

Herbal Remedies In Management Of Polycystic Ovary Syndrome (Pcos): Mechanisms, Clinical Evidence, And Future Perspectives: A Review

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ABSTRACT:

Polycystic ovary syndrome (PCOS) is a multifactorial endocrine disorder that affects 6- 20% of women of reproductive age worldwide. It is characterized by hyperandrogenism, ovulatory dysfunction, and metabolic abnormalities such as insulin resistance and dyslipidemia. Standard pharmacological therapies, including oral contraceptives, metformin, and anti-androgenic drugs, often provide symptomatic relief but are associated with adverse effects and do not address the long-term metabolic and reproductive complications of PCOD. In recent years, herbal remedies have gained interest as potential complementary and alternative interventions. Medicinal plants such as vitex agnus-castus (chasteberry), Trigonella foenum-graecum (fenugreek), Nigella sativa (black seed), Cinnamomum verum (cinnamon), and Curcuma longa (turmeric) have shown beneficial effects in experimental and clinical studies. Their mechanisms include improving insulin sensitivity, modulating androgen levels, restoring menstrual cyclicity, reducing inflammation, and promoting fertility.

KEY WORDS: Polycystic ovary syndrome (PCOD), herbal medicine, phytotherapy, insulin resistance, reproductive health

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a widely recognized endocrine and metabolic disorder that affects a substantial proportion of women during their reproductive years. Its global prevalence is estimated to range from 6% to 20%, depending on the clinical and diagnostic criteria applied across populations [1,2]. PCOS is not a single-dimensional condition; rather, it is a complex syndrome characterized by reproductive disturbances such as ovulatory dysfunction and menstrual irregularities, metabolic abnormalities including insulin resistance and obesity, and dermatological manifestations such as hirsutism and acne. These clinical features are accompanied by an increased long-term risk of developing type 2 diabetes mellitus, dyslipidemia, hypertension, and cardiovascular diseases [3].

Beyond the physical symptoms, many women struggle with emotional and psychological burdens, including reduced self-esteem and anxiety related to infertility and appearance, which negatively affect their overall quality of life [4].

The etiology of PCOS is multifactorial and remains an area of ongoing research. Current evidence suggests that a combination of genetic susceptibility, hormonal imbalances, and environmental influences contributes to the development and progression of the disorder. Insulin resistance, which is seen in a majority of women with PCOS, plays a pivotal role in its pathophysiology. Elevated insulin levels enhance androgen synthesis in ovarian theca cells, aggravating hyperandrogenism and its downstream effects, such as anovulation and metabolic disturbances [5]. This persistent interaction between hyperinsulinemia and androgen excess creates a self-perpetuating cycle that complicates both diagnosis and long-term management.

Conventional treatment strategies for PCOS primarily aim to relieve symptoms and manage associated metabolic risks rather than provide a cure. Lifestyle interventions, including weight management, dietary modification, and physical activity, remain the cornerstone of therapy. Pharmacological options such as combined oral contraceptives help regulate menstrual cycles, anti-androgenic agents reduce hirsutism and acne, and insulin-sensitizing drugs like metformin improve glucose metabolism. However, these therapies are not without limitations. Many women experience adverse effects, incomplete symptom relief, or limited improvement in hormonal and metabolic imbalances, underscoring the need for more holistic and individualized treatment approaches [6, 7].

In recent years, interest in the use of herbal and phytotherapeutic interventions has grown significantly as women increasingly seek natural, complementary, or integrative options for managing PCOS. Traditional medicinal plants have historically been used to regulate menstruation, enhance fertility, reduce androgen-related symptoms, and improve metabolic health [8]. Several herbs including *Vitex agnus-castus* (chasteberry), *Trigonella foenum-graecum* (fenugreek), *Nigella sativa* (black seed), *Cinnamomum verum* (cinnamon), and *Curcuma longa* (turmeric) have shown promising outcomes in both experimental studies and human clinical trials. Findings suggest improvements in ovulatory function, insulin sensitivity, lipid profiles, inflammation, and hormonal balance, indicating that these natural agents may target multiple aspects of PCOS simultaneously [6, 7].

Despite the expanding body of evidence supporting herbal therapy, significant challenges remain. Variations in plant species, harvesting conditions, extraction processes, and formulation techniques can lead to inconsistent concentrations of active phytochemicals. Additionally, the lack of standardized doses and limited large-scale randomized controlled trials restricts their integration into mainstream clinical practice [8].

Nevertheless, when used alongside conventional treatments, herbal interventions have the potential to offer a more comprehensive, patient-centered, and potentially safer approach to PCOS management.

This review, therefore, aims to systematically examine the pharmacological mechanisms, clinical evidence, therapeutic benefits, and safety considerations of key herbal remedies used in the management of PCOS, emphasizing their role as valuable complementary strategies. [7, 8]

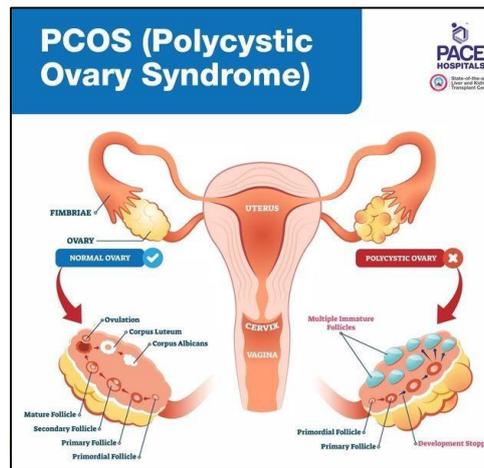
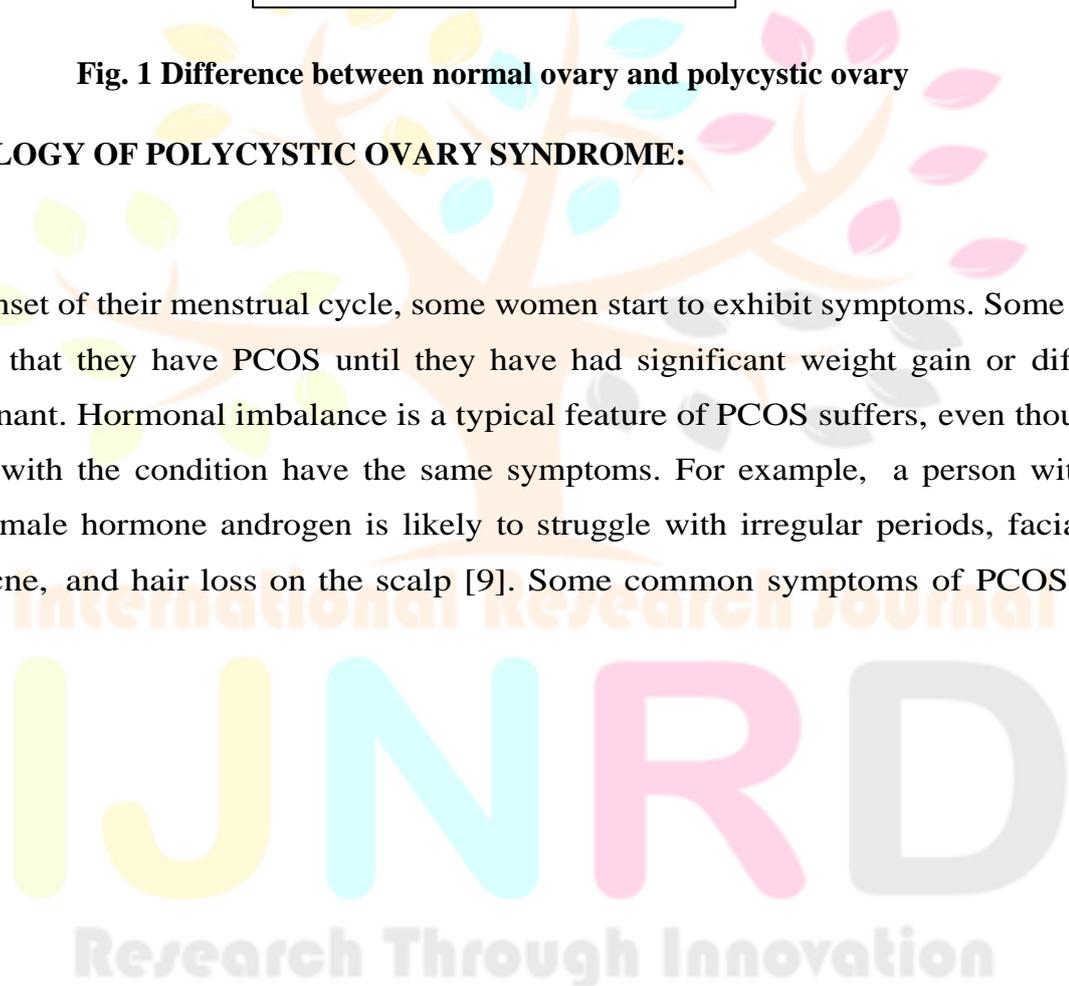


Fig. 1 Difference between normal ovary and polycystic ovary

PATHOBIOLOGY OF POLYCYSTIC OVARY SYNDROME:

Symptoms:

Before the onset of their menstrual cycle, some women start to exhibit symptoms. Some people are unaware that they have PCOS until they have had significant weight gain or difficulty getting pregnant. Hormonal imbalance is a typical feature of PCOS suffers, even though not all womens with the condition have the same symptoms. For example, a person with high level of the male hormone androgen is likely to struggle with irregular periods, facial hair, hormonal acne, and hair loss on the scalp [9]. Some common symptoms of PCOS are in fig. 2.



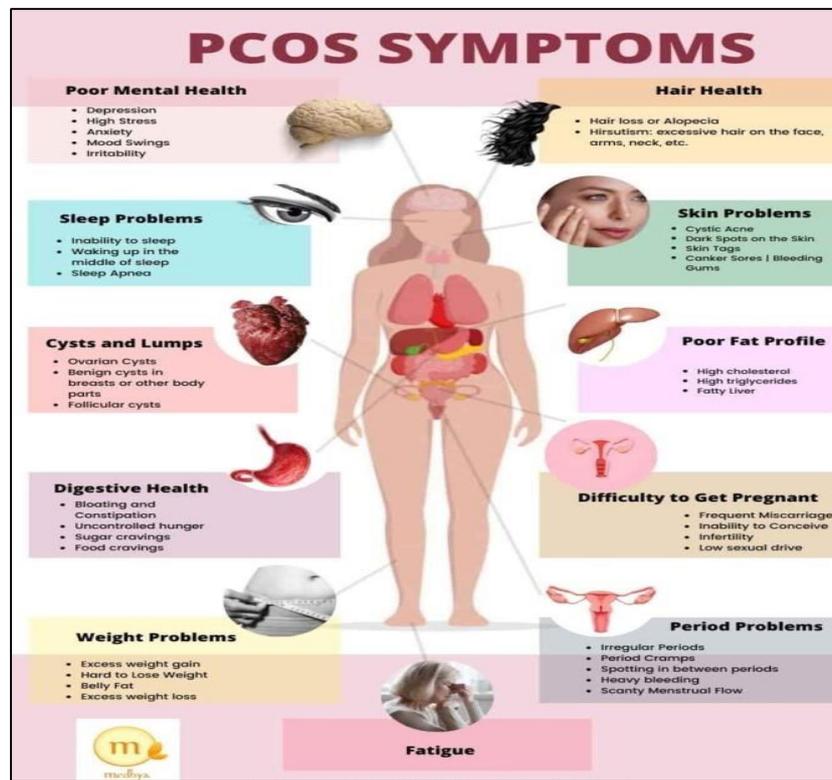


Fig. 2 Symptoms of PCOS

Pathophysiology of Polycystic Ovary Syndrome (PCOS)

Polycystic Ovary Syndrome (PCOS) is a multifaceted endocrine and metabolic disorder that affects reproductive, hormonal, and metabolic functions in women of reproductive age. It is clinically recognized by a combination of menstrual irregularities, excessive androgen levels, and the presence of multiple immature follicles in the ovaries.[9,10] However, the disorder extends far beyond the ovaries, involving a complex interplay of genetic predisposition, hormonal disturbances, metabolic dysfunctions, and environmental influences. The interconnected nature of these factors makes PCOS a highly heterogeneous condition, with symptoms and severity varying widely from one individual to another.

A central contributing mechanism in PCOS is the dysfunction of the hypothalamic–pituitary–ovarian (HPO) axis. Abnormalities in the secretion of gonadotropin-releasing hormone (GnRH) lead to an increased luteinizing hormone (LH) to follicle-stimulating hormone (FSH) ratio.[11,12] Elevated LH stimulates ovarian theca cells to produce excessive androgens, disrupting normal follicular development and resulting in anovulation or irregular ovulation. This hormonal imbalance contributes to symptoms such as hirsutism, acne, and alopecia, which are common indicators of hyperandrogenism in PCOS.

Insulin resistance plays a major metabolic role in the development and progression of PCOS. Many individuals with PCOS exhibit reduced insulin sensitivity, leading to compensatory hyperinsulinemia. Insulin acts synergistically with LH to further enhance androgen production in ovarian theca cells, creating a vicious cycle that perpetuates hormonal imbalance. Additionally, hyperinsulinemia impairs normal follicular maturation and contributes to weight gain, particularly abdominal obesity, which further aggravates insulin resistance and metabolic dysfunction[13].

Herbal Remedies to Cure Polycystic Ovary Syndrome:

Herbal medicines has gained increasing attention as an adjunct or alternative therapy for PCOS due to its effectiveness in restoring hormonal balance, improving insulin sensitivity, reducing hyperandrogenism, and regulating menstrual cycles with fewer side effects compared to conventional therapy.

1. Cinnamon: (cinnamomum zeylanicum, dalchini)

Family: Lauraceae



Fig. 3 Cinnamon

Mechanism: Polyphenols and cinnamon aldehyde imitate the effects of insulin, improve insulin receptors signaling, and stimulate the uptake of glucose by cells [14]. Enhancing insulin sensitivity lowers compensatory hyperinsulinemia, which in turn lowers the production of androgens by antioxidant properties also aid in lowering chronic Low-grade inflammation in PCOS [15]. This combined effects enhance ovulation and menstrual cyclicity [16].

Dosage and safety: Most clinical trials used 1.5-3 g /day of cinnamon powder or aqueous extract, showing improvements in insulin sensitivity and menstrual cyclicity [19]. Cassia cinnamon contains coumarin, which may causes hepatotoxicity at high doses; therefore, ceylon cinnamon (*C. Verum*) is safer for long-term use . Overall, cinnamon is considered well tolerated when consumed in moderate doses [20].

2. Nigella Sativa : (Black seeds)

Family: Ranunculaceae



Fig 4. Nigella Sativa

Nigella sativa, commonly known as *black seeds* or *kalonji*, has been traditionally valued in various medicinal systems for managing metabolic, reproductive, and gynecological disorders. The plant's principal bioactive constituent, thymoquinone, possesses strong antioxidant, anti-inflammatory, and insulin-sensitizing activities. These pharmacological properties make *Nigella sativa* a promising natural therapeutic agent in the management of Polycystic Ovary Syndrome (PCOS), particularly due to its ability to target multiple pathways involved in the disorder's pathogenesis.

Mechanisms of Action

1. Improvement in Insulin Sensitivity:

thymoquinone has been shown to enhance glycemic control by stimulating insulin secretion and improving pancreatic β -cell activity. Through this mechanism, it helps reduce insulin resistance—a key metabolic abnormality in PCOS [21].

2. Anti-androgenic Effect:

Nigella sativa contributes to hormonal balance in women with PCOS by lowering elevated serum testosterone levels. This anti-androgenic action supports the improvement of symptoms such as hirsutism, acne, and menstrual irregularities [22].

3. Anti-inflammatory and Antioxidant Properties:

Chronic low-grade inflammation and oxidative stress are major contributors to the progression of PCOS. Thymoquinone and other constituents of *Nigella sativa* help modulate inflammatory cytokines and neutralize oxidative radicals, thereby reducing ovarian and systemic inflammation [23].

Evidence from Studies: Clinical evidence supports the therapeutic potential of *Nigella sativa* in PCOS. A human trial demonstrated significant improvements in menstrual regularity, fasting blood glucose, insulin sensitivity, and androgen levels following supplementation with *Nigella sativa* [22]. Animal studies further revealed that *Nigella sativa* extract restored normal ovarian architecture, reduced cyst formation, and enhanced follicular development [24]. Additional research highlights improvements in lipid profiles and reductions in body weight, making it particularly beneficial for obese PCOS patients [25].

Regarding safety, *Nigella sativa* is generally well tolerated when used within recommended limits. Some individuals may experience mild gastrointestinal discomfort. While long-term safety data in PCOS is still limited, the herb has been widely used safely in conditions such as diabetes and metabolic syndrome, supporting its favorable safety profile [21].

3. Fenugreek (*Trigonella foenum-graecum*)

Family: Fabaceae

Fenugreek seeds are rich in bioactive compounds, particularly soluble fibers such as **galactomannans** and steroidal saponins, including furostanolic saponins, which exert multiple metabolic and hormonal benefits. These constituents enhance insulin signaling, regulate glucose metabolism, and help reduce hyperandrogenism—making fenugreek a valuable herbal candidate in the management of Polycystic Ovary Syndrome (PCOS). Its ability to positively influence ovarian function and menstrual regularity further supports its therapeutic significance.



Fig. 5. Fenugreek

Mechanisms of Action

Insulin Sensitization and Glycemic Control: The high soluble fiber content in fenugreek slows intestinal glucose absorption, helping regulate post-prandial glycemic spikes. Meanwhile, saponins enhance insulin receptor sensitivity, leading to a reduction in insulin resistance and improved HOMA-IR scores in PCOS patients [26, 27].

Anti-androgenic and Ovarian Effects: Fenugreek supplementation has been associated with reductions in free testosterone levels and normalization of ovarian volume. These effects contribute to improved menstrual cyclicity and better regulation of ovulatory function [26].

Lipid Modulation and Anti-inflammatory Properties: Studies indicate that fenugreek helps decrease LDL cholesterol and triglycerides while enhancing antioxidant activity. These properties collectively reduce inflammation, an important factor in PCOS pathogenesis [27].

Dosage Used in Studies: Standardized fenugreek extract (Furocyst®) was administered at a dose of 500 mg twice daily (1,000 mg/day) for 90 days, which produced significant clinical improvements in both trials [26, 27].

Safety and Drug Interactions: Fenugreek is generally safe when used short-term, with mild gastrointestinal discomfort being the most commonly reported adverse effect [28]. However, due to its glucose-lowering properties, it may potentiate hypoglycemia in individuals taking antidiabetic medications. Caution and monitoring are advised when using fenugreek alongside glucose-lowering drugs or insulin therapy [28, 29].

4. *Vitex agnus-castus*

Common name: Chasteberry

Vitex agnus-castus (VAC), widely known as chasteberry, has a long history of use in traditional medicine for managing gynecological and reproductive disorders. Its therapeutic value in PCOS is linked mainly to its dopaminergic activity, regulation of pituitary gonadotropin secretion, and correction

of luteal phase defects—factors that frequently contribute to menstrual dysfunction in women with PCOS [33]. Through its multi-targeted hormonal effects, VAC offers a complementary approach to restoring reproductive balance in affected individuals.



Fig. 6. *Vitex agnus-castus*

Mechanisms of Action

Dopaminergic Modulation: VAC contains several active diterpenes, including **agnuside** and **casticin**, which act on dopamine D2 receptors. By enhancing dopaminergic signaling, these constituents reduce excessive prolactin secretion. Lowering prolactin helps restore the physiological balance between luteinizing hormone (LH) and follicle-stimulating hormone (FSH), a key requirement for normal ovulatory function [34, 35].

Dosing Used in Studies

Most clinical studies have employed standardized extracts equivalent to 20–40 mg/day of dried fruit extract, typically standardized to contain agnuside. Treatment duration usually ranges from 8–12 weeks, although some protocols extend therapy up to 6 months for sustained benefits [33, 35].

Safety and Drug Interactions: VAC is generally well tolerated with a low risk of adverse effects. Mild gastrointestinal discomfort, skin rash, or headache may occur in some individuals [37]. However, because of its dopaminergic action, VAC may interact with dopamine-related medications such as bromocriptine, cabergoline, or antipsychotic drugs, potentially altering their efficacy. Caution and medical supervision are advised when co-administering these agents [38].

Limitations: Despite encouraging evidence, several important limitations hinder the widespread clinical adoption of herbal therapies, including VAC, for PCOS management. Many available studies are based on preclinical animal models, involve small sample sizes, or include short-duration interventions, limiting the generalizability of findings to broader populations [39, 40,41].

CONCLUSION:

Reproductive dysfunction, insulin resistance, and hormonal imbalance are all linked to PCOS, a complex condition. Traditional pharmaceutical treatments work well, but prolonged usage frequently has negative side effects. Herbal remedies offer a viable supplementary strategy for PCOS management because of their diverse pharmacological activities. By means of

mechanisms like insulin sensitization, anti-androgenic activity, antioxidant qualities, and gonadotropin regulation, medicinal plants like *cinnamomum verum*, *mentha spicata*, *vitex agnus-castus*, *trigonella foenum-graecum*, *withania somnifera*, *aloe vera*, *curcuma longa*, and *camellia sinensis* have shown positive effects. Improvements in metabolic, hormonal, and reproductive outcomes are suggested by data from both clinical and experimental research. For women with PCOS, combining herbal medicines with conventional therapy under a doctor's supervision may provide a more comprehensive, secure, and successful management approach.

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