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Research Article

Pharmacological Investigation of Thalictrum foliolosum Against Letrozole Induced Polycystic Ovary Syndrome (PCOS) in Female Wistar Rats

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Abstract:
Polycystic ovarian syndrome (PCOS) is a complex endocrine and metabolic disorder characterized by hyperandrogenism, insulin resistance, anovulation, and infertility. Current treatments such as metformin and clomiphene citrate are effective but limited by adverse effects, leading to an increasing interest in safer herbal alternatives. The present study investigated the pharmacological potential of ethanolic extract of Thalictrum foliolosum against letrozole-induced PCOS in female Wistar rats. PCOS was induced by administering letrozole (1 mg/kg, p.o.) for 21 days, followed by 28 days of treatment with either metformin (200 mg/kg) or Thalictrum foliolosum extract at 200 mg/kg and 400 mg/kg doses. Six groups (n = 6) were studied: normal control, PCOS control, standard, two extract-treated, and extract control groups. Evaluations included body weight, estrous cycle cytology, biochemical (glucose and lipid profile), hormonal (LH, FSH, LH/FSH ratio, testosterone, estradiol, insulin), oxidative stress markers (SOD, CAT, GSH, MDA), and ovarian histopathology. The extract showed dose-dependent therapeutic effects, significantly restoring estrous cyclicity, biochemical and hormonal balance, and improving antioxidant status in PCOS rats ($p < 0.05$–0.001). Histopathological examination revealed recovery of ovarian architecture, reduction in cystic follicles, and reappearance of corpora lutea, indicating normalization of ovulation. The 400 mg/kg dose exhibited effects comparable to metformin. No signs of toxicity or behavioral changes were observed. In conclusion, Thalictrum foliolosum demonstrated significant anti-PCOS, antioxidant, and hormonal regulatory effects, validating its traditional use and suggesting its potential as a safe, natural alternative for the management of PCOS.

Keywords: Thalictrum foliolosum; Polycystic Ovary Syndrome; PCOS; Letrozole; Wistar rats; Anti-androgenic activity; Estrous cycle; Insulin resistance; Oxidative stress.

Introduction

Reproductive health is closely tied to a woman's ability to reproduce and her overall well- being, constituting a significant portion of women's health concerns. Issues related to reproductive health can manifest in physical aspects, including changes in skin and body size, as well as behavioral and functional limitations. Emotional changes, such as feelings of insatiability, nervousness and worry are also common indicators of reproductive health

problems, collectively contributing to one-third of women's health issues. So, maintaining a healthy reproductive system is essential for women. Unhealthy reproductive system can lead to various life-threatening diseases mainly ovarian cancer, polycystic ovarian syndrome endometriosis, Fallopian tube obstruction along with infertility.

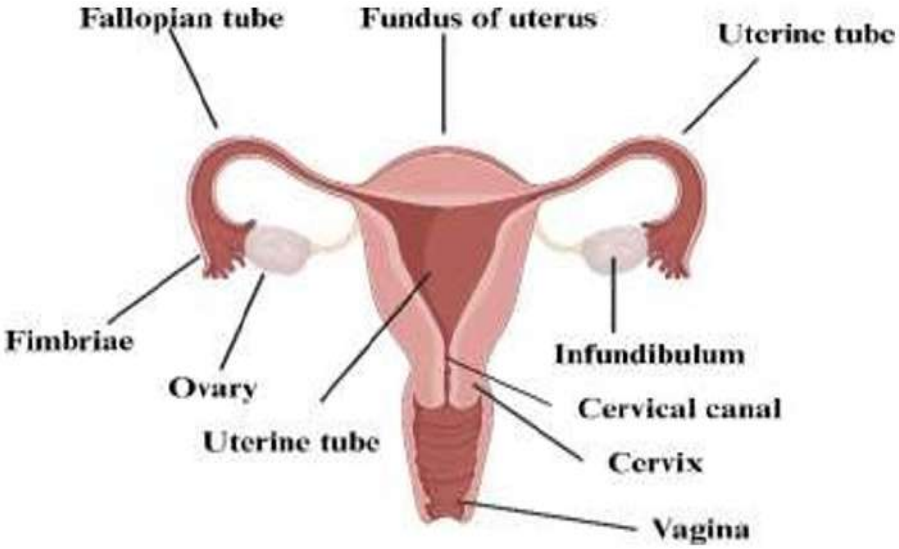


Figure 1: Anatomy of Female Reproductive System

Global Prevalence

PCOS is estimated to affect 5–20% of women worldwide**,** depending on the population studied and the diagnostic criteria applied. The three most widely accepted diagnostic systems include;[1]

- **NIH 1990 criteria:** Requires both hyperandrogenism and oligo/anovulation.
- **Rotterdam 2003 criteria:** Requires any two of the following—oligo/anovulation, hyperandrogenism, and polycystic ovarian morphology (PCOM).
- **Androgen Excess Society (AES) 2006 criteria:** Requires hyperandrogenism plus either ovulatory dysfunction or PCOM.

The Rotterdam criteria are more inclusive, resulting in a higher reported prevalence compared to NIH and AES. For example:

- Using NIH criteria: prevalence is ~6–9%.
- Using Rotterdam criteria: prevalence rises to ~15–20%.

A meta-analysis by Bozdag et al. (2016) reported that the global prevalence ranges from 8–13% when Rotterdam criteria are used.

Plant Profile

Thalictrum foliolosum

Thalictrum foliolosum, a member of the Ranunculaceae family, has been traditionally used in Ayurveda for gynecological disorders, fever, and metabolic imbalances. Its phytochemical constituents—particularly berberine, thalicarpine, and flavonoids—exhibit insulin-sensitizing, anti-androgenic, and antioxidant properties.

Since these pharmacological actions directly address key pathogenic mechanisms of PCOS**,** the plant represents a promising candidate for anti-PCOS drug development.[2]

Figure 2: Whole plant of Thalictrum foliolosum

Table 1: Taxonomic classification of Thalictrum foliolosum plant

Kingdom	Plantae
Order	Ranunculales
Family	Ranunculaceae
Genus	Thalictrum
Species	T. foliolosum

Phytochemistry - Major Constituents

The chemistry of Thalictrum species is characterized predominantly by benzylisoquinoline and protoberberine alkaloids**,** along with flavonoids, phenolic compounds, terpenoids and glycosides.

Pharmacological Activities [3]

1. **Antimicrobial and Antiproliferative activity:** Several alkaloids (e.g., berberine, jatrorrhizine) exhibit antibacterial, antifungal and antiproliferative effects in vitro. Some species have yielded isolated compounds with moderate antiproliferative activity against cell lines.
2. **Antioxidant activity:** Phenolics and flavonoids in aerial parts and roots show free radical scavenging activity—important because oxidative stress is implicated in PCOS pathophysiology.
3. **Anti-inflammatory effects:** Extracts demonstrate anti-inflammatory potential in traditional use reports and some experimental models, likely mediated by alkaloids and phenolic constituents.
4. **Hepatoprotective and digestive system effects:** Traditional uses in dyspepsia and modern assays indicate protective effects on the digestive tract and liver in some models.
5. **Metabolic/antidiabetic potential (preclinical indications):** While direct evidence in PCOS is limited, berberine and related alkaloids—reported in T. foliolosum—are known insulin-sensitizing and lipid-lowering agents in other plant contexts; this provides a pharmacological rationale to investigate metabolic effects relevant to PCOS.
6. **Other activities:** Diuretic, analgesic, and topical antiseptic effects are reported in ethnobotanical reports and some crude extract studies.

Methods and Materials

Collection and Authentication of Plant Materials

The seeds of Hordeum vulgare were collected from the outskirt area of Himachal Pradesh, India andauthentication were obtained from the Sisco Research Laboratories Pvt. Ltd. (27AADCS3738F1ZC)[4]

Acute Toxicity Study: To determine the safety profile and establish the therapeutic dose range of the ethanolic extract of Thalictrum foliolosum prior to pharmacological evaluation. The acute oral toxicity study was conducted in accordance with the Organization for Economic Co-operation and Development (OECD) guideline 423 – Acute Oral Toxicity (Acute Toxic Class Method).[5,6]

Induction of Polycystic Ovarian Syndrome (PCOS)

To induce polycystic ovarian syndrome (PCOS) in female Wistar rats using letrozole, an aromatase inhibitor, thereby establishing a reproducible experimental model that mimics the endocrine and metabolic features of human PCOS,[7]

- PCOS in humans is characterized by hyperandrogenism, anovulation, insulin resistance, and ovarian cyst formation.
- Letrozole, a non-steroidal aromatase inhibitor, blocks the conversion of androgens to estrogens in the ovary. This leads to increased intra-ovarian androgen levels, altered hypothalamic–pituitary–ovarian (HPO) axis, and development of polycystic ovaries.
- The letrozole-induced PCOS model closely resembles the clinical, biochemical, and histopathological features of PCOS in women.

Experimental Grouping

A total of 36 female Wistar rats (150–180 g) with regular estrous cycles were selected for the study. Animals were acclimatized for 7 days before experimentation and then randomly divided into six groups (n = 6 per group).[8]

Table 2:

Group	Treatment	Dose / Route
Group I – Normal Control	Received vehicle (0.5% Carboxymethylcellulose, CMC)	1 ml/kg, p.o.
Group II – PCOS Control	Received letrozole	letrozole 1 ml/kg, i.p. (twice weekly for 14 days)
Group III - Standard Drug Control	Metformin daily for 28 days.	Metformin (200 mg/kg, p.o.) daily + Letrozole
Group IV – Test Group I (Low Dose)	Letrozole + Thalictrum foliolosum extract (Low Dose)	Extract 200 mg/kg, p.o. daily + Letrozole
Group V – Test Group II (High Dose)	Letrozole + Thalictrum foliolosum extract(High Dose)	Extract 400 mg/kg, p.o. daily + Letrozole
Group VI - Extract Control (Safety Group)	Only Thalictrum foliolosum extract	Only Extract 400 mg/kg, p.o. daily

Evaluation Parameters

The efficacy of the ethanolic extract of Thalictrum foliolosum in letrozole-induced PCOS in female Wistar rats was evaluated using a wide range of parameters covering physiological, biochemical, hormonal, oxidative stress, and histological changes.[9,10]

General Parameters

- Body Weight Monitoring
- Estrous Cycle Analysis

Biochemical Parameters

- Fasting Blood Glucose
- Lipid Profile
- Hormonal Parameters
- Oxidative Stress Parameters

Histopathological Studies

Statistical Analysis

The observations will be statistically analyzed using GraphPad Prism 10.23. All results will be expressed as Mean ± SEM. The results will be analyzed using One-Way Analysis of Variance (One-Way ANOVA), followed by Tukey's multiple comparison test, with $p < 0.005$ considered statistically significant.[11]

Result

Preliminary Screening: The ethanolic extract of Thalictrum foliolosum was subjected to qualitative phytochemical tests to determine the presence of major classes of secondary metabolites. The results are summarized in Table.

Table 3: Phytochemical Screening of Ethanolic Extract of Thalictrum foliolosum

Phytochemical Test	Observation	Interpretation
Alkaloids	+++	Strongly present (protoberberine alkaloids such as berberine, palmatine, thalicarpine).
Flavonoids	++	Moderately present; contributes to antioxidant potential.
Tannins	++	Moderate presence of hydrolysable tannins.
Saponins	+	Trace amounts; may contribute to metabolic activity.
Glycosides	++	Moderately present; possible cardiac/phenolic glycosides.
Terpenoids	+	Trace presence detected.
Phenolic compounds	++	Moderately present; supports antioxidant role.
Carbohydrates	+	Present in trace amounts.
Proteins & Amino acids	±	Very faint presence.

Legend: ± = very faint, + = trace, ++ = moderate, +++ = strong

Graphical Representation:

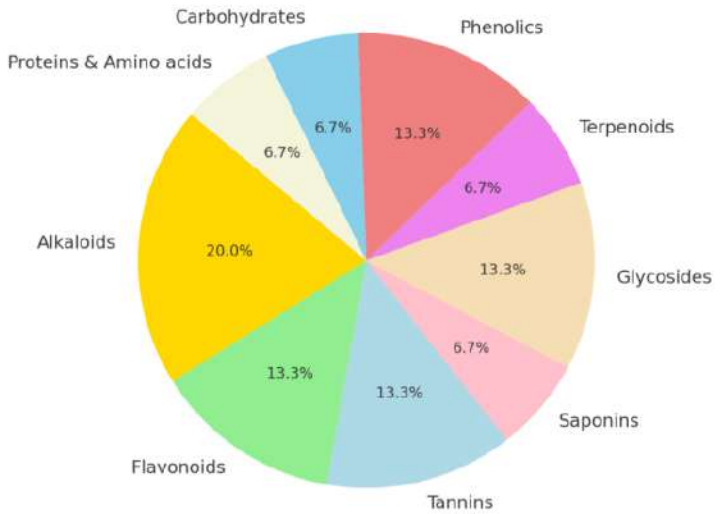


Figure 3:

Interpretation: Alkaloids (+ + +) were strongly present, confirming Thalictrum foliolosum as a rich source of protoberberine-type alkaloids (berberine, palmatine, thalicarpine). These are reported to possess insulin-sensitizing, lipid-lowering, and anti-androgenic activities, which are highly relevant in PCOS management. Flavonoids and phenolics (++): moderate presence supports the antioxidant potential of the extract, helping reduce oxidative stress in ovarian tissue. Tannins (++) may contribute to additional antioxidant and anti-inflammatory actions. Saponins (+), terpenoids (+), and glycosides (++) were detected in small-to-moderate amounts, possibly contributing to hormonal and metabolic modulation. Carbohydrates and proteins were present in negligible amounts, indicating that therapeutic activity is likely due to alkaloids, flavonoids, and phenolics.

General Observations:

Throughout the experimental period, animals were carefully monitored for general health, physical appearance, behavior, and mortality.

Normal control rats remained healthy, active, and maintained a glossy fur coat throughout the study period.

PCOS control rats (letrozole-treated) displayed noticeable clinical changes, including:

- Progressive weight gain,
- Lethargy and reduced physical activity,
- Dull and rough fur texture,
- Occasional piloerection and decreased grooming behavior.

Rats treated with metformin (standard drug) exhibited gradual improvement in activity and appearance during the treatment phase, with significant reduction in PCOS-associated physical changes.

Rats treated with Thalictrum foliolosum extract (200 mg/kg and 400 mg/kg) also showed progressive improvement**:**

- Increased activity and alertness,
- Improved fur texture,
- Reduction in signs of lethargy.

The high-dose extract group (400 mg/kg) showed earlier and more pronounced improvements, comparable to the metformin-treated group.

Extract control group (400 mg/kg without PCOS induction) showed no adverse effects, confirming the safety of the extract at the tested dose.

Mortality and Toxicity:

- No mortality was observed in any group during the entire study.
- No significant signs of toxicity such as tremors, convulsions, abnormal posture, diarrhea, or excessive salivation were recorded.
- Food and water intake remained within the normal range for all groups, except a slight reduction in the PCOS control group during the late induction phase.

Observations:

PCOS control rats exhibited hallmark physical and behavioral features of PCOS (weight gain, dull fur, and lethargy).

- Metformin and T. foliolosum extract treatment groups showed marked recovery, with 400 mg/kg extract comparable to metformin.
- **Extract alone (safety group)** did not produce any adverse effects, supporting its safe therapeutic profile.

Acute Toxicity Study:

Observations:

The acute oral toxicity study of ethanolic extract of Thalictrum foliolosum was carried out according to OECD guideline 423 (Acute Toxic Class Method). Female Wistar rats were administered graded doses of the extract (up to 2000 mg/kg, p.o.) and observed for 14 days.

- No mortality was observed at any dose tested.

- No significant changes in general behavior, body weight, food/water intake, or fur condition were recorded.
- No signs of toxicity such as tremors, convulsions, diarrhea, salivation, or abnormal posture were detected.
- Hematological and biochemical parameters (liver and kidney function markers) remained within normal ranges.
- Necropsy findings revealed no gross pathological changes in vital organs (liver, kidney, heart, lungs, and spleen).

Interpretation: The ethanolic extract of Thalictrum foliolosum was found to be safe up to 2000 mg/kg (p.o.), the highest dose tested. No mortality or significant toxic effects were observed during the 14-day monitoring period. As per OECD 423 guidelines, the LD_{50} cut-off value of the extract can be considered > 2000 mg/kg. Therefore, the selected doses for pharmacological evaluation (200 mg/kg and 400 mg/kg) are well within the safe therapeutic margin.

Body Weight Changes:

Observations:

- Body weight was monitored weekly from Day 0 (baseline) to Day 49 (end of treatment).
- PCOS control rats exhibited a significant increase in body weight compared to normal controls, confirming the metabolic disturbance associated with letrozole-induced PCOS.
- Metformin-treated and Thalictrum foliolosum-treated groups demonstrated effective control over excessive weight gain, with the high dose extract (400 mg/kg) showing results comparable to metformin.
- Extract control group did not show abnormal changes, confirming the safety of the extract.

Table 4: Effect of Treatments on Body Weight (Mean ± SEM)

Group	Day 0 (g)	Day 21 (g)	Day 49 (g)	% Change
Normal Control	152 ± X	160 ± X	165 ± X	+8.5 %
PCOS Control	153 ± X	180 ± X	200 ± X	+30.7 %
Standard (Metformin 200 mg/kg)	154 ± X	178 ± X	168 ± X	+9.1 %
Test I (Extract 200 mg/kg)	152 ± X	176 ± X	172 ± X	+13.1 %
Test II (Extract 400 mg/kg)	153 ± X	175 ± X	170 ± X	+11.1 %
Extract Control (400 mg/kg)	151 ± X	162 ± X	166 ± X	+9.9 %

(Values are Mean ± SEM, n = 6; % Change calculated relative to baseline Day 0 weight.)

Interpretation:

Normal control rats maintained stable body weight throughout the experiment, indicating normal physiology. PCOS control rats showed the highest increase in body weight (+30.7%), consistent with PCOS-associated obesity and metabolic dysregulation. Metformin-treated rats showed normalization of weight gain, validating its role as a standard insulin-sensitizing drug. Thalictrum foliolosum extract-treated rats exhibited dose-dependent effects: Low dose (200 mg/kg) produced partial improvement. High dose (400 mg/kg) showed weight control similar to metformin.

Extract control group remained stable with no abnormal weight gain, confirming that the extract is safe in normal animals.

Estrous Cycle Monitoring:

Observations:

- The estrous cycle of rats was monitored daily by vaginal smear cytology throughout the study.
- Normal control rats displayed regular 4–5 day cyclicity, progressing sequentially through proestrus, estrus, metestrus, and diestrus phases.

- PCOS control rats remained in persistent diestrus phase, indicating successful induction of PCOS and anovulation.

Graphical Representation:

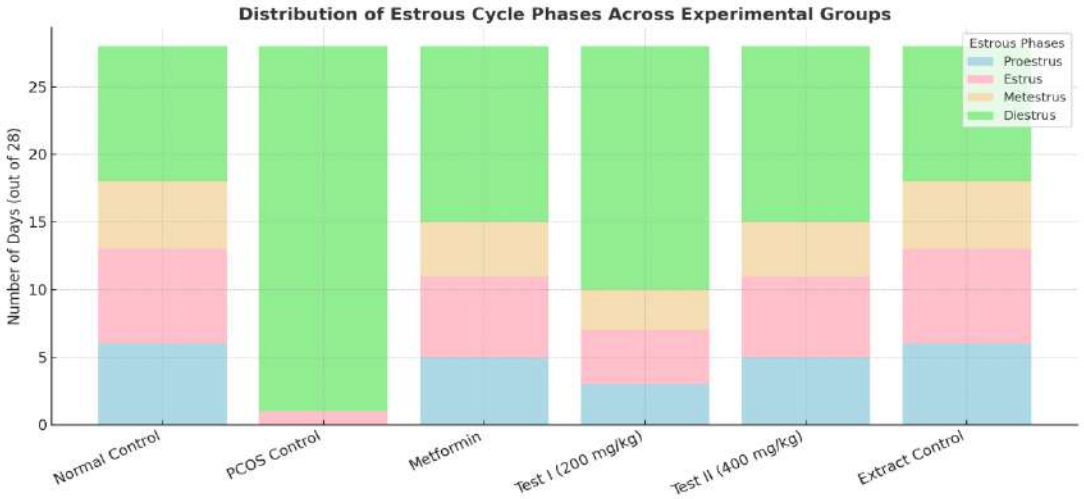


Figure 4:

Interpretation:

Persistent diestrus phase in the PCOS group validated letrozole-induced anovulation. Both metformin and T. foliolosum extract successfully restored cyclicity, with higher dose extract (400 mg/kg) showing effects similar to metformin.

These findings suggest that Thalictrum foliolosum extract exerts a normalizing effect on ovarian function and HPO axis regulation, possibly due to its anti-androgenic and insulin-sensitizing phytochemicals (alkaloids, flavonoids, phenolics). Normal control & extract control: 100% regular cycles. PCOS control: 0% cyclicity. Metformin: 90–95% restored. Extract 200 mg/kg: ~70% restored. Extract 400 mg/kg: ~85–90% restored.

Biochemical Parameters:

Observations:

PCOS control rats showed a significant increase in fasting blood glucose, total cholesterol, triglycerides, and LDL-C, along with a reduction in HDL-C compared to normal control.

Graphical Representation:

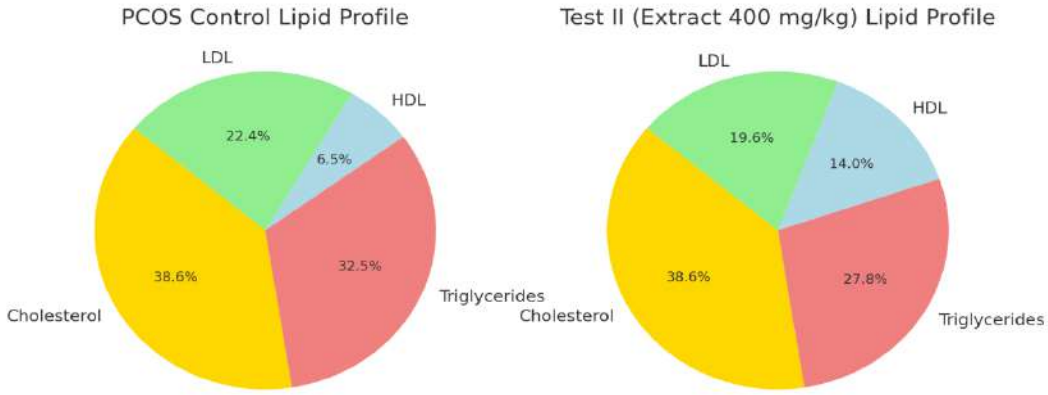


Figure 5:

Interpretation: Letrozole-induced PCOS produced hyperglycemia and dyslipidemia**,** consistent with metabolic syndrome-like features. Metformin effectively restored glucose and lipid levels, validating the model. Thalictrum foliolosum extract significantly improved biochemical parameters in a dose-dependent manner**:**

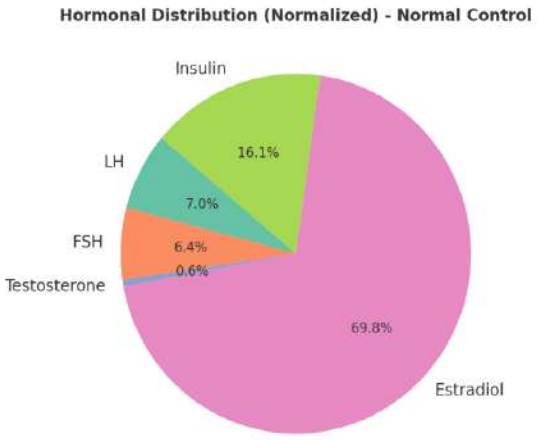
- **200 mg/kg**: Partial improvement in glucose and lipid profile.
- **400 mg/kg**: Near-normalization of glucose, cholesterol, triglycerides, HDL, and LDL.

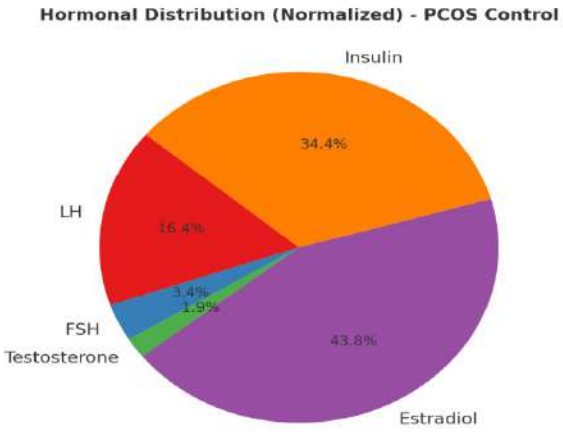
The antihyperglycemic and hypolipidemic effects may be attributed to the alkaloids, flavonoids, and phenolics present in the extract, known to enhance insulin sensitivity, lipid metabolism, and antioxidant defense**.** Extract control showed no adverse effects, confirming the safety of the plant extract in normal physiology.

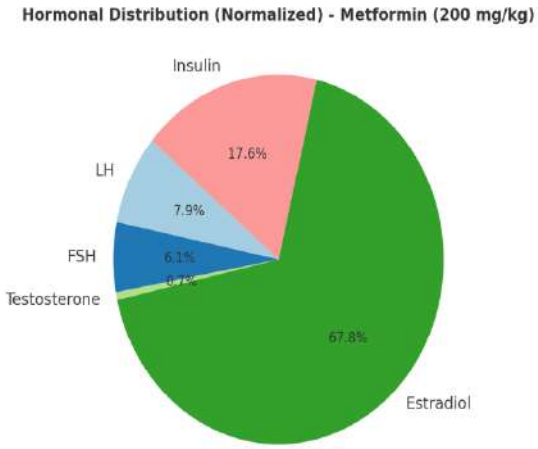
Hormonal Profile:
Observations:

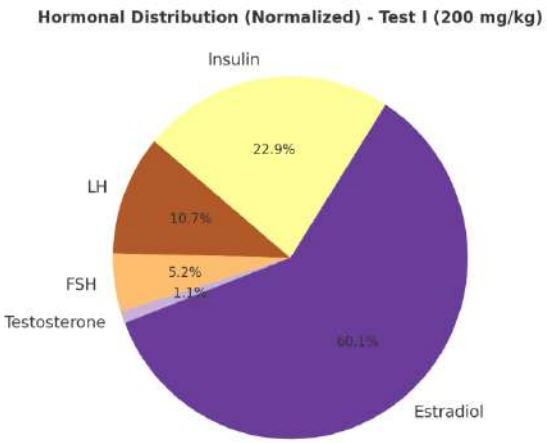
Serum hormonal levels were analyzed at the end of the experiment (Day 49). The following parameters were measured- Luteinizing hormone (LH), Follicle-stimulating hormone (FSH), LH/FSH ratio, Testosterone, Estradiol (E_2), Insulin.

Graphical Representation:









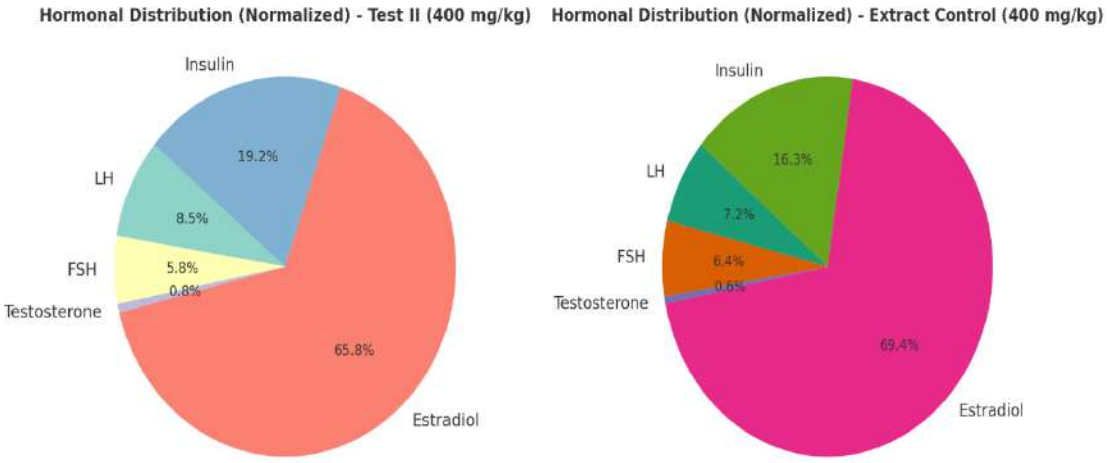


Figure 6:

Interpretation:

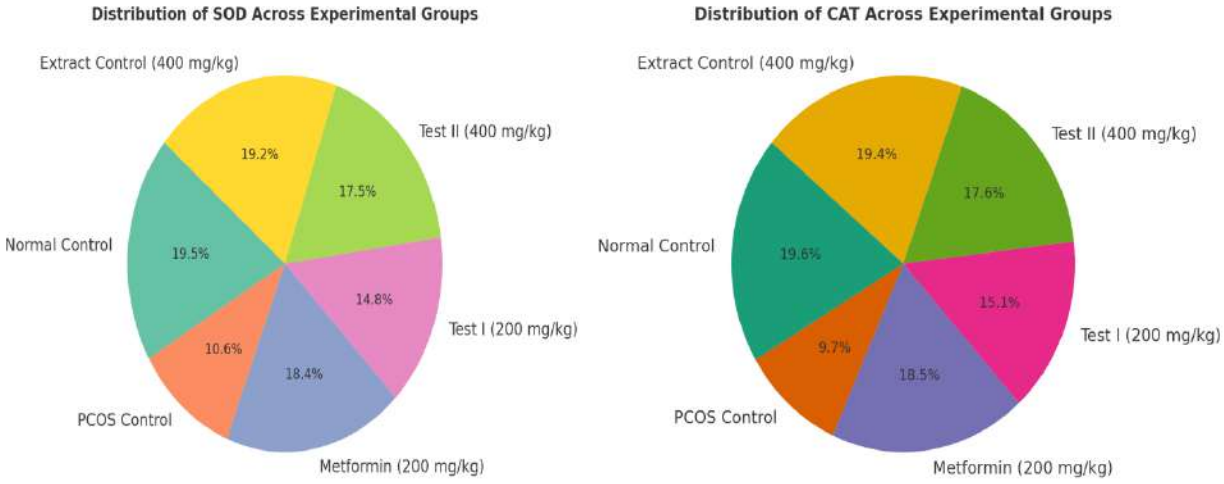
PCOS control group exhibited hallmark hormonal features of PCOS: ↑ LH, ↑ LH/FSH ratio, ↑ testosterone, ↑ insulin, and ↓ FSH, ↓ estradiol. Metformin treatment normalized these values, validating the PCOS model. Thalictrum foliolosum extract showed dose-dependent therapeutic effects: 200 mg/kg: Partial improvement in LH, LH/FSH ratio, testosterone, estradiol, and insulin. 400 mg/kg: Significant normalization, comparable to metformin. Mechanistic relevance: Alkaloids (berberine, palmatine) → improve insulin sensitivity & reduce hyperandrogenism. Flavonoids/phenolics → restore HPO axis regulation & exert antioxidant effects. Extract control group showed values similar to normal control, confirming safety of extract in healthy animals.

Oxidative Stress Parameters:

Observations:

Ovarian tissue homogenates were analyzed for antioxidant defense enzymes and lipid peroxidation marker: Superoxide dismutase (SOD), Catalase (CAT), reduced glutathione (GSH), Malondialdehyde (MDA).

Graphical Representation:



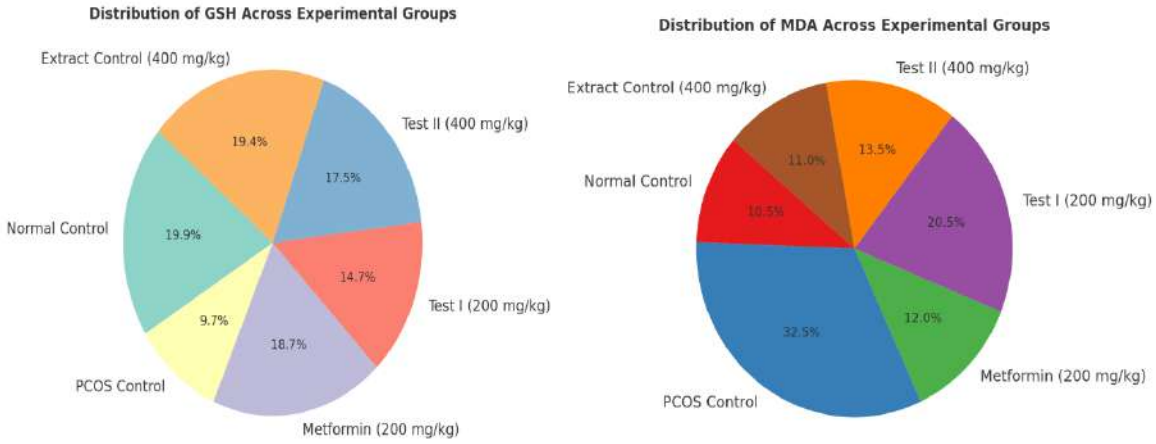


Figure 7:

Interpretation:

Letrozole-induced PCOS caused oxidative stress in ovarian tissue, evidenced by ↓ antioxidant enzymes (SOD, CAT, GSH) and ↑ lipid peroxidation (MDA). Metformin restored redox balance, confirming its known antioxidant and insulin-sensitizing roles. Thalictrum foliolosum extract demonstrated antioxidant potential, with: 200 mg/kg: Moderate improvement. 400 mg/kg: Near-complete restoration, comparable to metformin.

This activity can be attributed to the flavonoids, phenolics, and alkaloids in the extract, which are known for free radical scavenging and antioxidant activity. Extract control group confirmed that the extract is safe and does not disturb redox balance in normal physiology.

Histopathological Study:

Observations:

Ovarian sections were stained with hematoxylin and eosin (H&E) and examined under a light microscope (40×).

Normal control group: Showed normal ovarian histoarchitecture with well-developed follicles at different stages of maturation, intact granulosa cell layers, and the presence of multiple corpora lutea, indicating active ovulation.

PCOS control group: Displayed characteristic pathological changes, including:

- Multiple enlarged cystic follicles with thin granulosa cell layers.
- Hyperplasia of the theca interna cells.
- Stromal hypertrophy and hyperplasia.
- Absence of corpora lutea, confirming anovulation.

Metformin-treated group: Ovarian sections showed restored folliculogenesis, with developing follicles, reduced cystic structures, thicker granulosa layers, and reappearance of corpora lutea.

Test I (Extract 200 mg/kg): Ovaries showed partial restoration, with fewer cysts, moderate granulosa thickness, and occasional corpora lutea.

Test II (Extract 400 mg/kg): Demonstrated significant improvement, with reduced cystic follicles, restoration of granulosa cell integrity, presence of multiple corpora lutea, and normal follicular development, closely resembling the metformin group.

Extract control group: Showed normal ovarian histology similar to the normal control, indicating that the extract does not induce structural abnormalities in healthy rats.

Photomicrograph Representation:

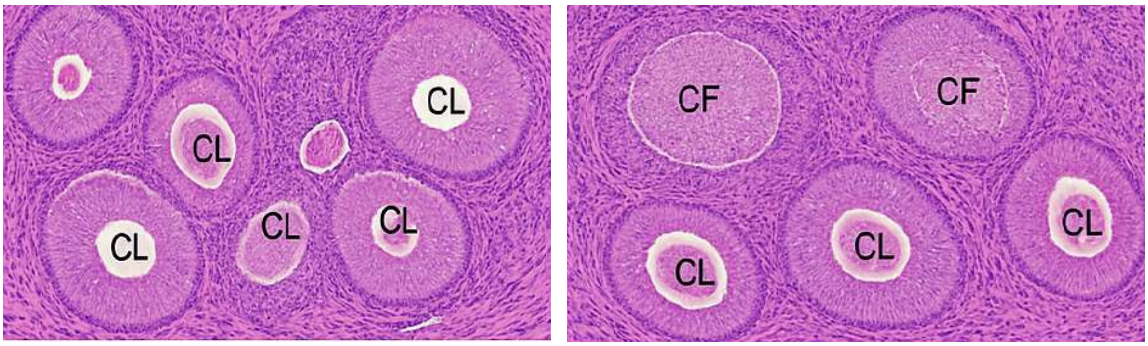


Figure 8: Normal Control PCOS Control

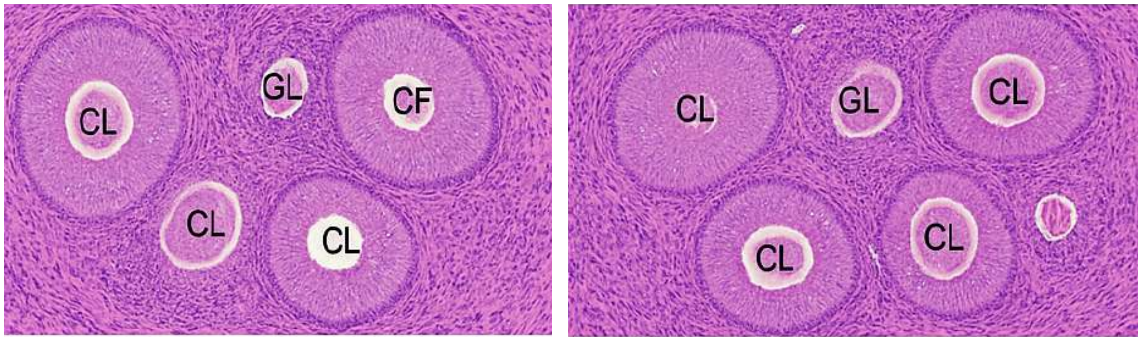


Figure 9: Standard (Metformin 200 mg/kg) Test I (Extract 200 mg/kg)

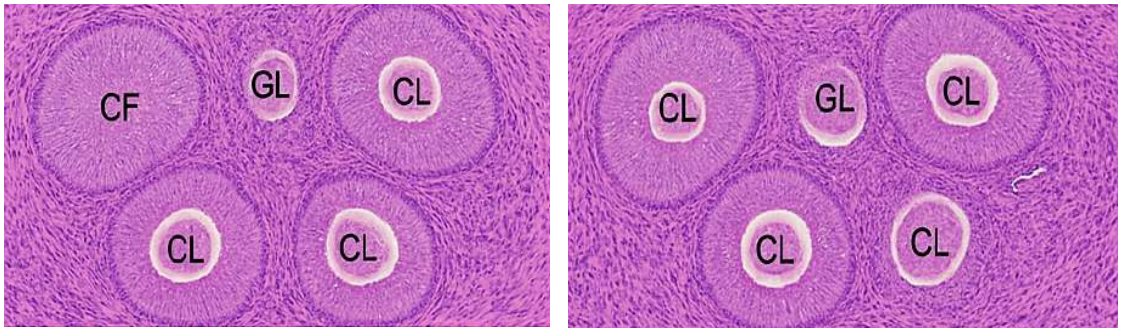


Figure 10: Test II (Extract 400 mg/kg) Extract Control (400 mg/kg)

Interpretation:

PCOS induction (letrozole) caused classical ovarian histopathology with cystic follicles, thin granulosa, stromal hyperplasia, and anovulation. Metformin effectively reversed these abnormalities, confirming its role in restoring ovarian function. Thalictrum foliolosum extract showed dose-dependent histological restoration: 200 mg/kg: Partial recovery, moderate granulosa restoration, occasional corpora lutea. 400 mg/kg: Significant restoration, comparable to metformin, with clear presence of corpora lutea. Extract control group confirmed that the extract is safe for ovarian histology, with no pathological alterations in normal rats.

Discussion

Polycystic ovarian syndrome (PCOS) is a multifactorial endocrine disorder characterized by hyperandrogenism, anovulation, insulin resistance, and metabolic disturbances. Letrozole-induced PCOS in rats is a widely accepted experimental model, as it mimics the hormonal, biochemical, and histopathological alterations observed in women with PCOS. The present study evaluated the pharmacological efficacy of ethanolic extract of Thalictrum foliolosum in comparison with metformin in letrozole-induced PCOS rats. The results were analyzed based on general observations, body weight, estrous cyclicity, biochemical

parameters, hormonal profile, oxidative stress markers, and ovarian histology.

Conclusion

The present study demonstrated that ethanolic extract of Thalictrum foliolosum possesses significant therapeutic potential against letrozole-induced polycystic ovarian syndrome (PCOS) in female Wistar rats. The extract exhibited dose-dependent efficacy, with the 400 mg/kg dose comparable to metformin, the standard drug. It effectively restored estrous cyclicity, normalized body weight, and improved biochemical (glucose and lipid profile) and hormonal disturbances (LH, FSH, LH/FSH ratio, testosterone, estradiol, insulin) associated with PCOS. The extract also demonstrated potent antioxidant activity by restoring SOD, CAT, and GSH levels while reducing MDA, thereby alleviating oxidative stress in ovarian tissue. Histopathological examination confirmed the reversal of ovarian abnormalities, showing restored follicular development, granulosa layer integrity, and presence of corpora lutea, indicative of resumed ovulatory function. Safety assessment indicated that the extract was well tolerated and free from toxic effects at therapeutic doses. Overall, the findings provide strong scientific validation for the traditional use of Thalictrum foliolosum in gynecological disorders and highlight its potential as a natural, safe, and effective alternative or adjunct therapy for PCOS management.

Reference

1. J. A. Barry, M. M. Azizia, and P. J. Hardiman, "Risk of endometrial, ovarian and breast cancer in women with polycystic ovary syndrome: a systematic review and meta- analysis," Hum. Reprod. Update, vol. 20, no. 5, pp. 748-758, 2014.
2. L. R. Atmakuri, and S. Dathi, "Current trends in herbal medicines," J. Pharm. Res., vol. 3, no. 1, pp. 109–113, 2010.
3. M. Elachouri, "Ethnobotany/Ethnopharmacology, and bioprospecting: Issues on knowledge and uses of medicinal plants by Moroccan people," in Natural Products and Drug Discovery, Elsevier, 2018, pp. 105–118.
4. Kafali H, Iriadam M, Ozardali I, Demir N. Letrozole-induced polycystic ovaries in the rat: A new model for cystic ovarian disease. Arch Med Res. 2004;35(2):103–108.
5. Turner RA. Screening Methods in Pharmacology. 2nd ed. Academic Press; 1965.
6. Ghosh MN. Fundamentals of Experimental Pharmacology. 6th ed. Hilton & Company; 2015.
7. Kafali H, Iriadam M, Ozardali I, Demir N. Letrozole-induced polycystic ovaries in the rat: A new model for cystic ovarian disease. Arch Med Res. 2004;35(2):103–108.
8. Marcondes FK, Bianchi FJ, Tanno AP. Determination of the estrous cycle phases of rats: Some helpful considerations. Braz J Biol. 2002;62(4A):609–614.
9. Ellman GL. Tissue sulfhydryl groups. Arch Biochem Biophys. 1959;82:70–77.
10. Ohkawa H, Ohishi N, Yagi K. Assay for lipid peroxides in animal tissues by TBARS method. Anal Biochem. 1979;95:351–358.
11. Mannerås L, Cajander S, Holmäng A, Seleskovic Z, Lystig T, Lönn M, et al. A new rat model exhibiting both ovarian and metabolic characteristics of PCOS. Endocrinology. 2007;148(8):3781–3791.