The modulative biochemical effect of extract of Ocimum gratissimum as anti-oxidant on diabetic albino rats

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SUMMARY

This study was conducted to elucidate the therapeutic modulative effects of herb Ocimum on alloxan-induced diabetic rats. Adult albino rats were divided into five groups. Control intact adult (G 1), Control adult (positive control) injected with 75 mg/kg body weight of Alloxan (G II). Adult hyperglycemic rats treated with 200 mg/kg body weight (low dose) of Ocimum (G III). Adult hyperglycemic rats treated with 400 mg/kg. body weight (high dose) of Ocimum (G IV). Adult intact rats injected with 200 mg/kg body weight (low dose) of Ocimum only (G V).

A significant increase in serum glucose level in the control hyperglycemic group. Treatment with ocimum resulted in a highly significant improvement in serum glucose level. After treatment with ocimum a highly significant enhancement was observed in oestradiol hormone level, testosterone level, AST and ALT activities in all treated groups especially at high dose. A highly significant improvement was achieved in serum total cholesterol and triglycerides concentrations in all treated groups especially at high dose. A slight changes was observed in calcium, phosphorus, total protein and albumin contents in serum in all treated groups but non significant.

INTRODUCTION

Ocimum herb has been known as early as the vedic period. It is grown in flower pots in most countries. Its leaves are used in the worship of gods & goddesses & partaken as Prasad (Manyam et al., 1995).

The chemical composition of Ocimum herb has several active constituents. Volatile oil 0.4-0.8% containing chiefly eugenol app. 21% & β-caryophyllene 37% (eugenol content reaches maxi-
mum in spring & minimum in autumn). A number of sesquiterpenes & monoterpenes viz., bornyl acetate, β-elemene, methyleugenol, neral, B-pinene, camphene, a-pinene etc.: ursolic acid, campestoral, cholesterol, stigmasterol, bis-tosterol and methyl esters of common fatty acids (Vats et al., 2004 a & b).

This herb has numerous pharmacological activities like hypoglycemic immunomodulatory, antistress, analgesic, antipyretic, anti-inflammatory, expectorant, antiulcerogenic, antihypertensive, CNS depressant, radioprotective, antitumorogenic and antibacterial. Leaves of this plant are used in a variety of pathophysiological states like asthma, dysentery, dyspepsia, chronic fever, skin disease, helminthiasis eradication for ring worms. It is also used as antistressor (Vats et al., 2002).

Diabetes has two forms; in the type that develops early in childhood (type 1), the insulin-secreting cells of the pancreas are destroyed (probably by a viral infection), and blood level of insulin drop nearly to zero. However, in type 2 diabetes (usually developing in adults) insulin remains plentiful, but the body does not respond normally to it. Aqueous extract of Ocimum canum Sim, (Lamiaceae) is used by some Ghanaians to manage diabetes mellitus. In vivo modulation of levels of fasting blood glucose by Ocimum extract was evaluated in type-II diabetes mellitus (Nyarko et al., 2002).

So this work was aimed to study effect of diabetes mellitus on some serum electrolytes (calcium and phosphorus), hormome content (oestradiol and testosterone) as well as serum total cholesterol and triglycerides as well as the effect of use ocimum as trial for treatment of this condition.

MATERIALS AND METHODS
Experimental animals:
One hundred adult female Wistar albino rats, with average body weights 120 ± 10 gm/animal, about 5-7 months of age rats, were used in the present study. The experimental animals were obtained from the breading unit of the Egyptian Organization for Biological and Vaccine production, A.R.E. The animals were kept under good ventilation and a balanced diet. The rats were maintained at a temperature of 25 ± 5° C, and water was allowed ad libitum.

Animal grouping:
Adult rats were divided into five groups each group containing 20 rats.
1 - Control intact adult, negative control, (G 1).
2- Control adult (positive control) injected with 75 mg/kg body weight of Alloxan (G II).
3- Adult hyperglycemic rats
treated with 200 mg/kg body weight (low dose) of Ocimum (G III).

4- Adult hyperglycemic rats treated with 400 mg/kg body weight (high dose) of Ocimum (G IV).

5- Adult intact rats injected with 200 mg/kg body weight (low dose) of Ocimum only (G V).

Adult rats received different doses of Ocimum for 2 weeks respectively. Rats were injected intraperitoneally (i.p.) daily and were sacrificed after one week and two weeks. Blood samples was collected, left to clot, centrifuged at 3000 rpm for 10 min., then clear supernatant serum was separated, kept at -20ºC till used.

**Laboratory serum analysis:**

Calcium content was determined as recommended by Teitz (1970), phosphorus content by using the method of Vanderlinde and Kowatski (1971). Oestradiol hormone was assessed using the method described by Abraham et al. (1977), testosterone hormone by Jaffe and Behrman (1974), total cholesterol and triglycerides were measured according to Richmond (1973).

Total proteins were measured according to Henry (1964), and albumin according to Doumas et al. (1971). AST and ALT activities were measured according to Reitman and Frankel (1957).

**Statistical analysis:**

Statistical analysis was performed according to Hine and Wetherill (1975). All values were expressed as means ± SD, (n = 10). Statistical comparison was detected through Student’s t-test.

**RESULTS**

**Effect of ocimum on glucose level, total protein and albumin contents in serum in albino rats:**

The data in Table (1) showed a significant increase in serum glucose level in treated hyperglycemic group compared with the control negative group. Whereas the mean serum glucose level was 101.38 ± 2.35 mg% in control intact group (GI), it was 203.06 ± 14.04 mg% in the control hyperglycemic group (G II).

Treatment with ocimum resulted in a highly significant improvement in serum glucose level in (G III) and (G IV). The serum glucose level in hyperglycemic albino rats and was nearly returned to control intact adult (GI) especially at high dose of ocimum (G IV). In group III hyperglycemic rats treated with 200 mg/kg body weight (low dose) of Ocimum, the serum glucose level dropped to 160.36 ± 8.97 mg%, while in group IV (hyperglycemic rats treated with 400 mg/kg body weight (high dose) of Ocimum and 113.04 mg/dl in (G IV) for the first
week and 138.0 mg/dl in (G III), and 106.06 mg/dl (G IV) for the second week as a compared with the control hyperglycemic albino rats (G II).

This improvement reached -1.04% in (G III), -44.34% in (G IV) and -52.05% in (G V) respectively for first week and -30.99% in (G III), -46.97% in (G IV) and -57.95% for second week as a comparison with the control hyperglycemic albino rats (G II).

A non significant increase was observed in total protein in all treated groups for first week and second week as a comparison with the control hyperglycemic albino rats (G II). A significant increase was showed in albumin concentration in all groups except for (G III) which non significant after changes first week. After two weeks significant decrease was showed in albumin concentration in all groups in comparison with the control hyperglycemic albino rats (G II), reached to 1.53 g/dl, 1.88 g/dl and 1.82 g/dl for (G III), (G IV) and (G V), respectively.

Effect of ocimum on oestradiol hormone (E₂) and testosterone hormone concentrations in serum albino rats:

Table (2) summarizes the data concerned with changes of oestradiol hormone; the level was 508.38 ± 4.75 µg/dl in (G I) and 700.2 ± 5.85 µg/dl in (G II). After treatment with ocimum a highly significant decrease was observed from 590.28 ± 6.95 to 542.0 ± 4.49 µg/dl after first and second weeks as compared to control group (G II). The emerged data revealed that the average of testosterone hormone was 0.55 ± 0.01 µg/dl in (G I) and 0.31± 0.04 µg/dl in (G II), while after treatment with ocimum a highly significant increase was observed from 0.46 ± 0.02 µg/dl, 0.53 ± 0.03, 0.72 ± 0.02 µg/dl after first week and 0.498 ± 0.02, 0.44 ± 0.05 and 0.765± 0.01 µg/dl after second week as compared to the control hyperglycemic group (G II).

Effect of ocimum on total cholesterol and triglycerides concentrations in serum of albino rats:

The results showed in table (3) reveal the effect of Ocimum on total cholesterol and triglycerides concentrations in serum. A highly significant improvement was achieved in serum total cholesterol and triglycerides concentrations in all treated groups especially at high dose, 231.06 (G3), 220.36 (G4), 200.48 (G1), one week post-treatment and 224.5 (G3), 222.48 (G4) and 196.22 (G5) mg/dl in serum total cholesterol as compared to control group (GII).

Effect of ocimum on calcium and phosphorus contents in serum of
albino rats:
The results recorded in table (4) revealed that the effect of ocimum on calcium and phosphorus contents in the serum of albino rats. A non significant decrease was observed in calcium and phosphorus contents in serum in all treated groups, reached 11.9 ± 2.32, 12.1 ± 1.83 and 12.9 ± 1.41 mg/dl for calcium and 4.18 ± 0.76, 4.38 ± 0.45 and 4.62 ± 0.66 mg/dl in phosphorus after first week. 12.1 ± 1.96, 12.52 ± 1.47 and 12.46 ± 1.63 mg/dl in calcium and 4.42 ± 0.9, 4.64 ± 0.48 and 4.62 ± 0.49 mg/dl, in phosphorus after second week as compared to control group (G II).

Effect of ocimum on AST and ALT activities in serum of albino rats:
The data presented in Table (5) show that AST and ALT activities in serum of rats (G II) significantly increased as compared to those of control adult female rats. After treatment with ocimum, a highly significant decrease was observed, which reached 50.06 ± 7.013, 44.82 ± 3.04, 28.38 ± 3.04 u/ml after the first week and 45.34 ± 3.09, 36.44 ± 2.84 and 27.62 ± 1.39 u/ml after the second week for AST and 23.46 ± 1.52, 18.24 ± 0.98, 13.36 ± 0.98 u/ml, for ALT at the first week for treated groups, respectively. 26.16 ± 1.03; 17.06 ± 1.34 and 14.16 ± 1.41 u/ml after the second week for treated groups, respectively as compared to control group (G II).

Effect of ocimum on Hb% and hematocrite in blood of albino rats:
A highly significant increase was observed in Hb (g/dl) and hematocrite in serum of albino rats as shown in table (6). The changes reached 7.88 ± 0.48, 8.68 ± 0.23, 8.62 ± 0.23 g/dl and post-treatment 8.13 ± 0.26, 8.22 ± 0.34, 8.53 ± 0.39 g/dl in Hb, for one and two weeks respectively and 13.11 ± 0.34, 14.28 ± 0.37, 14.09 ± 0.43 g/dl and 13.22 ± 0.39, 13.40 ± 0.75, 14.12 ± 0.31 g/dl, respectively, in hematocrite after the first and second weeks respectively as compared to control hyperglycemic group (G II).
Table (1): Statistical analysis of glucose, total protein and albumen in the serum of treated groups in contrast to control.

<table>
<thead>
<tr>
<th></th>
<th>One week</th>
<th>Two weeks</th>
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<tbody>
<tr>
<td></td>
<td>G1</td>
<td>G2</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>Average ± SD</td>
<td>101.38 ± 2.35</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>**</td>
</tr>
<tr>
<td>% of change</td>
<td></td>
<td>-21.044</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>Average ± SD</td>
<td>4.44 ± 0.78</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>Non Sig.</td>
</tr>
<tr>
<td>% of change</td>
<td></td>
<td>6.942</td>
</tr>
<tr>
<td>Total protein (g/dl)</td>
<td>Average ± SD</td>
<td>1.88 ± 0.07</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>Non Sig.</td>
</tr>
<tr>
<td>% of change</td>
<td></td>
<td>19.668</td>
</tr>
</tbody>
</table>

G1 = control  
G2 = injected with Alloxan 75 mg/kg body weight  
G3 = Hyperglycemic rats treated with 200 mg/kg body weight Ocimum  
G4 = Hyperglycemic rats treated with 400 mg/kg body weight Ocimum  
G5 = intact rats injected with 200 mg/kg body weight Ocimum  
* = P-value 0.05 = significant  
** P-value 0.01 = highly significant  
Non Sig. = Non significant P-value > 0.05
Table (2): Statistical analysis of estrogen and testosterone in the serum of treated groups in contrast to control.

<table>
<thead>
<tr>
<th></th>
<th>One week</th>
<th>Two weeks</th>
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<tbody>
<tr>
<td></td>
<td>G1</td>
<td>G2</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>508.38±4.75</td>
<td>700.2±5.85</td>
</tr>
<tr>
<td><strong>Estrogen</strong></td>
<td><strong>% of change</strong></td>
<td><strong>% of change</strong></td>
</tr>
<tr>
<td><strong>± SD</strong></td>
<td>4.75</td>
<td>5.85</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
<td>****</td>
<td>****</td>
</tr>
<tr>
<td><strong>Testosterone</strong></td>
<td>0.552±0.01</td>
<td>0.31±0.04</td>
</tr>
<tr>
<td>± SD</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>% of change</strong></td>
<td><strong>50.327</strong></td>
<td><strong>73.203</strong></td>
</tr>
</tbody>
</table>

G1 = control  
G2 = injected with Alloxan 75 mg/kg body weight  
G3 = Hyperglycemic rats treated with 200 mg/kg body weight Ocimum  
G4 = Hyperglycemic rats treated with 400 mg/kg body weight Ocimum.  
G5 = intact rats injected with 200 mg/kg body weight Ocimum  
* = P-value 0.05 = significant  
** P-value 0.01 = highly significant  
Non Sig. = Non significant P-value > 0.05
Table (3): Statistical analysis of cholesterol and triglyceride in the serum of treated groups in contrast to control.

<table>
<thead>
<tr>
<th></th>
<th>One week</th>
<th>Two weeks</th>
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<tbody>
<tr>
<td></td>
<td>G1</td>
<td>G2</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>± SD</td>
</tr>
<tr>
<td>Cholesterol (mg/dl)</td>
<td>213.88±</td>
<td>16.96</td>
</tr>
<tr>
<td></td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>% of change</td>
<td>-21.685</td>
<td>-25.312</td>
</tr>
<tr>
<td>Triglyceride (mg/dl)</td>
<td>147.7 ± 6.52</td>
<td>10.29</td>
</tr>
<tr>
<td></td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>% of change</td>
<td>-24.779</td>
<td>-35.166</td>
</tr>
</tbody>
</table>

G1 = control  
G2 = injected with Alloxan 75 mg/kg body weight  
G3 = Hyperglycemic rats treated with 200 mg/kg body weight Ocimum  
G4 = Hyperglycemic rats treated with 400 mg/kg body weight Ocimum.  
G5 = intact rats injected with 200 mg/kg body weight Ocimum  
* = P-value 0.05 = significant  
** P-value 0.01 = highly significant  
Non Sig. = Non significant P-value > 0.05
Table (4): Statistical analysis of calcium and phosphorus in the serum of treated groups in contrast to control.

<table>
<thead>
<tr>
<th></th>
<th>One week</th>
<th></th>
<th>Two weeks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G1</td>
<td>G2</td>
<td>G3</td>
<td>G4</td>
</tr>
<tr>
<td>Calcium (mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average ± SD</td>
<td>12.6 ± 1.34</td>
<td>10.7 ± 1.54</td>
<td>11.9 ± 2.32</td>
<td>12.1 ± 1.83</td>
</tr>
<tr>
<td>P-value</td>
<td>Non Sig.</td>
<td>Non Sig.</td>
<td>Non Sig.</td>
<td>*</td>
</tr>
<tr>
<td>% of change</td>
<td>11.215</td>
<td>13.084</td>
<td>20.561</td>
<td></td>
</tr>
<tr>
<td>Phosphorus (mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average ± SD</td>
<td>4.54 ± 0.43</td>
<td>3.92 ± 0.64</td>
<td>4.18 ± 0.76</td>
<td>4.386 ± 0.45</td>
</tr>
<tr>
<td>P-value</td>
<td>Non Sig.</td>
<td>Non Sig.</td>
<td>*</td>
<td>Non Sig.</td>
</tr>
<tr>
<td>% of change</td>
<td>6.633</td>
<td>11.888</td>
<td>17.857</td>
<td></td>
</tr>
</tbody>
</table>

G1 = control  
G2 = injected with Alloxan 75 mg/kg body weight  
G3 = Hyperglycemic rats treated with 200 mg/kg body weight Ocimum  
G4 = Hyperglycemic rats treated with 400 mg/kg body weight Ocimum.  
G5 = intact rats injected with 200 mg/kg body weight Ocimum.  
* = P-value 0.05 = significant  
Non Sig. = Non significant P-value > 0.05
Table (5): Statistical analysis of AST and ALT in the serum of treated groups in contrast to control.

<table>
<thead>
<tr>
<th></th>
<th>One week</th>
<th>Two weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G1</td>
<td>G2</td>
</tr>
<tr>
<td>Average AST (u/ml) ± SD</td>
<td>27.68 ± 2.42</td>
<td>72.48 ± 10.69</td>
</tr>
<tr>
<td>P-value</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>% of change</td>
<td>-30.933</td>
<td>-38.162</td>
</tr>
<tr>
<td>Average ALT (u/ml) ± SD</td>
<td>13.02 ± 0.98</td>
<td>40.64 ± 1.35</td>
</tr>
<tr>
<td>P-value</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>% of change</td>
<td>-42.274</td>
<td>-55.118</td>
</tr>
</tbody>
</table>

G1 = control          G2 = injected with Alloxan 75 mg/kg body weight
G3 = Hyperglycemic rats treated with 200 mg/kg body weight Ocimum
G4= Hyperglycemic rats treated with 400 mg/kg body weight Ocimum.
G5 = intact rats injected with 200 mg/kg body weight Ocimum.
* = P-value 0.05 = significant
** = P-value 0.01 = highly significant
Table (6): Statistical analysis of Hb content and haematocrite value in the serum of treated groups in contrast to control.

<table>
<thead>
<tr>
<th></th>
<th>One week</th>
<th>Two weeks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>G1</td>
<td>G2</td>
</tr>
<tr>
<td><strong>Hb (g/dl)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average ± SD</td>
<td>8.43±0.49</td>
<td>6.04±0.563</td>
</tr>
<tr>
<td>% of change</td>
<td>30.464</td>
<td>43.742</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
<td>****</td>
<td>****</td>
</tr>
<tr>
<td><strong>PCV %</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average ± SD</td>
<td>14.43±0.33</td>
<td>11.18±0.36</td>
</tr>
<tr>
<td>% of change</td>
<td>17.29</td>
<td>27.76</td>
</tr>
</tbody>
</table>

G1 = control
G2 = injected with Alloxan 75 mg/kg body weight
G3 = Hyperglycemic rats treated with 200 mg/kg body weight Ocimum
G4 = Hyperglycemic rats treated with 400 mg/kg body weight Ocimum.
G5 = intact rats injected with 200 mg/kg body weight Ocimum.

** P-value 0.01 = highly significant
DISCUSSION

Several kinds of medicinal plants have been used to treat diabetes mellitus. Attitajat et al. (2004) described the anti-diabetic effect of Thunbergia laurifolia Linn. (purple flower strain) in alloxan-induced diabetic rats. Aqueous extract from the leaves was found to produce a significant decrease in blood glucose levels and recovery of the beta cells in the islets of Langerhans.

The antioxidant effect of an ethanolic extract of Coccinia indica leaves, an indigenous plant used in Ayurvedic medicine in India was studied in Streptozotocin-diabetic rats (Venkateswaran and Pan, 2003). Oral administration of Coccinia indica leaf extract resulted in a significant reduction in thiobarbituric acid reactive substances and hydroperoxides. The extract also caused a significant increase in reduced glutathione, superoxide dismutase, catalase, glutathione peroxidase and glutathione-S-transferase in liver and kidney of streptozotocin diabetic rats, which clearly shows the antioxidant property of CLEt. The effect of CLEt at 200 mg/kg body weight was more effective than glibenclamide.

The herb Ocimum has been known for a long time. It is native to India, but is grown all over the world (Manyam et al., 1995). The importance of Ocimum as a medicinal plant has been previously documented in several studies. Its importance has been shown in the treatment of a variety of diseases. The value of the medicinal plant Ocimum sanctum was described in various studies. Ocimum sanctum has been found to have stress alleviating effects (Archana and Namaisvayam, 2000). Moreover, a combination of ethanolic extracts of Cassia alata and Ocimum sanctum was shown to possess anti-Cryptococcus activity (Ranganathan and Balajee, 2000).

Ocimum basilicum has shown significant gastric antiulcerogenic effects in rats. Akhtar and Munir (1989) found that Ocimum basilicum (aerial parts) powder and its aqueous and methanolic extracts decreased the ulcer index. The suggested mechanism is a decrease of acid and pepsin outputs which enhance gastric mucosal strength. Singh and Majumdar (1999) found that the fixed oil of Ocimum basilicum possessed significant anti-ulcer activity against aspirin, indomethacine, alcohol, histamine, reserpine, serotonin and stress-induced ulceration in experimental animal models. The mechanism is thought to be the lipoxygenase inhibiting, histamine antagonistic and antisecretory effects of the oil. Thus it may be considered as a natural drug with both
anti-inflammatory and anti-ulcer activity.

The Anti-HIV-1 activity of Ocimum basilicum has also been studied. Yamasaki et al. (1998) showed that Ocimum basilicum had significant inhibitory effects against HIV-induced cytopathogenicity in MT-4 cells.

Ocimum gratissimum was found to have a significant antidiarrheal activity. Ocimum gratissimum extract is active against several organisms; most active against S. dysenteriae (Hori et al., 1996).

In addition Ocimum gratissimum oil may be capable of enhancing normal hair growth and promoting follicular proliferation in cyclophosphamide-induced hair loss (Orafidiya et al., 2004).

The present study investigated the effect of Ocimum gratissimum extract on diabetes in adult albino rats.

We found a significant improvement in serum glucose level after treatment with ocimum gratissimum. This improvement was more marked in the group that received a high dose of ocimum (400 mg/Kg body weight). These results are in agreement with the data reported by Aguiyi et al. (2000), who showed that methanolic extract of Ocimum gratissimum had a significant hypoglycemic effect in alloxan-induced diabetic rats.

The hypoglycemic action of ocimum has also been proven in humans. A randomized placebo-controlled, crossover single blind trial on patients with non insulin-dependent diabetes mellitus studied the effect of treatment with whole basil leaves (Ocimum sanctum and Ocimum album) on blood glucose levels. Results showed a significant decrease in fasting and post prandial levels during treatment with whole basil leaves compared to during treatment with placebo leaves (Agrawal et al., 1996 and Rai et al., 1997).

Alloxan’s harmful effects on the pancreas are so severe and Ocimum showed varying degree of hypoglycemic and antihyperglycemic activity (Grover et al., 2005).

The hypoglycemic effect of the aqueous (Aq) extract of the bark of Pterocarpus marsupium (PM) and alcoholic (Alc) extract of seeds of Trigonella foenum-graecum (FG) and leaves of Ocimum sanctum (OS) was investigated in both normal and alloxan-induced diabetic rats. The Aq extract of PM (1 g/kg P0) significantly (P<0.001) reduced the blood sugar levels and also significantly lowered the blood glucose in alloxan diabetic rats after daily oral administration of the extract. Similarly, reduction was seen with Alc extract of FG in normal rats and in diabetic rats. The extract also
showed a favorable effect on glucose disposition in glucose fed hyperglycemic rats (Vats et al., 2002 and Vats et al., 2004 a & b).

Effect of ocimum on blood glucose levels in normal rats as presented showed a decrease in blood glucose level in group V (normal rats receiving Ocimum in a dose of 200 mg/Kg body weight) in comparison to the control group (group I). This is in accordance with Aguiyi et al. (2000) and Gupta et al. (2006), who demonstrated a hypoglycemic effect of methanolic extract of Ocimum gratissimum in normal rats.

The present investigation results showed a significant decrease in oestradiol and a significant increase in testosterone levels after treatment with ocimum. A previous study (Misra et al., 2005) has also shown an increase of testosterone level in response to treatment with a medicinal plant extract containing ocimum sanctum, but this study was performed on male rats. A composite extract of Withania somniferous, ocimum sanctum, and Zingiber officinale was found to have a role in alleviating oxidative stress on male sex organs in rats. This demonstrates the important anti-oxidant activity of Ocimum.

The anti-oxidant activity of ocimum was also demonstrated by the protective ability of ocimum sanctum against radiation injury. Devi and Ganasoundari (1988) found that Ocimum extract protects against radiation-induced lipid peroxidation. Glutathione and the antioxidant enzymes appear to have an important role in the protection.

The effect of ocimum on glutathione appears also to be related to its anti-diabetic action. A decrease in the glutathione content of the blood is known to be an important factor in the development of alloxan diabetes (Natli et al., 1953). Thus, the improvement of glutathione levels by ocimum is a possible mechanism of its hypoglycemic effect.

Ocimum induced immune responsiveness. Thus, Ocimum appears to modulate both humoral and cell-mediated immune responsiveness and these immunomodulatory effects may be mediated by GABAergic pathways (Davydov and Kirkorian, 2000 and Mediratta et al., 2002).

In the present study, a highly significant improvement was achieved in serum total cholesterol and triglycerides concentrations in all treated groups especially at high dose. On the other hand, results in humans, reported by Agrawal et al. (1996), showed a mild reduction of cholesterol levels during treatment with whole basil leaves (Ocimum sanctum and
Ocimum album) in patients with non insulin-dependent diabetes mellitus reduced significantly glutathione (GSH), superoxide dismutase (SOD) and LDH levels. It also inhibited the lipid peroxidation as observed by the reduced Thiobarbituric acid reactive substances (TBARS) levels. In the present study (Os) at the dose of 50 mg/kg was found to demonstrate maximum cardioprotective effect (Sharma et al., 2001). Antidiabetic effect of O. sanctum seed oil was evaluated in alloxan diabetic rabbits. Antihyperlipidaemic and antioxidant effect of Ocimum sanctum Linn seed oil (OSSO) was investigated in rabbits. Administration of OSSO (0.8 g/kg body weight/day) for four weeks (100 mg/kg body weight/day) in fed rabbits significantly decreased serum cholesterol, triacylglycerol and LDL+VLDL-cholesterol as compared to untreated cholesterol fed group. There was significant fall in atherogenic index in OSSO treated group. In addition, treatment with OSSO decreased lipid peroxidation and increased reduced glutathione content in blood (Gupta et al., 2006).

A significant reduction in the levels of total cholesterol (11.3%), low-density lipoprotein-cholesterol (14.0%), very low-density lipoprotein cholesterol (16.3%) and triglycerides (16.4%). No appreciable change was noticed in high-density lipoprotein-cholesterol. Ocimum extract has general and metabolic effect reflected here from significant variation in activities of liver AST and ALT may due to elevation in the level of antioxidant status, may protects against the damaging effects and effective inhibitor of lipid peroxidation because of elevating scavenger enzymes activity (Rai et al.1997).

**CONCLUSION**

Our study suggests that Ocimum has significant anti-diabetic effects. Although this herb has several beneficial effects in different diseases, its hypoglycemic action can be the most important, because diabetes mellitus is a common disease. Further clinical studies on humans are recommended to establish Ocimum extracts as anti-diabetic drugs, alone or in conjunction with other hypoglycemic agents.

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التأثير الفيسيولوجي المحسن لمستخلص نبات الريحان على الجرذان البيضاء المصابة بمرض السكري

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الملخص العربي

إن علم الاهتمام في هذه الأونة الأخيرة بالعلاج بالأعشاب قد أثار الانتباه تجاه نبات الريحان ويهدف هذا البحث إلى دراسة التغييرات الفيسيولوجية والتأثير العلاجي
لمستخلص الريحان على الجرائز البيضاء المصابة بمرض السكر المحدث بمادة الألوكرزان، وقد تم استخدام خمسة مجموعات وقسمت إلى مجموعات ضابطة سليمة بالغة (1) ومجموعة ضابطة حقن بالألوكرزان 50 ملليجرام/كم من وزن الجسم الذي يسبب مرض السكر (2) ومجموعة مصابة علقت ب200 ملليجرام من مستخلص الريحان/كم من وزن الجسم (3) ومجموعة مصابة علقت بين 400 و500 ملليجرام من مستخلص الريحان/كم من وزن الجسم (4) ومجموعة ضابطة بالغة علقت ب200 ملليجرام من مستخلص الريحان/كم من وزن الجسم (5).

سجلت الدراسة زيادة ذا دلالة إحصائية في مستوى الجلوكوز في المصل بعد أن حققت الحيوانات بمادة الألوكرزان بينما حدث تحسن كبير ذو دلالة إحصائية بعد المعالجة بمستخلص الريحان في مستوي الجلوكوز في المصل، وزاد هرمون الاستراديول بينما انخفض هرمون التستوستيرون في المجموعة المصابة بمرض السكر وقد حدد أنخفاض واضح ذو دلالة إحصائية بعد المعالجة بمستخلص الريحان في مستوى هرمون الاستراديول في المصل وزيادة مستوى هرمون التستوستيرون.

وأيضاً أظهرت النتائج تحسنًا واضحًا في مستوى الكوليسترول الكلسي والجليسريدات الثلاثية بعد المعالجة بمستخلص الريحان خاصة مع الجرعات العالية، وزاد مستوى كلا من إنزيمات الأنزيمات وأنزيمات أمينوترايسفيرينيز لمرضى السكر وظهر تحسن إحصائي في مستويات بعد العلاج بمستخلص الريحان وعلى النقيض من ذلك في الهيموجلوبين والهيماتوكريت.

سجلت الدراسة تغيرات طفيفة لبسمة دلالة إحصائية في محتوى البروتين الكلسي والإيثاممير وكذلك في محتوى الكالسيوم والفسفور لكل المجموعات. ويتضح من هذه الدراسة أن نبات الريحان تأثيرًا علاجياً ومضاداً لمرض السكري.

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