Original Research Article

Evaluation of Anti-Hyperlipidemic and Hepato-Renal Protective Role of Ethanolic Extract from *Mimosa pudica* Leaves on High Fat Induced Hyperlipidemic Rat Model

Abstract

Traditional herbal medicine (THM) is a centuries-old scientific discipline that draws its inspiration from natural sources. Throughout millennia, it has assisted humanity in combating illnesses and safeguarding vitality, well-being, and procreation. This study examined the effect of a *Mimosa pudica* extract on lipid profiles in rats with hyperlipidemia caused by a high-fat diet. Regarding the liver function test, Group 6, which received a large amount of fat at a rate of 900 mg/kg, showed statistically significant results ($p < 0.05$) in terms of SGPT levels. The renal function test findings indicated that group 6, which was administered dosages of 900 mg/kg, displayed significantly increased levels of urea ($p < 0.05$). The study of creatinine in groups 4, 5, and 6 yielded statistically significant findings ($p < 0.05$) for dosages of 300, 600, and 900 mg/kg, respectively. Groups 5 and 6 showed statistically significant findings ($p<0.05$) in relation to HDL and LDL. Groups 5 and 6 showed statistically significant results when given doses of 600 and 900 mg/kg, respectively. A significant statistical disparity ($p < 0.05$) was seen in the triglyceride levels between groups 5 and 6. The total cholesterol levels in Group 6, which was administered a dosage of 900 mg/kg, exhibited statistically significant findings ($p < 0.05$).

Keywords: Herbal medicine, *Mimosa pudica*, HDL, LDL, Phytochemicals.

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Introduction

The liver, the largest glandular organ, controls the majority of an individual's physiological activities. The liver receives the entire volume of an individual's blood multiple times throughout the day. It has a vital function in human metabolism [1, 2]. Excessive alcohol use, drug addiction, exposure to certain toxic compounds, or infection by viruses or parasites can induce an elevation in reactive oxygen species (ROS) activity, such as OH, H_2O_2, and O_2, which can lead to cellular damage in the liver [3]. The Centers for Disease Control and Prevention surveyed 1492 clinicians providing ambulatory treatment in non-government facilities, and found that hyperlipidemia ranks second only to hypertension among the top ten chronic conditions they see [4]. According to the research that has been conducted, the primary reason for hyperlipidemia is the excessive consumption of foods that are rich in fat [5].

The liver undergoes extensive metabolism of the most commonly used anti-hyperlipidemic drugs, such as Atorvastatin, Pravastatin, Fluvastatin, Simvastatin, Lovastatin, and Rosuvastatin, which results in very low bioavailability [6].

Statins function as reversible competitive inhibitors of the enzyme 3-hydroxy-3-methylglutaryl-co-A reductase (HMG-CoAR). By doing so, they reduce the production of cholesterol within cells. The ability of statins to penetrate the hepatocyte and inhibit HMG-CoAR dictates their pharmacological response [7]. Muscle problems, also known as statin-associated muscle symptoms (SAMS), are the most common side effect that limits the use of statins. Other side effects include diabetic mellitus (DM) and problems with the central nervous system [8]. In addition to the severe adverse effects, these artificial medications are expensive, and the patient may face financial challenges if they complete the whole course of treatment [9]. Therefore, it is essential to develop powerful antihyperlipidemic medications that have minimal negative side effects. Plants are crucial in the process of discovering and synthesising novel drugs. They are a valuable and plentiful source of naturally occurring therapeutic chemicals [10].

Experts in the field suggest that some chemical constituents obtained from medicinal plants have therapeutic properties. Consequently, researchers are always searching for novel herbal remedies and other plant-derived treatments to address a diverse array of diseases [4]. Many countries around the world have long-standing traditional medicine that uses herbal therapies, dietary supplements, and alternative medical approaches. Individuals rely on traditional medicine, which has recently gained popularity, for most of their healthcare needs. [11]. Medicinal plants include a wide range of chemical components, which enables them to have a diverse range of

pharmacological and therapeutic effects. These substances exemplify components such as tanning agents, glycosides, alkaloids, saponins, polysaccharides, essential oils, terpenoids, resins, and plant lipids [12-14]. Genetically modifying plants enables precise control over chemical concentrations, hence achieving the desired medicinal effect. Reverse genetics has several potential uses, including enhancing secondary metabolite synthesis, such as alkaloids [15]. Advancements in global scientific research have prompted more investigation into the therapeutic attributes of botanical species [16]. This is because plants are inherently safe, possess potent pharmacological properties, and provide a more economical alternative to synthetic medications.

It has been identified as lajjalu in Ayurveda and has been found to have antiasthmatic, aphrodisiac, analgesic, and antidepressant properties. *M. pudica* is known to possess sedative, emetic, and tonic properties, and has been used traditionally in the treatment of various ailments including alopecia, diarrhea, dysentery, insomnia, tumor, and various urogenital infections. Phytochemical studies on *M. pudica* have revealed the presence of alkaloids, non-protein amino acid (mimosine), flavonoids C-glycosides, sterols, terpenoids, tannins, and fatty acids [17,18]. In traditional folk agent that is utilized in the management of various diseases including cognitive dysfunction, demonstrated the improvement of memory in experimentally induced amnesia. The beneficial effects of *M. pudica* have been reported due to the presence of flavonoids, saponins, alkaloids, polyphenols, and steroids [19]. It has Wound healing activity, Regeneration of sciatic nerve, Antidepressant action, Anticonvulsant action, Hyperglycemic effect, Diuretic effect, Effect on uterine bleeding, Antifertility activity, Spasmogenetic potential, Antihepatotoxic and antioxidant potential, Antivenom activity, Antimicrobial properties and Aphrodisiac property [17,20,21,22].

The purpose of our present study is to evaluate the hepatoprotective effects of *Mimosa pudica.* In the study we will assess several blood parameters for e.g. Liver functioning test (SGPT, SGOT),renal functioning test (Creatinine, Urea) and Lipid Profile (HDL, LDL, Total Cholesterol, Trigluceride) to explore the therapeutic consequences of our plant extract. Based on the findings, we may conclude that whether our plant extract can reverse the hyperlipidemic condition or not.

Materials and methods

Plant Collection and Extract Preparation

The specimens of *Mimosa pudica*were collected from a Dhaka-based market. The National Herbarium of Bangladesh confirmed the validity of the material. Rinsing Mimosa pudica well with water was the initial step, followed by letting it dry naturally. Lastly, the dried leaves were ground into a fine powder. The powder was soaked in 70% ethanol for fifteen days. For fifteen days, the solution was kept. Shaking, both intermittent and forceful, was also done. Filtration was then performed on the solution. A rotary evaporator was used to dry the collected filtrate under reduced pressure and temperature. In the end, the raw materials were tested for any relevant pharmaceuticals.

Drugs and Chemicals

Atorvastatin drug was obtained from inceptapharmacetucals as a gift sample. Ethanol was bought from Taj Scientific store. All food and ingredients that are required for the preparation of highfat were purchased from local market.

Experimental Animal Procurement, Nursing, and Grouping

The 90 male rats, ranging in weight from 120 to 150 grams, were procured from Jahangirnagar University in Savar, Dhaka. The specimens were maintained in a controlled environment that varied the temperature by three degrees Celsius, the relative humidity by five and a half percent, and the length of the day and night by twelve hours. Institution of Nutrition and Food Science (INFS) at University of Dhaka supplied this setting. They were given regular food and were permitted to drink water that had been cleansed. In order to see how the animals adapted, they were housed in this habitat for at least one week prior to the study. All procedures used in the experiments were in accordance with the standards established by the IEAC. Nine groups, each with ten rats, were created from a pool of ninety rats.

Experimental design

For the purpose of studying its anti-hyperlipidemic activity, rats were weighed individually and then split into nine separate groups. Each group had five rats, and the distribution of the animals was determined by their weight. Table 1 displays the atorvastatin control group, which consists of rats given atorvastatin in conjunction with a high-fat diet. This was done because administering the drug alone would have been fatal for the animals. The presence or absence of a therapeutic treatment in this group of rats is indicated by the value of N/A.

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Table 1: Antihyperlipidemic activity analysis

Group number	Group Status	Treatment specimen & Dose	Group Abbreviation
1	Negative Control	Physiological Saline	N
2	HFD Control	High Fat Diet	P
3	High Fat Diet +RV_{10}	High Fat Diet + Atrovastatin	HFD + ATV
4	High Fat Diet+ *M. pudica*	High Fat Diet+ MP_{300}	HFD + MP_{300}
5	High Fat Diet+ *M. pudica*	High Fat Diet + MP_{600}	HFD + MP_{600}
6	High Fat Diet+ *M. pudica*	High Fat Diet + MP_{900}	HFD + MP_{900}
7	*M. pudica*	MP_{300}	MP_{300}
8	*M. pudica*	MP_{600}	MP_{600}
9	*M. pudica*	MP_{900}	MP_{900}

High Fat Diet: The high-fat diet was modified based on the composition supplied by Levin and Dunn-Meynell. The high fat diet is composed of 50% lipid, 40% carbohydrate, and 10% protein. The diet's composition is shown in **Table 2**.

Table 2: Composition of high fat diet

Food Ingredients	Composition
Lipid (50%)	Milk powder (10%) Ghee (30%) Mutton fat (40%) Coconut oil (10%)

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	Butter (10%)
Carbohydrate (40%)	Boiled rice (40%) Smashed potato (40%) Boiled corn (20%)
Protein (10%)	Dry powdered prone (40%) Dry boiled mutton (20%) Cheese (20%) Egg (20%)

After mixing the ingredients thoroughly, the high fat diet was given to the rats to induce obesity for 10 weeks [23].

Evaluation of anti-hyperlipidemic Activity

Table 3: Application of treatment efficacy

Group Number	**Group Specification**	**Treatment species**	**Dose treatment species (mg/kg)**	**Abbreviation of Groups**
1	Negative control	Physiological saline	10 ml/kg	N
2	High Fat	N/A	N/A	HF
3	HF+RV_{10}	Rovast 10mg/kg	10	At_{10}
4	HF+MP_{300}	*M. pudica*	300	MP_{300}
5	HF+MP_{800}	*M. pudica*	600	MP_{600}
6	HF+MP_{900}	*M. pudica*	900	MP_{900}
7	MP_{300}	*M. pudica*	300	MP_{300}
8	MP_{600}	*M. pudica*	600	MP_{600}
9	MP_{900}	*M. pudica*	900	MP_{900}

For this experiment, 100 rats were randomly picked and equally divided into fourteen groups

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Sacrifice and analysis of blood parameter: After 10 weeks, all rats belonged too different groups were sacrificed and blood samples were collected and taken in test tube and one drop of heparin was added in each test tube to counteract the blood clotting process. Next, bloods were taken in eppendorf tube and placed in centrifuge machine. Subsequently, the samples were centrifuge at 5000 rpm for 5 minutes. Afterwards, supernatant serum was collected carefully using micro-pipette. Finally these serums were used analyze different parameter by Humalyzer 3000.

Statistical analysis:

We used the spreadsheet program Microsoft Excel to record and analyze all of our results, or raw data, in terms of numerical parameters. Results were presented as mean SD after descriptive statistics were applied to the collected data. We utilized the "One-way Anova test" in SPSS 16 to analyze inter-group heterogenicity according to several biological parameters in order to determine statistical significance. The events are deemed to have occurred due to statistical significance as the 'p' value was lower than 0.05 ($p<0.5$).

Results and discussion

The use of herbal medicines for the management of diverse health conditions is experiencing significant global expansion. In both emerging and established countries, there has been a significant increase in the acceptability and public interest in natural medicines. These herbal remedies are now not only accessible in pharmacy shops but also in grocery stores. Herbal medical goods serve as the main healthcare resource for the significant population residing in developing nations [24]. This study examined the impact of*M. pudica* extract on the lipid profiles of rats suffering from hyperlipidemia due to a high-fat diet. Group 6, which received a large quantity of fat at a rate of 900 mg/kg, showed statistically significant results ($p<0.05$) in SGPT levels. Regarding SGOT, its level did not decrease significantly, even with a large dosage. However, the dosage determined the reduction in SGOT amount. Two further inquiries arrived at the same findings [25, 26]. This plant contains phytochemical elements such as saponins, alkaloids, flavonoids, and triterpenoids, which have antioxidant properties, the capacity to scavenge free radicals, and the ability to reduce lipid peroxidation activity [27]. The renal function test findings indicated that group 6, which was administered doses of 900 mg/kg, had a

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statistically significant increase in urea levels ($p< 0.05$). The study of creatinine in groups 4, 5, and 6 yielded statistically significant findings ($p< 0.05$) for doses of 300, 600, and 900 mg/kg, respectively. The results of two separate investigations on the issue were identical [28,29]. *M. pudica's* antioxidant properties, which reduce oxidative damage in the renal tubular cell membrane, may be responsible for its preventive effect [30. Groups 5 and 6 showed statistically significant findings ($p<0.05$) in relation to HDL and LDL. When groups 5 and 6 received doses of 600 and 900 mg/kg, the findings showed statistical significance outcomes. A significant statistical difference ($p< 0.05$) was seen in the triglyceride levels between groups 5 and 6, which was also statistically significant for doses of 600 and 900 mg/kg. Group 6, which was at a dose of 900 mg/kg, had statistically significant outcomes ($p< 0.05$) in terms of total cholesterol levels. The findings were consistent in two further studies [31, 32]. Indoles, flavonoids, lignans, and phytosterols have the potential to reduce levels of LDL, cholesterol and triglycerides [33].

Table 4: Lipid profile of*M. pudica*

Groups	**SGPT**	**SGOT**	**Creatinine**	**Urea**	**TC**	**HDL**	**LDL**	**TG**
NC	33.67±3.26	38.21±4.23	0.53±0.24	37.42±4.10	125.24±6.90	84.74±4.90	38.42±3.38	47.29±6.18
HFD	86.96±7.24	89.30±7.52	2.89±0.83	102.36±9.36	229.46±12.41	41.46±3.30	146.39±13.49	114.79±13.26
HFD+ RV_{10}	58.24±5.73	62.46±5.23	1.46±0.63	57.57±8.26	161.46±11.93	65.53±5.53	80.22±10.53	66.43±8.93
HFD+MP_{300}	85.75±6.91	89.10±4.91	2.32±0.64*	100.46±8.62	226.20±8.78	44.26±5.59	142.20±13.43	110.21±6.97
HFD+MP_{600}	82.21±4.81	87.54±5.36	2.01±0.79*	97.39±7.70	221.34±9.91	49.39±6.90*	136.79±12.21*	104.36±7.47*
HFD+MP_{900}	80.42±3.75*	86.86±6.29	1.89±0.63*	93.10±6.61*	215.53±7.07*	54.26±8.29*	131.29±14.79*	96.24±6.90*
MP_{300}	35.22±2.16	37.30±3.31	0.63±0.37	35.50±3.63	127.73±6.24	82.82±4.39	39.59±4.57	49.21±7.93
MP_{600}	31.67±4.26	35.50±4.02	0.68±0.52	38.26±4.67	121.93±5.7	84.63±5.	36.63±5.	44.22±6.

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					3	53	57	50
MP_{900}	35.57±3.26	36.31±3.40	0.54±0.83	32.29±3.17	126.22±6.78	83.19±2.93	33.27±6.21	47.70±6.22

Note: The results were expressed in Mean±SEM (standard mean error) *p< 0.05, **p< 0.01, and ***p< 0.001 were considered as statistically significant. The statistical analysis followed by one-way analysis of variance (Dunnett's test) compared to the control.

Conclusion

The hepatoprotective effects of an ethanolic *M. pudica* extract were the primary research focuses here. According to the results of this study, an ethanol extract of the *M. pudica* plant may offer protection against high cholesterol, liver damage, and impaired kidney function. To determine which components of the total extract are responsible for the beneficial effects on hyperlipidemia and diabetes, additional studies are required. A extensive investigation can be carried out once the active substances have been identified.

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