Evaluation of Antidiabetic and Antihyperlipidemic Effect of Ethanolic Leaves Extract of Centratherum anthelminticum (L) Kuntze against STZ Induced Diabetic Rats

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ABSTRACT

Objective: To evaluate the Antidiabetic & Antihyperlipidemic effect of Centratherum Anthelminticum (L) Kuntze extract against STZ induced diabetic rats.

Methods: The present study examined the influence of Centratherum Anthelminticum extract (CASE), on blood glucose level and antioxidant enzymes level in STZ induced diabetic rats. The possible effects of chronic administration of the extract on the fasting serum glucose, insulin, and total cholesterol and triglycerides levels in STZ-induced diabetic rats were also evaluated.

Results: The extracts showed a marked Antidiabetic & Antihyperlipidemic effect. Centratherum anthelminticum ethanolic seeds extract is capable of exhibiting glycemic control through its inhibitory effect on glycogenolytic enzyme glycogen phosphorylase, gluconeogenic enzymes such as glucose-6-phosphatase and fructose-1, 6-bis phosphatase and stimulatory effect on hexokinase, which is the key enzyme in the glycolytic pathway.

Antihyperlipidemic activity of Centratherum anthelminticum ethanolic seeds extract proved by restoration of altered lipid profile

Conclusions: The results of the study indicate that the extract of Centratherum Anthelminticum possesses strong antidiabetic & antihyperlipidemic activity. This study also describes therapeutic effect of Centratherum anthelminticum in diabetes which will give a new direction for the future scientific research.

Keywords: Diabetes, Centratherum anthelminticum, Pharmacological, Antidiabetic, Antihyperlipidemic

INTRODUCTION

Diabetes mellitus is a metabolic disorder with high blood sugar levels over a prolonged period of time. Symptoms of high blood sugar may be polyuria, polydipsia and polyphagia. Diabetes mellitus is a chronic metabolic disorder characterized by a high blood glucose concentration - hyperglycemia (fasting plasma glucose>126 mg/dL, or plasma glucose >200 mg/dL 2 hrs after a meal) - caused by insulin deficiency, often combined with insulin resistance. In diabetic patients, oxidative stress also has been found to be mainly due to increased production of oxygen free radicals and sharp reduction of anti-oxidant defense 1. Hypoinsulinemia associated with diabetes increases the activity of enzyme, fatty acyl Coenzyme A oxidase which initiates the β-oxidation of the fatty acids, resulting in lipid peroxidation. Increased lipid peroxidation impairs membrane function by decreased membrane fluidity and changing the activity of the membrane-bound enzyme and receptors 2. Its products (lipid radicals and lipid peroxides) are harmful to the cell in the body and associated with atherosclerosis and brain damage. Diabetes Mellitus is associated with abnormalities in carbohydrates and lipid metabolism that results in excessive production of reactive oxygen species [ROS] and oxidative stress 3.

Therefore the present study is undertaken to evaluate antidiabetic and anti-oxidant activity of C. anthelminticum in STZ induced diabetic rats.

The ethnobotanical information reports about 800 plants that may possess antidiabetic potential. Folk medicine for diabetes from Rayalaseema reports 26 plants with antidiabetic activity. One such plant is C. anthelminticum synonyms Vernonia anthelmintica, Conyza anthelmintica belongs to the family Asteraceae. In Hindi it is known as Kalizeeri 4.
Description of Plant

**Ethno medicinal & traditional uses of different parts of *Centratherum anthelminticum***

The indications of Leaves of *C. anthelminticum* are rheumatism, chronic persistent fevers, phlegmatic cough, and dropsy. The indications of Seed of *C. anthelminticum* are kidney troubles, pustules, skin irritation, hiccough, eye itching, cold phlegmatic inflammation, chronic persistent fevers, dysuria, rheumatism, leucoderma, psoriasis, colic, vitiligo, sores, asthma, and pimples.

Roots of *C. anthelminticum* are used in rheumatic swellings. Seed (powder) of *C. anthelminticum* is used in pimples, thread worms, irritative skin & round worms.

Herb Paste of *C. anthelminticum* is used in skin eruptions, rheumatism. The Indications of infusion (seed) of *C. anthelminticum* are phlegmatic cough, dropsy, rheumatic affections, and chronic persistent fevers.

**Significance of the Study**

*C. anthelminticum* is an important drug of indigenous system of medicine and has been known for a number of medicinal properties in Ayurveda. *C. anthelminticum* is used as folk-medicine for diabetes in Rayalaseema of Andhra Pradesh of India but still its pharmacological potential for anti-diabetic activity has not been fully explored. This study will try to provide scientific basis for the further development of antidiabetic activity of herbal drugs.

**MATERIAL AND METHOD**

- Collection & identification of plant material *C. anthelminticum* (L) kuntze.
- Preparation of ethanolic extract of *C. anthelminticum*.
- Assessment of antihyperglycemic effect of ethanolic extract of *C. anthelminticum* seeds in normal and STZ induced diabetic rats:
  - Body weights of the animals were recorded and they were divided into 7 groups of 6 animals each as follows:
    - **Group I:** Normal rats were administered with CMC
    - **Group II:** Diabetic control - Rats were induced with Streptozotocin in normal saline at a dose of 60 mg/kg body weight IP.
    - **Group III:** Groups of diabetic rats treated with ethanolic extract of *C. A*(100mg/kgbw) orally for 60 days
    - **Group IV:** Groups of diabetic rats treated with ethanolic extract of *C. A*(200mg/kgbw) orally for 60 days
    - **Group V:** Groups of diabetic rats treated with ethanolic extract of *C. A*(300mg/kgbw) orally for 60 days

**Preparation of ethanolic extract**

*C. anthelminticum* seed were dried under shade coarsely powdered and passed through 40 mesh sieves. Successive solvent extraction scheme was followed for the preparation of different extracts. Coarsely powdered *C. anthelminticum* seed were defatted with petroleum ether using Soxhlet apparatus. The dried marc was further extracted with ethanol using Soxhlet apparatus. Solvent was removed under reduced pressure using rotary evaporator to yield dried ethanolic extract.

**Induction of diabetes & Experimental design**

Assessment of antihyperglycemic effect of ethanolic extract of *C. anthelminticum* seeds in normal and STZ induced diabetic rats:

- Body weights of the animals were recorded and they were divided into 7 groups of 6 animals each as follows:
  - **Group I:** Normal rats were administered with CMC
  - **Group II:** Diabetic control - Rats were induced with Streptozotocin in normal saline at a dose of 60 mg/kg body weight IP.
  - **Group III:** Groups of diabetic rats treated with ethanolic extract of *C. A*(100mg/kgbw) orally for 60 days
  - **Group IV:** Groups of diabetic rats treated with ethanolic extract of *C. A*(200mg/kgbw) orally for 60 days
  - **Group V:** Groups of diabetic rats treated with ethanolic extract of *C. A*(300mg/kgbw) orally for 60 days
Group VI: Normal rats were administered orally the ethanolic extract of Centrtherum anthelminticum (300mg/kgbw) for 60 days.

Group VII: Groups of diabetic rats treated with Glibenclamide (5 mg/kgbw/oral) for 60 days

Animal care and selection

Adult male Swiss albino mice were obtained from the suitable source. They will be housed in polycryplene cages in groups of six mice per cage and kept in a room maintained at 25±2°C with a 12-h light/dark cycle. They will be allowed to acclimatize for 1 week before the experiments and will be given free access to standard laboratory feed and water ad libitum. Protocol is approved by Institutional animal ethics committee.

Acute toxicity study

The acute toxicity study will be performed according to OECD guideline 423. The adult Albino Swiss mice 20-25 g will be randomly divided into five groups containing three animals in each group. The animals will be fasted overnight, and the C. anthelminticum seeds extracts will be administered orally of various dose levels (mg/kg, BW) suspended in 0.5% Carboxymethyl cellulose. Fifth group will be maintained as control and administered the vehicle only. The animals will be observed continuously for 2 h, then occasionally for a further 24 h, and finally any mortality. The behaviour of the animals and any other toxic symptoms will be observed for 72 h, and they were kept under observation for one week 13.

Evaluation of Biochemical Parameters

Estimation of serum glucose level (GOD-POD method), serum insulin level (RIA method), serum cholesterol (enzymatic method), HDL cholesterol (enzymatic method), serum triglyceride (enzymatic method), serum urea (Berthelot method) and creatinine (alkaline picrate method) has to be observed for 72 h, and they were kept under observation for one week 13.

Estimation of total cholesterol & triglyceride: 1.0 ml of isopropanol was mixed with 0.1 ml of sample and 0.1, 0.2, 0.3, 0.4 and 0.5 ml of standard solution. To this 0.4g of alumina was added and mixed well for 15 min. The content was centrifuged at 3000 rpm for 10 minutes and 0.5 ml of the supernatant was transferred to reaction tubes and heated at 65 °C for 15 min. Then 0.6 ml of the saponification reagent was added and cooled. Then 1.0 ml of sodium metaperiodate and 0.5 ml of acetyl acetone reagent were added and heated at 65 °C for 30 minutes. The contents were cooled and the colour developed was read at 430 nm.

From the standard optical density values, the amount of triglyceride in the sample was calculated and expressed as mg/dl 15.

Estimation of phospholipids

0.1 ml of sample (tissue lipid) was digested with 0.2 ml of perchloric acid over a sand bath. Digestion was continued till it was colorless. The liberated phosphorus was estimated. 4.3ml of deionised water was added to the digested sample followed by 0.5 ml of ammonium molybdate. After 10 min 0.2 ml of ANSA was added. Tubes were well shaken and kept aside for 20 mins. Blue colour read at 620 nm. The total phospholipids were estimated by multiplying the value of Pi by 25 and expressed as mg/g wet tissue 16.

Estimation of HDL cholesterol

To 1.0 ml of lipid extract, 0.18 ml of heparin manganese chloride reagent was added and mixed. This was allowed to stand in an ice bath for 30 minutes and then centrifuged in a refrigerated centrifuge 2500 g for 30 minutes. The supernatant contained HDL fraction. Aliquots of the HDL supernatant were estimated for cholesterol, phospholipids 17.

Estimation of VLDL

To 1 ml of lipid extract was added to 0.15 ml of SDS solution. The contents were mixed well and incubated for 2 hours. The contents were centrifuged in a refrigerated centrifuge at 10,000 g for 30 minutes. VLDL aggregated as a pellet at the top. The supernatant was a mixture containing HDL and LDL fractions. The fractions of lipoproteins were assayed after heparin manganese chloride and SDS precipitation. The values are expressed in mg/dl plasma. After precipitation the cholesterol levels in supernatant was measured to get HDL cholesterol. SDS precipitated VLDL and the cholesterol content in the supernatant was measured for HDL cholesterol, LDL cholesterol and VLDL cholesterol 18.

Evaluation of antioxidant Parameters

Animal are scarified at the end of 28 days treatment. The liver of animal is dissected out rinsed with ice cold distilled water followed by sucrose solution (0.25 M). One gm of liver tissue is homogenized in 10 ml ice cold Tris hydrochloride buffer. The prepared homogenates are centrifuged and used for the determination of antioxidant parameters like Malondialdehyde (MDA), Superoxide dismutase (SOD), catalase, Reduced Glutathione (GSH) levels and total protein estimation. Liver and kidney are isolated from one animal of each group and used for histopathology 19.

Measurement of MDA i.e. lipid peroxidation, was measured spectrophotometrically by the method of using 1, 1, 3, 3-tetraethoxypropane as standard. MDA is expressed as nanomoles per mg protein. GSH was determined by its reaction with 5, 5'-dithiobis (2-nitrobenzoic acid) (Ellman1959) to yield a yellow chromophore which was measured spectrophotometrically. GSH is expressed as µg/mg protein 20. Nitrite is a stable end product of nitric oxide metabolism (as RNI) was measured in brain homogenate by Griess method. Briefly, the following procedure was adapted. The sample and reagents were well mixed and incubated for 10 min at room temperature in dark. Then absorbance was taken at 540 nm. The concentration of nitrite in supernatant was determined from sodium nitrite standard curve 21.

Histopathological studies

For histopathological study, the tissues were fixed in Bouin’s fluid. The classical paraffin sectioning and haematoxylin and eosin staining techniques were used for histopathological studies. The various steps involved in the preparation of tissues for histopathological studies were carried out 22.

Statistical analysis

The results are expressed as means±S.E.M. Statistical analysis of passive avoidance, Morris water maze and biochemical values were performed by comparison Duncan’s multiple range test (DMRT).
RESULT AND DISCUSSION:

Anti-diabetic activity of ethanolic leaves extract of *Centratherum anthelminticum*

Effect of ethanolic leaves extract on Body weight, of experimental animals

Body weights of the animals were recorded and they were divided into 7 groups of 6 animals each as follows:

**Body weight**

The effect of administration of different doses (100, 200 and 300mg/kg) of ethanolic leaves extract of *Centratherum anthelminticum* and Glibenclamide on body weight of rats during the experimental period is summarized on Table 4.15 & Fig 4.10. Diabetes induced animals showed significant decrease (p<0.05) in body weight day by day when compared with control animals. The ethanolic extract of *Centratherum anthelminticum* treated animals were found to be have significant increase (p<0.05) in body weight when compared with diabetes-induced animals. The results showed significant dose dependent increase in the body weight of the diabetic rats treated with the leaves extracts and the standard drug. The increase in ethanol extract treated group was similar to the normal group. There is no significant changes were observed in *Centratherum anthelminticum* alone (without induction of diabetes) treated rats.

Table 1: Effect of ethanolic leaves extract on Body Weight of experimental animals

<table>
<thead>
<tr>
<th>Groups</th>
<th>0th day</th>
<th>15th day</th>
<th>30th day</th>
<th>45th day</th>
<th>60th day</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>180.00±3.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>201.25±3.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>215.00±1.67&lt;sup&gt;a&lt;/sup&gt;</td>
<td>237.50±4.86&lt;sup&gt;a&lt;/sup&gt;</td>
<td>248.75±3.49&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>II</td>
<td>187.50±3.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>151.25±2.57&lt;sup&gt;b&lt;/sup&gt;</td>
<td>145.00±1.94&lt;sup&gt;b&lt;/sup&gt;</td>
<td>132.50±2.64&lt;sup&gt;b&lt;/sup&gt;</td>
<td>126.50±2.46&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>III</td>
<td>180.00±15.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>196.25±4.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>215.00±12.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>240.50±17.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>231.25±12.73&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IV</td>
<td>182.50±13.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>205.00±15.46&lt;sup&gt;a&lt;/sup&gt;</td>
<td>210.00±26.77&lt;sup&gt;a&lt;/sup&gt;</td>
<td>238.00±30.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>242.50±25.47&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>V</td>
<td>185.00±12.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>210.00±10.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>220.50±20.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>235.00±20.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>245.50±28.94&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>VI</td>
<td>186.00±11.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>202.00±11.73&lt;sup&gt;a&lt;/sup&gt;</td>
<td>160.00±18.56&lt;sup&gt;a&lt;/sup&gt;</td>
<td>230.50±16.46&lt;sup&gt;a&lt;/sup&gt;</td>
<td>238.00±21.21&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>VII</td>
<td>185.00±2.36&lt;sup&gt;a&lt;/sup&gt;</td>
<td>200.00±13.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>204.50±20.38&lt;sup&gt;a&lt;/sup&gt;</td>
<td>217.50±21.95&lt;sup&gt;a&lt;/sup&gt;</td>
<td>240.00±21.86&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are expressed as Mean ± SD for six rats. Mean values within a group followed by different letters are significantly different from each other at P <0.05 level comparison by Duncan’s multiple range test (DMRT).

Fig 1: Effect of ethanolic seeds extract on Body Weight, of experimental animals

Table 2: Effect of ethanolic seeds extract on Glucose (mg/dl) of experimental animals

<table>
<thead>
<tr>
<th>Groups</th>
<th>4th day</th>
<th>15th day</th>
<th>30th day</th>
<th>45th day</th>
<th>60th day</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>106.40±1.62&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.60±0.68&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.75±0.66&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.75±0.66&lt;sup&gt;a&lt;/sup&gt;</td>
<td>104.00±0.66&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>II</td>
<td>178.00±4.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>222.60±0.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>225.60±0.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>228.60±0.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>231.60±0.47&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>III</td>
<td>151.00±5.85&lt;sup&gt;c&lt;/sup&gt;</td>
<td>212.45±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td>207.45±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td>202.45±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td>197.45±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>IV</td>
<td>142.00±2.33&lt;sup&gt;c&lt;/sup&gt;</td>
<td>207.95±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td>199.95±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td>191.95±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td>183.95±0.34&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>V</td>
<td>114.00±2.71&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.95±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>102.70±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>117.70±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>118.70±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>VI</td>
<td>107.60±1.57&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.45±0.68&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.60±0.66&lt;sup&gt;a&lt;/sup&gt;</td>
<td>104.23±0.66&lt;sup&gt;a&lt;/sup&gt;</td>
<td>104.35±0.66&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>VII</td>
<td>106.40±1.62&lt;sup&gt;a&lt;/sup&gt;</td>
<td>108.35±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>106.45±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>114.45±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>122.45±0.34&lt;sup&gt;a&lt;/sup&gt;</td>
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</tbody>
</table>

Values are expressed as Mean ± SD for six rats. Mean values within a group followed by different letters are significantly different from each other at P <0.05 level comparison by Duncan’s multiple range test (DMRT).
Effect of Centratherum anthelminticum ethanolic seeds extract on HDL, LDL, VLDL, FFA, PL and TC of experimental animals.

Total cholesterol (TC), Triglycerides (G), Phospholipids (PL), free fatty acid (FFA), Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL) and Very Low Density Lipoprotein (VLDL) content was shown in Table 4.18 and Fig 4.14. Streptozotocin induced diabetic rats showed increased LDL (245.57mg/dl), TG (353.60mg/dl), VLDL (78.93mg/dl), FFA (2.77mg/dl), PL (1.96mg/dl), TC (392.00mg/dl) while decreased HDL (26.60mg/DL) content was observed 24. Administration of different doses (100, 200 and 300mg/kg) of ethanolic leaf extract of Centratherum anthelminticum decreased content in LDL, TC, VLDL, FFA, PL, TC and increased HDL content was observed dose dependent manner. Among the various doses, the highest dose (300mg/kg) of leaf extract of Centratherum anthelminticum shows significantly (p>0.05) restored the LDL (89.90mg/dl), TG (80.21mg/dl), VLDL (23.93mg/dl), FFA (1.43mg/dl), PL (1.41mg/dl), TC (140.54mg/dl) and increased HDL (70.80mg/DL) content to normal rats 25. The standard treated group also decreased LDL, VLDL, FFA, TC while increased HDL content. Centratherum anthelminticum alone (300mg/kg) treated rats did not show any significant variation in lipid profile throughout the experimental period 26.

### Table 3: Effect of Centratherum anthelminticum ethanolic seeds extract on HDL, TG, LDL, VLDL, FFA, PL and TC of experimental animals

<table>
<thead>
<tr>
<th>Groups</th>
<th>Total Cholesterol (mg/g)</th>
<th>Triglycerides (mg/g)</th>
<th>HDL (mg/dl)</th>
<th>LDL (mg/dl)</th>
<th>VLDL (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>136.40±1.65 a</td>
<td>62.00±0.65 a</td>
<td>77.20±0.93 a</td>
<td>39.00±7.87 a</td>
<td>10.33±2.07 a</td>
</tr>
<tr>
<td>II</td>
<td>392.00±1.12 b</td>
<td>353.60±1.31 b</td>
<td>26.60±0.98 b</td>
<td>245.57±49.12 b</td>
<td>78.93±11.79 b</td>
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<tr>
<td>III</td>
<td>327.60±1.02 c</td>
<td>312.60±0.80 c</td>
<td>46.31±0.74 c</td>
<td>213.90±42.81 c</td>
<td>62.10±10.42 c</td>
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<tr>
<td>IV</td>
<td>230.00±1.55 d</td>
<td>262.60±0.94 d</td>
<td>54.80±0.79 d</td>
<td>143.90±28.83 d</td>
<td>43.77±8.75 d</td>
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<tr>
<td>V</td>
<td>140.54±0.98 a</td>
<td>73.60±1.10 a</td>
<td>70.80±0.67 a</td>
<td>89.90±18.02 a</td>
<td>23.93±4.79 a</td>
</tr>
<tr>
<td>VI</td>
<td>138.60±1.77 a</td>
<td>80.21±0.94 a</td>
<td>77.80±0.79 a</td>
<td>68.73±13.90 a</td>
<td>20.27±4.06 a</td>
</tr>
<tr>
<td>VII</td>
<td>144.00±1.98 a</td>
<td>72.80±5.10 a</td>
<td>81.80±0.34 a</td>
<td>44.70±9.15 a</td>
<td>7.13±1.69 a</td>
</tr>
</tbody>
</table>

Values are expressed as Mean ± SD for six rats. Mean values within a graph followed by different letters are significantly different from each other at P<0.05 level comparison by Duncan’s multiple range test (DMRT)

**Fig 2: Effect of Centratherum anthelminticum ethanolic seeds extract on HDL, TG, LDL, VLDL, TC of experimental animals**

Effect of Centratherum anthelminticum ethanolic seeds extract on liver LPO, SOD, CAT, GPx, GST, GSH of experimental animals 27

The lipid peroxidation (LPO) content, Superoxide dismutase (SOD), Catalase (CAT), Glutathione peroxidase (GPx), Glutathione S transferase (GST) activity, Reduced glutathione (GSH), Vitamin C and E content in liver was given in Table 4.19 and Fig 4.15, 4.16 and 4.71. Streptozotocin induced diabetic rats showed increased LPO content while decreased in the activities of SOD, CAT, GPx, GST and content of GSH, Vitamin C and E was observed. Administration of different doses (100, 200 and 300mg/kg) of ethanolic leaf extract of
Centratherum anthelminticum decreased LPO content while increased in the activities of SOD, CAT, GPx, GST and content of GSH, Vitamin C and E was observed in dose dependent manner. Among the various doses, the highest dose (300mg/kg) of leaf extract of Centratherum anthelminticum shows significantly (p>0.05) restored the LPO content, the activities of SOD, CAT, GPx, GST and content of GSH, Vitamin C and E content to normal rats. The standard treated group showed no significant changes were observed in antioxidant enzymes. Centratherum anthelminticum alone (300mg/kg) treated rats did not show any significant variation in antioxidant status throughout the experimental period.

Table 4: Effect of Centratherum anthelminticum ethanolic seeds extract on liver LPO, SOD, CAT, GPx & GSH of experimental animals.

<table>
<thead>
<tr>
<th>Groups</th>
<th>LPO (nmol MDA/mg protein)</th>
<th>SOD (Liver) (U/mg protein)</th>
<th>CAT (Liver) (U/mg protein)</th>
<th>GPx (U/mg protein)</th>
<th>GSH (μg/g tissue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>2.77±0.09a</td>
<td>1600.53±4.51a</td>
<td>24.0±1.5a</td>
<td>997.0±151.7a</td>
<td>48636.4±5.0a</td>
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<tr>
<td>Group II</td>
<td>13.91±0.08b</td>
<td>825.67±2.69b</td>
<td>8.8±2.3b</td>
<td>434.5±251.6b</td>
<td>25776.0±1.7b</td>
</tr>
<tr>
<td>Group III</td>
<td>10.05±0.06c</td>
<td>1186.00±10.97d</td>
<td>15.6±1.5c</td>
<td>584.5±234.6d</td>
<td>32124.8±2.4c</td>
</tr>
<tr>
<td>Group IV</td>
<td>7.47±0.21d</td>
<td>1362.53±13.00c</td>
<td>18.0±6.0d</td>
<td>831.5±184.2c</td>
<td>39684.0±2.0d</td>
</tr>
<tr>
<td>Group V</td>
<td>3.02±0.04a</td>
<td>1516.80±8.12a</td>
<td>22.0±1.0a</td>
<td>970.0±156.4a</td>
<td>46418.7±1.0a</td>
</tr>
<tr>
<td>Group VI</td>
<td>2.83±0.03a</td>
<td>1599.33±6.59a</td>
<td>23.0±0.7a</td>
<td>995.5±151.6a</td>
<td>47653.2±4.3a</td>
</tr>
<tr>
<td>Group VII</td>
<td>3.23±0.07a</td>
<td>1590.53±4.51a</td>
<td>24.0±1.5a</td>
<td>997.0±151.7a</td>
<td>48614.3±2.0a</td>
</tr>
</tbody>
</table>

Values are expressed as Mean ± SD for six rats. Mean values within a graph followed by different letters are significantly different from each other at P <0.05 level comparison by Duncan’s multiple range test (DMRT).

Effect of Centratherum anthelminticum on AST, ALT, ALP activities and Direct Bilirubin, Total Bilirubin, protein content of experimental animals

The AST, ALT, ALP activities and direct bilirubin, total bilirubin, protein content was represented in normal and experimental rats represented in Table 4.20 and Fig 4.18. Streptozotocin induced diabetic rats showed significantly increased in the activities of AST, ALT, ALP and content of direct bilirubin, total bilirubin while decreased protein content was observed. Administration of different doses (100, 200 and 300mg/kg) of ethanolic leaf extract of Centratherum anthelminticum significantly restored in the activities of AST, ALT, ALP and content of direct bilirubin, total bilirubin while increased protein content was observed in dose dependent manner. Among the various doses, the highest dose (300mg/kg) of leaf extract of Centratherum anthelminticum shows significantly (p>0.05) restored the activities of AST, ALT, ALP and content of direct bilirubin, total bilirubin and protein content to normal rats. The standard treated group showed no significant changes were observed in liver markers. Centratherum anthelminticum alone (300mg/kg) treated rats did not show any significant variation in liver marker enzymes throughout the experimental period.

Fig 3: Effect of Centratherum anthelminticum on AST, ALT, ALP activities and Direct Bilirubin, Total Bilirubin, protein content of experimental animals.
Histology of Liver

Photomicrographs of normal liver showed well visualized architecture with predominant nucleus. Liver sections of streptozotocin induced diabetic rats showed marked structural alterations in the liver. The major alteration was periportal fatty infiltration, necrosis of hepatocytes. This damage was reversed and regeneration of parenchyma cells by the leaf extract of Centratherum anthelminticum (300mg/BW) and Glibenclamide treatments (plate.1).

Histology of pancreas

Photomicrographs of pancreas showed normal acini and normal cellular population in the islets of langerhans in pancreas of control rats. Pancreas sections of streptozotocin induced diabetic rats showed extensive damage to the islets of langerhans and reduced dimensions of islets. Photomicrograph of Pancreatic Islets of Streptozotocin induced rat treated with Centratherum anthelminticum (300mg/kg) and Glibenclamide (1mg/kgbw) showing regeneration of Islets of Langerhans, blood vessels and acinus (plate.2).
SUMMARY

Overall, the experimental studies suggest that Centratherum anthelminticum ethanolic seeds extract has potential antioxidant and antidiabetic activity. This study is the first scientific report that provides convincing Phytochemical and ethno pharmacological evidence for the relevance of Centratherum anthelminticum, thus providing scientific validity to its traditional consumption by the local populace of south India. The antioxidant and antidiabetic activity of Centratherum anthelminticum ethanolic seeds might be present in bioactive compounds.

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Conflict of Interest:
The authors declare no conflict of interest.

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