Original Research Article

An Assessment of Anti-hyperlipidemic Potentialities of Ethanolic Extract of *Hemidesmus indicus* in High Fat Induced Rat Modle

Abstract:

The art or practice of utilizing herbs and herbal preparations to preserve health and to prevent, treat, or cure illnes s is referred to as herbal remedies. Rats were utilized to examine the lipid, liver, and renal profiles of hemidesmus indicus extract. Compared to the positive control group, triglycerides dropped in groups 4,5 and 6, but not significantly. At doses of 1000 and 1500 mg/kg, the extract decreased total cholesterol ($p<0.05$). Only higher doses of 1500mg/kg markedly decreased HDL and LDL levels as compared to the positive control ($p<0.05$). The doses of 1000 and 1500 mg/kg significantly decreased the SGPT in liver function tests. Serum glutamic-oxaloacetic transaminase (SGOT) concentrations were lowered only by dosages of 1500mg/kg ($p<0.05$). The levels of creatinine were considerably lowered by all doses of 500, 1000, and 1500mg/kg ($p< 0.05$). Only doses of 1500mg/kg or above reduced urea in comparison to the positive control group. Groups 7,8, and 9 had the same outcomes as the negative control group but were not statistically significant because they only got the lower, medium, and higher extract dosages. Patients with liver, kidney, and cardiovascular diseases might reap advantages from these discoveries.

Keywords: herbal remedies, *Hemidesmus indicus,* cholesterol, cardiovascular patient, phytopharmacology

Introduction

The term "hyperlipidemia" refers to a group of inherited and acquired illnesses that are characterized by high lipid levels in the human body. As an alternative, a more objective definition of hyperlipidemia states that it exists when low-density lipoprotein (LDL), total cholesterol, triglyceride, or lipoprotein levels are higher than the 90th percentile in comparison to the general population, or when HDL levels are lower than the 10th percentile in the general population [1][2]. According to statistics from a study of 1492 doctors who offer ambulatory care in nongovernment institutions conducted by the Centres for Disease Control and Prevention, hyperlipidemia is next only to hypertension on the list of the ten most prevalent chronic illnesses spotted [3]. The vast majority of commonly used anti-hyperlipidemic medications, such as Atorvastatin, Pravastatin, Fluvastatin, Simvastatin, Lovastatin, and Rosuvastatin, are effectively

absorbed but undergo significant hepatic first-pass metabolism, resulting in extremely poor absolute bioavailability [4]. Statins are reversible competitive inhibitors of 3-hydroxy-3-methylglutaryl-coenzyme A reductase (HMG-CoAR), reducing intracellular cholesterol production. Statins' pharmacological reaction is determined by their capacity to enter the hepatocyte and inhibit HMG-CoAR [5]. The development of muscular symptoms, known as statin-associated muscle symptoms (SAMS), as well as diabetes mellitus (DM) and central nervous system disputes, is the most common adverse response limiting statin usage [6]. Apart from the serious side effects, these synthetic drugs are costly, and the patient could run into financial difficulties if the entire therapy program is continued [7]. As a result, potent antihyperlipidemic drugs with fewer adverse effects are necessary.

According to medicinal plant specialists, unique chemical compounds produced from medicinal plants might have therapeutic benefits. As a result, scientists are continually searching for alternative or plant-based herbal medicines to treat a variety of maladies. Because of the presence of numerous chemical constituents such as phenols, alkaloids, terpenoids, saponins, glycosides, tannins, flavonoids, resins, polysaccharides, plant lipids, essential oils, and so on, these medicinal plants can provide a wide range of pharmacological and therapeutic effects [8–9]. Again, the level of the plant's chemical constituents, whether increasing or decreasing, may provide the intended therapeutic benefit, which may be achieved by plant genetic manipulation. For example, using reverse genetics, we can boost the biosynthesis of secondary metabolites such as alkaloids [10].

Many plants, *including Eclipta prostrata, Terminalia chebula, Hibiscus sabdariffa L., and Salvia officinalis L.*, have been shown to have antihyperlipidemic activity [11–14]. According to Ahluwlaia and Amma [15], feeding the oleoresin of gum guggul (*Comrniphora mukul*) reduced total cholesterol and its fractions in lipoproteins. Reshma et al. [16] discovered that corilagin and chebulinic acid from Haritaki had hypolipidemic actions. The concentrated tannins of *Solanum melongena* decrease hyperlipidemia and hyperglycemia, according to Sudheesh et al. [17]. Several authors have reported hypolipidemic effects of proteins, saponins, gums, and beta-sitosterol.

Indian sarsaparilla, a kind of plant found in South Asia, is classified as *Hemidesmus indicus* and is a member of the Apocynaceae family. From the upper Gangetic plain in the east to Assam, as well as in a few locations in central, western, and southern India, it is present throughout the

majority of the country. *H. indicus* is a thin, laticiferous, twining, perennial, wiry shrub that grows quickly and is either prostrate or semi-erect. Its roots are short, inflexible, tuberous, woody, and scented. Anantmool means "the eternal root" because its roots extend far beyond the surface of the ground [18]. Steroids, triterpenoids, triterpenoids, alkaloids, carbohydrates, tannins, glycosides, polyphenols, and saponins are present in *Hemidesmus indicus* [19, 20]. Beta-sitosterol, which has lipid-lowering properties, is found in the roots of *Hemidesmus indicus* [21, 22]. High levels of phytosterols are seen in cell cultures obtained from *Hemidesmus indicus*. Phytosterol beta-sitosterol is said to be helpful in the treatment of hyperlipidemia [23]. The plant exhibits cytotoxic, immunostimulatory, hepatoprotective, anti-diabetic, antihypercholesterolemic, anti-ulcerogenic, cardioprotective, anti-atherogenic, and antithrombotic properties [23-29].

Our study aims to investigate the anti-hyperlipidemic activity of *Hemidesmus indicus.*

Materials and Methods

Drugs, Chemicals, and Instruments:

Ethanol was purchased from Sigma-Aldrich, Germany. Rosuvastatin, a common antihyperlipidemic medication, was received as a gift sample from Healthcare Pharmaceutical Limited. HDL, LDL, Triglycerides, Total Cholesterol, SGOT, SGPT, and Creatinine were provided by Plasmatic Laboratory Product Ltd. in the UK. Shahbag in Dhaka, and the Humalyzer 3000 (Semi-Automated Clinical Chemistry Analyzer) were used to assess the biochemical parameters. Ingredients for the preparation of the high-fat diet were bought from a super shop.

Plant Collection and Extract Preparation:

Hemidesmus indicus was collected from the medicinal plant garden of the University of Dhaka's Faculty of Pharmacy. The process of taxonomic identification and authentication was then finished. Plant specimens were kept in the National Herbarium of Bangladesh in compliance with their norms. The Herbarium authorities issued accession number 47380, dated 11-2-2019, for future use. The plant was then shade-dried for 7–10 days before being coarsely crushed. While steeping in 70% ethanol, the powdered plants were violently shaken for 96 hours. The extract was filtered when it had finished soaking, and the filtered liquid was collected. The extracted solution was then concentrated using a rotary evaporator. The dried extract was then carefully collected and stored for future use [30-31]

Experimental Animal Handling: Male wistar adult rats weighing 100–150 g were obtained from the pharmacy department of Jahangirnagar University in Dhaka, Bangladesh, and housed at the University of Dhaka's Institute of Nutrition and Food Science under a 12-hour light/dark cycle at a constant temperature of 25°C. Regular supplies of a standard pellet diet and pure water

were given. Before the inquiry began, the rats were left there to acclimate. Experiments involving the rats were all conducted by the institutional animal ethics committee's rules (IEAC). According to the standards set forth by the Swiss Academy of Medical Sciences (SAMS) and the Swiss Academy of Sciences (SCNAT), animals were handled and treated humanely.

Experimental Guidelines: The 2013 Declaration of Helsinki's ethical guidelines were followed in the execution of all tests [32].

Experimental Design: Each rat was weighed individually, and then the animals were divided into groups (Table 1) with an even distribution of rodents according to their body weight and five rats in each group.

Table 1: Antihyperlipidemic activity analysis

Group number	Group Status	Treatment specimen & Dose
1	Negative Control	N/A
2	Positive control	High Fat
3	High fat + drug	High Fat
4	High fat + extract low	High Fat+ 500 mg/kg
5	High fat + extract medium	High Fat+1000 mg/kg
6	High fat + extract high	High Fat+1500 mg/kg
7	Low extract	500 mg/kg

8	Medium extract	1000 mg/kg
9	High extract	1500 mg/kg

The N/A refers to the fact that rats of this group were administered with no therapeutic treatment.

High-Fat Diet: Based on the composition provided by Levin and Dunn-Meynell, the high-fat diet was adapted [33]. The high-fat diet contains 50% lipid, 40% carbohydrate, and 10% protein. The composition of the diet is presented 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%) 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, a high-fat diet was given to the rats to induce obesity for 10 weeks [33].

Experiment:

The whole duration of the experiment is ten weeks. We maintained the rats in the experimental area after collecting them to ensure reliable findings. After 2 weeks, we gave the rats a high-fat diet and a plant extract for a total of 8weeks.

Biological Sample Collection: After the sacrifice, the heart was promptly punctured to obtain blood samples, which were then transferred to a microcentrifuge tube. To acquire the supernatant fluid, the collected samples were centrifuged at 5,000 rpm for 5 minutes. To perform biochemical tests, this fluid was then transferred to another microcentrifuge tube.

Estimation of Biochemical Parameters: Lipid profile, kidney, and liver function tests were carried out using Humalyzer 3000.

Statistical Analysis: The "one-way ANOVA test" was used to evaluate intergroup heterogeneity in terms of several biological parameters and to establish statistical significance for all study parameters that belonged to each group. Software called "SPSS 16" was utilized for the analysis. When the "p" value was less than 0.05 ($p<0.05$), the outcome was deemed statistically significant.

Results:

Groups 4, 5, and 6 exhibited a statistically significant ($p<0.05$) decrease in total cholesterol after administering plant extract at 1000 and 1500 mg/kg doses. The experimental groups receiving 500, 1000, and 1500 mg/kg doses had decreased serum cholesterol levels compared to the positive control group. While triglyceride levels were reduced across all groups while using the extract, no dosage produced a statistically significant difference when compared to the positive control group. At a dosage of 1500 mg/kg, there was a statistically significant ($p< 0.05$) reduction in LDL. HDL levels in rats were raised across all doses as compared to the positive control group. In the cases of 1000 and 1500 mg/kg doses, there was a statistically significant reduction in SGPT levels. However, only a dosage of 1500 mg/kg reduced SGOT concentration by a statistically significant amount ($p< 0.05$). The creatinine levels of rats were reduced by a statistically significant amount ($p<0.05$) after administration of 500, 1000, and 1500 mg/kg. However, only the 1500 mg/kg dosage reduced urea levels relative to the positive control group.

The conventional medicine alone reduced the lipid profile, SGPT, SGOT, creatinine, and urea levels significantly in all the groups 3. When compared to the negative control group, the results from groups 7, 8, and 9 where all the rats were treated solely with extract, were not statistically significant.

Table 3: Cholesterol

C	CCL4	CCL4+S10	CCL4+VVI 500	CCL4+VVI 1000	CCL4+VVI 1500	VVI500	VVI1000	VVI1500
100.25	167.55	130.42	161.42	140.56	137.45	102.44	105.45	101.45
107.4	155.55	121.24	147.96	142.55	130.44	105.44	103.44	102.32
104.56	155.55	126.45	162.78	137.8	140.9	96.45	96.96	104.55
97.44	157.44	117.89	153.47	151.39	135.55	90.44	102.44	105.66
97.5	162.51	119.78	152.55	144.2	137.44	99.44	99.89	101.44
101.43	159.72	123.156	155.636	143.3	136.356	98.842	101.636	103.084
4.421402492	5.221810031	5.157890073	6.277485962	5.113174161	3.829768923	5.769577108	3.292450455	1.919721334

Table 4: Triglyceride

NC	CCl4	CCl4+Atv	CCl4+HI low	CCl4+HI medium	CCl4+HI High	HI Low	HI medium	HI High
49.23	110.23	74.56	110.23	108.45	105.92	53.21	48.429	50.5
4.291	4.259	3.269	3.425	2.239	3.214	2.292	1.298	2.3962

Table 5: LDL

NC	CCl4	CCl4+Atv	CCl4+HI low	CCl4+HI medium	CCl4+HI High	HI Low	HI medium	HI High
37.43	70.48	51.45	68.48	70.892	60.23	33.48	39.4528	41.23
1.97	3.4598	3.1498	2.4582	4.2328	3.149	1.298	2.23914	2.239

Table 6: HDL

NC	CCl4	CCl4+Atv	CCl4+HI low	CCl4+HI medium	CCl4+HI High	HI Low	HI medium	HI High

67.88	48.52	58.23	48.89	51.047	56.76	65.47	67.89	69.74
1.268	5.21492	4.623	3.489	3.598	2.948	4.216	3.1296	3.635

Table 7: SGOT

NC	CCl4	CCl4+Atv	CCl4+HI low	CCl4+HI medium	CCl4+HI High	HI Low	HI medium	HI High
42.23	90.41	63.45	87.45	85.45	81.452	41.25	37.88	38.45
2.452	4.1256	3.2285	4.225	4.255	2.455	2.33	3.2285	2.33

Table 8: SGPT

NC	CCl4	CCl4+Atv	CCl4+HI low	CCl4+HI medium	CCl4+HI High	HI Low	HI medium	HI High
29.7	74.63	58.9	71.485	68.48	63.125	30.46	31.29	33.22
1.983	3.4982	4.9827	3.254	2.48	3.245	2.982	1.769	1.439

Table 9: UREA

NC	CCl4	CCl4+Atv	CCl4+HI low	CCl4+HI medium	CCl4+HI High	HI Low	HI medium	HI High
28.47	84.52	59.47	81.4	80.54	75.4581	27.58	32.32	31.48
2.12465	5.264189	3.26188	6.45129	4.296521	4.52973	1.4982	2.14622	2.15938

Table 10: Creatinine

C	CCL4	CCL4+S10	CCL4+VVI 500	CCL4+VVI1000	CCL4+VVI1500	VVI500	VVI1000	VVI1500
0.52	2.4	0.9	1.8	1.4	1.1	0.7	0.8	0.5
0.149232173	0.5.1894	0.433971	0.494187	0.24844	0.0297252	0.0.22478	0.02587441	0.028411

Discussion:

Hyperlipidemia is one of the important risk factors involved in the development of cardiovascular diseases. Atherosclerosis and congestive heart diseases are strongly associated with disorders of lipid metabolism and plasma lipoproteins. In this study, we evaluated the antihyperlipidemic activity of the plant(roots) of *Hemidesmus indicus.*

In the case of groups 4,5 and 6, all the doses of extract lowered the triglyceride level but it was not statistically significant when compared to the positive control group.

But the extract at medium and higher doses lowered the total cholesterol level in the body which is statistically significant($p<0.05$). The HDL and LDL level was decreased only on higher doses which is also statistically significant when compared to the positive control group.

In the case of the liver function test, SGPT levels were decreased statistically significantly in the case of medium and high doses. But in the case of SGOT only high doses lowered the concentration of SGOT which is statistically significant ($p<0.05$).

There was a statistically significant ($p <0.05$) drop in LDL at a dose of 1500 mg/kg. Rats had greater amounts of HDL at all doses compared to the positive control group. There was a statistically significant drop in SGPT levels at dosages of 1000 and 1500 mg/kg. However, only a dose of 1500 mg/kg resulted in a statistically significant drop in SGOT concentration ($p <0.05$). Rats given doses of 500, 1000, and 1500 mg/kg experienced statistically significant drops in their creatinine levels ($p <0.05$). However, in contrast to the positive control group, only the 1500 mg/kg treatment lowered urea levels. In all the groups 3, the conventional medicine alone considerably decreased the lipid profile, SGPT, SGOT, creatinine, and urea levels.

In the kidney function test, after administration of all the doses, lower, medium, and high the creatinine level in the rats decreased statistically significantly level ($p<0.05$). But urea was decreased only on high doses when compared to the positive control group.

The group 7,8 and 9 which were treated only the lower, medium and higher doses of the extract showed the result as same as the negative control group which is not statisticaaly significant.so we can say that, it has no impcact in the change of normal physiological function of the body.

Conclusion:

The present study revealed that the ethanolic extract of Hemidesmus indicus protects against oxidative stress, hyperlipidemia and liver damage. Though the plant extract has the anti-hyperlipedemic activity but this can not give the extraordinary effect. So this requires further study to identify which compound from the whole extract actually gives the anti-hyperlipedemic effect by screening process. Further vigorous studies can be done after isolating the specific effective compounds. A new therapeutic agent can be invented in Anti-hyperlipedemic management system by going through the advanced processes, such as NMR, Mass spectrometry processes etc.

Ethical Approval: We received ethical approval from the Research Ethics Committee of the Department of Zoology University of Dhaka, Bangladesh. All of the experiments in this research were carried out under their guidance.

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