</td>
<td>2 ml/kg</td>
<td>90.0±4.0</td>
<td>84.6 ± 8.4</td>
<td>87.5±1.668</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Diabetic control (STZ)</td>
<td>50</td>
<td>263.6±18.3*</td>
<td>289±9.322*</td>
<td>316±5.49±86*</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Extract treated</td>
<td>400</td>
<td>250±16.0**</td>
<td>203±12.45**</td>
<td>113.8±4.87**</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Glibenclamide</td>
<td>0.9</td>
<td>254±14.3**</td>
<td>179±1.866**</td>
<td>102±72.896**</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Antidiabetic studies

| Data are expressed as mean ± S.E., n = 6, * p < 0.001 Vs Control vs ** p < 0.001 Vs Diabetic Control |

Histological changes (Fig. 2 (a–d))
The histopathological examination revealed extensive alterations in pancreas of STZ-induced diabetic rats (Fig. 2 (a–d)). The pancreas of control rat (Fig. 2a) showing normal islets. Diabetic pancreas showing (Fig. 2b) atrophy of β-cells and vascular degenerative changes in the islets. Extract (Fig. 2c) and glibenclamide (Fig. 2d) treated diabetic pancreas showing initial stages of regenerating islets and increase in the islets as compared to diabetic pancreas.

DISCUSSION
Findings of the present study clearly indicate that treatments with FE extract showed significant hypoglycemic activity and reports on such activity could not be traced in the available literature. As eluded earlier the objective of the study was to investigate hypoglycemic activity of methanolic extract of Feronia elephantum. Though the present study was not aimed to elicit the mechanism of hypoglycemic activity of the extract, the phytochemical constituents of Feronia elephantum bioflavonoid, triterpenoids, stigma sterol, bergapten could be responsible for its hypoglycemic activity by virtue of their antioxidant property. Antioxidants have been reported to exert beneficial effects on pancreatic β-cell function by preventing or delaying β-cell dysfunction due to glucose toxicity. If the findings of the present study extrapolated to clinical situation, the fruits are good for consumption by the diabetics and by patients on oral hypoglycemic as it is not expected to develop severe hypoglycemia. However the impact of such consumption on chronic basis by the patients on oral hypoglycemic needs to be explored clinically and experimentally.

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