__Original Research Article__

An Evaluation of Anti-hyperlipidemic Activity of Ethanolic Extract of *Asparagus racemosus* on High Fat Induced Hyper-lipidemic Rat Model

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Abstract

Traditional medicine, according to the World Health Organization, encompasses the knowledge, skills, and practices derived from the theories, beliefs, and experiences of various cultures. It is used to maintain health and prevent, diagnose, improve, or treat physical and mental illnesses.This research examined the effects of *A. racemosus*extract on lipid profiles in rats that had developed hyperlipidemia due to a high-fat diet. Neither the SGPT nor SGOT values yielded statistically significant findings ($p<0.05$) in the liver function test. The renal function test revealed that there was no significant statistical variation in the levels of urea. Nevertheless, the examination of the creatinine levels revealed statistically significant outcomes ($p< 0.05$) in groups 5 and 6, where the dosage of high fat and extract administered was 600 and 900 mg/kg, respectively. Groups 5 and 6 showed statistically significant results ($p<0.05$) for high-density lipoprotein (HDL); however, only group 6 produced statistically significant outcomes ($p<0.05$) for low-density lipoprotein (LDL). Groups 5 and 6 were given dosages of 600 and 900 mg/kg, respectively. There was a significant statistical difference ($p<0.05$) in the triglyceride levels between groups 5 and 6. The data referring to total cholesterol levels did not demonstrate any statistical significance.

Keywords:*A. racemosus*, HDL, LDL, Phytochemicals, Phytotherapy.

Introduction

The liver, the largest glandular organ, regulates the majority of physiological activities in the body. The liver is the organ that receives an individual's entire blood volume many times throughout the day. It is crucial to the metabolic activities of humans [1, 2]. Excessive alcohol consumption, drug addiction, exposure to some hazardous compounds, or infection with viruses or parasites may lead to an elevation in the levels of reactive oxygen species (ROS), such as OH, H_2O_2, and O_2 [3]. This may lead to hepatocellular damage. The Centers for Disease Control and Prevention conducted research involving 1492 clinicians who offer ambulatory treatment in non-government facilities. According to the survey, hyperlipidemia ranks as the second most common chronic illness among these doctors, with hypertension being the only condition they see more frequently [4]. The study's results suggest that the primary cause of hyperlipidemia [5] is the excessive eating of high-fat meals. The liver plays a crucial role in metabolising commonly used anti-hyperlipidemic drugs such as atorvastatin, pravastatin, fluvastatin, simvastatin, lovastatin, and rosuvastatin. Consequently, the bioavailability of these drugs is significantly limited [6]. The enzyme 3-hydroxy-3-methylglutaryl-coenzyme A reductase (HMG-CoAR) can be temporarily stopped from working by statins. This enzyme reduces cholesterol levels. This allows them to reduce cholesterol synthesis inside the cells. Statins have the ability to enter hepatocytes and inhibit HMG-CoAR, which is responsible for their pharmacological effects [7]. Statin-associated muscle symptoms (SAMS), often known as muscular problems, are the most common side effect that limits the use of statins. Two other potentially detrimental consequences include the onset of diabetes mellitus (DM) and complications affecting the central nervous system [8]. These synthetic medicines not only have substantial adverse effects, but they are also expensive, potentially causing financial hardships for patients who need to continue taking them during the whole therapy [9]. Therefore, it is crucial to develop highly effective antihyperlipidemic medications with minimal unwanted effects. Plants are essential in the process of discovering and synthesizing novel therapies. The user's text is "[10]". They serve as a useful and abundant reservoir of naturally occurring chemicals for therapeutic applications. Specialists on the subject propose that certain chemical constituents obtained from medicinal plants have therapeutic properties. As a result, researchers are always searching for novel herbal remedies and other medicines derived from plants to effectively treat various ailments [4]. Herbal treatments, nutritional supplements, and alternative medical practices have a long history of being used as traditional medicines in many countries around the world. Traditional medicine has grown more popular in recent years, and many people rely on it for most of their health care needs [11]. Plants used for medical reasons include a diverse range of chemical constituents,

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enabling them to produce a broad array of pharmacological and therapeutic impacts. These substances include many constituents, including tanning agents, glycosides, alkaloids, saponins, polysaccharides, essential oils, terpenoids, resins, and plant lipids [12–14]. Genetically engineered plants provide a means to exert precise control over chemical concentrations, thereby facilitating the attainment of the intended medicinal outcome. Reverse genetics has several potential uses, one of which is the augmentation of secondary metabolite synthesis, such as the generation of alkaloids [15]. Global scientific advancements have led to an increase in the investigation of plant species' therapeutic attributes [16]. Plants are becoming more popular because of their inherent safety, potent pharmacological properties, and cost-effectiveness compared to synthetic drugs.

Asparagus racemosus, sometimes referred to as Satawar, Satamuli, and Satavari, is a plant that thrives at low altitudes in India. It belongs to the Liliaceae family. A. racemosus is distributed from Sri Lanka to India and the Himalayas. The species has a broad distribution in Asia, Australia, and Africa, mostly found at low altitudes in shaded, tropical climates. *Asparagus racemosus* is the predominant Asparagus species cultivated in India for its therapeutic properties [17].

This plant has a high concentration of steroid, flavonoid, saponin, phenolic, and carbohydrate components [18]. It has been shown to be beneficial in combating germs, reducing cholesterol levels, treating diabetes, inhibiting enzymes, protecting the liver, promoting urine production, eliminating parasites, killing cells, alleviating depression, preventing ulcers, and acting as an antioxidant, among other applications [19-28].

The present study seeks to assess the hepatoprotective characteristics of*Asparagus*racemosus.

Materials and methods

Plant Collection and Extract Preparation

Specimens of *Asparagus* racemosus were acquired from a nearby market in Dhaka. The National Herbarium of Bangladesh has confirmed the authenticity of the sample. Initially, *Asparagus racemosus* was properly washed with water, and subsequently let to air dry. Finally, we ground the dried leaves into a fine powder. The powder was submerged in a solution of 70% ethanol for a period of 15 days. The solution was held for a period of 15 days. Periodic, violent shaking was

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also performed. Afterwards, the solution was filtered. The collected filtrate underwent drying by the use of a rotary evaporator, employing lowered temperature and pressure conditions. Finally, the crude remnants were subjected to the required pharmacological analysis.

Drugs and Chemicals

Atorvastatin drug was obtained from Incepta Pharmaceuticals as a gift sample. Ethanol was bought from the Taj Scientific store.

Experimental Animal Procurement, Nursing, and Grouping

A total of 90 male rats weighing between 120 and 150 grams were acquired from Jahangirnagar University in Savar, Dhaka. The specimens were maintained in a controlled environment with a temperature range of 25±3°C, relative humidity between 55±5%, and a 12-hour light-dark cycle. The Institute of Nutrition and Food Science (INFS) at the University of Dhaka provided this facility. The individuals were given regular meals and permitted to drink purified water. Each animal was kept in this setting for at least one week prior to the investigation in order to monitor their adaption. The experimental protocols followed the rules established by the Institutional Animal Ethics Committee (IEAC). A total of 90 rats were randomly assigned to 9 groups, with each group including 10 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.

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

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3	High Fat Diet +RV_{10}	High Fat Diet + Atrovastatin	HFD + ATV
4	High Fat Diet + *A. racemosus*	High Fat Diet+ AR_{300}	HFD + AR_{300}
5	High Fat Diet + *A. racemosus*	High Fat Diet + AR_{600}	HFD + AR_{600}
6	High Fat Diet *A. racemosus*	High Fat Diet + AR_{900}	HFD + AR_{900}
7	*A. racemosus*	AR_{300}	AR_{300}
8	*A. racemosus*	AR_{600}	AR_{600}
9	*A. racemosus*	AR_{900}	AR_{900}

High Fat Diet: The high-fat diet was adjusted according to the composition provided by Levin and Dunn-Meynell. The high fat diet consists of 50% lipids, 40% carbohydrates, and 10% proteins. The dietary composition is displayed 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%)

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After mixing the ingredients thoroughly, the high fat diet was given to the rats to induce obesity for 10 weeks [29].

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	$HF+AR_{300}$	*A.racemosus*	300	AR_{300}
5	$HF+AR_{800}$	*A.racemosus*	600	AR_{600}
6	$HF+AR_{900}$	*A.racemosus*	900	AR_{900}
7	AR_{300}	*A.racemosus*	300	AR_{300}
8	AR_{600}	*A.racemosus*	600	AR_{600}
9	AR_{900}	*A.racemosus*	900	AR_{900}

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

Statistical analysis:

The raw data we collected in terms of numerical parameters were recorded and evaluated on a broadsheet using the MS Excel application. The collected data undergone descriptive statistical analysis, and the results were provided as the mean and standard deviation (SD). In order to assess statistical significance, we employed the "One-way Anova test" feature of the SPSS 16 software to analyze the inter-group heterogeneity with respect to several biological parameters.

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The occurrences are regarded as statistically significant due to the 'p' value being less than 0.05 ($p<0.5$).

Results and discussion

Traditional medicine and ethnomedicine, which are studies of customary therapeutic practices among many ethnic groups, have existed since the beginning of human civilization. Historically, traditional medicine has used natural resources for medicinal purposes. In the past, herbs and plant extracts were the main components of the original medicines used in traditional medical procedures throughout many cultures and civilizations. Throughout history, plants and herbs have played a crucial role in providing pharmaceuticals, either in the form of traditional extracts or isolated active components. This study investigated the impact of an extract from *Asparagus racemosus* on the lipid profiles of rats suffering from hyperlipidemia due to a high-fat diet.

Both the SGPT and SGOT levels did not provide statistically significant ($p<0.05$) results in case of liver function test. Two other experiments [30, 31] yielded the same findings. The renal function test indicated that the levels of urea did not show any meaningful statistical difference. However, the analysis of the creatinine levels showed statistically significant results ($p< 0.05$) in groups 5 and 6, where the dose of high fat and extract given was 600 and 900 mg/kg, respectively. Two other inquiries [32, 33] arrived at identical findings on the subject matter. Groups 5 and 6 exhibited statistically significant results ($p<0.05$) for high-density lipoprotein (HDL), but only group 6 demonstrated statistically significant outcomes ($p<0.05$) for low-density lipoprotein (LDL). Specifically, groups 5 and 6 were given doses of 600 and 900 mg/kg, respectively. There was a statistically significant difference ($p<0.05$) in the triglyceride levels between groups 5 and 6. The results pertaining to total cholesterol levels did not show any statistical significance. Two other studies [34, 35] yielded the same findings.

Table 4: Lipid profile of*A.racemosus*

Groups	SGPT	SGOT	Creatinine	Urea	TC	HDL	LDL	TG
NC	30.42±2.67	35.59±3.36	0.53±0.169	33.29±1.45	124.24±7.89	80.22±6.29	36.22±3.22	45.50±6.30
HFD	81.37±6.24	84.25±8.29	2.82±0.467	95.90±5.33	226.46±10.29	43.52±5.11	144.21±5.22	119.26±8.89
HFD+	60.22±5.63	57.35±6.72	1.53±0.321	64.22±4.59	173.91±6.82	66.19±4.77	101.52±7.53	84.54±3.22

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RV$_{10}$								
HFD+AR$_{300}$	79.93±6.42	83.79±7.20	2.61±0.129	94.59±3.21	222.45±9.79	47.21±5.14	142.24±5.59	116.21±3.24
HFD+AR$_{600}$	77.69±5.50	82.79±5.29	2.24±0.532 *	99.26±4.70	210.27±8.72	50.52±4.2 *	139.22±6.10	108.24±5.5 *
HFD+AR$_{900}$	76.41±7.19	80.95±6.21	1.89±0.341 *	91.18±5.63	196.58±10.26	53.24±2.8 *	138.21±4.50 *	102.63±6.2 *
AR$_{300}$	27.17±1.89	33.48±1.82	0.67±0.29	34.22±1.37	120.29±8.12	77.46±5.19	37.20±4.22	48.56±4.22
AR$_{600}$	30.20±2.24	34.61±3.38	0.83±0.39	30.25±2.62	122.39±6.80	84.16±6.72	35.19±4.50	43.24±5.36
AR$_{900}$	32.15±1.77	30.29±2.16	0.74±0.42	31.96±1.89	124.23±5.83	80.52±6.12	33.22±5.06	45.73±4.12

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

This investigation focused on the hepatoprotective effects of an ethanolic *Asparagus racemosus* extract. This study's results suggest that an ethanol extract of the *Asparagus racemosus* plant may provide protection against high cholesterol, liver damage, and kidney dysfunction. To identify the exact active ingredients in the whole extract that may reduce hyperlipidemia and diabetes, further study is required. A thorough examination may be carried out after the active compounds have been identified.

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