HYPOGLYCEMIC AND ANTIOXIDANT ACTIVITIES OF METHANOLIC EXTRACT OF ECLIPTA ALBA IN EXPERIMENTALLY INDUCED DIABETES MELLITUS IN RATS

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ABSTRACT
In the present study the hypoglycemic and antioxidant effects of methanolic extract of Eclipta alba in alloxan induced diabetic model in albino rats was examined. Diabetes mellitus was induced by injecting alloxan monohydrate dissolved in normal saline at the dose rate of 120 mg/kg b.wt. intraperitoneally as a single dose in rats. Diabetes was confirmed after a fortnight by estimating serum glucose level and rats with blood glucose level more than 200 mg/dl were selected for study. The animals received methanolic extract of Eclipta alba at the dose rate of 100, 200 and 400 mg/kg body weight per os for next four weeks. Glibenclamide was used as a reference drug at 600 g/kg body weight per os. Serum glucose was estimated at weekly intervals and urea, creatinine, cholesterol and triglycerides were assayed at the end of experiment period. Antioxidant efficacy was evaluated by carrying out lipid peroxidation, enzymatic and non-enzymatic assays in liver homogenate. Treatment with methanolic extract of Eclipta alba brought about a significant reduction in serum glucose (P<0.01) at the dose rate of 400 mg/kg body weight. The elevated serum biochemical parameters due to diabetes were significantly reduced by methanolic extract at the dose rate of 400 mg/kg body weight. Further, the increased levels of lipid peroxidation, catalase and superoxide dismutase were reduced significantly (P<0.05) whereas decreased content of reduced glutathione was corrected to normal by methanolic extract at 400 mg/kg body weight dose.

Key Words: Diabetes mellitus, Eclipta alba, Hypoglycemic, Antioxidant, Effect, Rats.

INTRODUCTION
Diabetes mellitus (DM) is a chronic metabolic disorder/syndrome characterized by hyperglycaemia associated with impairment in insulin secretion and/or insulin action as well as alteration in intermediary metabolism of carbohydrate, proteins and lipids.

Oral hypoglycaemic drugs are used widely for the control of diabetes but their use carries significant risks. They cause hypoglycaemic coma, nausea and vomiting, cholestatic jaundice, dermatological reactions (Davis and Granner, 2001). Reactive oxygen species play a relevant role in the etiology and pathogenesis of diabetes mellitus and its complications (Punitha and Manoharan, 2006).
The use of herbal medicine has attracted wide attention in our country because of easy availability. Evaluation of plant products to treat diabetes mellitus is of growing interest as they contain many bioactive substances with therapeutic potential. Management of diabetes without any side effects is still a challenge to the medical system. This leads to increasing demand for natural products with antidiabetic activity and less side effects.

The present study was undertaken to explore the hypoglycaemic and antioxidant potential of methanolic extract of Eclipta alba against alloxan induced diabetes mellitus in rats.

**MATERIALS AND METHODS**

**Materials:** The methanolic extract of the whole plant Eclipta alba was obtained from M/s. Natural Remedies, Bangalore as gratis along with authentication certificate. Alloxan monohydrate (Loba Chemie, Mumbai) and glibenclamide (Aventis pharma Ltd) were the drugs used.

**Animals:** Male Wistar albino rats weighing above 250 g were used for the experiment. The rats were kept in polypropylene cages and fed with pelleted feed (Tetragon Pvt. Ltd, Bangalore) and provided with water ad libitum. The experiments were carried out with the approval of Institutional Animal Ethics Committee. One ml of blood was collected from rats by using heparinised capillary tubes by retro orbital puncture (Babu et al., 2002) before giving alloxan injection to rule out spontaneous diabetes and those animals showing normal blood glucose levels of 50-70 mg/dl were selected for the study (Christopher et al., 2003). Immediately after collection, blood samples were centrifuged using spinwin microcentrifuge at 3000 rpm for 10 min, (Mahdi et al., 2003) to separate the serum and glucose level was estimated within 1 hr after collection.

**Induction of diabetes:** Adult rats weighing around 250g and showing a blood glucose level of 50-70 mg/dl were fasted 12 hours prior to alloxan injection. Diabetes was induced by injecting intraperitoneally 120mg/kg b.wt of alloxan dissolved in normal saline immediately before use (Chattopadhayay et al., 1997). Since alloxan is capable of producing total hypoglycemia as a result of massive pancreatic insulin release, rats were given 20% glucose solution intraperitoneally 6 hours after alloxan administration and glucose mixed drinking water for the next 24 hours to avoid mortality (Abdel - Barry et al., 1997). After two weeks of induction, those animals which survived and showed blood glucose level above 200mg/dl were selected for the further treatment.

**Experimental protocol:** Thirty diabetic animals chosen for experiment were randomly assigned to five groups of six animals each. A group of six animals, which were not exposed to alloxan treatment was included as normal control. The hypoglycemic effect of Eclipta alba methanolic extract were studied using three different doses each and compared with the standard oral hypoglycemic drug glibenclamide. The treatment schedule was as follows:

**Normal Control:** Received aqueous suspension of 0.1% carboxy methyl cellulose at a dose rate of 10 ml/kg.

**Group 1(Diabetic Control):** Received aqueous suspension of 0.1% carboxy methyl cellulose at a dose rate of 10 ml/kg.

**Group 2(Standard Control):** Received aqueous suspension of glibenclamide 0.01% w/v with 0.1% carboxy methyl cellulose at a dose rate of 600 μg/kg.

**Group 3(Test):** Received aqueous suspension of 0.1% carboxy methyl cellulose with methanolic extract of Eclipta alba at a dose rate of 100 mg/kg.
Group 4 (Test): Received aqueous suspension of 0.1% carboxy methyl cellulose with methanolic extract of Eclipta alba at a dose rate of 200 mg/kg.

Group 5 (Test): Received aqueous suspension of 0.1% carboxy methyl cellulose with methanolic extract of Eclipta alba at a dose rate of 400 mg/kg.

The above treatments were continued up to the 6th week of alloxan administration.

Biochemical assays

Blood was collected at weekly intervals during the period for estimation of serum glucose.

Blood was collected from the experimental animals on the 30th day just before sacrifice and serum was separated and stored at -20°C for further biochemical analysis.

Serum glucose was estimated calorimetrically at 530 nm using the standard diagnostic kit. Urea, creatinine, triglycerides and cholesterol were estimated as per the protocol described in the standard kits (Agappe diagnostics) using semi auto analyser.

Antioxidant assays

After collection of blood, animals were sacrificed by cervical dislocation. Liver was immediately removed, flushed with ice cold normal saline solution, blotted and packed in an aluminum foil and stored at -70°C for performing the following antioxidant assays.

<table>
<thead>
<tr>
<th>Assay</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipid peroxidation</td>
<td>(Soon and Tan, 2002).</td>
</tr>
<tr>
<td>Reduced Gluthathione (GSH)</td>
<td>(Moron et al. 1979).</td>
</tr>
<tr>
<td>Catalase</td>
<td>(Caliborne, 1985)</td>
</tr>
<tr>
<td>Superoxide dismutase</td>
<td>(Marklund and Marklund, 1974).</td>
</tr>
</tbody>
</table>

Statistical analysis

The results are expressed as mean ± S.E and compared using randomized block design as well as completely randomized design and any significant difference between individual groups were compared using Duncan's multiple range comparison tests.

RESULTS

The hypoglycaemic and antioxidant activities of Eclipta alba extract in alloxan induced diabetic rats were tested at three different dose levels viz. 100, 200 and 400 mg/kg b.wt and the results are furnished below.

HYPOGLYCEMIC EFFECT OF METHANOLIC EXTRACT OF E. ALBA

Changes in serum glucose level

The observations of methanolic extract treatment on blood glucose levels are presented in Table 1. A maximum increase (265.5 ± 6.06) in serum glucose level of diabetic rats was observed at three weeks after alloxan injection in methanolic extract treatment (Table 1).

Changes in serum biochemical parameters

The effect of methanolic extract of Eclipta alba on serum urea, creatinine, cholesterol and triglycerides in diabetic rats are given in table 2 (P<0.05).

Urea

Serum urea level raised significantly (p<0.05) in diabetic control rats when compared to normal rats. Administration of methanolic extract at 400 mg/kg b.wt dose significantly (p<0.05) lowered the urea levels which was comparable to glibenclamide treatment (Table 2).
Creatinine

There was a significant rise in creatinine levels in diabetic rats which was reversed by all the three doses of methanolic extract (100, 200 and 400 mg/kg) similar to glibenclamide (Table 2). All the doses of methanolic extract induced significant reduction comparable to glibenclamide but not as that of normal (Table 2).

Cholesterol

The levels of cholesterol was significantly higher in the diabetic rats compared to normal rats. All the three doses of methanolic extract showed similar reduction in cholesterol levels and was comparable to glibenclamide.

Triglycerides

The levels of triglycerides were increased in serum of diabetic rats when compared with the normal control group. Treatment of the diabetic rats with the 400 mg/kg dose was comparable with the standard drug glibenclamide which restored the levels to normal (Table 2). Methanolic extract of the plant at 400 mg/kg dose produced significant reduction in serum triglyceride levels (Table 2).

ANTIOXIDANT EFFECT OF METHANOLIC EXTRACT OF ECLIPTA ALBA

As lipid peroxidation and oxidative stress play a key role in the pathogenesis of diabetes, the effect of the plant on the levels of TBARS and endogenous antioxidants was evaluated.

Lipid peroxidation

The amount of TBARS in liver was increased significantly in diabetic rats. The values are presented in Table 3.

The values were reversed to normal in those groups treated with methanolic extract 400 mg/kg b.wt and the effect was comparable with that of glibenclamide. Similarly, the higher doses (200 and 400 mg/kg) of methanolic extract were able to restore the lipid peroxidation levels as that of normal control.

Non enzymatic antioxidant assay

Reduced Gluthathione (GSH)

The liver GSH was significantly decreased in diabetic rats as compared to normal control (Table 3). Administration of methanolic extract 200 and 400 mg/kg b.wt increased GSH level significantly similar to glibenclamide as compared to diabetic rats.

Enzymatic antioxidants

Catalase

The liver of diabetic control rats showed a significant increase in catalase activity as compared to normal control (Table 4).

Treatment with 400 mg/kg b.wt dose of methanolic extract reduced the liver catalase level significantly when compared to diabetic control, similar to glibenclamide treated group.

Superoxide dismutase

SOD level in the liver showed a significant change in the diabetic control of methanolic extract treatment (Table 4). In methanolic extract 200 and 400 mg/kg doses elucidate a significant reduction in SOD level and was similar to glibenclamide.

DISCUSSION

Medicinal plants continue to provide valuable therapeutic agents, both in modern medicine and in traditional system. The doubts about the efficacy and safety of the oral hypoglycaemic agents have prompted a search for safer and more effective drugs in the treatment of diabetes (Reaven, 1983). A wide variety of the traditional herbal remedies are used by diabetic patients, especially in the Third world countries (Gray and Flatt, 1998) and therefore represent new...
avenues in the search for alternative hypoglycaemic drugs.

ALLOXAN INDUCED DIABETES MELLITUS

Alloxan monohydrate is one of the chemical agents used to induce diabetes mellitus in animals. It can induce several processes: Oxidation of -SH group, inhibition of glucokinase, generation of free radicals and disturbances in calcium homeostasis (Szkudelski et al., 1998). Alloxan induces diabetes by partial destruction of beta cells of islets of Langerhans (Abdel-Barry et al., 1997). The partial destruction of beta cells leads to decreased levels of insulin resulting in hyperglycaemia. There is a possibility for the survival of a few beta cells and this has been proved by several research groups who observed anti-hyperglycaemic activity with oral hypoglycaemic agents in alloxan-induced diabetic rats (Prince and Menon 1999).

Hypoglycaemic effect of methanolic extract of Eclipta alba

Effect on serum glucose

Increase in blood glucose level is the important feature in diabetes. In this study after administration of alloxan at 120 mg/kg b.wt, a significant increase in serum glucose level was noticed similar to other reports by Punitha and Manoharan (2006) and Roy et al. (2005).

Methanolic extract of Eclipta alba at the dose of 400 mg/kg b.wt for four weeks were able to produce greater hypoglycaemic effect than glibenclamide, the standard drug. Cassia Kleinni leaf extract too produced hypoglycemic effect in diabetic rats (Babu et al., 2002).

Diabetes and kidney function

The diabetic hyperglycemia induces elevation of the plasma levels of urea and creatinine which are considered as significant markers of renal dysfunction (Almdal and Vilstrup, 1988).

Serum urea

The results showed significant elevation in the levels of serum urea in the diabetic groups. The elevation of urea level observed in the diabetic rats was declined to normal by the administration of methanolic extract at highest dose 400 mg/kg b.wt. Administration of glibenclamide also significant reduced urea levels to normal which is consistent with the findings of Nagappa et al. (2003).

Serum creatinine

There was a significant increase in serum creatinine level in diabetic animals over control group. All the three treatment groups exhibited reversal of elevated creatinine levels to normal. Reduction in elevated serum urea and creatinine treated with Lupinus termis and Halfa barr in diabetic rats was observed (Mansour et al., 2002).

From these results, it could be concluded that these plant extracts are capable of ameliorating the impaired diabetic renal function in addition to its hypoglycemic effect. The reversal of serum urea and creatinine levels and also the normalization of renal damage after administration of Eclipta alba are suggestive of a beneficial role of Eclipta alba in diabetes induced renal impairment.

Diabetes and dysfunction of lipid metabolism

Serum cholesterol

Diabetes mellitus in often linked with abnormal lipid mobilisation. The impairment of insulin secretion results in enhanced metabolism of lipids from the adipose tissue to the plasma. It has been demonstrated that the insulin deficiency in diabetes mellitus causes a variety of derangements in metabolic and regulatory processes, which in turn leads to accumulation of lipids such as total cholesterol and triglycerides in diabetic patients (Shukla et al., 1995).
After induction of diabetes, a significant increase in serum cholesterol values was observed. Similar observations were recorded by Bopanna et al., (1997) in untreated diabetic rats which was reversed in rats treated with neem kernel powder. Administration of methanolic extract at the dose of 400 mg/kg reduced serum cholesterol level over diabetic control. Momordica cymbalaria fruit also produced hypocholesterolaemia in alloxan induced diabetic rats. (Rao et al., 1999).

Serum triglycerides

The higher concentration of serum lipid in the diabetic subject is mainly due to increase in the mobilization of free fatty acids from the peripheral fat depots (Bopanna et al., 1997). In the present study, Eclipta alba at the dose of 400 mg/kg b.wt (methanolic extract) significantly reduced serum triglycerides in diabetic treated rats. Punitha and Manoharan (2006) reported that serum triglycerides were significantly decreased after treatment with glibenclamide and Pongamia pinnata flower extract.

Antioxidant effect of methanolic extract of Eclipta alba

Role of oxidative stress in diabetes mellitus

Oxidative stress plays an important role in chronic complications of diabetes and is postulated to be associated with increased lipid peroxidation (Elangovan et al., 2000). Under physiological conditions, a wide range of antioxidant defenses protects the body against the adverse effects of free radicals production in vivo (Halliwell and Gutteridge, 1990). The elevated levels of blood glucose in diabetics produce oxidative free radicals that cause membrane damage due to peroxidation of membrane lipids and protein glycation (Baynes, 1991 and Hunt et al., 1988). Glucose auto-oxidation in the presence of transition metal ions generates oxidative free radicals that make the membrane vulnerable to oxidative damage (Hunt et al., 1990).

The action of alloxan produces reactive free radicals that have been shown to be cytotoxic to the cells of the pancreas (Heikkila et al., 1976). Because the diabetogenic action of alloxan is preventable by SOD, CAT and other hydroxyl radical scavengers such as ethanol and dimethyliurea, there is evidence to suggest that the action of alloxan involves a superoxide anion and hydroxyl radicals. Thus, alloxan induced diabetes could elicit the antioxidant defense system in response to increased oxidative stress. The deleterious effects of O-2 and OH-radicals in oxidative stress can be counteracted by antioxidant enzymes such as SOD, CAT and glutathione peroxidase (Hunt et al., 1990).

Lipid per oxidation

Hypoinsulinaemia in diabetes increases the activity of the enzyme fatty acyl coenzyme A oxidase which initiates beta oxidation of fatty acids, resulting in lipid peroxidation (Horie et al., 1981). This impairs membrane function by decreasing membrane fluidity and changing the activities of membrane bound enzymes and receptors (Acworth et al., 1997). Its products are harmful to most of the cells in the body and associated with a variety of diseases (Xing and Tan, 2000).

The present study showed significant elevation of liver TBARS content in diabetic rats suggesting that peroxidative injury may be involved in the development of diabetic complications. Both aqueous and alcoholic extracts at 200 and 400 mg/kg b.wt dose and glibenclamide could significantly reduce the lipid peroxidation product levels in diabetic rats. This indicates that Eclipta alba is a potent inhibitor of oxidative damage of hepatic tissue.

Non-enzymatic antioxidants

Reduced glutathione

GSH is mainly involved in the synthesis of important macromolecules and in the protection
against reactive oxygen compounds (Kaplowitz et al., 1985). The decreased GSH content contributes to the pathogenesis of complications associated with chronic diabetic state.

In the present study there was decrease in GSH level in hepatic tissue of diabetic control rats which significantly increased upon treatment with extract. This finds support from the findings of Ananthan et al. (2003) who reported increased GSH level in diabetic rats after treatment with Gymnema montanum extracts.

**Enzymatic antioxidants**

SOD and CAT are the two scavenging enzymes that remove the toxic free radicals (Wohaieb and Godin, 1987).

**Superoxide dismutase**

Of the enzymatic antioxidant defense system, SOD is one of the most important enzymes and scavenger of O2- anion (which is the first product of oxidative radicals) to form H2O2 and hence diminishes the toxic effects due to this radical or other free radicals derived from secondary reactions (Arunabh et al., 1999).

In the present study, increase in SOD activity was observed in diabetic rats. The increase in SOD activity may protect CAT and glutathione peroxidase against inactivation of O2- anions as these anions have been shown to inactivate CAT.

It is suggested that at the initial stages of diabetes the increase in SOD may point to an adaptive reaction to oxidative stress reflecting free radical overproduction and hence increased enzyme biosynthesis. Elevated SOD activity may also play a protective role in preventing cells from peroxynitrite anion formation (Yadav et al., 1997).

SOD activities in hepatic tissue of diabetic rats were significantly increased compared with the control rats. Similar increase was observed by Lee (2005) in diabetic rat liver, in aorta (Yue et al., 2005). Methanolic extract of Eclipta alba at 200 and 400 mg/kg b.wt doses to diabetic rats significantly lowered the enzyme activities.

**Catalase**

Catalase has been regarded as a major determinant of hepatic and cardiac antioxidant status (Wohaieb and Godin, 1987). It is known to be involved in detoxification of H2O2 concentrations (Yoshikawa et al., 1993).

The results of the present study revealed an increase in CAT level of hepatic tissue in diabetic rats induced by high concentrations of H2O2. Similar increase was reported in diabetic rats by Lee (2005). A significant reduction was observed in the group treated with methanolic extract 400 mg/kg b.wt dose inferring that the low CAT activity indicates low substrate concentrations.

The effects of Gongronema latifolium leaves (Vgochukwu and Cobourne, 2003) and mulberry leaf extract (Andallu and Vardacharyulu, 2003) in diabetic treated groups were similar to that of Eclipta alba.

The treatment groups lowered the enzyme activities suggesting decreased generation of free radicals and thereby decreasing the need for overproduction of scavenging enzymes such as SOD and CAT. Similar results were observed after treatment with plant extracts in diabetic rats (Lee, 2005 and Yue et al., 2005).

**Possible mechanism of action of E.alba extracts**

In this study, however the direct pancreatic effects of Eclipta alba have not been investigated. On perusing the literature it is found that little information is available on the effects of plant extracts or their active ingredients directly on the beta cells of pancreas. Both the extracts of Eclipta alba in this study have shown significant antioxidant action. The complications of chronic diabetes such
as atherosclerosis, myocardial infarction, nephropathy have been related to the oxidative stress consequent to increased glucose levels (Sabu and Kuttan, 2002). The antioxidant property of Eclipta alba could therefore help in reducing the post diabetic complications. In addition the extracts of Eclipta alba have also been found to reduce blood glucose levels similar to glibenclamide which is known to enhance insulin secretion by a direct action on the pancreas (Davis and Granner, 2001). It will be interesting to investigate the effects of Eclipta alba extracts on pancreatic or extra pancreatic mechanisms that account for reduced levels of blood glucose. Further studies are needed to understand the possible mechanisms of antidiabetic effect of Eclipta alba which seems to be a promising agent for the treatment of diabetic and post diabetic complications.

**CONCLUSION**

1. Methanolic extract of Eclipta alba lowered glucose levels in alloxan induced diabetic rats.
2. The extract of Eclipta alba normalized biochemical changes and nephritic damages.
3. The extract of Eclipta alba have shown reduction in the lipid peroxidative damage and improved antioxidant status.

Thus results of the present study indicate that the extracts of Eclipta alba has a potential therapeutic efficacy in controlling diabetes and post diabetic complications by possessing both hypoglycemic as well as antioxidant properties.

**REFERENCES**


Hypoglycemic and antioxidant.....


### Table - 1

**Effect of methanolic extract of Eclipta alba on serum glucose levels (mg/dl) in diabetic rats (n=6, Mean ± SE)**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Period in weeks after alloxan administration</th>
<th>Overall mean pooled over period &amp; (% decrease)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1st</td>
</tr>
<tr>
<td>Normal control (Distilled water, P/O)</td>
<td>62.50 ± 1.58</td>
<td>60.16 ± 2.53</td>
</tr>
<tr>
<td>Diabetic control (0.1% carboxymethyl cellulose P/O)</td>
<td>65.83 ± 3.62</td>
<td>150.83 ± 5.24</td>
</tr>
<tr>
<td>Glibenclamide (600 μg/kg, P/O)</td>
<td>61.66 ± 1.62</td>
<td>173 ± 7.72</td>
</tr>
<tr>
<td>E.alba (100 mg/kg, P/O)</td>
<td>64 ± 1.75</td>
<td>170.83 ± 3.11</td>
</tr>
<tr>
<td>E.alba (200 mg/kg, P/O)</td>
<td>61.66 ± 2.33</td>
<td>164.66 ± 4.49</td>
</tr>
<tr>
<td>E.alba (400 mg/kg, P/O)</td>
<td>65.5 ± 2.36</td>
<td>160 ± 4.68</td>
</tr>
</tbody>
</table>

Means bearing different superscripts differ significantly (P<0.01)

### Table - 2

**Effect of methanolic extract of Eclipta alba on urea, creatinine, cholesterol and triglycerides (mg/dl) in serum in diabetic rats (n=6, Mean ± SE)**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Urea</th>
<th>Creatinine</th>
<th>Cholesterol</th>
<th>Triglycerides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal control (Distilled water, P/O)</td>
<td>36.78a ± 1.47</td>
<td>0.54a ± 0.01</td>
<td>64.05a ± 1.40</td>
<td>44.81a ± 6.4</td>
</tr>
<tr>
<td>Diabetic control (0.1% carboxymethyl cellulose, P/O)</td>
<td>49.40b ± 1.89</td>
<td>0.88c ± 0.03</td>
<td>102.35b ± 4.22</td>
<td>73.28c ± 2.77</td>
</tr>
<tr>
<td>Glibenclamide (600 μg/kg, P/O)</td>
<td>37.45a ± 1.76</td>
<td>0.62ab ± 0.04</td>
<td>73.03a ± 3.54</td>
<td>47.71a ± 1.38</td>
</tr>
<tr>
<td>Eclipta alba (100 mg/kg, P/O)</td>
<td>42.80ab ± 5.88</td>
<td>0.69b ± 0.05</td>
<td>68.78a ± 5.86</td>
<td>68.60bc ± 0.76</td>
</tr>
<tr>
<td>Eclipta alba (200 mg/kg, P/O)</td>
<td>43.70ab ± 7.30</td>
<td>0.71b ± 0.04</td>
<td>68.55a ± 4.82</td>
<td>59.65b ± 3.42</td>
</tr>
<tr>
<td>Eclipta alba (400 mg/kg, P/O)</td>
<td>37.25a ± 1.18</td>
<td>0.69b ± 0.04</td>
<td>65.80a ± 7.31</td>
<td>54.41ab ± 2.10</td>
</tr>
</tbody>
</table>

Means bearing different superscripts differ significantly (P<0.05)
### Table - 3

Effect of methanolic extract of Eclipta alba on TBARS (lipid peroxidation) and GSH (reduced glutathione) levels in diabetic rat liver (n=6, Mean ± SE)

<table>
<thead>
<tr>
<th>Groups</th>
<th>TBARS (n moles/g tissue)</th>
<th>GSH (mg/g tissue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal control (Distilled water, P/O)</td>
<td>916.50 ± 43.86</td>
<td>25.22 ± 1.15</td>
</tr>
<tr>
<td>Diabetic control (0.1% carboxy methyl cellulose, P/O)</td>
<td>1230.66 ± 14.50</td>
<td>15.32 ± 0.59</td>
</tr>
<tr>
<td>Glibenclamide (600 μg/kg, P/O)</td>
<td>825.50 ± 37.78</td>
<td>21.71 ± 0.54</td>
</tr>
<tr>
<td><em>Eclipta alba</em> (100 mg/kg, P/O)</td>
<td>1141.83 ± 26.94</td>
<td>18.09 ± 0.91</td>
</tr>
<tr>
<td><em>Eclipta alba</em> (200 mg/kg, P/O)</td>
<td>871.00 ± 32.01</td>
<td>20.65 ± 0.85</td>
</tr>
<tr>
<td><em>Eclipta alba</em> (400 mg/kg, P/O)</td>
<td>888.33 ± 57.22</td>
<td>21.92 ± 0.45</td>
</tr>
</tbody>
</table>

Means bearing different superscripts differ significantly (P<0.05)

### Table - 4

Effect of methanolic extract of Eclipta alba on CAT and SOD levels in diabetic rat liver (n=6, Mean ± SE)

<table>
<thead>
<tr>
<th>Groups</th>
<th>CAT Units^A/ min / mg protein</th>
<th>SOD Units^B/ min / mg protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal control (Distilled water, P/O)</td>
<td>0.26 ± 0.02</td>
<td>39.53 ± 4.09</td>
</tr>
<tr>
<td>Diabetic control (0.1% carboxymethyl cellulose, P/O)</td>
<td>0.95 ± 0.17</td>
<td>72.06 ± 7.2</td>
</tr>
<tr>
<td>Glibenclamide (600 μg/kg, P/O)</td>
<td>0.59 ± 0.07</td>
<td>48.34 ± 2.32</td>
</tr>
<tr>
<td><em>Eclipta alba</em> (100 mg/kg, P/O)</td>
<td>0.72 ± 0.19</td>
<td>58.00 ± 4.65</td>
</tr>
<tr>
<td><em>Eclipta alba</em> (200 mg/kg, P/O)</td>
<td>0.67 ± 0.20</td>
<td>51.78 ± 1.3</td>
</tr>
<tr>
<td><em>Eclipta alba</em> (400 mg/kg, P/O)</td>
<td>0.60 ± 0.07</td>
<td>49.53 ± 6.3</td>
</tr>
</tbody>
</table>

Means bearing different superscripts differ significantly (P<0.05)

Units A - moles H2O2 consumed
Units B - Enzyme required to inhibit 50% pyrogallol antioxidation.