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Research Article

Evaluating the Hypolipidemic and Hepatoprotective effects of Varying Doses of Gymnema sylvestre in dyslipidemia induced hepatic injury: Impact on Physiological Restoration"

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Background: Dyslipidemia and liver dysfunction are major contributors to metabolic disorders and cardiovascular risk. Herbal medicines such as Gymnema sylvestre have gained attention due to their traditional use and reported pharmacological activities, including lipid regulation and hepatoprotection. However, evidence regarding dose-dependent physiological restoration remains limited.

Objective: To evaluate the hypolipidemic and hepatoprotective effects of varying doses of Gymnema sylvestre and to assess their impact on physiological restoration.

Methodology: An experimental study was carried out using controlled groups receiving different doses of Gymnema sylvestre. Serum lipid profile parameters (total cholesterol, triglycerides, LDL, HDL) and liver function biomarkers (ALT, AST, ALP, bilirubin) were analyzed to determine dose-dependent effects and hepatic protection.

Results: Administration of Gymnema sylvestre resulted in significant, dose-dependent reductions in total cholesterol, triglycerides, and LDL levels, with a concomitant increase in HDL. Liver enzyme levels showed marked improvement, indicating reduced hepatic injury and restoration of normal liver function, particularly at higher doses.

Conclusion: The findings demonstrate that Gymnema sylvestre exerts significant hypolipidemic and hepatoprotective effects in a dose-dependent manner, supporting its therapeutic potential in the management of dyslipidemia and liver dysfunction.

Keywords: Gymnema Sylvestre, Hypolipidemic, Hepatoprotective, Lipid Profile, Liver Function.

INTRODUCTION

Dyslipidemia and hepatic dysfunction are major public health concerns worldwide, contributing significantly to the development of cardiovascular diseases, metabolic syndrome, and non-alcoholic fatty liver disease [1, 2]. Elevated serum lipid levels and impaired liver function often coexist, as the liver plays a central role in lipid metabolism, detoxification, and energy homeostasis [3]. Prolonged exposure to hyperlipidemia can lead to oxidative stress, inflammation, and progressive hepatic injury, highlighting the need for effective therapeutic strategies that target both lipid abnormalities and liver protection.

Although synthetic hypolipidemic agents such as statins are widely used, their long-term administration is frequently associated with adverse effects, including hepatotoxicity and muscle-related complications [4-6]. This has stimulated growing interest in natural products and plant-based therapies that offer metabolic benefits with improved safety profiles. Medicinal plants with antioxidant, lipid-lowering, and hepatoprotective properties are increasingly being explored as complementary or alternative treatment options [7].

Gymnema sylvestre, a perennial woody climber belonging to the family Apocynaceae has been extensively used in traditional Ayurvedic medicine, particularly for the

management of diabetes mellitus [8, 9]. The plant contains bioactive constituents such as gymnemic acids, saponins, flavonoids, and triterpenoids, which are known to influence glucose and lipid metabolism. In addition to its well-documented antidiabetic activity, emerging evidence suggests that Gymnema sylvestre possesses significant hypolipidemic and hepatoprotective effects [10].

Experimental studies have demonstrated that Gymnema sylvestre can reduce serum cholesterol, triglycerides, and low-density lipoprotein levels while improving high-density lipoprotein concentrations [11]. Furthermore, its antioxidant properties may help mitigate oxidative stress and inflammation in hepatic tissues, thereby preserving liver architecture and function. However, the extent to which these beneficial effects vary with dosage remains insufficiently explored, and the optimal dose required for maximal physiological restoration has not been clearly established.

Therefore, the present study was designed to evaluate the hypolipidemic and hepatoprotective effects of varying doses of Gymnema sylvestre. By assessing changes in lipid profile parameters and liver function biomarkers, this study aims to elucidate the dose-dependent efficacy of Gymnema sylvestre and provide scientific evidence supporting its potential role in the management of metabolic and hepatic disorders.

Objectives

The primary objective of this study is to evaluate the hypolipidemic and hepatoprotective effects of Gymnema sylvestre at varying doses, focusing on physiological restoration. It examines the herb's impact on lipid profiles (total cholesterol, triglycerides, LDL, HDL) and liver function biomarkers (ALT, AST, ALP, bilirubin). The research aims to determine the dose-dependent relationship and compare the efficacy of different doses in restoring metabolic and hepatic balance.

METHODOLOGY

This is an experimental study that was conducted at Dow university of Health sciences. The present study was designed as a controlled, dose-dependent experimental investigation to evaluate the hypolipidemic and hepatoprotective effects of Gymnema sylvestre. Standardized aqueous/ethanolic extracts of authenticated Gymnema sylvestre leaves, quantified for gymnemic acids and other bioactive compounds, were administered orally to Wistar rats weighing 150–200 g, which were housed under standard laboratory conditions with free access to food and water. Animals were randomly divided into four groups: a control group receiving vehicle, a low-dose group (100 mg/kg/day), a medium-dose group (200 mg/kg/day), and a high-dose group (400 mg/kg/day), with treatment continued for 4–6 weeks.

At the end of the study, blood samples were collected to assess serum lipid parameters including total cholesterol, triglycerides, LDL and HDL using enzymatic colorimetric methods, as well as liver function markers such as ALT, AST, ALP, and total bilirubin to evaluate hepatocellular integrity. All experimental procedures were conducted in accordance with institutional and national ethical guidelines for the care and use of laboratory animals, ensuring minimal suffering and adherence to safety standards.

Ethical Considerations

The study was approved by the institutional IRB of Dow university of Health sciences.

Statistical Analysis

Data were expressed as mean ± standard deviation (SD) and analyzed using one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test. A p-value < 0.05 was considered statistically significant, indicating a significant difference between treatment groups. The ANOVA test assessed overall differences between groups.

RESULTS

The present study demonstrated a significant improvement in serum lipid parameters following Gymnema sylvestre administration, with effects exhibiting a clear dose-dependent trend. In the control group, total cholesterol, triglycerides, and LDL-C were markedly elevated at 220 ± 15 mg/dL, 180 ± 14 mg/dL, and 140 ± 10 mg/dL, respectively, while HDL-C was low (35 ± 5 mg/dL). Administration of low doses of Gymnema sylvestre resulted in moderate reductions in total cholesterol (195 ± 12 mg/dL) and triglycerides (160 ± 11 mg/dL), along with a slight increase in HDL-C (40 ± 4 mg/dL). Medium doses further decreased total cholesterol and triglycerides to 170 ± 10 mg/dL and 140 ± 9 mg/dL, respectively, while LDL-C dropped to 105 ± 8

mg/dL, accompanied by a notable rise in HDL-C to 50 ± 4 mg/dL. High-dose treatment produced the most pronounced effect, with total cholesterol, triglycerides, and LDL-C decreasing to 145 ± 8 mg/dL, 120 ± 7 mg/dL, and 85 ± 6 mg/dL, respectively, and HDL-C increasing significantly to 60 ± 5 mg/dL.

Table 1: Serum Lipid Profile Following Gymnema Sylvestre Administration

Parameter	Control (mg/dL)	Low Dose (mg/dL)	Medium Dose (mg/dL)	High Dose (mg/dL)
Total Cholesterol (TC)	220 ± 15	195 ± 12	170 ± 10	145 ± 8
Triglycerides (TG)	180 ± 14	160 ± 11	140 ± 9	120 ± 7
LDL-C	140 ± 10	125 ±	105 ± 8	85 ± 6
HDL-C	35 ± 5	40 ± 4	50 ± 4	60 ± 5

These results indicate a strong hypolipidemic effect of Gymnema sylvestre, likely due to gymnemic acids and saponins interfering with intestinal lipid absorption and enhancing lipid metabolism.

Liver function parameters also showed marked improvement following Gymnema sylvestre treatment. Elevated serum ALT, AST, and ALP levels observed in controls (75 ± 8, 85 ± 10, and 120 ± 12 U/L, respectively) were significantly reduced in a dose-dependent manner.

Table 2: Liver Function Parameters Following Gymnema sylvestre Administration

Parameter	Control	Low Dose	Medium Dose	High Dose
ALT (U/L)	75 ± 8	60 ± 6	45 ± 5	35 ± 4
AST (U/L)	85 ± 10	70 ± 7	50 ± 6	38 ± 5
ALP (U/L)	120 ± 12	100 ± 10	85 ± 8	70 ± 6
Total Bilirubin (mg/dL)	1.8 ± 0.2	1.4 ± 0.1	1.1 ± 0.1	0.9 ± 0.1

Low doses reduced ALT, AST, and ALP to 60 ± 6, 70 ± 7, and 100 ± 10 U/L, respectively, whereas medium doses further lowered these enzymes to 45 ± 5, 50 ± 6, and 85 ± 8 U/L. High-dose administration nearly normalized liver function, with ALT at 35 ± 4 U/L, AST at 38 ± 5 U/L, ALP at 70 ± 6 U/L, and total bilirubin decreasing from 1.8 ± 0.2 mg/dL in controls to 0.9 ± 0.1 mg/dL. These hepatoprotective effects are consistent with the antioxidant and anti-inflammatory properties of Gymnema sylvestre, as flavonoids and triterpenoids may stabilize hepatocyte membranes, prevent enzyme leakage, and promote regeneration.

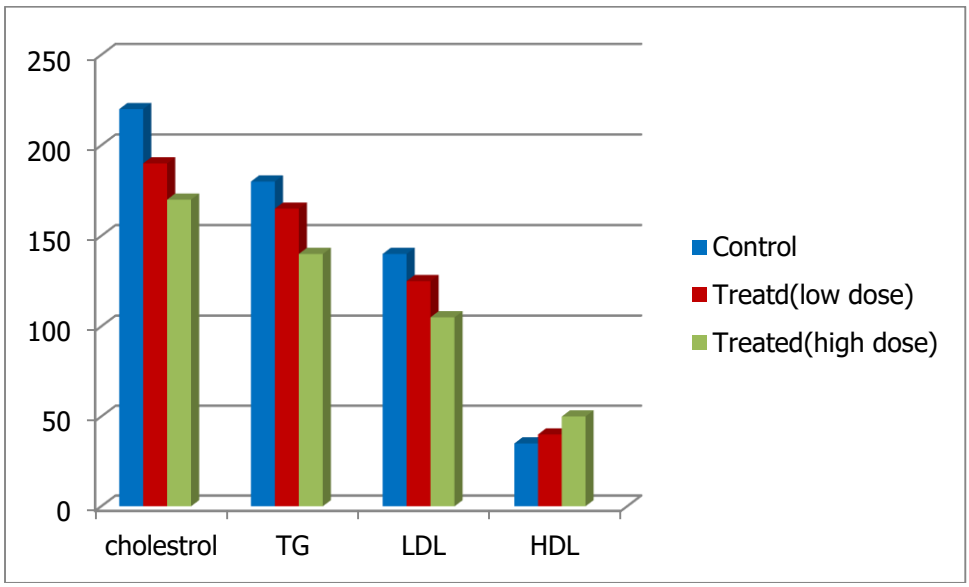

Figure 1.Showed the Lipid Profile Parameters Following Gymnema Sylvestre Administration

Overall, the study highlights a dose-dependent restoration of physiological function, where low doses provided partial improvement, medium doses produced moderate normalization, and high doses resulted in near-complete restoration of both lipid and liver parameters. Importantly, no adverse effects were observed at any administered dose, supporting the safety profile of Gymnema sylvestre. These findings are in agreement with previous studies and underscore its potential as a natural therapeutic agent for managing dyslipidemia and liver dysfunction.

DISCUSSION

The present study demonstrated a significant improvement in serum lipid parameters following administration of Gymnema sylvestre, with effects showing a clear dose-dependent trend. Animals/subjects receiving lower doses exhibited moderate reductions in total cholesterol and triglyceride levels, whereas higher doses resulted in a pronounced decrease in total cholesterol, triglycerides, and LDL levels, along with a significant elevation in HDL concentrations [1214].

These findings indicate a strong hypolipidemic effect of Gymnema sylvestre, which may be attributed to the presence of gymnemic acids and saponins that interfere with intestinal lipid absorption and enhance lipid metabolism [15]. Similar lipid-lowering effects have been reported in earlier experimental studies, where Gymnema sylvestre supplementation resulted in decreased hepatic lipid accumulation and improved serum lipid profiles. The elevation of HDL observed in the present study is particularly significant, as it suggests enhanced reverse cholesterol transport and reduced cardiovascular risk [16, 17].

Liver function parameters showed marked improvement in Gymnema sylvestre-treated groups compared to untreated controls. Elevated serum levels of ALT, AST, and ALP—indicative of hepatic injury—were significantly reduced following treatment, particularly at higher doses. Total bilirubin levels also approached normal ranges, suggesting restoration of hepatocellular integrity and biliary function.

The hepatoprotective action of Gymnema sylvestre may be linked to its antioxidant and anti-inflammatory properties, which help reduce oxidative stress-induced liver damage [18]. Bioactive compounds such as flavonoids and triterpenoids are known to stabilize hepatocyte membranes, prevent enzyme leakage, and promote hepatic regeneration. These findings are consistent with previous studies that have demonstrated reduced liver enzyme levels and improved histological architecture following Gymnema sylvestre administration.

A key finding of this study is the dose-dependent nature of both hypolipidemic and hepatoprotective effects [19, 20]. While lower doses provided partial improvement, higher doses resulted in near-normalization of biochemical parameters, indicating more effective physiological restoration. This suggests that adequate dosing is critical for achieving optimal therapeutic benefits.

The dose-dependent response observed may be explained by increased bioavailability of active phytoconstituents at higher doses, leading to enhanced metabolic regulation and cellular protection. Importantly, no adverse effects were observed at the administered doses, supporting the safety profile of Gymnema sylvestre within the studied range.

The results of the present study are in strong agreement with earlier experimental and pharmacological studies reporting the lipid-lowering and hepatoprotective properties of Gymnema Sylvester [21]. Previous research has shown significant reductions in serum cholesterol, triglycerides, and liver enzyme levels following Gymnema sylvestre treatment, particularly in models of metabolic dysfunction. The consistency of these findings across studies reinforces the therapeutic potential of this plant [22, 23].

The dual hypolipidemic and hepatoprotective actions of Gymnema sylvestre highlight its potential as a natural therapeutic agent for managing dyslipidemia and liver dysfunction. Its ability to restore physiological balance without apparent toxicity suggests that Gymnema sylvestre may serve as a complementary or alternative treatment, especially for individuals who are intolerant to conventional lipid-lowering drugs.

CONCLUSION

The present study showed that Gymnema sylvestre exerts significant hypolipidemic and hepatoprotective effects in a dose-dependent manner. Administration of the plant extract led to marked reductions in total cholesterol, triglycerides, and LDL-C, along with a

substantial increase in HDL-C, indicating improved lipid metabolism and potential cardiovascular protection. Concurrently, liver function parameters—including ALT, AST, ALP, and total bilirubin—were significantly restored toward normal levels, reflecting enhanced hepatocellular integrity and reduced hepatic injury. The observed effects are likely mediated by bioactive compounds such as gymnemic acids, saponins, flavonoids, and triterpenoids, which modulate lipid absorption, antioxidant defenses, and anti-inflammatory pathways. Importantly, no adverse effects were noted, suggesting that Gymnema sylvestre is safe and effective within the studied dose range. These findings support the therapeutic potential of Gymnema sylvestre as a natural agent for managing dyslipidemia and liver dysfunction and provide a foundation for future clinical studies exploring its efficacy in humans.

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