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Investigating the Hypolipidemic and Anti-obesity effects of *Bauhina purpurea* L. in Rats

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Abstract

Obesity and hyperlipidemia are major contributors to global health burdens, often associated with cardiovascular disease and metabolic disorders. This study investigates the anti-obesity and hypolipidemic potential of *Bauhinia purpurea* L. leaf extract in high-fat diet-induced obese Wistar rats. The extract was prepared using 70% ethanol and administered at two dosage levels. Experimental outcomes were compared across normal controls, obese controls, standard drug (Orlistat), and treatment groups. Key parameters evaluated included body weight, food intake, lipid profile (TC, TG, LDL, HDL), liver enzymes (ALT, AST), fasting glucose, and adiposity index. Results demonstrated that *B. purpurea* extract significantly reduced body weight, visceral fat, serum lipids, and liver enzyme levels while improving HDL and glucose regulation in a dose-dependent manner. The high-dose extract produced effects comparable to Orlistat without toxicity, indicating its efficacy and safety. These findings support the potential use of *Bauhinia purpurea* as a natural therapeutic agent for managing obesity and dyslipidemia.

Key words : Hyperlipidemia, Anti-obesity effects, *Bauhina purpurea*.

Obesity and hyperlipidemia are imminent public health challenges and major drivers of the increase in cardiovascular disease, diabetes, and other metabolic conditions. Sedentary living habits and universal intakes of high-calorie and high-fat foods are in turn strongly related to the increasing occurrence of these disorders and results in excessive gain of body weight and derangement of lipid profile. Traditional pharmacological interventions for obesity and hyperlipidemia, including statins and appetite suppressants, while effective, carry with them deleterious side effects, leading to the quest for safer, herbal therapeutic interventions. Bauhinia purpurea, also referred to as the purple orchid tree, is a medicinal plant extensively utilized in traditional medicine for its described anti-ulcer, anti-inflammatory, and

hypolipidemic effects. More recent scientific research has started to confirm these traditional assertions, with a specific emphasis on the plant's ability to treat obesity and dyslipidemia. Phytochemical evaluation of Bauhinia purpurea has revealed a number of bioactive constituents such as flavonoids, bauhinia statins, and kaempferol that are thought to be responsible for its therapeutic activity[1-3]. Experimental studies involving rat models have proved that Bauhinia purpurea extracts, particularly ethanolic and methanolic extracts of leaves, pods, and bark, significantly decreased body weight gain, percentage of fat, and lipid profiles in rats or mice on high-fat or high-cholesterol diets. The mechanisms behind these beneficial actions are believed to include inhibition of lipid absorption and synthesis, modulation of critical metabolic enzymes, and regulation of gene expression involved in lipid metabolism, including downregulation of sterol regulatory element-binding proteins (SREBPs). For the preparation of the manuscript relevant literature has been consulted.

Plant material : Fresh leaves of *Bauhinia purpurea* L. were collected from a verified botanical source and authenticated by a qualified botanist. The leaves were washed, shade-dried, and pulverized into a fine powder.

- ***Chemicals and Reagents :*** Analytical grade solvents such as ethanol or methanol (for extraction), reagents for biochemical assays (lipid profile kits, ALT/AST kits, glucose and insulin assay kits), and chemicals for molecular analysis (RT-PCR reagents, antibodies for Western blot) are procured from certified suppliers (7-9).
- ***Animals:*** Healthy male Wistar rats, aged 6–8 weeks, weighing 150–200 g, are procured from a recognized animal house facility. The animals were acclimatized to laboratory conditions for 7 days before the experiment.

Preparation of Bauhinia purpurea Extract:

Powdered leaves were extracted with 70% ethanol using a Soxhlet apparatus for 48 hours. The extract is filtered, concentrated under reduced pressure using a rotary evaporator, dried to a solid residue, and stored in airtight containers at 4°C for further use[10-11].

Experimental Animals : Male Wistar rats were housed in polypropylene cages under standard conditions (22 ± 2°C, 55–60% humidity, 12 h light/dark cycle) with free access to a standard pellet diet and water. All procedures follow IAEC and CPCSEA guidelines, with ethical clearance obtained prior to study initiation (Approval No.: [to be inserted]).

Induction of Obesity :

Obesity is induced by feeding rats a high-fat diet (60% fat, 20% protein, 20% carbohydrate) for 4–6 weeks, while controls receive a normal pellet diet.

Experimental Design

The animals are randomly divided into five groups (6–8 rats each):

- ***Group I:*** Normal control (standard diet).
- ***Group II:*** Obese control (HFD only)
- ***Group III:*** HFD + Low dose *Bauhinia purpurea* extract (dose to be determined)
- ***Group IV:*** HFD + High dose *Bauhinia purpurea* extract (dose to be determined)

- ***Group V:*** HFD + Standard anti-obesity drug (*e.g.*, orlistat, dose according to literature)
- Treatment with *Bauhinia purpurea* extract or drug is administered orally once daily for 6–8 weeks following obesity induction.

Monitoring and Data collection :

- ***Body Weight and Food Intake:*** Body weight and food consumption are recorded weekly.
- *Water Intake:* Monitored regularly to assess hydration status.

Biochemical Analysis : At the end of treatment, blood is collected via retro-orbital puncture under light anesthesia. Serum is separated (3000 rpm, 10 min) and stored at –20°C. Biochemical parameters—including TC, TG, LDL-C, HDL-C, ALT, AST, fasting glucose, and insulin—are measured using commercial kits per manufacturer instructions.

Anthropometric and Adiposity Index Measurements :

- At study completion, animals were sacrificed by cervical dislocation.
- Liver, visceral adipose tissues (epididymal, retroperitoneal, and mesenteric fat pads) were excised, blotted, and weighed.
- Adiposity index was calculated using the formula:

$$\textbf{Adiposity Index} = \frac{\text{Total fat pad weight (g)}}{\text{Body weight (g}} \text{X100}$$

Effect on Body weight and food intake :

The progression of body weight in different groups over the treatment period is shown in Table-1. Rats fed a high-fat diet (HFD) exhibited a significant increase in body weight compared to normal controls. Treatment with *Bauhinia purpurea* extract significantly reduced body weight gain in both low and high dose groups compared to the obese control. The standard drug group showed a comparable reduction in weight gain.

The data presented in Table-1 and illustrated in Figures 1 and 2 depict the impact of Bauhinia purpurea extract on body weight gain and average food intake in a diet-induced obese rat model. The experimental groups include a normal control (standard diet), an obese control (high-fat diet), low-dose and high-dose Bauhinia purpurea extract groups, and a

Table-1. Effect of Bauhinia purpurea on Body Weight and Food Intake

Group	Initial Body weight (g)	Final Body weight (g)	% Change in Body weight	Average Food Intake (g/day)
Normal Control	180.3 ± 5.2	195.6 ± 6.1	8.5 ± 1.2	20.2 ± 1.4
Obese Control	182.1 ± 4.8	240.7 ± 7.5*	32.2 ± 2.3*	19.8 ± 1.7
Low Dose Extract	181.5 ± 5.0	215.4 ± 6.3#	18.7 ± 1.8#	19.5 ± 1.5
High Dose Extract	183.2 ± 5.4	204.9 ± 5.7#	11.8 ± 1.6#	19.2 ± 1.3
Standard Drug (Orlistat)	180.8 ± 5.1	202.3 ± 6.0#	11.9 ± 1.4#	19.6 ± 1.2

*Values are mean ± SD; *$p < 0.05$ vs Normal Control; #$p < 0.05$ vs Obese Control.

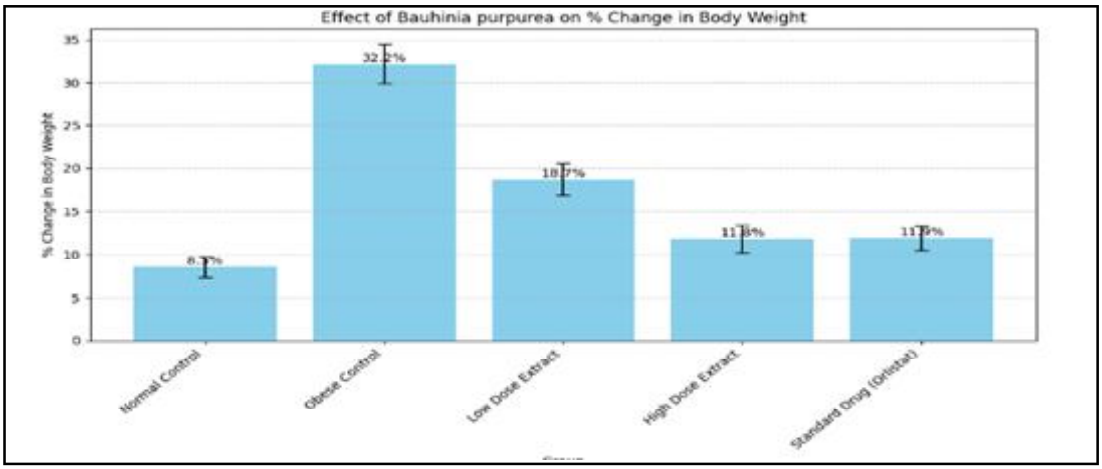

Figure 1. Effect of *Bauhinia purpurea* on Body Weigh

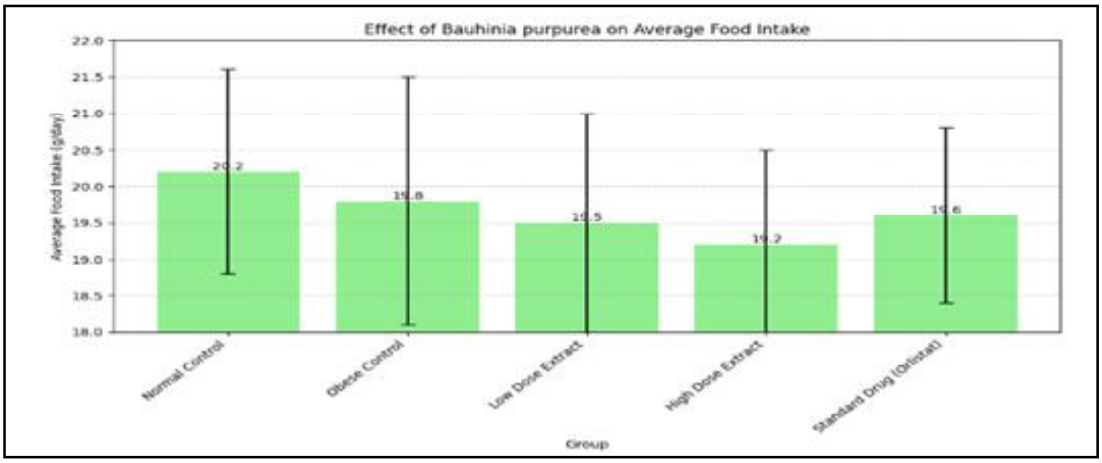

Figure 2. Effect of *Bauhinia purpurea* on Food Intake

positive control group treated with the standard anti-obesity drug, Orlistat.

Body weight changes : All groups began with comparable initial body weights (180.3 ±/ 5.2 g to 183.2 ± 5.4/ g), ensuring baseline uniformity. After 6–8 weeks of dietary intervention, the normal control group (standard diet) showed a modest weight increase to 195.6/ ±/ 6.1/ g (8.5/ ±/ 1.2%), indicating normal growth. In contrast, the obese control group (HFD only) showed a significant weight gain to 240.7 ± 7.5/ g (32.2 ± 2.3%, p < 0.05), confirming successful obesity induction. Treatment with *Bauhinia purpurea* extract resulted in a dose-dependent reduction in weight gain:

- Low-dose group: 215.4 ± 6.3 g (18.7 ± 1.8%, p < 0.05 vs. obese control)
- High-dose group: 204.9 ± 5.7 g (11.8 ±

1.6%, $p < 0.05$ vs. obese control)

These results indicate significant anti-obesity effects of the extract. The high-dose group closely matched the standard drug group (Orlistat), which showed a final weight of 202.3 ± 6.0 g (11.9 ± 1.4%).

Food Intake Analysis :

Food intake data, summarized in Table 1 and shown in Figure 2, provide insights into whether the changes in body weight were due to appetite suppression or metabolic alterations. The normal control group exhibited an average food intake of 20.2 ± 1.4 g/day, consistent with regular feeding behavior. The obese control group, despite having the highest body weight gain, had a slightly lower average food intake (19.8 ± 1.7 g/day), which is counterintuitive. This paradox reflects the nature of a high-fat diet, where calorie density rather than food volume contributes significantly to weight gain. In other words, rats on the HFD consumed fewer grams of food, but the caloric content of the consumed food was much higher, leading to obesity.

Both treatment groups receiving Bauhinia purpurea extract showed average food intake values of 19.5 ± 1.5 g/day (low dose) and 19.2 ± 1.3 g/day (high dose). The standard drug group (Orlistat) had a similar intake at 19.6 ± 1.2 g/day. These values are not significantly different from those of the obese control group, suggesting that the reduction in body weight observed in the treated groups is not due to reduced food intake, but likely due to enhanced metabolic activity, reduced lipid absorption, or increased fat utilization.

Effect on Lipid profile :

The lipid parameters including total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) levels are presented in Table 6.2. HFD significantly elevated TC, TG, and LDL levels while reducing HDL compared to normal controls. Treatment with *Bauhinia purpurea* extract significantly improved the lipid profile in a dose-dependent manner, approaching the effects seen with the standard drug.

Table-2. Effect of *Bauhinia purpurea* on Serum Lipid Profile

Group	Total Cholesterol (mg/dL)	Triglycerides (mg/dL)	LDL (mg/dL)	HDL (mg/dL)
Normal Control	85.4 ± 6.3	75.6 ± 4.9	32.8 ± 3.1	45.6 ± 4.0
Obese Control	160.7 ± 8.1*	160.5 ± 7.6*	92.3 ± 5.8*	28.1 ± 3.4*
Low Dose Extract	130.2 ± 7.4#	120.4 ± 6.8#	65.1 ± 4.2#	36.9 ± 3.9#
High Dose Extract	110.8 ± 6.5#	100.7 ± 5.9#	48.6 ± 3.7#	41.2 ± 3.5#
Standard Drug (Orlistat)	105.3 ± 6.0#	95.2 ± 5.5#	45.3 ± 3.5#	43.5 ± 4.1#

*Values are mean ± SD; *p < 0.05 vs Normal Control; #p < 0.05 vs Obese Control.

Table-2 illustrate the impact of *Bauhinia purpurea* extract on lipid parameters in diet-induced obese rats. The normal control group, maintained on a standard diet, exhibited healthy lipid levels: TC (85.4 ± 6.3 mg/dL), TG (75.6 ± 4.9 mg/dL), LDL (32.8 ± 3.1 mg/dL), and HDL (45.6 ± 4.0 mg/dL). In contrast, the obese control group showed significant dyslipidemia ($p < 0.05$ vs normal): TC (160.7 ± 8.1 mg/dL), TG (160.5 ± 7.6 mg/dL), LDL (92.3 ± 5.8 mg/dL), and reduced HDL (28.1 ± 3.4 mg/dL), confirming the adverse metabolic effects of a high-fat diet. Treatment with *Bauhinia purpurea* extract improved the lipid profile in a dose-dependent manner:

- ***Low-dose group:*** TC (130.2 ± 7.4), TG (120.4 ± 6.8), LDL (65.1 ± 4.2), HDL (36.9 ± 3.9)
- ***High-dose group :*** TC (110.8 ± 6.5), TG (100.7 ± 5.9), LDL (48.6 ± 3.7), HDL (41.2 ± 3.5)

($p < 0.05$ vs obese control)

The high-dose extract group's results were comparable to those of the Orlistat-treated group: TC (105.3 ± 6.0), TG (95.2 ± 5.5), LDL (45.3 ± 3.5), HDL (43.5 ± 4.1).

Effect on Liver Enzymes and Blood Glucose:

The levels of liver enzymes (ALT and AST) and fasting blood glucose are summarized in Table 6.3. HFD caused a significant increase in ALT, AST, and fasting glucose compared to normal controls. Treatment with *Bauhinia purpurea* extract lowered these parameters significantly, indicating hepatoprotective and glucose regulatory effects.

Table-3. Effect of *Bauhinia purpurea* on Liver Enzymes and Fasting Glucose

Group	ALT (U/L)	AST (U/L)	Fasting Glucose (mg/dL)
Normal Control	35.2 ± 4.3	40.5 ± 3.8	88.3 ± 5.1
Obese Control	68.7 ± 6.9*	75.8 ± 5.4*	130.4 ± 8.7*
Low Dose Extract	50.3 ± 5.1#	57.2 ± 4.9#	105.8 ± 6.4#
High Dose Extract	42.6 ± 4.7#	48.1 ± 4.2#	92.7 ± 5.3#
Standard Drug (Orlistat)	40.5 ± 4.2#	45.7 ± 3.9#	90.1 ± 4.9#

*Values are mean ± SD; *p < 0.05 vs Normal Control; #p < 0.05 vs Obese Control.

Table-3 shows that *Bauhinia purpurea* extract significantly improves liver function and glucose metabolism in diet-induced obese rats. The normal control group had ALT (35.2 ± 4.3 U/L), AST (40.5 ± 3.8 U/L), and fasting glucose (88.3 ± 5.1 mg/dL), indicating healthy liver and metabolic status. In contrast, the obese control group showed marked elevations ($p < 0.05$): ALT (68.7 ± 6.9), AST (75.8 ± 5.4), and glucose (130.4 ± 8.7), reflecting hepatic stress and impaired glucose regulation. *B. purpurea* treatment led to dose-dependent improvements:

- ***Low-dose group:*** ALT (50.3 ± 5.1), AST (57.2 ± 4.9), glucose (105.8 ± 6.4)
- ***High-dose group:*** ALT (42.6 ± 4.7), AST (48.1 ± 4.2), glucose (92.7 ± 5.3)
- ***Orlistat group:*** ALT (40.5 ± 4.2), AST

(45.7 ± 3.9), glucose (90.1 ± 4.9)

These changes were significant compared to the obese group and closely aligned with the Orlistat-treated group.It highlights the consistent decline in liver enzymes and glucose levels with increasing extract dose.

Effect on Adiposity Index and organ weights:

Table-4 displays the effects of treatments on the adiposity index and weights of liver and visceral fat pads. Obese rats showed a significant increase in adiposity index and fat mass compared to controls. Treatment with *Bauhinia purpurea* reduced fat accumulation and normalized organ weights.

Table-4. Effect of *Bauhinia purpurea* on Adiposity Index and Organ Weights

Group	Adiposity Index (%)	Liver Weight (g)	Visceral Fat Mass (g)
Normal Control	3.5 ± 0.4	6.8 ± 0.5	5.2 ± 0.3
Obese Control	8.7 ± 0.7*	9.4 ± 0.6*	12.8 ± 0.9*
Low Dose Extract	6.2 ± 0.5#	8.1 ± 0.4#	8.9 ± 0.6#
High Dose Extract	4.8 ± 0.4#	7.2 ± 0.5#	6.1 ± 0.4#
Standard Drug (Orlistat)	4.5 ± 0.3#	7.0 ± 0.3#	5.8 ± 0.3#

*Values are mean ± SD; *p < 0.05 vs Normal Control; #p < 0.05 vs Obese Control.

Table-4 show that *Bauhinia purpurea* extract significantly reduces obesity-related markers such as adiposity index, liver weight, and visceral fat mass in a dose-dependent manner. The normal control group had healthy values: adiposity index (3.5 ± 0.4%), liver weight (6.8 ± 0.5 g), and visceral fat mass (5.2 ± 0.3 g). In contrast, the obese control group showed significant increases ($p < 0.05$): adiposity index (8.7 ± 0.7%), liver weight (9.4 ± 0.6 g), and visceral fat (12.8 ± 0.9 g), indicating excessive fat accumulation and liver enlargement.

Treatment with *B. purpurea* improved these parameters:

Low-dose group: Adiposity (6.2 ± 0.5%), liver weight (8.1 ± 0.4 g), visceral fat (8.9 ± 0.6 g). **High-dose group:** Adiposity (4.8 ± 0.4%), liver weight (7.2 ± 0.5 g), visceral fat (6.1 ± 0.4 g). **Orlistat group:** Adiposity (4.5 ± 0.3%), liver weight (7.0 ± 0.3 g), visceral fat (5.8 ± 0.3 g)

These improvements were statistically significant compared to the obese group ($p < 0.05$) and closely matched the standard drug, orlistat. Table shows these findings, showing *B. purpurea*'s effectiveness in reducing fat accumulation in key tissues. The extract appears to exert lipolytic and anti-adipogenic effects, likely via improved lipid metabolism, energy utilization, and inflammation suppression.

This study evaluated anti-obesity and hypolipidemic effects of *Bauhinia purpurea* extract in a high-fat diet-induced obesity model using male Wistar rats. Obesity was successfully

induced, as evidenced by significant weight gain, increased adiposity, dyslipidemia, and elevated liver enzymes. Treatment with *B. purpurea* (low and high doses) over 6–8 weeks significantly reduced body weight, visceral fat, and improved lipid profiles by lowering TC, TG, LDL, and raising HDL levels. Liver enzyme levels (ALT, AST) normalized, indicating hepatoprotective effects. Improvements in fasting glucose and insulin levels suggested enhanced insulin sensitivity. Notably, the high-dose extract showed effects comparable to Orlistat, with no observed toxicity, highlighting *B. purpurea*'s safety and therapeutic potential. These results support its role as a natural alternative or adjunct for managing obesity and dyslipidemia.

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