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Evaluation of Hypolipidemic Activity of *Allium schoenoprasum* in Albino Rats

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Authors' contributions

This research article was designed by the combined efforts of all authors. Authors AM and RA supervised the project. Authors SFN, AB and HA did all the experimental work including statistical work. Authors MJ, QA and BA compiled this research article. All authors read and approved the final draft of manuscript.

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ABSTRACT

Aim of Study: This study was designed to evaluate the hypolipidemic action of aqueous and ethanolic extracts of leaves of *Allium schoenoprasum* in albino rats.
Methodology: 500 g of dried leaves powder was initially soaked in 3 L of 99.9% ethanol for three days and after filtration residues was soaked in 2 L distilled water for further three days. Both filtrates were subjected to rotary evaporator to get semi solid pastes. Rats were divided in five groups with six animals in each group. Hyperlipidemia was induced in rats by intraperitoneal administration of Triton X-100 (100 mg/kg/ip). After 72 hours, normal group was given normal saline while hyperlipidemic protocols were given to other groups. 200 mg/kg/p.o dose of ethanolic and aqueous extracts were administered to the experimental groups while Atorvastatin 10 mg/kg/p.o was given to standard control groups for 7 days. At 8th day blood sample was collected and serum samples were analyzed for biochemical parameters i.e. total serum cholesterol, serum triglycerides, HDL, LDL and VLDL level.

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Results: %age yield of ethnolic extract was 17% and for aqueous extract it was 9%. 113±3.3, 105±5.7, 29±1.3, 102±2.0 and 27±1.1 mg/dl were level of serum cholesterol, triglycerides, HDL, LDL and VLDL respectively, observed in ethanolic extract treated rats while aqueous extract treated rats showed 111±2.0, 103± 2.2, 24±0.88, 102±1.1 and 27±0.95 mg/dl, respectively which were significantly (P < .001) different from disease controlled group. Results indicate significant reduction in the levels of total serum cholesterol, triglycerides, LDL and VLDL while level of HDL was significantly elevated in the experimental control groups.
Conclusion: All investigations indicated that *Allium schoenoprasum* dried leave extracts have potential to cause hypolipidemia.

Keywords: Hyperlipedemia; Triton; HDL; VLDL; serum triglycerides.

1. INTRODUCTION

Hyperlipidemia is an excess of lipids in the bloodstream and it is characterized as a heterogeneous group of disorders. These lipids include cholesterol, phospholipids, cholesterol esters and triglycerides [1]. Lipids are transported as large lipoproteinsin the blood. Based on density; Lipoproteins are divided into five major classes; high-density lipoproteins (HDL), low-density lipoproteins (LDL), intermediate-density lipoproteins (IDL) very low-density lipoproteins (VLDL) and chylomicron. Mostly triglyceride is transported in chylomicrons or VLD and cholesterol is mostly carried in the form of LDL and HDL [2].

Cholesterol is both our friend as well as foe at normal levels. It is a substance that is essential for the body's normal function, but if its levels get too high in the blood, it becomes a danger that puts us silently towards heart attack [3]. Cholesterol is found in every cell of our body and it has important natural functions. It is synthesized by the body but it can also be taken from food. Its appearance is waxy and fat-like [4,5].

Cholesterol is oil-based and blood is water-based. It does not mix with the blood, so lipoproteins are carried around the body [6,7]. Hypercholesterolemia is a condition in which level of cholesterol in blood is higher than normal and manifested by elevated serum total cholesterol; lipoprotein, low density, very low density and decreased in level of high density lipoprotein that are the risk factors for coronary heart diseases. Hyperlipidemia can also causes the atherosclerotic cardiovascular disease [8] insulin resistance and glucose intolerance [9]. A wide variety of active constituents have been separated from plants that are being used in current medication. Along with the pure components crude extracts and essential oils of plants are also experienced in modern medicine. More than 100 plants are being used in modern medicine around the world [10]. The objective of this study was to investigate the antihyperlipidemic potential of both aqueous and ethanolic extracts of *Allium schoenoprasum* leaves. *Allium schoenoprasum* is native to central Europe and enriched with constituents; carotenoides, peroxidases, flavonoids, and cinnamic acid [11]. This is extensively used as stimulant, diuretic, antioxidant, and antiseptic [12], have anti-inflammatory effects [13].

2. MATERIALS AND METHODS

2.1 Materials

Cholesterol diagnostic kits (Total cholesterol, LDL, triglyceride, HDL), Ethanol, Atorvastatin and Triton X-100. Atorvastatin was donated by CCL Pharmaceuticals, Pakistan upon request. Triton X-100 was purchased from Sigma Aldrich distributors.

2.2 Equipments

Digital electronic balance (Yoke Galvani), Grinder (National Model MJ-176NR, China), Vortex mixer (Digitek instruments VM 300), UV spectrophotometer (Yoke Galvani -1900), Centrifuge machine (Centurion scientific DHG 9053A), Merck Microlab 300 (Merck Germany).

2.3 Collection of Plant Material

The plant of *Allium schoenoprasum* was collected from the local green market of Khushab city with the help of native botanist and was identified from botany department of Lahore College for Women University and sample of it was preserved in herbarium of Riphah Institute of Pharmaceutical Sciences Lahore with voucher no RIU-02-06-25. After authentication, the plant

was cleaned of extra parts, washed out with fresh water for debris and dust and sample of it was submitted to the herbarium of Pharmacology Research Lab, Riphah Institute of Pharmaceutical Sciences, Riphah International University Lahore Campus.

2.4 Preparation of Extract

After cleansing the whole plant of *Allium schoenoprasum* was cut down into small pieces and dried under shade for 3 weeks. After drying the plant was ground into coarse powder by using grinding machine (National, Model MJ-176NR, China) and 500 g powdered material was soaked into 3 L of 99.9% ethanol for maceration purpose at room temperature. After three days the soaked material was filtered first with muslin cloth and then re-filtered with Watmann Grade-1 filter paper. Residue was dried to evaporate ethanol and was again soaked in 2 L of distilled water for the preparation of aqueous extract. After three days filtrate was obtained. Both aqueous and ethanolic filtrates were subjected to rotary evaporator for evaporation of aqueous and ethanolic contents of extracts. At the end semisolid paste like extracts (blackish green erhanolic extract and golden brown aqueous extract) were obtained which were preserved in refrigerator after sealing in air tight containers with proper labeling [14]. The purpose of using ethanol and distilled water as solvent was to extract maximum of phytochemical constituents from plant. %age yield for ethanolic extract was 17% while for it was 9% for aqueous extract which was calculated as:

Percentage (%) yield = Weight of extract (g) / Weight of powder (g) X 100.

2.5 Solubility Study

Both extracts were dissolved in different solvents such as ethanol, water, normal saline and DMSO at different ratio such as 1 mg extract and 1 ml solution (1:1), 5 mg extracts and 5 ml solution (5:5) and 10 mg extract and 10 ml solution (10:10). Solubility study was performed for oral administration of plant extracts for experimental purposes.

2.6 Phytochemical Analysis of Plant Extract

Primary requisition to carry out experimental work with crude extract was to evaluate variety of chemical constituents. Crude extracts were analyzed for phytochemical analysis for determination of alkaloids, phenols, flavonoids, glycosides, tannins, saponins and proteins. This process was carried out as follow:

2.6.1 Alkaloid's detection

500 mg of sample extract was taken and dissolved into 8 ml of 1% HCl and filtered. This filtrate was used for alkaloid's testing [15].

2.6.1.1 Mayer's test

2 ml of filtrate was treated with 6 drops of Mayer's reagent (Potassium mercuric iodide) appearance of yellow colored precipitates indicated the presence of alkaloids.

2.6.1.2 Wagner's test

6 drops of Wagner's reagent (iodine in potassium iodide) was added to 2 ml of filtrate and observed for the presence of reddish brown precipitates.

2.6.1.3 Dragendroff's test

Potassium bismuth iodide (Dragendroff's reagent) was added to filtrate. Appearance of red colored precipitates confirmed presence of alkaloids.

2.6.1.4 Hager's test

Yellowish precipitation was observed when filtrate was treated with Hager's reagent (picric acid solution).

2.6.2 Test for glycosides

Crude plant extract was hydrolyzed with dilute HCl for glycoside identification [16].

2.6.2.1 Salkowski's test

Plant extract was treated with 2 ml of chloroform and filtered. Filtrate was mixed with few drops of conc. sulphuric acid carefully, shaken well and allowed to stand for few minutes. Reddish brown ring indicated the presence of steroidal ring.

2.6.2.2 Liebermann's test

Crude plant extract was treated with 2 ml of chloroform and 2 ml of acetic anhydride and cooled the mixture in ice then conc. sulphuric acid was added. Formation of violet to blue green ring at the junction confirmed the presence of glycosides.

2.6.2.3 Keller-Kiliani test

500 mg of plant extract was dissolved into 5 ml of water followed by mixing of 2 ml glacial acetic acid in a test tube. At the end, 1-2 drops of 2% ferric chloride solution were added to it carefully. 2 ml of conc. sulphuric acid was added along the sides of test tube and observed for ring color. A brown colored ring at interphase indicated the presence of glycosides.

2.6.3 Test for carbohydrates

Crude plant extract was dissolved in 5 ml of distilled water and filtered, the filtrate was used for testing carbohydrate's detection [15].

2.6.3.1 Molish's test

Filtrate was mixed with 2 drops of alcoholic α-naphthol solution in a test tube. Formation of violet ring at the junction justified the presence of carbohydrates.

2.6.3.2 Benedict's test

Filtrate was mixed with 2 ml of Benedict's reagent and heated gently then observed for the precipitates color. Reddish brown precipitates confirmed the presence of carbohydrates.

2.6.3.3 Fehling's test

Equal volume of Fehling A and Fehling B reagents were mixed and 2 ml of it was added to the filtrate and boiled. At the bottom of test tube brick red colored precipitates confirmed the presence of carbohydrates.

2.6.4 Test for proteins and amino acids

2.6.4.1 Ninhydrin test

Crude plant extract was mixed with Ninhydrin reagent (0.25% w/v) and boiled for few minutes. Blue color confirmed amino acids presence [15].

2.6.4.2 Xanthoproteic test

Appearance of yellow color indicated the presence of proteins when extract was treated with conc. nitric acid [15].

2.6.5 Identification of phenols

2.6.5.1 Ferric chloride test

Crude plant extract was mixed with 3-4 drops of ferric chloride solution. Bluish black ring formation indicated the presence of phenols [15].

2.6.6 Test for tannins

Two tests were performed to verify presence of tannins.

2.6.6.1 Ferric chloride test

500 mg of crude plant extract was mixed with 10 ml of water and shaken well then filtered. Filtrate was treated with 1% ferric chloride solution and observed for bluish black or greenish black color ring indicated the presence of tannins [17].

2.6.6.2 Gelatin test

1% gelatin solution containing sodium chloride was added to the plant extract. Formation of white colored precipitates confirmed the presence of tannins.

2.6.7 Detection of saponins

0.5 mg of plant extract and 2 ml of water was shaken vigorously. Formation and persistence of foam within 10 minutes confirmed the presence of saponins [15].

2.6.8 Identification of flavonoids

2.6.8.1 Alkaline reagent test

Flavonoids were determined by treating plant extract with few drops of sodium hydroxide (NaOH) solution. Intense yellow color appeared which was disappeared by adding dilute acid. It confirmed the presence of flavonoids [18].

2.6.8.2 Lead acetate test

Addition of few drops of lead acetate to crude plant extract produced yellow colored precipitates which showed presence of flavonoids [15].

2.6.9 Test for terpenoids

2 ml of chloroform was added to crude extract and evaporated to dryness. To this, 2 ml of concentrated H_2SO_4 was mixed and heated for about 2 minutes. A grayish color indicated the presence of terpenoids [16].

2.6.10 Testfor steroids

Crude extract was dissolved in 2 ml of chloroform and concentrated H_2SO_4 was added sidewise. A red color produced in the lower chloroform layer detected the presence of steroids.

Another test was performed by adding crude extract with 2 ml of chloroform. Then 2 ml of concentrated H_2SO_4 and acetic acid were poured into the mixture. The formation of a greenish coloration indicated the presence of steroids [16].

2.6.11 Test for quinones

Small amount of plant extract was mixed with concentrated HCl and observed for yellow coloration which confirmed positive results [18].

2.7 Pharmacological Studies

2.7.1 Animal selection

For this study Albino rats weighing 180-200 g of either sex were purchased from the Institute of Molecular Biology & Biotechnology Department, The University of Lahore and were housed in animal house of Riphah Institute of Pharmaceutical Sciences, Riphah International University Lahore. Ethical approval regarding use of animals was obtained from research and ethical committee RIPS-RIU Lahore with protocol no RIU-AEC-109. All the rats were kept in polycarbonate cages (47×34×18 cm) and provided with standard conditions of temperature and neat and clean environment in animal house. The standard conditions of temperature (24 ±1℃), humidity with dark and light cycle (12 h-12 h) and standard animal feed containing choker, chicken feed and dry milk in ratio of 2:2:1, respectively, were provided to rats till the end of study. Saw dust was spread in animal cages and was changed after every 48 hours.

2.7.2 Induction of hyperlipidemia

Hyperlipidemia was induced in rats by single dose of freshly prepared solution of Triton-X-100 (100 mg/kg) in normal saline solution administered by intraperitoneal injection after overnight fasting [19].

2.7.3 Hypolipidemic activity

For evaluation of hypolipidemic activity of plant extracts the albino rats of both sexes having weight 180-200 g were divided into five groups with six animals in each group. Group-I was given standard pellet diet, water and was orally administered with normal saline daily at the dose of 5 ml/kg body weight. Groups II-V received single dose of freshly prepared solution of Triton-X-100 (100 mg/kg) in normal saline solution administered by intraperitoneal injection. After 72 hours of triton injection, Group II received normal saline only while Group III was orally administered with the standard Atorvastatin 10 mg/kg. Group IV and V were orally administered with daily dose of 200 mg/kg of ethanolic extract and aqueous extract of plant respectively [14].

2.7.4 Collection of blood sample

At the end of seven days treatment the animals were kept on overnight fasting and on 8^{th} day blood was collected by cardiac puncture under mild chloroform anesthesia. Blood was poured in centrifuge tube and kept at room temperature. Collected blood samples were centrifuged for 15 minutes at 2500 revolution per minute. With the help of micropipette serum was collected from the centrifuge tube into apandrof tubes. Serum samples were analyzed for biochemical parameters (Total cholesterol, triglycerides, LDL and HDL) with the help of diagnostic kits in Merck microlab [20].

2.7.5 Serum analysis

Serum so collected was then subjected to measure the biochemical parameters to determine Total cholesterol, Triglyceride, Low density lipoproteins (LDL) and High density lipoproteins (HDL) levels. The entire tests were performed by using cholesterol diagnostic kits of Human, Germany. Results were measured by running the samples, reagents blank and standard on the microlab (Merck Microlab Germany).

2.8 Statistical Analysis

Graph Pad Prism version 6 was used for statistical analysis of all collected data results. Values were expressed as mean ± standard error mean with confidence interval of 95%. Two way ANOVA test was applied. All the experimental groups were compared with disease control while disease control group was compared with normal control group. P values <0.05 was considered as significant.

2.9 Acute Toxicity Study

Acute toxicity study was performed to assess safety profile of testing materials. Following protocols were practiced for acute toxicity testing [21].

3. RESULTS

3.1 Solubility Study

Ethanolic and aqueous extracts of plant were dissolved in different solvents at different ratios for oral administration of dose to experimental animal. Following results were obtained for the solubility study of plant extracts.

3.2 Phytochemical Analysis

3.2.1 Phytochemical analysis of ethanolic extract and aqueous extract

Ethanolic extract of *Allium schoenoprasum* and Aqueous extract of *Allium schoenoprasum was* analyzed by phytochemical investigation which confirmed that *Allium schoenoprasum* contains alkaloids, carbohydrates, protein, flavonoids, glycosides, phenols, tannins and steroids. Following outcomes were observed for the phytochemical analysis of *Allium schoenoprasum* extract.

3.3 Effects of Ethanolic and Aqueous Extract of *Allium schoenoprasum* (200 mg/kg) on Serum Cholesterol (mg/dl), Triglyceride (mg/dl), HDL (mg/dl), LDL (mg/dl) and VLDL Levels (mg/dl) in Albino Rats

At the 8th day of study, blood was collected by cardiac puncture under mild chloroform anesthesia. Collected blood sample was kept at room temperature for half an hour to clot. After that collected blood samples were centrifuged at 2500 rpm for 15 minutes. Serum was collected in apandrof tubes and frozen for biochemical parameters. Frozen serum samples were defrosted at room temperature and were analyzed for serum cholesterol, triglyceride, HDL, LDL and VLDL levels (mg/dl) with the help of diagnostic kits (Human, Germany) in Merck Microlab. Two way ANOVA was applied as statistical tool. The results showed that serum total cholesterol level was markedly elevated in disease control group to which Triton X-100 (100 mg/kg) was administered. Standard drug Atorvastatin (10 mg/kg) showed marked reduction in serum cholesterol level. Ethanolic and aqueous extracts of plant at dose of 200 mg/kg showed highly significant (P < .001) reduction in the level of serum cholesterol. Moreover, ethanolic and aqueous extracts of plant (200 mg/kg) showed highly significant (P < .001) reduction in the level of serum triglycerides, significant (P < .01) elevation in the level of HDL and highly significant (p<0.001) reduction in the levels of LDL and VLDL.

4. DISCUSSION

Current study was conducted to scientifically investigate the plant which was being used as antihyperlipidemic medicine on basis of sequential knowledge. For this purpose *Allium schoenoprasum* was selected on folk trend.

The ethanolic and aqueous extracts of *Allium schoenoprasum* were subjected to phytochemical analysis. The plant extract showed the presence of different components as glycosides, alkaloids, carbohydrates, proteins, quinines, terpenoids, steroid and flavonoids. Several phytoconstituents like glycosides, alkaloids, flavonoids, quinones, terpinoids and steroids were responsible for anti-hyperlipidemic properties [14].

Treatment with aqueous and ethanolic extract of *Allium schoenoprasum* for 7 days successfully prevented the elevation of serum Total Cholesterol, Triglycerides, Low Density Lipoproteins (LDL) and very Low Density Lipoproteins (VLDL) and also inhibited the reduction of serum High Density Lipoproteins (HDL) in Triton model rats. Triton induced hyperlipidemia in rats was an acute model for the primary investigation of hypolipidemic agents. Triton actually rendered the alteration of very low density lipoprotein cholesterol to refract their action of lipolytic enzymes of blood and tissues, delaying or inhibiting their removal from blood and tissues [22]. Therefore the antihyperlipidemic effect of *Allium schoenoprasum* administration could be due to an enhanced catabolism of cholesterol into bile acids. Hyperlipidemia is a major health problem in India and other developing countries, which lead to many risk factors like atherosclerosis and stroke etc. Hyperlipidemia provokes the damage in different tissues which on the other hand deregulates the cellular functions leading towards damage and different pathological conditions [23]. Cholesterol is synthesized in all animal tissues. It is important in the stabilization of membrane structures because of its hard planar structure. It is also used as a precursor for the production of steroid hormones. Elevated amount of cholesterol leads to cardiovascular disease mainly coronary heart disease [24].

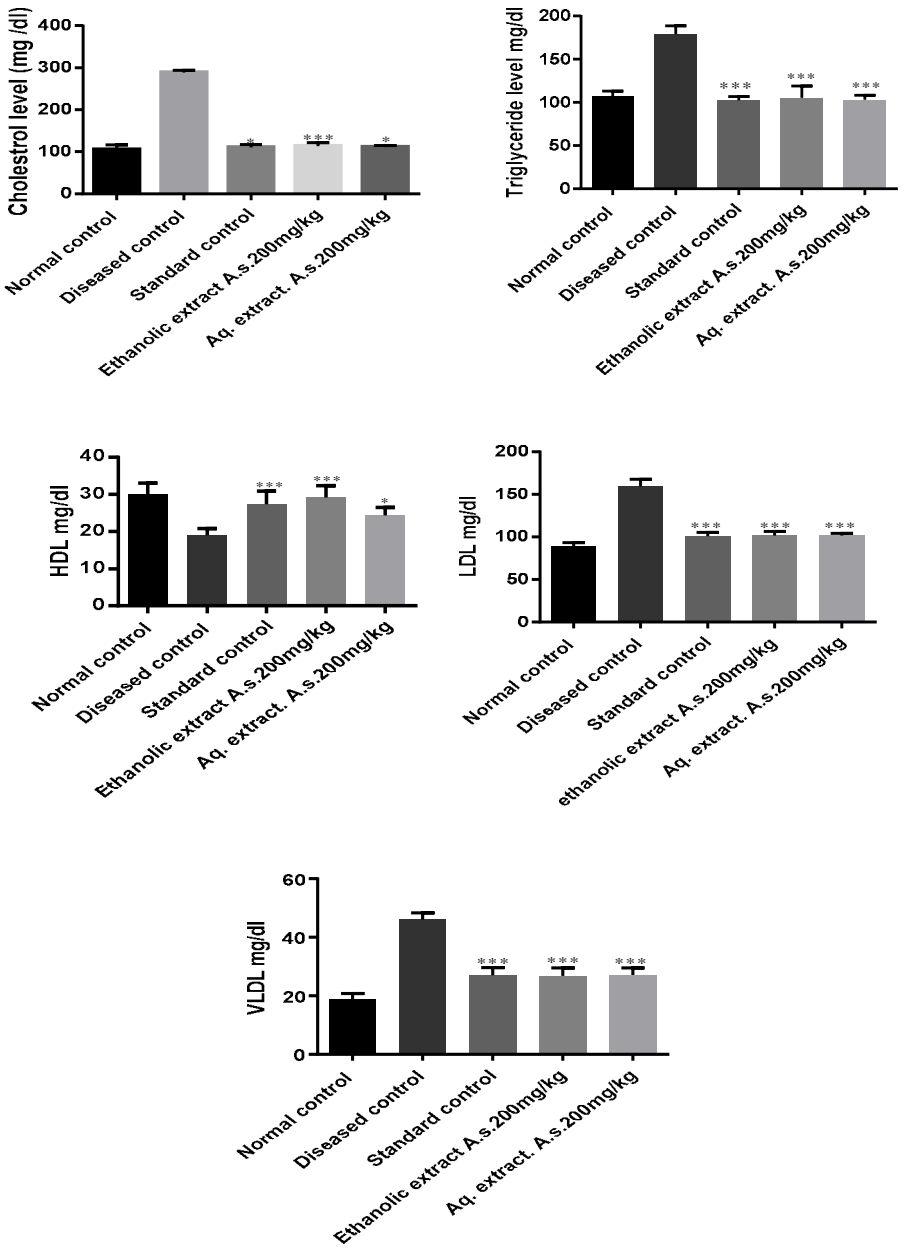

Fig. 1. Effects of ethanolic and aqueous extract of *Allium schoenoprasum* 200 mg/kg on serum cholesterol level (mg/dl)

Note; All values were expressed as Mean ± SEM (n=6) and two way ANOVA test was applied. P values were considered as P ≥ .05 non-significant (^{ns}), P < .05 significant (*), P ≤ .01 more significant (**) and P ≤ .001 highly significant (***)

Table 1. Solubility study of ethanolic and aqueous extracts

Extracts	Solvents			
	Ethanol	Water	0.9% NaCl	DMSO
Ethanolic extract	Yes	Yes	Yes	Yes
Aqueous extract	No	Yes	Yes	Yes

Table 2. Phytochemical analysis results for ethanolic and aqueous extract

Test name	Ethanolic extract of *Allium schoenoprasum*	Aqueous extract of *Allium schoenoprasum*
Alkaloids	Present	Present
Carbohydrates	Present	Present
Flavonoids	Present	Present
Glycosides	Present	Present
Proteins and amino acids	Present	Present
Phenols	Present	Present
Quinones	Present	Present
Saponins	Absent	Absent
Steroids	Present	Present
Tannins	Present	Present
Terpenoids	Absent	Absent

Table 3. Effects of ethanolic and aqueous extract of *Allium schoenoprasum* (200 mg/kg) On serum cholesterol (mg/dl), triglyceride (mg/dl), HDL (mg/dl), LDL (mg/dl) and VLDL levels (mg/dl) in albino rats

No	Groups	Serum cholesterol (mg/dl)	Serum triglycerides (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
1.	Normal control	105±4.5	107±2.6	30±1.2	88±2.0	19±0.8
2.	Diseased control	288±2.2	179±4.0	19±0.73	159±3.5	46±1.1
3.	Standard control	111±2.7*	102±1.8***	27±1.4***	101±1.8***	27± 1.1***
4.	Ethanolic extract of As.200 mg/kg	113±3.3***	105±5.7***	29±1.3***	102±2.0***	27±1.1***
5.	Aqueous extract of As.200 mg/kg	111±2.0*	103± 2.2***	24±0.88*	102±1.1***	27±0.95***

All values were expressed as Mean ± SEM (n=6) and two way ANOVA test was applied. P values were considered as P ≥ .05 non-significant (^{ns}), P < .05 significant (*), P ≤ .01 more significant (**) and P ≤ .001 highly significant (***)

The non-ionic detergent, Triton X-100, has been generally used to block the uptake of triacyl glycerol-rich lipoproteins from plasma by peripheral tissues to generate acute hyperlipidemia in animal models which are mostly used for a number of objectives particularly for investigating natural or chemical hypolipidemic drugs [23]. With this objective the medicinal plants have been assessed for their anti-hyperlipidemic activity against Triton X-100 induced hyperlipidemia. The result demonstrated the possibility of using Triton induced hyperlipidemic rats as an investigational model to study the hypolipidemic effect of herbal extracts. Present study markedly showed that the large elevation in serum levels of cholesterol and triglycerides due to Triton X-100 injection resulted mainly from an elevation of VLDL secretion by the liver accompanied by a strong decrease of VLDL and LDL catabolism. The decline of total cholesterol by the aqueous and ethanolic extract of plant was related with a decrease of its LDL fraction in serum and liver, which was the objective of numerous hypolipidemic drugs. The ratio of LDL-C to HDL-C is also a defending indicator of cardio vascular disease prevalence. The induction of hyperlipidemia by Triton produced a considerable increase of this marker. On the other hand elevated fraction in treated group and Atorvastatin group returned to basal value when the data were compared to the data found in Triton model rats. The drop of plasma total cholesterol was related with a decrease in its LDL fraction which was a major risk factor of cardio vascular disease [25]. Aqueous and ethanolic extracts of *Allium schoenoprasum* showed protective action which was reported to have a preventive function to cardio vascular risk incidence and arthrosclerosis. The lipoprotein called “good cholesterol” helps the transformation of triglycerides and cholesterol from plasma to liver where it is catabolised and eliminated in the form of bile acids. The possible mechanism of the plant extract may be the catabolism and elimination of blood lipids through

enterohepatic tissues. It is recently studied that triglycerides play a major role in the regulation of lipoprotein interaction to carry out normal lipid metabolism. Actually, the elevated plasma TG levels were related with an increased prevalence of coronary artery disease [26]. Furthermore these higher plasma TG levels have been recognized mainly to increase the small, dense LDL deposits which were very atherogenic and leading to atherosclerosis CAD. Ethanolic and aqueous extracts of *Allium schoenoprasum* significantly ($P < .001$) restored the elevated blood concentration of TGs. This result purposed that the extracts were capable to restore the catabolism of TG. The underlying mechanism of activity was not illustrated by current study. However, as hypothesized by numerous works with other plants, the suppression of catabolic mechanism of TGs would be due to an elevated stimulation of the lipolytic activity of Plasma Lipoprotein Lipase (LPL) [27].

It is also essential to have higher plasma HDL and lower LDL to prevent atherogenesis, coronary heart disease and ischemia because there was a positive relationship between an increased LDL/HDL ratio and the development of atherosclerosis [28]. So, the administration of ethanolic and aqueous extracts of *Allium schoenoprasum* extensively suppressed the higher values of LDL/HDL ratio showing the favorable effect of the plant in preventing atherosclerosis occurrence.

Flavonoids were reported to enhance HDL and cause reduction in LDL and VLDL levels in hypercholesteremic rats. Flavonoids and phenols found in the extracts of *Allium schoenoprasum* could therefore be considered favorable in rising HDL and decreasing LDL and VLDL in extract treated rats. VLDL level was markedly ($P < .01$) reduced in treated group as compared to the hyperlipidemic group.

5. CONCLUSION

The results provide some biochemical basis for the use of extracts of *Allium schoenoprasum* as antihyperlipidemic agent having protective and curative effect against hyperlipidemia. Additional studies are required to more insight in to the potential mode of action.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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