

Introduction
The word drug is as old as disease the largest population of India is suffering from diabetes mellitus one of the major problem currently the developing countries faced today. Almost 1.3% of the population suffers from this disease throughout the world and number of diabetics is increasing by 6% per year. Approximately 3,00,000 deaths each year are attributed to diabetes. Its prevalence increases with age, from about 0.2% in persons less than 17 years of age to about 10% in persons aged 65 years and over.

Diabetes mellitus is one of the refractory diseases identified by ICMR for which an alternative medicine is a need for the treatment. Diabetes mellitus has become a growing problem in the contemporary world. The prevalence of NIDDM is increasing exponentially. Its prevalence in more affluent societies is spectacular and of general concern. It has recently broken the age barrier and appears even in younger people. It is debilitating metabolic disorder and robs persons of their energy and vitality. In India, diabetes has been known for a long time, but its incidence is not of the same magnitude across the subcontinent. The wide range of structures of the plant constituents, which appears to be the active hypoglycemic properties, needs to be investigated for those plants that are commonly used in the management of diabetes.

Diabetes mellitus is a heterogeneous group of disease, characterized by a state of chronic hyperglycemia, resulting from a diversity of etiologies, environmental and genetic, acting jointly. The underlying cause of diabetes is the defective production or action of insulin, a hormone that controls glucose, fat and amino acid metabolism. Characteristically diabetes is a long-term disease with variable clinical manifestations and progression, chronic hyperglycemia, from whatever cause, leads to a number of complications including cardiovascular such as hypertension, renal, neurological such as anxiety, stress, ocular and other such an intercurrent infections.

Present Treatment for Diabetes Mellitus:
Drug treatment for diabetes mellitus is based on the type (i.e. stage of diabetes. Usually there are two types of diabetes mellitus i.e. one is insulin dependent diabetes mellitus (IDDM)/Type I or juvenile diabetes which occur in younger people and another one is non-insulin dependent diabetes mellitus (NIDDM)/ Type II which usually occurs in older people.
The treatment for diabetes mellitus includes the following categories of drugs:

- **Insulin:**
  
  It is useful in type-I diabetes mellitus because those people are having lack of secretion of insulin by β-islet of langerhans. Insulin is given intravenously in diabetic coma and followed by subcutaneous (Dose 40-60 unit of insulin). Insulin is the oldest and best drug in the treatment of diabetes mellitus and administration of this result in blood glucose regulation.

I. **Oral hypoglycemic agents:**

  Insulin due to its nature, on oral administration it is destroyed by the gastric environment so there is a need of an alternative for insulin. As a result the oral hypoglycemic agents have become popular in the treatment. Oral hypoglycemic agents act on the β -islet of langerhans and stimulate the β -cells. This stimulation leads help in the secretion of insulin and this makes the decrease in elevated blood glucose level. There are other mechanisms also which increases peripheral utilization of glucose and delay digestion of carbohydrate. Various drugs are available as oral hypoglycemic agents and are categorized into:

  a. **Sulphanylureas:** Tolbutamide, Chlorpropamide, Acetohexamide, Glibenclamide, Gldornuride, Glipizide, Gliquidone etc.
  
  b. **Biguanidines:** Metformin, Fenformin.
  
  c. **α-glycocidase inhibitors:** Acarbose.
  
  d. **Thiazolidinones:** Rosiglitazone
  
  e. **Aldose reductase inhibitors:** Tolrestat

II. **Herbal Remedies:**

  The herbal remedies for diabetes mellitus are gaining more interest now a day. It is because of herbal drugs showed the promising activity when compared with the standard drugs. These herbal drugs are useful in the treatment of type-I i.e. NIDDM. The herbal drugs are of natural origin, which regulates the glucose level and also maintains the functioning of pancreas, kidney. With regular exercise, yoga and Pranayama Diabetes mellitus can be controlled and treated very well. More discovery and work are in progress to exploit these herbal drugs as a major strategy for the treatment of all types of diabetes mellitus. From this new gain of interests indicates or shows that there is a definite advantage such as:

Pharmacognostic, phytochemical and pharmacological investigation on *Pterospermum acerifolium* WILLD. (Sterculiaceae)
1. All plants are available in the various regions of India.
2. Economical and easily available.
3. Synthetic drugs have more side effects than the herbal drugs.
4. Easy route of administration (oral because in the case of insulin, should be administered only subcutaneous route.
5. Simultaneous administration of insulin cause hypoglycemic shock, such as, hyperirritability, trembling, in cardination, convulsions, unconsciousness and death.
6. Hypoglycemia may be reported with sulphonyl ureas.
7. A biguanides should not be used in patients with renal diseases.
8. Continuous administration of insulin by parenteral route causes thrombosis and pain to the patients.

Reports on herbal remedies for diabetes mellitus have showed the promising antidiabetic activity when compared with the standard drugs. Ayurveda and other traditional system of medicine supports *Pterosperum acido folium* bark, Leaves and wood as anti-diabetic, which are efficacious and economical, as compared to synthetic drugs, but not evaluated systematically till date. Hence, the present study was aimed towards the comparative screening of the above mentioned plant extracts for anti-diabetic activity by using streptozocin induced diabetic model.

Oxidative stress, defined as an imbalance between oxidants and antioxidants leads to many biochemical changes and is an important causative factor in several human chronic diseases, such as atherosclerosis and cardiovascular diseases, mutagenesis and cancer, several neurodegenerative disorders and the aging process. Diabetes mellitus is one such disease and it is estimated that the number of diabetic patients will continue to increase in the future. It has been postulated that the etiology of the complications of diabetes involves oxidative stress perhaps as a result of hyperglycemia. The elevated levels of blood glucose in diabetes produce oxygen-free radicals (OFR), which cause membrane damagedue to peroxidation of membrane lipids and protein glycation. Baynes (1991) reported that plasma thiobarbituric acid reactive substance (TBARS) levels increased in diabetic patients due to vascular lesions induced by hyperglycemia. Diabetic patients thus have an increased
incidence of vascular diseases and it has been suggested that free radical activity increased in diabetes\textsuperscript{12}. It has also been shown that glucose under physiological conditions produces oxidants that possesses reactivity similar to the hydroxyl-free radicals. Recent years have witnessed a renewed interest in plants as pharmaceuticals because they synthesize a variety of secondary metabolites with antioxidant potential which can play a major role in protection against molecular damage induced by reactive oxygen species (ROS)\textsuperscript{13, 14}. Many traditional plant treatments for diabetes mellitus are used throughout the world. Few of the medicinal plant treatments for diabetes have received scientific scrutiny, for which World Health Organization (WHO) has also recommended attention\textsuperscript{15}.

However, to date no antioxidant investigations or hypoglycemic activity in experimental animals have been reported in the aerial part of this plant. Therefore, the present study was undertaken to investigate the effect of \textit{Hygrophila auriculata} on the level of antioxidant enzymes like superoxide dismutase (SOD), CAT, glutathione (GSH), GPx, glutathione S-transferase (GST) along with TBARS and hydroperoxides in streptozotocin (STZ)-induced diabetic rats and validate the ethnobotanical and clinical claims of the plant.
MATERIAL AND METHODS

Animals:
Healthy Albino male rats (160-180 g) were controlled with standard environmental conditions, water and feed, and used for present study. They were housed in polypropylene cages maintained under standard condition (12 h light/dark cycle; 30+4 °C, 36-60 humidity). The ethical clearance (before the experiment) was taken from the Institutional Animal Ethics Committee.

Drugs and chemicals
All the drugs and chemicals were obtained from Sigma Chemical Co. (St. Louis, MO, USA). All solvents were of analytical grade and were obtained from Sd. Fine Chemicals, Mumbai, India.

Evaluation of TMPAL, TMPAB and TMPAW on normal healthy rats:

Experimental protocol for
SET I: Fasted rats were divided into four groups carrying six animals each. Group I-control group and received distilled water, Groups II-IV, received TMPAL, TMPAB and TMPAW 200 mg/kg p.o. Blood samples were collected from the retro-orbital plexus at 30, 60, 120 and 180 minutes with subsequent treatment after extract loading. Serum was separated and blood glucose levels were measured immediately by the glucose oxidase method.

SET II: Fasted rats were divided into four groups carrying six animals each. Group I-control group and received distilled water, Groups II-IV, received TMPAB at 100, 200 and 400 mg/kg p.o. Procedure was repeated as above.

Evaluation of EAPAB and TMPAB in Streptozotocin induced diabetes:

Experimental induction of diabetes
A freshly prepared solution of streptozotocin (50 mg/kg, body weight) + 1IU insulin in 0.1M citrate buffer (pH 4.5) was injected intraperitoneally in a volume of 1 ml/kg. STZ-injected animals exhibited massive glycosuria and hyperglycemia within 2 days. Diabetes was confirmed in STZ rats by measuring the fasting blood glucose concentration 96 h after the injection of STZ. The rats with blood glucose level >250 mg/dl were considered to be diabetic and were used in the experiment.

Experimental design:
Chapter VI
Pharmacological investigation

The diabetic rats (glucose level > 250 mg/dl) were divided into nine groups of six rats each. Group I served as negative control and received distilled water. Group II served as the diabetic control, Group III received the Glibenclamide 5mg/kg as standard drug, Group IV-IX received the EAPAB and TMPAB at doses of 100, 200 and 400 mg/kg, p.o. The administration of the extract was continued for 21 days, once daily. Blood samples were collected from the retro-orbital plexus on days 0, 7th, 15th and 21st of extract administration. The blood glucose level was determined for all the samples by the glucose oxidase method.

Antioxidant assay

Dissection and homogenization

The animals were sacrificed by decapitation. The brains were removed; forebrain dissected out, rinsed with isotonic saline, and weighed. A 10% (w/v) tissue homogenate was prepared in 0.1M phosphate buffer (pH 7.4), the post nuclear fraction for catalase assay was obtained by centrifugation of homogenate at 1000 g for 20 min, at 4°C and for other enzyme assays centrifuged at 12,000 g for 60 min at 4°C.

- Estimation of lipid peroxidative indices

Lipid peroxidation as evidenced by the formation of thiobarbituric acid reactive substances (TBARS) was measured by the method of Niehaus and Samuelsson (1968). In brief, 0.1mL of homogenate (Tris-HCl buffer, pH 7.5) was treated with 2mL of (1 : 1 : 1 ratio) TBA–TCA–HCl reagent (Thiobarbituric acid 0.37%, 0.25N HCl, and 15% TCA) and placed in water bath for 15 min, cooled and centrifuged at room temperature for 10 min at 1000 rpm. The absorbance of clear supernatant was measured against reference blank at 535 nm. The results were expressed as LPO nanomole per milligram wet tissue.

- Estimation of reduced glutathione

Reduced glutathione (GSH) was determined by the method of Ellman (1959). To the homogenate 10% trichloroacetic acid added and centrifuged, followed by addition of 1.0mL of Ellmans reagent (19.8 mg of 5, 50-dithiobisnitro benzoic acid (DTNB) in 100mL of 1.0% sodium citrate and 3mL of phosphate buffer (pH 8.0)). The colour developed was measured at 412 nm. The results were expressed as nanomole GSH per milligram wet tissue. For glutathione peroxidase, an enzyme unit represents a decrease in GSH concentration of 0.001 log unit per minute after subtraction of non-
enzymic mode and glutathione S-transferase activities were assayed according to the method of Habig et al. (1974).

- **Measurement of superoxide dismutase activity**
  The assay of superoxide dismutase (SOD) was based on the ability of SOD to inhibit spontaneous oxidation of adrenaline to adrenochrome. To 0.05mL supernatant, 2.0mL of carbonate buffer and 0.5mL of EDTA were added. The reaction was initiated by addition of 0.5mL of epinephrine and the autooxidation of adrenaline (3X10⁴ M) to adrenochrome at pH 10.2 was measured by following change in optical density at 480 nm. The change in optical density every minute was measured at 480nm against reagent blank. The results are expressed as units of SOD activity (milligram per protein). One unit of SOD activity induced approximately 50% inhibition of adrenaline. The results were expressed as nmol SOD U/mg wet tissue.

- **Measurement of Catalase activity**
  The reaction mixture consisted of 2mL phosphate buffer (pH 7.0), 0.95mL of hydrogen peroxide (0.019 M), and 0.05mL supernatant in final volume of 3 mL. Absorbance was recorded at 240nm every 10 s for 1 min. One unit of Cat was defined as the amount of enzyme required to decompose 1 mmol of peroxide per min, at 25°C and pH 7.0. The results were expressed as units of CAT activity (milligram per protein). Units of activity were determined from the standard graph of H₂O₂. The results were expressed as catalase U/mg wet tissue.

Protein content in tissue homogenate was measured by the method of Lowry et al. (1951).
RESULTS AND DISCUSSION

As total methanol extracts of *P. acerifolium* bark, leaves and wood contains significant amount of total flavonoids and total phenol, methanol extract of *P. acerifolium* bark, leaves and wood was evaluated for hypoglycemic activity by normoglycemic method and antihyperglycemic activity by streptozotocin-induced method.

TMPAL, TMPAB and TMAPAW were evaluated for hypoglycemic activity at dose 200 mg/kg b.w. p.o. All the extracts showed considerable hypoglycemic activity but amongst all TMPAB showed potent hypoglycemic activity as compare to TMPAL and TMAPAW (Table 6.3.1). Based on the primary study TMPAB was again screened for normoglycemic activity at doses 100 mg/kg, 200 mg/kg and 400 mg/kg b.w. The results showed significant (p < 0.01, p < 0.05) reduction of blood glucose level over 3-h period (Table 6.3.2). Result for normoglycemic activity was compared to control group. In normoglycemic rats, TMPAB showed dose dependent hypoglycaemic effect at 3 h.

As TMPAB showed potent hypoglycemic activity it was evaluated for antihyperglycemic activity at doses 100 mg/kg, 200 mg/kg and 400 mg/kg b.w. (Table 6.3.3). EAPAB also contain considerable amount of total flavonoids and total phenol it was also evaluated for antihyperglycemic activity at doses 100 mg/kg, 200 mg/kg and 400 mg/kg b.w and activity of EAPAW was compared with TMPAB. EAPAB and TMPAB at various doses showed considerable antihyperglycemic activity, but as compared TMPAB, EAPAB showed significant (p <0.01, p <0.05) antihyperglycemic activity at dose 200 and 400 mg/kg b.w. Activity of EAPAW may be due to maximum amount of total phenol and total flavonoids. Results for antihyperglycemic activity was compared to control group and diabetic control. Standard used for antihyperglycemic activity was Glibenclamide (0.25mg/kg).

A significant reduction in GSH, GPx, GST, SOD and catalase was observed in the diabetic control rats as compared to the normal control rats. Oral administration of EAPAB and TMPAB (100, 200,400 mg/kg body weight) for 3 weeks shows significant increase level of GST, GPx, CAT. Among all EAPAB at 400 mg/kg shows significant increase level of GST 6.59±0.29; GPx 9.17±0.88; CAT 70.22±1.24. SOD level (6.22±0.43) in erythrocytes decreased upon induction of diabetes and
significantly increased on treatment with EAPAB restoring it to the near-normal control group. The results were comparable to that of the glibenclamide. Activities of these enzymes decreased significantly in the diabetic control rats as compared to the normal control. Oral administration of the EAPAB and TMPAB (100, 200 and 400 mg/kg body weight) for 3 weeks significantly reversed these enzymes to near-normal values.

Free radical-induced LPO has been associated with a number of disease processes including diabetes mellitus. The increase in oxygen-free radicals in diabetes could be due to increase in blood glucose levels, which generate free radicals upon autoxidation. Glucose auto-oxidises in the presence of transition metal ions generating oxygen-free radicals which make the membrane vulnerable to oxidative damage. The action of diabetes-inducing agents produces reactive free radicals, which have been shown to be cytotoxic to the β cells of the pancreas. The diabetogenic action can be prevented by the superoxide dismutase, catalase and other hydroxyl radical scavengers, such as ethanol and dimethyl urea, hence there is evidence to suggest that the incidence of diabetes involves superoxide anion and hydroxyl radicals. The deleterious effects of superoxide anion and hydroxyl radicals can be counteracted by antioxidant enzymes, such as SOD, CAT and glutathione peroxidase. In addition to these enzymes, glutathione reductase (GSH-R) and glutathione S-transferase provide glutathione and help to neutralize toxic electrophiles, respectively. There is clear cut evidence to show the role of free radicals in diabetes and studies indicate that tissue injury in diabetes may be due to free radicals. The capacity of TMPAB and EAPAB to significantly decrease the elevated blood glucose close to normal level is an essential trigger for the liver to revert to its normal homeostasis during experimental diabetes. These findings coincide with those of the earlier studies which report the antidiabetic activity of the plant by clinical studies. LPO is also one of the features of chronic diabetes and lipid peroxide-mediated damage has been observed in both type I and type II diabetes mellitus. Under physiological conditions, low concentrations of lipid peroxides are found in tissues, which stimulate the secretion of insulin. The involvement of free radicals in diabetes and the role of these toxic species in LPO and the antioxidant defense system have been studied. Depletion of tissue glutathione and increase in LPO have been observed in diabetes.
Besides this, other pathways, such as fatty acid and cholesterol biosynthesis also compete for NADPH with GSH. The decrease in GSH level in liver during diabetes is probably due to its increased utilization by the hepatic cells which could be the result of decreased synthesis or increased degradation of GSH by oxidative stress in diabetes 32. We have also observed the decrease in GSH. The activities of GPx and GST were observed to decrease significantly in diabetic rats. GPx an enzyme with selenium and GST, catalyzes the reduction of hydrogen peroxide to non-toxic compounds33.

EAPAB and TMPAB significantly attenuated the increased lipid peroxidation which could be due to the antioxidant effect of flavonoids and phenolics, detected in the preliminary phytochemical screening. Quantitative estimation shows the presence of prominent amount of phenol and flavonoids in EAPAB and TMPAB. Flavonoids are known to regenerate the damaged beta cells in the alloxan diabetic rats 34. Phenolics are found to be effective antihyperglycemic agents35.

From this study, we can conclude that EAPAB has beneficial effects on blood glucose level. It has the potential to impart therapeutic effect in diabetes. Administration of EAPAB and TMPAB and glibenclamide increased the activities of GPx and GST in diabetic conditions. SOD and catalase are two major scavenging enzymes that remove the toxic-free radical in vivo. Reduced activities of SOD in erythrocytes and catalase have been observed during diabetes and this may result in a number of deleterious effects due to the accumulation of superoxide radicals and hydrogen peroxide36. EAPAB TMPAB and glibenclamide-treated rats showed decreased LPO that is associated with increased activity of SOD and catalase37. The results obtained thus suggest that EAPAB possesses potent antidiabetic and antioxidant activity.
Table 6.3.1: Effect of TMPAL, TMPAB and TMPAW on normal rats

<table>
<thead>
<tr>
<th>Groups</th>
<th>Treatment</th>
<th>Fasting (dose mg/kg)</th>
<th>30min</th>
<th>60min</th>
<th>120min</th>
<th>180min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td></td>
<td>80.4± 2.337</td>
<td>79.6± 2.379</td>
<td>78.8± 2.267</td>
<td>78.4± 2.227</td>
<td>77.8± 1.908</td>
</tr>
<tr>
<td>Group I</td>
<td>TMPAL-200</td>
<td>80± 1.095</td>
<td>75.6± 1.327**</td>
<td>71± 1.673**</td>
<td>72.6± 1.749**</td>
<td>73± 1.497**</td>
</tr>
<tr>
<td>Group II</td>
<td>TMPAB-200</td>
<td>84.8± 1.158</td>
<td>79.4± 1.030ns</td>
<td>72.2± 0.9695*</td>
<td>62.4± 0.894**</td>
<td>69.4± 1.208**</td>
</tr>
<tr>
<td>Group III</td>
<td>TMPAW-200</td>
<td>84.2± 0.5831</td>
<td>81.4± 0.6782**</td>
<td>77.4± 0.8124*</td>
<td>72.2± 0.8602**</td>
<td>74± 0.8367**</td>
</tr>
</tbody>
</table>

Results are expressed as ± SEM (n=6), Data processed by one way ANOVA followed by Dunnett’s test, **p < 0.01, *p < 0.05 significant when compared to control group.

Figure 6.3.1 : Effect of TMPAL, TMPAB and TMPAW on normal rats
Table 6.3.2: Effect of TMPAB at different doses on normal rats

<table>
<thead>
<tr>
<th>Groups</th>
<th>Treatment (dose mg/kg)</th>
<th>Fasting</th>
<th>30min</th>
<th>60min</th>
<th>120min</th>
<th>180min</th>
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</thead>
<tbody>
<tr>
<td>Control</td>
<td>-</td>
<td>83.8±</td>
<td>82.3±</td>
<td>82±</td>
<td>81.4±</td>
<td>82.8±</td>
</tr>
<tr>
<td>Group</td>
<td>TMPAB-100</td>
<td>82.2±</td>
<td>79.8±</td>
<td>76.4±</td>
<td>71±</td>
<td>72.6±</td>
</tr>
<tr>
<td>IA</td>
<td>mg/kg</td>
<td>1.655</td>
<td>1.744ns</td>
<td>1.806ns</td>
<td>1.761**</td>
<td>1.887**</td>
</tr>
<tr>
<td>Group</td>
<td>TMPAB-200</td>
<td>83±</td>
<td>78.6±</td>
<td>74.4±</td>
<td>62.8±</td>
<td>70±</td>
</tr>
<tr>
<td>IIA</td>
<td>mg/kg</td>
<td>1.225</td>
<td>1.288ns</td>
<td>0.8718*</td>
<td>0.8004**</td>
<td>0.7071**</td>
</tr>
<tr>
<td>Group</td>
<td>TMPAB-200</td>
<td>80.6±</td>
<td>74.8±</td>
<td>70.2±</td>
<td>63.2±</td>
<td>66.4±</td>
</tr>
<tr>
<td>IIIA</td>
<td>mg/kg</td>
<td>2.182</td>
<td>2.518**</td>
<td>2.437**</td>
<td>2.245**</td>
<td>2.358**</td>
</tr>
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</table>

Results are expressed as ± SEM (n=6), Data processed by one way ANOVA followed by Dunnett’s test, **p < 0.01, *p < 0.05 significant when compared to control group.

Figure 6.3.2: Effect of TMPAB at different doses on normal rats
Table 6.3.3: Effect of EAPAB and TMPAB on diabetic rats

<table>
<thead>
<tr>
<th>Group</th>
<th>Treatment</th>
<th>Blood glucose concentration in mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 day</td>
</tr>
<tr>
<td>I</td>
<td>Control (Normal saline)</td>
<td>83.2±</td>
</tr>
<tr>
<td>II</td>
<td>Diabetic control</td>
<td>312.8±</td>
</tr>
<tr>
<td>III</td>
<td>Glibenclamide (0.25mg/kg)</td>
<td>317 ±</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.408</td>
</tr>
<tr>
<td>IV</td>
<td>EAPAB-100mg/kg</td>
<td>313.6±</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.847</td>
</tr>
<tr>
<td>V</td>
<td>EAPAB-200mg/kg</td>
<td>319±</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.474</td>
</tr>
<tr>
<td>VI</td>
<td>EAPAB-400mg/kg</td>
<td>327.8±</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.370</td>
</tr>
<tr>
<td>VII</td>
<td>TMPAB-100mg/kg</td>
<td>321.2±</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.575</td>
</tr>
<tr>
<td>VIII</td>
<td>TMPAB-200mg/kg</td>
<td>328.4±</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.745</td>
</tr>
<tr>
<td>IX</td>
<td>TMPAB-400mg/kg</td>
<td>314.2±</td>
</tr>
<tr>
<td></td>
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<td>13.324</td>
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</table>

Results are expressed as ± SEM (n=6), Data processed by one way ANOVA followed by Dunnett’s test, *p < 0.01, **p < 0.05 significant when compared to control group. a p <0.01, b p <0.05 significant when compared to diabetic control.
### Table 6.3.4: Effect of EAPAB and TMPAB on antioxidant enzyme activities in normal and diabetic rats

<table>
<thead>
<tr>
<th></th>
<th>SOD (U/mg wet tissue)</th>
<th>Catalase (μmol of H₂O₂ consumed/min/mg protein)</th>
<th>LPO (nmol/mg)</th>
<th>GSH nmol of DTNB conjugated/min/mg protein</th>
<th>GPx (μg glutathione consumed/min/mg protein)</th>
<th>GST (μmol of CDNB–GSH conjugate formed/min/mg protein)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal control</td>
<td>6.5</td>
<td>0.08</td>
<td>2.0</td>
<td>14.5</td>
<td>4.36</td>
<td>3.18</td>
</tr>
<tr>
<td>Diabetic control</td>
<td>3.4</td>
<td>0.04</td>
<td>16.2</td>
<td>5.2</td>
<td>1.11</td>
<td>1.32</td>
</tr>
<tr>
<td>TMPAB (100 mg/kg)</td>
<td>4.2</td>
<td>0.06</td>
<td>2.0</td>
<td>10.0</td>
<td>2.41</td>
<td>1.64</td>
</tr>
<tr>
<td>TMPAB (200 mg/kg)</td>
<td>4.8</td>
<td>0.08</td>
<td>2.1</td>
<td>12.6</td>
<td>2.48</td>
<td>1.97</td>
</tr>
<tr>
<td>TMPAB (400 mg/kg)</td>
<td>5.3</td>
<td>0.14</td>
<td>2.2</td>
<td>12.9</td>
<td>3.07</td>
<td>2.16</td>
</tr>
<tr>
<td>EAPAB (100 mg/kg)</td>
<td>4.9</td>
<td>0.12</td>
<td>2.4</td>
<td>9.6</td>
<td>3.18</td>
<td>2.48</td>
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<tr>
<td>EAPAB (200 mg/kg)</td>
<td>5.7</td>
<td>0.14</td>
<td>2.8</td>
<td>12.8</td>
<td>3.84</td>
<td>2.93</td>
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<tr>
<td>EAPAB (400 mg/kg)</td>
<td>6.2</td>
<td>0.18</td>
<td>3.6</td>
<td>16.8</td>
<td>4.32</td>
<td>3.20</td>
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<tr>
<td>Glibenclamide (0.25mg/kg)</td>
<td>5.18</td>
<td>0.2</td>
<td>3.80</td>
<td>18</td>
<td>4.79</td>
<td>3.14</td>
</tr>
</tbody>
</table>

The values represent the means±S.E.M. for six rats per group. NS, not significant; SOD, superoxide dismutase; GSH, glutathione; GPx, glutathione peroxidase; GST, glutathione S-transferase; CAT, catalase.

Data processed by one way ANOVA followed by Dunnett’s test, *p < 0.01, **p < 0.05 significant when compared to diabetic control group.
REFERENCES


