The hypoglycemic effect of Fenugreek (Trigonella foenum-gracecum) sead extract in experimentally diabetic rats

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ABSTRACT

This study was designed to investigate the hypoglycemic effect of ethanolic extract of fenugreek seed (Trigonella foenum-gracecum) in normal and streptozotocin-induced diabetic rats. Seeds extract was orally administered with 350 mg/kg for 21 days. Body weights and serum glucose levels were weekly checked in all treated and untreated groups. Administrations of the extract alleviated body weight loss and significantly decreased serum glucose levels in diabetic rats, whereas it increased serum insulin in diabetic rats but not in normal rats (P < 0.05). A comparison was made between the action of fenugreek seed extract and glibenclamide (600 μg/kg), the known antidiabetic drug. The antidiabetic effect of the extract was similar to that observed for glibenclamide. It is concluded that the plant should be considered as an excellent candidate for future studies on diabetes mellitus.

INTRODUCTION

Diabetes mellitus is one of the main threats to human health in the 21st century because changes in human behavior and lifestyle. Hence, the global number of people with diabetes is estimated to rise up to 366 millions in 2030 [1, 2].

Management of diabetes is being a tough task with the organic medicines as they have many side effects. The interest has increased on the medicinal plants used for remedy or reducing the risk of diseases. More than 400 medicinal plants are present worldwide for the treatment of diabetes mellitus, while only few of them have been subjected to scientific authentication as anti-diabetic agents [3]. Fenugreek (Trigonella foenum-gracecum) is an old medicinal plant and has been commonly used as a traditional food and medicine. The seeds are reported...
The hypoglycemic effect of Fenugreek (*Trigonella foenum-gracecum*) seed extract in experimentally diabetic rats

Yasir

to have restorative and nutritive properties [4] and its nutrient composition is moisture, protein, fat, saponins, and dietary fibers [5]. In addition, wide range of its medicinal applications were identified and its medical use for the treatment of inflammation, tumors, cardiovascular diseases, renal insufficiency, infections, and metabolic disorders has been clear in several studies [6, 7, 8, 9, 10, 11, 12]. It has been also shown that at the stated dose, it increases the bone marrow cell counts indicating its stimulatory effect on blood cells especially macrophages [13]. Furthermore, one of the nutritional profiles of Fenugreek seed is iron and may influence the iron absorption [14].

However, the present study has been aimed to investigate the hypoglycemic effect of ethanolic extract of Fenugreek seeds in streptozotocin (STZ) induced diabetic rats.

**MATERIALS AND METHODS**

**Plant material:**

The Fenugreek seeds (*Trigonella foenum-gracecum*) were purchased from local seed dealers in Baghdad, Iraq and identified by experts in College of Science, University of Baghdad, Iraq.

**Plants extract preparation:**

The healthy Fenugreek seeds were selected and kept in spirit for 1 minute. They were dried on the filter paper and powdered in a electrical grinder and stored at 5°C until further use. 50 g of seed powder with 150 ml ethanol were used for extraction by soxhlet extraction method for six hours. The extract was filtered. The residue was re-extracted twice under the same condition to ensure complete extraction. The extract was filtered and evaporated to dryness under reduced pressure at 60°C by a rotary evaporator. Extract was placed in dark bottle, and stored at -8 °C until further analysis [15].

**Animals:**

Thirty adult male Wistar rats weighing around 170-200 g were purchased from College of Veterinary Medicine, University of Baghdad, Abu Ghraib, Baghdad, Iraq. The animals were kept in polypropylene cages (three in each cage) at an ambient temperature of 25±4 °C and 55-65% relative humidity 12±1 hr light and dark schedule was maintained in the animal house till the animals were acclimatized to the laboratory conditions. They were fed commercially available rat chow and had a free access to water. The experiments were designed and conducted in accordance with the institutional guidelines.

**Experimental induction of diabetes:**

Streptozotocin (Sigma,USA) was freshly dissolved in citrate buffer (0.01M, pH 4.5) and maintained on ice prior to use. The overnight fasted
rats were made type 2 diabetes with a single intraperitoneal injection of STZ (50 mg/kg) [16]. Rats with plasma glucose levels above 250 mg/dL were considered as severe diabetic and were used in the experiment.

**Experimental design:**

The rats were divided into 5 groups comprising of 6 animals in each group as follows:

- **Group I**: Normal rats (Controls).
- **Group II**: Untreated diabetic rats.
- **Group III**: Normal + Plant extract treated rats.
- **Group IV**: Diabetic+ Plant extract treated rats.
- **Group V**: Diabetic+ Glibenclamide treated rats.

Normal rats (Controls) receiving 0.01M citrate buffer (pH 4.5). All treatments were orally given seed extract (350 mg/kg body weight/day) in aqueous solution once daily for 21 days.

**Measurement of blood glucose levels:**

At every interval of the experiment (1st, 7th, 14th, 21st days), the blood was drawn from the tail and measured the blood glucose levels by using Accuchek glucometer. The body weights of the rats were also recorded.

**Statistical analysis:**

Statistical analysis was carried out by using one way ANOVA as in standard statistical software package of social science (SPSS). All values are presented as the means for six records. P values below 0.05 were considered statistically significant.

**RESULTS AND DISCUSSION**

The body weights and the blood glucose levels of all the groups are expressed and showed in Table 1 and Table 2 respectively. Untreated diabetic rats (Group II) showed a significant decrease in body weight (p<0.05) when compared to the control rats (Group I). In Group III, the normal animals given seed extract showed slight changes in body weights compared to the control rats (Group I). The administration of seeds extract in Group IV significantly increased body weights compared to the diabetic group (Group II). However, there were no significant differences in body weight between Group IV and Group V which administered a standard drug Glibenclamide.

The levels of blood glucose were significantly higher (p<0.05) in diabetic rats as compared to the control rats (Group I). After 7, 14, 21 days of administration of seeds extract to diabetic rats, the blood glucose levels significantly decreased as compared to the untreated diabetic rats (Group II). However, the hypoglycemic effect of seeds extract was slightly less than that in animals treated with Glibenclamide.
The hypoglycemic effect of Fenugreek (*Trigonella foenum-gracecum*) seed extract in experimentally diabetic rats

Yasir

Table 1: Effect of ethanolic extract of fenugreek seed on animal body weights of streptozotocin (STZ) induced diabetic rats and normal rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Day 1</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (Normal)</td>
<td>185.67</td>
<td>189.23</td>
<td>191.43</td>
<td>198.59</td>
</tr>
<tr>
<td>II (Diabetic)</td>
<td>191.91</td>
<td>187.54</td>
<td>180.05(^a)</td>
<td>166.88(^a)</td>
</tr>
<tr>
<td>III (Normal + FSE)</td>
<td>188.25</td>
<td>190.77</td>
<td>194.82</td>
<td>197.70</td>
</tr>
<tr>
<td>IV (Diabetic + FSE)</td>
<td>192.17</td>
<td>188.81</td>
<td>185.71(^b)</td>
<td>189.93(^b)</td>
</tr>
<tr>
<td>V (Diabetic + Gli)</td>
<td>190.33</td>
<td>188.56</td>
<td>181.65</td>
<td>189.54(^b)</td>
</tr>
</tbody>
</table>

Values are calculated as mean for six rats in each group; \(^a\) Significant with respect to Group I (P<0.05); \(^b\) Significant with respect to Group II (P<0.05).

Table 2: Effect of ethanolic extract of fenugreek seed on blood glucose levels (mg/dL)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Day 1</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (Normal)</td>
<td>86.57</td>
<td>88.39</td>
<td>89.36</td>
<td>89.9</td>
</tr>
<tr>
<td>II (Diabetic)</td>
<td>252.6(^a)</td>
<td>280.02(^a)</td>
<td>311.39(^a)</td>
<td>317.12(^a)</td>
</tr>
<tr>
<td>III (Normal + FSE)</td>
<td>90.74</td>
<td>93.33</td>
<td>92.11</td>
<td>90.51</td>
</tr>
<tr>
<td>IV (Diabetic + FSE)</td>
<td>251.77</td>
<td>228.76(^b)</td>
<td>192.98(^b)</td>
<td>166.37(^b)</td>
</tr>
<tr>
<td>V (Diabetic + Gli)</td>
<td>250.12</td>
<td>220.38(^b)</td>
<td>182.82(^b)</td>
<td>161.92(^b)</td>
</tr>
</tbody>
</table>

Values are calculated as mean for six rats in each group; \(^a\) Significant with respect to Group I (P<0.05); \(^b\) Significant with respect to Group II (P<0.05).

Administration of Streptozotocin (50 mg/kg, i.p.) led to about 3-fold elevation of fasting blood glucose levels, which was maintained over a period of 3 weeks (Table 2). In diabetes the increased blood sugar levels might be due to either insulin resistance of the body cells or decreased secretion of insulin from beta cells manifest in the decreased serum insulin levels [17]. The reduction in the serum insulin levels in the STZ treated rats might be attributed to the reduced secretion of the hormone which might be due to the damage of the beta cells of endocrine pancreas. The STZ selectively destroys the pancreatic cells and induce hyperglycemia [18, 19, 20].

The present results indicate significant decrease in body weight and raise in blood glucose levels in diabetic rats and they became normal when treated with the seed extract (Table 1,2). This suggests that fenugreek seeds have a protective role in reducing glucose levels as well as in increasing body weight.

Three weeks of daily treatment of ethanolic extract of fenugreek seed led to a time-dependent fall in blood sugar levels, the highest effect was after 3 weeks of extract administration. The hypoglycemic effect of plants may be due to the presence of insulin-like substances in plants [22], stimulation of B cells to produce more insulin [23], high level of fiber
which interferes with carbohydrate absorption [24] or the regenerative effect of plants on pancreatic tissue [25, 26, 27].

Renuka and his colleagues [28] reported that the hypoglycemic action of the extract of herbal plants in diabetic rats may be possible through the insulinomimetic action or by other mechanism such as stimulation of glucose uptake by peripheral tissue, inhibition of endogenous glucose production of activation of gluconeogenesis in liver and muscle.

It may be concluded that fenugreek seed extract possess antidiabetic activities and the seeds extract may be used as an antidiabetic agent. The plant should be considered as an excellent candidate for future studies on diabetes mellitus. In addition, further comprehensive pharmacologic investigations, including experimental chronic studies should be carried out.

REFERENCES


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Yasir


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