ABSTRACT

The present study was aimed to elucidate antihyperlipidemic effect of ethanolic extract of bark of Dolichondrone falcata Bignoniaceae family by alloxan-induced hyperlipidemia in albino wistar rats and to investigate the serum lipid levels. Hyperlipidemia was induced experimentally in rats by inducing alloxan at a dose of 150mg/kg body weight. Hyperlipidemic rats were administered fresh ethanolic root extract at the dose of 200mg/kg b.w and 300mg/kg b.w and the standard drug Atorvastatin 10mg/kg b.w. Blood samples were collected after 24hrs of last administration and used for estimation of lipid profile. Serum cholesterol levels were estimated using standard methods. Fresh ethanolic extract at a dose of 200mg/kg b.w and 300mg/kg b.w resulted in dose dependent significant decline in total cholesterol (TC), triglycerides (TG), low density lipoprotein-cholesterol (LDL-C) and very low density lipoprotein-cholesterol (VLDL-C). Further, in comparison to atorvastatin 10mg/kg resulted in comparable decrease of total cholesterol (TC), triglycerides (TG), low density lipoprotein-cholesterol (LDL-C) and very low density lipoprotein-cholesterol (VLDL-C) levels. The phytochemical analysis revealed the presence of flavonoids, triterpenoids, alkaloids, phenolic compounds, tannins and saponins. The results of present study revealed antihyperlipidemic effect of Dolichondrone falcata in alloxan induced rats.

KEYWORDS: Dolichondrone falcata, Hyperlipidemia, Atorvastatin.
INTRODUCTION

Importance of Herbal Medicine

- The usage of herbs to treat a variety of different ailments is universal, and exists in every human culture on Earth. Despite this, the largest use of medical herbs still occurs in societies which are not fully industrialized.

- Because of the high costs involved with manufacturing modern medicines, many people living in developing nations simply do not have the financial resources to pay for them, and as a result, they are forced to use natural herbs as an affordable alternative.

- In recent years, many people living in industrialized countries have begin taking a second look at herbal medicines due to the rising cost of medicine and healthcare in their own nations.

- There are a number of herbal systems that dominate the world today and these systems are
  1. Chinese herbs,
  2. Ayurvedic medicine,
  3. Roman,
  4. Greek herbs,
  5. Shamanic herbs.

- Many of the pharmaceuticals which are currently used can be traced back to herbal remedies which were developed many centuries ago.

- The WHO has indicated that as many as 80% of all people living in the world make use of herbal medicine as their main source of healthcare.

- Because half the world's population (roughly 3 billion people), live on less than $2 per day, it is next to impossible for them to buy even basic medicines such as Tylenol.

- In the United States, the alternative health industry has exploded within recent years, and an intense global search is being made for plants which can be used to create different dietary supplements.
Both botanists, pharmacologists, and microbiologists are looking in different parts of the globe to find natural chemicals that can be used in the treatment of numerous diseases.

The alternative health industry has become a billion dollar a year business and this is driving the quest to find new plants or chemicals which are useful.

A number of statistics indicate that over 20% of all medicines produced in the United States have been taken from plants.

**Herbal medicine facts and statistics**

Research has shown that over 40% of plants comprise key ingredients which can be used for prescription drugs, and researchers look to traditional medicine as a guide to help them.

There are as many as one hundred and twenty compounds which have been taken from the higher plants and 80% of those which are used in modern medicine have a positive connection between their modern usage and their traditional usage.

Two thirds of all the plants in the world which have medicinal properties can be found in developing countries. Of all the components which comprise the current day pharmacopoeia, seven thousand were taken from plants.

To understand the importance of herbal medicine, it is first important to learn a little bit about plants. Every plant on the planet creates specific chemical compounds which is a basic part of their metabolic function.

These main metabolites may include fats or sugars, as well as metabolites which are found in a lower number of plants, but which are contained within a specific species.

Pigments are responsible for the harvesting of light and this will conceal the plant from radiation and will showcase colors which will invite pollinators.

While it may come as a surprise, many common weeds also have medical properties. When it comes to the second metabolites, their functions can vary greatly. They may act as toxins which are designed to block them from being eaten and they may also emit pheromones which will invite insects to pollinate them.
Phytoalexins are responsible for blocking both fungal and bacterial agents. Allelochemicals can be responsible for battling against other plants which are also fighting for light and soil.

Plants can also alter their biochemistry depending on the herbivores, microorganisms, and insects which live in their area.

The chemical profile of any plant is not set in stone and could change over a certain period of time depending on its surroundings.

The secondary metabolites are important in humans since they are responsible for therapy. These secondary metabolites can also be altered to create a variety of different drugs.

Plants are also responsible for the synthesis of an impressive amount of phytochemicals. The word "drug" is actually derived from "drug," which basically translates into "dried plant".

Plants are known for the synthesis of alkaloids, which comprises a ring that has nitrogen. Alkaloids can alter the central nervous system in a dramatic manner. The best example of a typical alkaloid is caffeine, which can give one a mild lift.

Plants also produce phenolics, which have rings made of phenol. These are responsible for making grapes purple and they also provide numerous attributes to tea.

**Herbal Medicines Today**
In 1991 WHO developed guidelines for the assessment of herbal medicine and the same were ratified by the 6th International Conference of Drug Regulatory Authorities held at Ottawa in the same year.

**Salient features of WHO guidelines include**
1. **Quality assessment:** crude plant material, plant preparation, finished product.
2. **Stability:** shelf life.
3. **Safety assessment:** documentation of safety based on experience or toxicological studies.
4. **Efficacy assessment:** documented evidence of traditional use or activity determination (animals, human) Valdiya, K.S., High Dams in the Himalaya, PAHAR, Nanital, 1993).

The medicinal plant is subjected to a single solvent extraction once or repeatedly, or water decoction or as described in ancient texts. The extract should then be checked for indicated biological activity in the experimental animal model (s). The bioactive extract should be standardized on the basis of active principle or major compound (s) along with fingerprints. The next important step is stabilization of the bioactive extract with a minimum shelf-life of over a year. The stabilized bioactive extract should undergo regulatory or limited safety studies.

**Hyperlipidemia**

Hyperlipidemia has been ranked as one of the greatest risk factors contributing to the prevalence and severity of coronary heart diseases. Hyperlipidemia increases with chronological age. Women and men ratio in hyperlipidemia is 40:37 and this level increase in the risk of vascular diseases (MI/CVA) is in direct proportion. Responsibility of elevated total cholesterol and especially LDL-cholesterol is now well established in the occurrence of cardiovascular disease (Irshad M & Dubey R 2005 Indian J Biochem Biophysiology). The prevalence of hyperlipidemia is in the range of 39%, 51% and 26% worldwide, developed and developing countries respectively. Overall, raised cholesterol is estimated to cause 2.6 million deaths (4.5% of total) and 29.7 million disability adjusted life years (DALYS), or 2.0% of total DALYS. 10% reduction in serum cholesterol in men aged 40 has been reported to result in a 50% reduction in a heart disease within 5 years, the same serum cholesterol reduction for men aged 70 years can result in an average 20% reduction in heart disease occurrence in the next 5 years (John K S, Kathiravan M K, Somani R S & Shishoo C J (2005) *Bioorg Med Chem*).

Hyperlipidemia is characterized by elevated serum total cholesterol, low density lipoprotein and very low density lipoprotein and decreased high density lipoprotein levels. Hyperlipidemia associated lipid disorders are considered to cause atherosclerotic cardiovascular disease. Among these hypercholesterolemia and hypertriglyceridemia are closely related to ischemic heart disease (IHD). Currently available hypolipidemic drugs have been associated with a number of side effects. The consumption of synthetic hypolipidemic drugs having adverse effects like hyperuricemia, diarrhoea, nausea, myositis, gastric
irritation, flushing, dry skin and abnormal liver function. Medicinal plants are used for various research purposes. More than 13,000 plants have been studied for various pharmacological properties (Warrnholtz A, Mollnau H Oleze M. Antioxidants and endothelial dysfunction in hyperlipidemia. *Curr Hypertens Rep.* 2001).

Hyperlipidemia can be either primary or secondary type, the primary disease may be treated by antilipidemic drugs, but the secondary type originating from diabetes, renal lipid nephrosis or hypothyroidism demands the treatment of the original disease rather than hyperlipidemia. Medicinal plants play a major role in hypolipidemic activity and suggest that the lipid lowering action is mediated through inhibition of hepatic cholesterol biosynthesis and reduction of lipid absorption in the intestine (Goldman P. Herbal medicines today and roots of modern pharmacology, *Ann. Intern. Med.* 2001; 135 (8): 594-600).

Dolichandron falcate is a small deciduous tree in the Bignoniaceae family. It is endemic to India. Tree attains a height of 15-20 feet. Leaves are compound 2-6 inches long with 3-6 obovate or oval shaped leaflets. Flowers are white and fragrant. Flowering occurs in April-May. Aqueous extract of dolichandron stem bark have anti pyretic activity. Alcoholic and aqueous extract of Dolichandron falcata leaves show antifertility activity causing cessation of estros cycle at the diesterous phase in albino rats. It is used in ayurvedic medicine for fish poison and to procure abortion (kirtikar, 1999). Leaf juice is used for the treatment of diabetes. Fruit extract of Dolichandron falcata is active against vibrio cholera, candida albicans and p. aeruginosa. The bark extract is effective against salmonella typhi, vibrio cholera and candida albicans.

**MATERIALS AND METHODS**

**Collection of drug**

Dried bark extract of Dolichandron falcata were collected. The plants were taxonomically identified and authenticated by DR. K. MADHAVA CHETTY assistant professor of botany department of pharmacognosy, Sri Venkateshwara University, tirupaty.

**Chemicals**

The following chemicals were used during the experiment; to analyze and interpret the anti hyperlipidaemic activity of ethanol dried bark extract of Dolichandron falcata in alloxan induced diabetic rats.
Ethanol
Alloxan monohydrate 150 mg/kg b.w.
Atorvastatin 10mg/kg b.w.

Preperation of plant extract
The leaves of both plants were subjected to shade drying. On complete drying the leaves are powdered and stored in air tight containers at room temperatures. The powders of both the plant leaves was macerated with ethanol for 7 days and then filtered. The filtrate was evaporated to obtain dried extracts. The extracts thus obtained were subjected for evaluation of antihyperlipidemic study. The plant extract was prepared by maceration process.

Maceration
In maceration (for fluid extract), whole or coarsely powdered plant drug is kept in contact with the solvent in a stoppered container for a defined period with frequent agitation until soluble matter is dissolved. This method is best suitable for use in case of the thermo labile drugs. Using this process, 250gm powder was added in ethanol in the ratio 1:2 and vigorous shaking was carried out for 7 days continuously and was kept at room temperature. The filtrate thus obtained was ethanolic extract. The filtrate obtained was dissolved in 0.9% normal saline and used as vehicle in the experiment.

Preliminary phytochemical screening
Standard screening test of the extract was carried out for various plant constituents. The crude extract was carried out for the presence or absence of secondary metabolites such as alkaloids, steroidal compounds, phenolic compounds, flavonoids, saponins, tannins and anthraquinones using standard procedures (Hymete, 1986).

Acute toxicity studies
Wistar rats of 5 groups weighing 100 to 250 gms were administered graded dose (100 to 2000mg/kg, i.p) of plant extract. After administration of the drug rats were observed for toxic effects if any after 48hrs of treatment. The toxicological effects were expressed in terms of mortality expressed as LD50. The number of animals dying during a period was noted. No mortality was observed. Therefore, the extract was safe to use even at high level of doses.
EXPERIMENTAL ANIMALS

Wistar rats (180-250 Gms) of either sex housed in standard conditions of temperature (55±5%) or light (12 hrs light/dark cycles) were used. They were fed with standard pellet diet and water ad libitum. Animals were randomly selected for grouping. All experiments were performed according to the norms of the ethical committee (CPCSEA).

![Experimental Albino Wistar Rats](image)

**Figure no. 1:** Experimental albino Wistar rats.

Experimental design

Evaluation of Ethanolic Bark Extract of Dolichondrone Falcata for Antihyperlipidemic Activity in Alloxan-Induced Albino Wistar Rats

**Table No.1: Experimental design.**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Experimental Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>Normal control rats received normal saline as a vehicle p.o</td>
</tr>
<tr>
<td>Group II</td>
<td>Control rats received alloxan i.p + normal saline p.o</td>
</tr>
<tr>
<td>Group III</td>
<td>Alloxan induced hyperlipidemic rats + ethanolic bark extract of dolichondrone falcata 200mg/kg b.w in normal saline p.o</td>
</tr>
<tr>
<td>Group IV</td>
<td>Alloxan induced hyperlipidemic rats + ethanolic bark extract of dolichondrone falcata 400mg/kg b.w in normal saline p.o</td>
</tr>
<tr>
<td>Group V</td>
<td>Alloxan induced hyperlipidemic rats + Atorvastatin 10mg/kg b.w in normal saline i.p</td>
</tr>
</tbody>
</table>

**Preperation of Drug Solution**

Ethanolic bark extract of dolichondrone falcate dissolved in normal saline to prepare dose level of 100, 200, 400mg/kg body weight for administration into rats.
Induction of Hyperlipidemia

To induce the hyperlipidemia rats were kept in fasting for 18 hrs with the excess of water and subjected to alloxan at the dose of 150mg/kg b.w i.p. and the different lipoprotein levels was evaluated at 24, 48, 72 hrs. It was observed that alloxan in the dose of 150mg/kg b.w i.p can induce maximum hyperlipidemia after 48 hrs. Hence 150mg/kg b.w i.p was considered the ideal dose for induction of hyperlipidemia.

Grouping Treatment

Hyperlipidemia was induced in groups II, III, IV, V by intraperitoneal injection of alloxan 150 mg/kg b.w. The Hyperlipidemic state of the animals was checked by weighing them and was confirmed.

Collection of Blood for Determination of Serum Glucose

The Hyperlipidemic control group rats were given alloxan at a dose 150mg/kg b.w. Animals in the third & fourth groups were treated with ethanolic bark extract of *Dolichondrone falcata*
200 & 400mg/kg b.w. The fifth group was treated with Atorvastatin at a dose of 10mg/kg b.w. Body weight was checked for every 3 day intervals during the experiment. The blood serum lipid levels were determined. After 21 days, blood from all the groups were collected by retro orbital puncture under mild anaesthesia for estimation of

- Total Cholesterol Levels (TC).
- Low Density Lipoprotein Cholesterol (LDLc) Levels.
- High Density Lipoprotein Cholesterol (HDLc) Levels.
- Very Low Density Lipoprotein Cholesterol (VLDLc) Levels.
- Triglyceride Levels &
- Cholesterol Ratio.

![Fig. 4 Collection of Blood by Retro-Orbital Puncture.](image)

**BIOCHEMICAL ESTIMATION**

**Estimation of Triglycerides**

Enzymatic (GPO/Tinder), End point Calorimetry, Single Reagent Chemistry with Lipid Clearing Factor (LCP).

**Principle**

The triglycerides in the serum sample are hydrolysed enzymatically by the action of lipase to glycerol and fatty acids. The glycerol formed is converted to glycerol phosphate by glycerol kinase. Glycerol phosphate is then oxidised to dihydroxy acetone phosphate by glycerol phosphate oxidase. The liberated H₂O₂ is then detected by a chromogenic acceptor, chlorophenol-4-aminoantipyrene in the presence of peroxidase. The red quinine formed is proportional to the amount of triglyceride present in the sample.

Triglycerides $\rightarrow$ glycerol + fatty acids (in the presence of lipase)
Glycerol + ATP → Glycerol-3-phosphate (in the presence of Glycerol kinase)
Glycerol-3-Phosphate → dihydroxy acetone phosphate + H₂O₂ (in the presence of glycerol phosphate oxidase).
H₂O₂ + chlorphenol-4-aminoantipyrine → Red quinine + 4H₂O (in the presence of peroxidase).

<table>
<thead>
<tr>
<th>Mode</th>
<th>End Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>505nm (490-550nm)</td>
</tr>
<tr>
<td>Temperature</td>
<td>37°C</td>
</tr>
<tr>
<td>Optical path length</td>
<td>1cm</td>
</tr>
<tr>
<td>Blanking</td>
<td>Reagent Blank</td>
</tr>
<tr>
<td>Sample Volume</td>
<td>10µl</td>
</tr>
<tr>
<td>Working Reagent Volume</td>
<td>1000µl</td>
</tr>
<tr>
<td>Incubation time</td>
<td>10min at 37°C</td>
</tr>
<tr>
<td>Concentration of Standard</td>
<td>200mg/dl</td>
</tr>
<tr>
<td>Stability of Colour</td>
<td>1 hour</td>
</tr>
<tr>
<td>Maximum Absorbance Limit</td>
<td>2,000</td>
</tr>
<tr>
<td>Linearity</td>
<td>1000mg/dl</td>
</tr>
<tr>
<td>Units</td>
<td>Mg/dl</td>
</tr>
</tbody>
</table>

**Procedure**

<table>
<thead>
<tr>
<th>Pipette in tubes marked</th>
<th>Blank</th>
<th>Standard</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum</td>
<td>-</td>
<td>-</td>
<td>10µl</td>
</tr>
<tr>
<td>Standard</td>
<td>-</td>
<td>10µl</td>
<td>-</td>
</tr>
<tr>
<td>Triglycerides reagent</td>
<td>1000µl</td>
<td>1000µl</td>
<td>1000µl</td>
</tr>
</tbody>
</table>

Mixed well and incubated at 37°C for 10 min. Absorbance of standard and sample was measured against reagent blank at 505nm within 60min.

**CALCULATION**

Triglycerides concentration (mg/dl) = Absorbance of test / Absorbance of Standard x 200.
Triglycerides concentration (mmol/L) = Concentration (mg/dl) x 0.014.

**Estimation of Total Cholesterol**

**Method**

Enzymatic (cholesterol oxidase- peroxidase), End point Calorimetry, Single Reagent Chemistry with Lipid Clearing Factor (LCF).

**Principle**

The estimation of Cholesterol involves the following enzymatic reactions.
Cholesterol esters $\rightarrow$ Cholesterol + Free Fatty Acids (in the presence of Cholesterol esterase).

Cholesterol + O$_2$ $\rightarrow$ Cholesten-3-one + H$_2$O$_2$ (in the presence of cholesterol oxidase).

H$_2$O$_2$ + Phenol + 4-aminoantipyrene $\rightarrow$ Quinoneimine dye + H$_2$O$_2$.

Absorbance of quinoneimine was measured at 505nm and is proportional to cholesterol concentration in the specimen.

<table>
<thead>
<tr>
<th>Mode</th>
<th>End point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>505nm (490-505nm)</td>
</tr>
<tr>
<td>Temperature</td>
<td>37ºC</td>
</tr>
<tr>
<td>Optical Path Length</td>
<td>1cm</td>
</tr>
<tr>
<td>Blanking</td>
<td>Reagent Blank</td>
</tr>
<tr>
<td>Sample Volume</td>
<td>10µl</td>
</tr>
<tr>
<td>Working Reagent Volume</td>
<td>1000µl</td>
</tr>
<tr>
<td>Incubation time</td>
<td>10 min at 37ºC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration of Standard</th>
<th>200mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability of Colour</td>
<td>1 hour</td>
</tr>
<tr>
<td>Maximum Absorbance Limit</td>
<td>2.0</td>
</tr>
<tr>
<td>Linearity</td>
<td>750mg/dl</td>
</tr>
<tr>
<td>Units</td>
<td>Mg/dl</td>
</tr>
</tbody>
</table>

**Procedure**

<table>
<thead>
<tr>
<th>Pipette in tubes marked</th>
<th>Blank</th>
<th>Standard</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum</td>
<td>-</td>
<td>-</td>
<td>10µl</td>
</tr>
<tr>
<td>Standard</td>
<td>-</td>
<td>10µl</td>
<td>-</td>
</tr>
<tr>
<td>Triglyceride reagent</td>
<td>1000µl</td>
<td>1000µl</td>
<td>1000µl</td>
</tr>
</tbody>
</table>

Mixed well and incubated at 37ºC for 10 min. Absorbance of standard and sample was measured against reagent blank at 505nm within 60min.

**CALCULATION**

Cholesterol Concentration (mg/dl) = Absorbance of Test/Absorbance of Standard x 200.

Cholesterol Concentration (mmol/L) = Concentration (mg/dl) x 0.0259.

**Estimation of HDL Cholesterol**

**Method**

Phosphotungstate.
**Principle**

Chylomicrons, VLDL & LDL fractions in serum and plasma are separated from HDL by phosphotungstic acid and magnesium chloride. After Centrifugation, the cholesterol in the HDL fraction, which remains in the supernatant, is assayed with enzymatic cholesterol method, using cholesterol esterase, cholesterol oxidase, peroxidase and the chromogen 4-aminoantipyrine phenol.

**Assay Parameter**

<table>
<thead>
<tr>
<th>Mode</th>
<th>End point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction Slope</td>
<td>Increasing</td>
</tr>
<tr>
<td>Wavelength</td>
<td>500nm (492-550nm)</td>
</tr>
<tr>
<td>Fall cell Temperature</td>
<td>30°C</td>
</tr>
<tr>
<td>Incubation time</td>
<td>5min 37°C</td>
</tr>
<tr>
<td>Blanking</td>
<td>Reagent Blank</td>
</tr>
<tr>
<td>Sample Volume (Supernatant)</td>
<td>20µl</td>
</tr>
<tr>
<td>Standard Concentration</td>
<td>100mg/dl</td>
</tr>
<tr>
<td>Working Reagent Volume</td>
<td>1.0ml</td>
</tr>
<tr>
<td>Units</td>
<td>Mg/dl</td>
</tr>
</tbody>
</table>

**Procedure**

<table>
<thead>
<tr>
<th>Pipette into test tubes marked</th>
<th>Blank</th>
<th>Standard</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconstituted reagent</td>
<td>1ml</td>
<td>1ml</td>
<td>1ml</td>
</tr>
<tr>
<td>Standard</td>
<td>-</td>
<td>20µl</td>
<td>-</td>
</tr>
<tr>
<td>Supernatant</td>
<td>-</td>
<td>-</td>
<td>20µl</td>
</tr>
</tbody>
</table>

Mixed well incubated at 37°C for 5min.

**Estimation of LDL Cholesterol**

The value of LDL cholesterol was calculated as follows: If the value of triglycerides was known LDL cholesterol can be calculated by Friedwald’s equation:

\[
LDL \text{ Cholesterol} = \frac{\text{Total Cholesterol} - \text{Triglycerides} - \text{HDL Cholesterol}}{5}
\]

**Estimation of VLDL Cholesterol**

\[
\text{VLDL Cholesterol} = \frac{\text{Triglycerides}}{5}
\]

**Estimation of Cholesterol Ratio**

\[
\text{Cholesterol Ratio} = \frac{\text{Total Cholesterol}}{\text{HDL Cholesterol}}
\]
RESULTS

Table no. 1: Phytochemical Analysis of Ethanolic Bark Extract of Dolichondrone Falcata.

<table>
<thead>
<tr>
<th>PHYTOCONSTITUENT</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steroids</td>
<td>+++</td>
</tr>
<tr>
<td>Glycosides</td>
<td>+++</td>
</tr>
<tr>
<td>Saponins</td>
<td>++</td>
</tr>
<tr>
<td>Alkaloids</td>
<td>+++</td>
</tr>
<tr>
<td>Sugar</td>
<td>++</td>
</tr>
<tr>
<td>Phenol</td>
<td>+</td>
</tr>
<tr>
<td>Tannins</td>
<td>-</td>
</tr>
</tbody>
</table>

Keys: +++ = appreciable amount, ++ = moderate amount, + = trace amount, − = completely absent.

Table 2: Effect of Dolichondrone Falcata on Serum Lipid Profile in Alloxan Induced Rats.

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SERUM LDL (mg/dl)</th>
<th>SERUM VLDL (mg/dl)</th>
<th>SERUM HDL (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>33.54±2.63</td>
<td>16.94±0.90</td>
<td>32.39±0.50</td>
</tr>
<tr>
<td>Test</td>
<td>76.3±1.9***</td>
<td>26.44±5.5</td>
<td>18.99±3.18</td>
</tr>
<tr>
<td>Plant extract (200mg/kg b.w)</td>
<td>42.38±0.75**</td>
<td>26.66±0.88**</td>
<td>30.58±0.10**</td>
</tr>
<tr>
<td>Plant extract (400mg/kg b.w)</td>
<td>40.08±0.88**</td>
<td>24.97±0.76**</td>
<td>31.48±0.09**</td>
</tr>
<tr>
<td>Atorvastatin treated</td>
<td>38.41±0.11***</td>
<td>19.24±0.62***</td>
<td>32.48±0.28***</td>
</tr>
</tbody>
</table>

Data represents mean ± SEM (n=6). *p < 0.01 compared to normal control group. Values are given as mean ± SEM for group of six animals in each group.

Hyperlipidemic control rats were compared with normal rats. Hyperlipidemic + plant extract 200mg/kg b.w, Hyperlipidemic + plant extract 400mg/kg b.w and Hyperlipidemic + Atorvastatin treated rats were compared with Hyperlipidemic control rats.

**P<0.05, **P<0.01, ***P<0.001 was considered significant comparing to Hyperlipidemic control group.
Dose 1 = Plant extract 200mg/kg b.w
Dose 2 = Plant extract 400mg/kg b.w
ANOVA followed by Dunnett’s test

**P<0.05, **P<0.01, **P<0.001 was considered significant comparing to Hyperlipidemic control group.

![Graph 2.](image)

Dose 1 = Plant extract 200mg/kg b.w
Dose 2 = Plant extract 400mg/kg b.w
ANOVA followed by Dunnett’s test

**P<0.05, **P<0.01, **P<0.001 was considered significant comparing to Hyperlipidemic control group.

![Graph 3.](image)
**P<0.05, **P<0.01, **P<0.001 was considered significant comparing to Hyperlipidemic control group.

Table 3: Effect of Dolichondrone Falcata on Serum Lipid Profile in Alloxan Induced Rats.

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>TOTAL CHOLESTEROL (mg/dl)</th>
<th>TOTAL TRIGLYCERIDES (mg/dl)</th>
<th>CHOLESTEROL RATIO = TC/HDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>82±0.17</td>
<td>84.72±0.43</td>
<td>2.55±0.0028</td>
</tr>
<tr>
<td>Test</td>
<td>122.43±5.78</td>
<td>130.28±1.9</td>
<td>6.80±0.56</td>
</tr>
<tr>
<td>Plant extract (200mg/kg b.w)</td>
<td>90.21±0.45**</td>
<td>108.49±0.48*</td>
<td>2.58±0.096**</td>
</tr>
<tr>
<td>Plant extract (400mg/kg b.w)</td>
<td>89.90±0.46**</td>
<td>98.00±0.72**</td>
<td>3.12±0.08**</td>
</tr>
<tr>
<td>Atorvastatin treated</td>
<td>86.87±0.61***</td>
<td>80.18±0.78***</td>
<td>3.42±0.104**</td>
</tr>
</tbody>
</table>

Data represents mean ± SEM (n=6). *p < 0.01 compared to normal control group.
Values are given as mean ± SEM for group of six animals in each group.

Hyperlipidemic control rats were compared with normal rats. Hyperlipidemic + plant extract 200mg/kg b.w, Hyperlipidemic + plant extract 400mg/kg b.w and Hyperlipidemic + Atorvastatin treated rats were compared with Hyperlipidemic control rats.

**P<0.05, **P<0.01, **P<0.001 was considered significant comparing to Hyperlipidemic control group.

Graph 4.

Dose 1 = Plant extract 200mg/kg b.w
Dose 2 = Plant extract 400mg/kg b.w
ANOVA followed by Dunnett’s test.

**P<0.05, **P<0.01, **P<0.001 was considered significant comparing to Hyperlipidemic control group.

![Graph 5.](image)

Dose 1 = Plant extract 200mg/kg b.w.
Dose 2 = Plant extract 400mg/kg b.w.
ANOVA followed by Dunnett’s test.

**P<0.05, **P<0.01, **P<0.001 was considered significant comparing to Hyperlipidemic control group.

**DISCUSSION**

Hyperlipidemia is the term used to denote raised serum levels of one or more of total cholesterol, low-density lipoprotein cholesterol, triglycerides, or both total cholesterol and triglycerides (combined hyperlipidemia). Dyslipidemia is a wider term that also includes low levels of high density lipoprotein cholesterol. Many types of hyperlipidemia carry an increased risk of cardiovascular disease (CVD). High density lipoprotein cholesterol (HDL-C) however confers protection. Generally the risk of coronary heart disease (CHD) rises as the ratio of total cholesterol (TC) to High density lipoprotein cholesterol (HDL-C) rise.
Primary hyperlipidemia

Idiopathic hyperchylomicronemia is a defect in lipid metabolism causing hypertriglyceridemia and hyperchylomicronemia caused by a defect in lipoprotein lipase activity or the absence of the surface apoprotein CII; familial disorder in the miniature schnauzer hyperchylomicronemia in cats familial, autosomal recessive defect in lipoprotein lipase activity idiopathic hypercholesterolemia occurs in some families of Doberman pinschers and Rottweilers; LDL cholesterol is high.

Secondary hyperlipidemia

Postprandial absorption of chylomicrons from the GIT occurs 30-60 minutes after ingestion of a meal containing fat may increase serum triglycerides for 3-10 hours (Virchow RP et.al).

Effect of ethanolic bark extract of Dolichondrone falcate on Total Cholesterol in Alloxan Induced Hyperlipidemic Rats

The biochemical parameter, serum cholesterol has shown significant increase in alloxan induced group when compared with the normal group. A significant decrease in the levels of serum cholesterol was observed on administration of Atorvastatin. The extract at 400mg/kg b.w caused a significant decrease in the serum cholesterol when compared to the dose at 200mg/kg.

Very Low Density Lipoprotein Cholesterol Levels

The rats induced by Alloxan showed a significant increase in VLDL levels was observed when compared to the normal group, the group receiving standard drug show a significant decrease in VLDL levels when compared to the control group. Administration of plant extract at a dose of 400mg/kg has shown a decrease in VLDL levels when compared to the dose at 200mg/kg b.w.

Low Density Lipoprotein Cholesterol Levels

The rats induced by Alloxan showed a significant increase in LDL levels was observed when compared to the normal group, the group receiving standard drug show a significant decrease in LDL levels when compared to the control group. Administration of plant extract at a dose of 400mg/kg has shown a decrease in LDL levels when compared to the dose at 200mg/kg b.w.
High Density Lipoprotein Cholesterol Levels
The rats induced by Alloxan showed a significant decrease in HDL levels was observed when compared to the normal group, the group receiving standard drug show a significant increase in HDL levels when compared to the control group. Administration of plant extract at a dose of 400mg/kg has shown a increase in HDL levels when compared to the dose at 200mg/kg b.w.

Total Triglycerides
The rats induced by Alloxan showed a significant increase in TG levels was observed when compared to the normal group, the group receiving standard drug show a significant decrease in TG levels when compared to the control group. Administration of plant extract at a dose of 400mg/kg has shown a decrease in TG levels when compared to the dose at 200mg/kg b.w was shown a slight action which was not that much effective.

Cholesterol Ratio
In present study of plant ethanolic leaves extract, group treated at a dose of 400mg/kg b.w effectively maintained the cholesterol ratio which is calculated as the ratio of total triglycerides with high density lipoprotein cholesterol levels in alloxan induces animals than 200mg/kg b.w.

SUMMARY AND CONCLUSION
Medicinal plant have been identified and used throughout human history. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions. The use of herbs to treat disease is almost universal among non-industrialised societies and is often more affordable than purchasing expensive modern pharmaceuticals.

Dolichandron falcate is a small deciduous tree in the Bignoniaceae family. It is endemic to India. Tree attains a height of 15-20 feet. Leaves are compound 2-6 inches long with 3-6 obovate or oval shaped leaflets.

The different pharmacological activities performed are Dolichandron falcate are antifertility activity anti-diabetic activity etc. Fruit extract of Dolichondrone falcata is active against vibrio cholera, candida albicans and p. aeruginosa. The bark extract is effective against salmonella typhi, vibrio cholera, and candida albicans.
Preliminary analysis of Dolichandron falcate for chemical constituents showed the presence of Alkaloids, Amino acids, Glycosides, Flavanoids, Saponins, Tannins, Starch, Steroids, Terpenoids & Coumarins. Phytochemical analysis of foliage of Pupalia lappacea by TLC and NMR Spectroscopy afforded 8 compounds, namely.

Docosa-nol, Stearic acid, Stigamasterol, βsitosterol, N-benzoyl-L-Phenylalaninol acetate, βsitosterol-3-0-D–glucopyranoside, Stigmasterol-3-0-β-D-glucopyranoside and 20 – hydroxylecdysone.

Various traditional uses are also known to be possessed by the plant like in arthritic pain relief, bone and joints disorders, corns, coughs, eczema, piles, ulcers, warts and many more. Many activities are not studied till date and needs attention to explore further medicinal properties of the plant.

The ethanolic bark extract of Dolichandron falcate was evaluated for in vivo antihyperlipidemic activity against alloxan induced method.

The results of the present investigation clearly indicates that the ethanolic bark extract of Dolichandron falcate at a dose of 200mg/kg b.w and 400mg/kg b.w possess a lipid lowering effect in alloxan induced rats.

As Dolichandron falcate has been successfully used in many health problems since a long time provides a wide area of interest for the research purposes should also be seen in combination with other medicinal agents and further biochemical and pharmacological investigations are needed to isolate and identify ingredients in the extract using other models.

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