Original Article

Comparative Effectiveness of Aloe Vera Gel and Atorvastatin on Serum Triglyceride Induced by High-fat Diet in Rats

Saha TM[1], Sanjida S[2], Mitu SJ[3], Akkas N[4], Naznine RA[5], Sultana D[6], Saha T[7]

Abstract

Background: *Hypertriglyceridemia is a major risk factor for cardiovascular diseases, often induced by high-fat diets. Atorvastatin is a widely used drug to lower lipid levels, but it may cause side effects. Natural alternatives, like Aqueous extract of Aloe vera gel, have an important regulatory impact on serum triglyceride, which may offer similar benefits with fewer risks.*

Objective: *To assess the effectiveness of Aloe vera gel and Atorvastatin on serum triglyceride induced by High-fat Diet in Rats.*

Materials and Methods: *This was an experimental study (animal). It was carried out in the department of Pharmacology and Therapeutics of Sir Salimullah Medical College, Dhaka, in collaboration with the Institute of Nutrition and Food Science (INFS), Dhaka University, from February 2023 to January 2024. A total of 24 healthy adult male rats (Long Evan) were taken, according to inclusion and exclusion criteria, and randomly divided into four groups (n=6 each). Treatments were administered orally for 42 days. Blood samples were collected after overnight fasting, and serum triglyceride levels were determined. The statistical analysis was performed by using SPSS version 26.*

Results: *Rats in the high-fat diet control group showed a significant increase in serum triglyceride levels compared to the normal control group ($p<0.05$). Both Atorvastatin and Aloe vera gel significantly reduced the serum triglyceride levels compared to the high-fat control group. The effect of Aloe vera was comparable to that of Atorvastatin, with no statistically significant difference between the treatment groups.*

Conclusion: *Aloe vera gel significantly reduced serum triglyceride levels induced by high-fat diet rats, showing a comparable effect to Atorvastatin. Aloe vera may be a potential natural alternative.*

Key words: *Aloe vera gel, Atorvastatin, Serum Triglyceride, Rat, High-fat diet*

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1. Dr. Tripti Moni Saha, Assistant Professor, MBBS (DU), MPhil (BSMMU), Department of Pharmacology and Therapeutics, Bikrampur Bhuiyan Medical College, Munshigong.
2. Dr. Siddika Sanjida, MBBS (DU), MD (BSMMU), Assistant Professor, Department of Biochemistry, International Medical College, Tongi, Gazipur.
3. Dr. Sabrin Jahan Mitu, MBBS (DU), MPhil (BSMMU), Assistant Professor, Department of Pharmacology and Therapeutics, Popular Medical College, Dhaka.
4. Dr. Nafisa Akkas, MBBS (RU), MPhil (BSMMU), Lecturer, Department of Pharmacology and Therapeutics, Chittagong Medical College, Chittagong,
5. Dr. Rifat Ara Naznine, MBBS (DU), MPhil (BSMMU), Assistant Professor, Department of Pharmacology and Therapeutics, Shahabuddin Medical College, Dhaka.
6. Dr. Dalia Sultana, MBBS (CMU), MD (BSMMU), Assistant Professor, Department of Biochemistry, Eastern Medical College, Cumilla.
7. Dr. Trishna Saha, MBBS (SUST), MD (BSMMU), Assistant Surgeon, Department of Transfusion Medicine, NIKDU, Dhaka.

Address of Correspondence: Dr. Tripti Moni Saha, MBBS (DU), MPhil (BSMMU), Assistant professor, Department of Pharmacology and Therapeutics, Bikrampur Bhuiyan Medical College, Munshigong.

Introduction

Hypertriglyceridemia is usually a multifactorial disorder; it is becoming common in the medical world, associated with an increased risk of cardiovascular disease and pancreatitis[1]. It typically results from genetic and secondary factors such as obesity, metabolic syndrome, and diabetes mellitus[2]. The prevalence of hypertriglyceridemia has been rising among young and adolescents due to the increasing rate of obesity and DM. Approximately 42% of individuals aged 60 years or older, with about 2% of subjects presenting very high triglyceride levels exceeding >500 mg/dL. The incidence of hypertriglyceridemia is higher among Mexican Americans as compared to white Americans and lowest in African Americans[3].

Atorvastatin is one of the most prescribed drugs for lowering cholesterol and triglyceride levels. It works by inhibiting HMG-CoA reductase, an enzyme involved in cholesterol biosynthesis and has been shown to reduce cardiovascular events in both primary and secondary hypercholesterolemia[4]. However, its long-term use has been associated with adverse effects, including hepatotoxicity, myopathy, and an increased risk of new-onset diabetes[5]. These concerns drew the interest of researchers toward safer and more natural lipid-lowering alternatives.

Aloe vera, a succulent plant, has been used for various medical purposes, including wound healing, anti-inflammatory effects, and gastrointestinal disorders. Recently, it has gained attention for its potential metabolic benefits. Several clinical studies show that Aloe vera contains bioactive compounds such as phytosterols, flavonoids, and poly-saccharides, which may contribute to its hypolipidemic and antioxidant properties[6-7]. Experimental studies demonstrate that Aloe vera gel supplementation can significantly reduce serum triglyceride, total cholesterol, and LDL levels while increasing HDL levels[8].

Considering these facts, the current study was planned to evaluate the comparison between the lipid-lowering effects of Aloe vera gel and Atorvastatin on serum triglyceride levels in a high-fat diet-induced rat model. The ultimate objective was to find the potential natural adjunct or alternative therapy in the management of hypertriglyceridemia. Using an animal model allows for controlled investigation of biochemical changes and provides a foundation for future clinical research.

Materials and Methods:

The study was an experimental study (animal) conducted in the Department of Pharmacology and Therapeutics of Sir Salimullah Medical College, Dhaka, in collaboration with the Institute of Nutrition and Food Science (INFS), Dhaka University, for a period of twelve months from February 2023 to January 2024. The study was conducted among 24 healthy adult male Long Evan rats (weight approximately 180 to 200 grams) and aged 10 to 12 weeks. The rats were purchased from Animal House of Pharmacy, Department of Jahangirnagar University, Savar, Bangladesh. Unhealthy, diseased female rats were excluded.

The rats were housed in the Institute of Nutrition and Food Science at Dhaka University in a different metallic cage under standard laboratory conditions (temperature: 22 ± 2°C, 12-hour light/dark cycle, and relative humidity: 50–60%). The cage was cleaned regularly, and proper hygiene and sanitary measures were ensured and allowed to acclimate for one week before the experiment. All procedures were conducted in accordance with institutional animal ethics guidelines, and ethical clearance was obtained from the Institutional Ethical Committee of Sir Salimullah Medical College (SSMC).

The rats were randomly divided into 4 groups, each group contained six rats (n=6 per group).

Group-A included (Normal Control): Fed standard pellet diet and distilled water ad libitum

Group B (High-Fat Diet Control): Fed high-fat diet (HFD) and distilled water ad libitum

Group C (Aqueous extract of Aloe vera gel treated group): Fed high-fat diet for the first 2 weeks, then received an aqueous extract of Aloe vera gel 300 mg/kg body weight orally along with a high-fat diet and distilled water for the last 4 weeks

Group D (Atorvastatin treated group): Fed high-fat diet for the first two weeks, then received Atorvastatin (10 mg/kg body weight) orally along with a high-fat diet and distilled water for the last four weeks

The high-fat diet was prepared using 40% edible coconut oil and 60% Vanaspati ghee. It was freshly prepared and given daily to the rats in the respective groups. Fresh Aloe vera leaves were collected, washed, and the gel was extracted manually. The gel was homogenized and stored at 8°C. A dose of 300 mg/kg was administered daily via orally.

After completion of 42 days of treatment, rats were fasted for 18 hours before the collection of blood samples. They were given only water ad libitum during the fasting period. All the animals were anesthetized under chloroform anesthesia, and blood samples were collected in previously labeled test tubes. Approximately 3-5 ml of blood from each rat was collected by cardiac puncture. The blood samples were allowed to clot for 30 minutes. After coagulation, the serum was taken to the biochemistry department of Sir Salimullah Medical College by ice box. Then, the serum was separated by centrifugation and transferred to separate test tubes and serum triglyceride (S. TG) levels were determined.

Data was expressed as mean±SD. Statistical comparisons among the groups were performed using One-way ANOVA followed by the Bonferroni test. The statistical analysis was performed by using SPSS version 26. A *p*-value of <0.05 was considered statistically significant.

Results

A total of 24 healthy adult male Long Evan rats were enrolled in this study in four groups. Among them 6 rats enrolled as normal control group (Group-A), 6 rats with hyperlipidemic control group (Group-B), 6 rats with aqueous extract treated group (Group- C) and 6 rats with Atorvastatin treated group (Group-D).

Mean serum TG level was 94.33±1.37 mg/dl in group-A, 136.33±1.51 mg/dl in group-B and 96.17±3.43 & 95.67±0.82 mg/dl in group-C & D, respectively. The mean serum TG levels in group- A, C & D were significantly lower (P<0.001) than in group B. However, the mean values of serum triglyceride levels did not differ significantly (p=1.000) in group C and group D.

Table-I

Comparison of serum triglyceride levels (mg/dl) in rats among different groups after completion of 42-day experiment (n=24)

Variable	Group A (n=6) mean±SD	Group B (n=6) mean±SD	Group C (n=6) mean±SD	Group D (n=6) mean±SD	*p*-value
S. TG(mg/dl)	94.33±1.37	136.33±1.51	96.17±3.43	95.67±0.82	000 (F=606.9)
Group A vs Group B					0.0018
Group A vs Group C					0.962^{ns}
Group A vs Group D					1.000^{ns}
Group B vs Group C					0.00012
Group B vs Group D					0.00021
Group C vs Group D					1.000^{ns}

Note: One-way ANOVA followed by the Bonferroni test was performed to compare between groups. ns= not significant

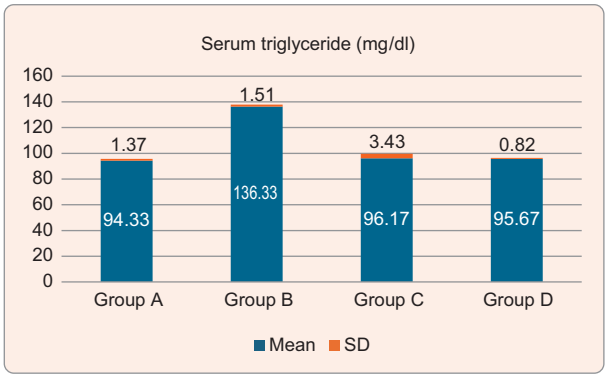

Figure-1: *Bar diagram showing the serum triglyceride level in different groups*

Discussion

This experimental study (animal) was carried out in the department of Pharmacology and Therapeutics, Sir Salimullah Medical college, Dhaka from February 2023 to January 2024, to assess the lipid lowering effect of Aloe vera gel in comparison to Atorvastatin in high-fat diet-induced rats. A total of 24 healthy adult rates were included based on predefined enrollment criteria.

In the present study, the mean value of serum triglyceride (TG) was 94.33±1.37 in group-A and 136.33±1.51 in group-B. It was observed that the hyperlipidemic control group (Group-B) exhibited significantly elevated serum TG levels compared to the normal control group (Group A), confirming the successful induction of hyperlipidemia. The mean value of serum triglyceride was 96.17±3.43 and 95.67±0.82 mg/dl in group-C &D. Treatment with Aloe vera gel (Group C) and Atorvastatin (Group D) resulted in a significant reduction in serum TG levels compared to the hyperlipidemic control group ($p<0.000$). Notably, there were no significant differences in TG levels among Groups C and D, indicating that Aloe vera gel alone was as effective as Atorvastatin in lowering serum triglycerides[8-11]. The triglyceride-lowering effect of Aloe vera may be attributed to its rich content of bioactive compounds, such as phytosterols, saponins, and flavonoids, which have been reported to modulate lipid metabolism, inhibit intestinal absorption of dietary fats, and exert antioxidant effects. Previous studies have supported the lipid-lowering and hepato-protective roles of Aloe vera in hyperlipidemic models, aligning with the present findings[12-16].

Conclusion

Aloe vera gel significantly reduced serum triglyceride levels induced by high-fat diet in rats, showing effects comparable to Atorvastatin. Given its natural origin and lower risk of side effects, Aloe vera may serve as a safe and effective alternative to Atorvastatin for managing hypertriglyceridemia. Its use could be particularly beneficial for individuals who are unable to tolerate statin therapy due to side effects. Further clinical research is needed to confirm these findings in human subjects.

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