



COMPREHENSIVE MANAGEMENT OF POLYCYSTIC OVARY SYNDROME: A COMBINED CONVENTIONAL AND PHYTOTHERAPEUTIC PERSPECTIVE

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ABSTRACT

Polycystic ovary syndrome (PCOS), also known as hyper androgenic anovulation affects approximately 5–10% of women of reproductive age. It is a heterogeneous endocrine disorder characterized by reproductive, metabolic, and psychological manifestations, including irregular menstruation, hyperandrogenism (Hirsutism, acne), obesity, and infertility. The underlying pathophysiological mechanisms involve hormonal imbalances, insulin resistance and ovarian dysfunction, which may predispose patients to long-term complications such as Type II diabetes mellitus, CVS disease, and cancer of endometrium. Lifestyle modification, including weight management, regular exercise, and balanced nutrition, remains the first-line therapeutic approach. Pharmacological interventions include anti-androgens such as Spironolactone and Flutamide, metformin for insulin sensitization, and Clomiphene citrate for ovulation induction. In addition to conventional therapies, complementary and herbal medicine is gaining recognition in the management of PCOS. In this review a comprehensive evaluation of 45 medicinal plants and their bioactive phytoconstituents has demonstrated promising outcomes in alleviating PCOS symptoms. Herbs such as *Mentha spicata*, *Pimpinella anisum*, *Cinnamomum verum*, *Glycyrrhiza glabra*, and *Tribulus terrestris* exhibit effects ranging from improved insulin sensitivity and ovulation enhancement to androgen reduction and hormonal regulation. Adaptogenic and estrogenic botanicals, including Ginseng (*Panax ginseng*), Shatavari (*Asparagus racemosus*), and Ashwagandha (*Withania somnifera*), support stress reduction and overall endocrine balance. Collectively, these phytotherapeutic agents have shown clinical potential in reducing Hirsutism, restoring menstrual cyclicity, and normalizing LH/FSH ratios. These reviews represents a comprehensive evaluation of conventional and herbal strategies, highlighting their mechanisms and potential for an extensive, personalized approach to PCOS care that would enhance the quality of life for PCOS-affected women.

KEYWORDS: Herbal compounds, Infertility, PCOS, Phytotherapeutic agent, Polycystic Ovary Syndrome.

INTRODUCTION

One of the most prevalent endocrine conditions affecting women of reproductive age is polycystic ovarian syndrome (PCOS), also known as hyperandrogenic anovulation (HA) or Stein-Leventhal syndrome. According to National Institutes of Health (NIH) diagnostic guidelines, 4–10% of women worldwide are diagnosed with PCOS.^[1] The condition manifests with diverse clinical features including menstrual

irregularities, Infertility, Hirsutism, acne, obesity, and alopecia, which collectively reduce quality of life.^[2,3] Although most cases are identified in women aged 20–30 years, PCOS can present as early as menarche.^[4]

PCOS has a complicated and multifaceted pathogenesis. Insulin resistance, hyperandrogenism, persistent low-grade inflammation, and hormonal imbalance all lead to poor folliculogenesis and put patients at risk for long-

term issues like endometrial cancer and type II diabetes. According to international guidelines, the three primary diagnostic criteria are ovarian morphology, anovulation, and hyperandrogenism.^[5] About 5–10% of women who are fertile are impacted, with adolescents increasingly recognized as a vulnerable group.^[6] Common manifestations in adolescents include irregular menstruation, acne, Hirsutism, and Acanthosis nigricans, highlighting the significance of early diagnosis to prevent early.^[7]

Historically, Stein and Leventhal (1935) described PCOS as a triad of amenorrhea, obesity, and Hirsutism, coining the term “polycystic ovarian disease”.^[8] Current understanding emphasizes insulin resistance and hyperandrogenism as central pathogenic mechanisms, linking PCOS to elevated metabolic and cardiovascular risks. Clinical symptoms include irregular or absent menstruation, heavy periods, acne, excessive hair growth, pelvic pain, difficulty conceiving, and patches of darkened skin. While PCOS cannot be entirely prevented, early recognition and long-term management significantly reduce complications.^[9]

PCOS is also highly prevalent in India, affecting about one out of 10 fertile women, with adolescents accounting for nearly 60% of cases.^[10] The hypothalamus, adipose tissue, ovaries, pituitary and adrenal glands, all contribute to the endocrine dysregulation underlying PCOS.^[11] Ovarian morphology can be identified and assessed with the use of diagnostic imaging modalities such as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound.^[12] Depending on

diagnostic criteria, prevalence estimates vary between 6% and 20%.^[13]

The psychosocial impact of PCOS is profound. Given that symptoms such as Hirsutism, obesity, and acne are culturally stigmatized, women frequently report feeling “unfeminine,” “different,” or “strange,” contributing to reduced self-esteem and quality of life.^[14–18] Therefore, effective management of PCOS requires not only medical treatment but also a comprehensive approach that addresses psychological, social, and cultural dimensions.^[19]

Clinical Symptoms of PCOS

Polycystic ovary syndrome manifests with a spectrum of clinical features, primarily resulting from hormonal imbalance and metabolic dysregulation. The common symptoms include:

- Menstrual irregularities – infrequent, prolonged, or absent menstrual cycles due to anovulation.
- Infertility – difficulty conceiving as a consequence of disrupted ovulation.
- Hyper androgenic manifestations:
 - Hirsutism – excessive growth of coarse body hair in androgen influenced areas.
 - Acne and oily skin – resulting from increased sebaceous gland activity.
 - Androgenic alopecia – scalp hair thinning or loss, typically in a male-pattern distribution.
- Metabolic disturbances – weight gain, central obesity, and insulin resistance (though variable).
- Psychological effects like anxiety, depression etc. in many patients.^[19] **(Figure 1)**

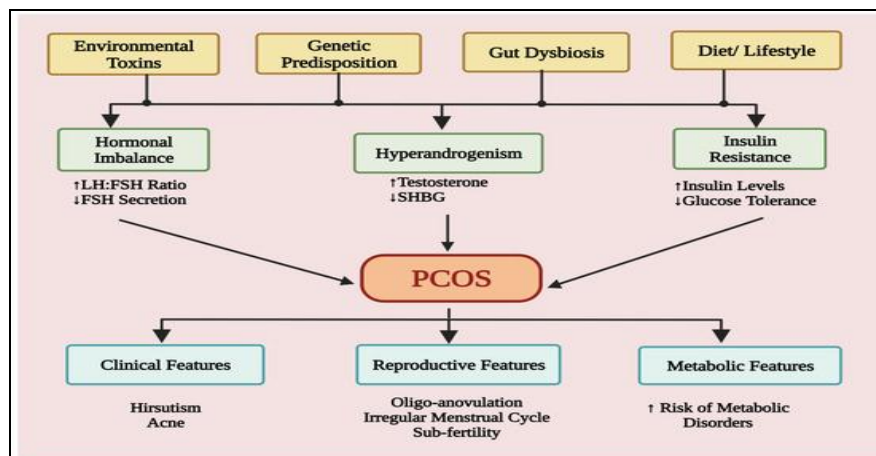


Figure 1: Symptoms of PCOS.

Etiology

There is no one recognized reason for PCOS, making it a complicated, multifaceted condition **(Table 1)**

Table 1: Etiology involved in PCOS.

Sr. no	Title	Activity	Reference
1	Insulin resistance	High levels of microRNA activity in fat cells prevent insulin from using glucose, which is linked to both insulin resistance and PCOS.	[11]
2	Hormonal imbalance	• High amounts of testosterone are the cause of hyperandrogenism. • High amounts of LH, which interfere with normal ovarian functions.	[11]

3	Genetic factors	The PCOS phenotype develops as a result of low birth weight and fetal exposure to androgens. PCOS is a single gene deficiency that is more likely to be oligogenic or polygenic.	[20]
4	Bisphenyl A (BPA)	PCOS is likely caused by bisphenyl, a regular industrial component utilized in packaging and dentistry. Ovarian dysfunction is influenced by BPA.	[11]
5	Stress and other psychological disorders	Stress can interfere with the regular menstrual cycle and cause hormonal changes, such as increased cortisol and prolactin levels, which can affect menstruation, which usually returns after the stress has subsided.	[11]
6	Ovarian follicular defect	Follicles grow very slowly because of maybe insufficient signals of growth from the ovary, and increase in follicle number is caused by androgen signaling.	[21]
7	Miscellaneous	Sedentary lifestyles, diet vacations, insufficient or intense physical activity, and other contributing factors like severe weight loss, endocrine system disorders, and different ovarian disorders are all examples.	[11]

Dietary and Lifestyle Factors

Lifestyle modification is considered the cornerstone of PCOS management. Clinical recommendations Encourage constant exercise and a healthy weight of the body following a balanced diet, and avoiding smoking for the prevention and management of complications of metabolism in PCOS-affected women. In contrast, sedentary behaviors and high-calorie diets contribute to the worsening of symptoms. High-sugar diets, in particular, may alter gut microbiota, encourage chronic inflammation, elevated resistance of insulin, and increased androgen production, thereby exacerbating the pathophysiological features of PCOS.

Obesity and weight gain further aggravate the syndrome. Evidence indicates that low-glycemic index (LGI) diets significantly reduce insulin (fasting), total cholesterol, LDL-C, triglycerides, waist circumference, and entire testosterone in PCOS patients matched to high-glycemic index (HGI) diets, although they may not affect glucose levels, body weight, or the free androgen index.^[22]

Physical activity is now widely recognized as an essential component of PCOS treatment. Resistance training and vigorous aerobic exercise have been shown to develop insulin sensitivity and lower the level of androgen in PCOS-affected women.^[23] For overweight or obese patients, lifestyle modification remains the first-line weight management strategy.^[24] Recommendations typically include a gradual increase in physical activity combined with a range of well-balanced dietary strategies to reduce calories.^[25]

Previous studies have investigated lifestyle interventions such as behavioral therapy, structured exercise, and dietary modification. A systematic review demonstrated that lifestyle modification programs effectively reduced body weight and BMI in PCOS patients, both with and without obesity. However, results regarding changes in metabolic parameters including lipid profile and glucose tolerance are still inconsistent.^[26]

The connection between obesity and PCOS is well established. Women having a BMI ≤ 25 kg/m² show a PCOS prevalence of approximately 4.3%, whereas the

prevalence rises to 14% among women with a BMI ≥ 30 kg/m².^[27]

Dietary Recommendations

Women with PCOS are advised to avoid certain dietary products that may exacerbate hormonal and metabolic imbalances. These include:

- Nicotine, caffeine, and alcohol, along with their habit-forming derivatives.
 - Soy-based products, as they may interfere with ovulation.
 - Milk proteins, which can disrupt testosterone metabolism.
 - Dairy products and red meat, both rich in saturated fats that may elevate estrogen production.
 - High -glycemic index foods, such as white rice and potatoes.
- Conversely, the following foods are beneficial and should be emphasized in the diet:
- Whole grains.
 - Green leafy vegetables, rich in vitamins and minerals.
 - Low-GI fruits such as oranges, plums, and apples.
 - Colorful vegetables including beets, carrots, capsicum, and salad greens.
 - Adequate proteins and complex carbohydrates.

Additionally, even 10 minutes of daily exercise has been shown to provide benefits for PCOS management.^[11]

Diagnosis of PCOS

Because of PCOS symptoms vary by age group, diagnosing the condition can be difficult. Pubertal changes, such as irregular cycles and the occurrence of several small antral follicles, may mimic PCOS in adolescents, while in menopausal women; retrospective assessment of menstrual history may be unreliable.^[11]

Over time, the PCOS diagnostic criteria have changed:

- Chronic anovulation with biochemical or clinical hyperandrogenism (NIH, 1990).
- Rotterdam Criteria (2003): At least two of the following must be met:
 1. Oligo-/anovulation;
 2. Biochemical or clinical hyperandrogenism; or

3. Imaging-based polycystic ovaries.

Other indicators: Menstrual irregularities (cycles ≥ 45 days or ≤ 8 cycles/year), oligomenorrhea, alopecia, hirsutism, obesity, acne, and infertility.

Recent studies suggest that serum Anti-Müllerian Hormone (AMH) levels and the stromal/ovarian area (S/A) ratio may serve as alternative diagnostic markers to ultrasonography.^[28]

Differential diagnoses to be considered include: exogenous androgen use, acromegaly, androgen-secreting tumors, Cushing's syndrome, primary ovarian failure, and other endocrine disorders.^[29] Laboratory evaluation typically involves biochemical confirmation of hyperandrogenism.^[30]

Pharmacological Management

- Clomiphene Citrate: The first medication used to induce ovulation in PCOS patients. As an estrogen receptor antagonist, it enhances FSH availability, thereby stimulating follicular growth.^[31,32]
- Metformin: An insulin-sensitizing medication that reduces testosterone levels and insulin resistance, restores ovulation, and regulates menstrual cycles. Treatment for 3–6 months is generally recommended to improve ovulatory function and testosterone regulation.^[32–34]
- Flutamide: A pure, non-steroidal anti-androgen that exhibits dose-dependent inhibition of androgen receptors. Despite being effective, it is not better than spironolactone.^[12]
- Glucocorticoids: Low-dose dexamethasone (0.25–0.5 mg) or prednisone may be recommended in PCOS patients with elevated adrenal androgens to induce ovulation.
- Gonadotropins: Used as a second-line therapy in clomiphene-resistant cases. Low-dose FSH regimens help achieve controlled follicular growth and ovulation.
- N-acetylcysteine (NAC): An antioxidant that increases glutathione production, reduces oxidative stress, and improves insulin sensitivity.^[32]

Surgical Management

For patients unresponsive to medical therapy, laparoscopic ovarian drilling (LOD) may be considered. The procedure destroys a portion of androgen-producing ovarian tissue, thereby restoring ovulatory cycles and correcting hormonal imbalances. LOD has also been shown to improve hyper androgenic symptoms like acne and hirsutism.^[11]

Integrating phytomedicine in the treatment of PCOS

PCOS is characterized by irregular menstrual cycles, infertility and insulin resistance, making it one of the most prevalent endocrine illnesses in fertile women. Conventional pharmacological treatments such as

metformin, clomiphene citrate, and oral contraceptives—are effective in alleviating symptoms, but they are frequently associated with adverse effects including gastrointestinal discomfort, mood changes, and long-term metabolic disturbances.

In recent years, herbal medicine has gained attention as a complementary and potentially safer alternative for PCOS management. Various medicinal plants have demonstrated beneficial effects in regulating hormonal balance, improving insulin sensitivity, reducing oxidative stress, and restoring ovarian function. Notable examples include:

- Fenugreek (*Trigonella foenum-graecum*) – enhances insulin sensitivity and may help restore menstrual regularity.
- Cinnamon (*Cinnamomum verum*) – improves insulin resistance and glucose metabolism.
- Ashwagandha (*Withania somnifera*) – acts as an adaptogen, reducing stress-related cortisol levels and supporting endocrine health.
- Licorice (*Glycyrrhiza glabra*) – exhibits anti-androgenic effects and assists in reducing hirsutism.
- Aloe vera (*Aloe barbadensis*) – supports ovarian function and metabolic balance.
- Chasteberry (*Vitex agnus-castus*) – modulates prolactin levels, restores luteal phase function, and improves fertility outcomes.

The bioactive compounds in these plants including flavonoids, saponins, alkaloids, and phytoestrogens exert multiple therapeutic effects, such as hormone modulation, antioxidant activity, and insulin regulation. Collectively, these properties suggest that phytotherapy offers a general line to the management of PCOS, addressing both reproductive and metabolic dysfunctions.^[33,34]

While the evidence from preclinical studies and small-scale clinical trials is promising, the clinical application of these herbal interventions requires further well-designed randomized controlled trials to validate efficacy, safety, dosage, and long-term outcomes. Nevertheless, the integration of herbal medicine with conventional therapy may represent a comprehensive and patient-centered strategy for managing PCOS. (Table 2)

Table 2: List of Medicinal plants used for managing PCOS.

Sr no	Botanical name	Family	Parts	Extract/ Phytoconstituent	Action	Result	Reference
1	<i>Mentha spicata</i>	Lamiaceae	Leaves	Essential oil	Reduces androgen Help in hirsutism	Active	[35]
2	<i>Pimpinella anisum L.</i>	Apiaceae	Leaves	methyl chavicol, trans-anethole, anisiketone and anisaldehyde	control and enhancement of women's LH/FSH secretion and menstrual periods	Active	[36]
3	<i>Cinnamomum verum</i>	Lauraceae	Bark	Procyanidin polyphenol type-A polymers, rutin, catechin, quercetin	Improves insulin sensitivity restore the estrous cyclicity ovary morphology	Active	[37]
4	<i>Glycyrrhiza glabra</i>	Fabaceae	Bark	Liquiritigenin, isoliquiritigenin, liquiritin, isoliquiritin, glabridin	Anti-androgenic Effect	Active	[37]
5	<i>Paeonia lactiflora</i>	Paeoniaceae	Roots	Catechin, methyl gallate, paeoniflorin, benzoic acid	Hormonal regulation	Active	[38]
6	<i>Lepidium meyenii</i>	Brassicaceae	Roots	Phenols, glucosinolates, alkylamides, and polysaccharides	Endocrine Function, Balanced effects on FSH, estradiol and progesterone	Active	[39]
7	<i>Tribulus terrestris</i>	Zygophyllaceae	Fruits	Steroidal saponins	Enhances Ovulation	Active	[40]
8	<i>Serenoa repens</i>	Arecaceae	Leaves extract	Fatty acids, Phytosterols, Ethanol extract	Anti-androgen, Hirsutism	Active	[41]
9	<i>Angelica sinensis</i>	Apiaceae	Root	Alkaloids, Phenolic acid, Flavonoids	Regulate menstrual cycle	Active	[42]
10	<i>Asparagus racemosus</i>	Asparagaceae	Roots	Carbohydrates - polysaccharides Flavonoids, Sitosterol, Glycosides and hyperoside are exist in fruits and flower, Root contain potassium, magnesium, calcium and zinc	Reproductive tonic, maintain libido of women	Active	[43]
11	<i>Withania somnifera</i>	Solanaceae	Roots, Leaves, Seed, Bark	Alkaloids, Steroidal lactones, Saponins	Balance hormone, Adaptogen	Active	[44]
12	<i>Aloe vera</i>	Liliaceae	Leaves Juice	Salicylic acids, amino acids, enzymes, lignin, minerals, saponins and vitamins	Improves insulin resistance, Antidiabetic	Active	[44]
13	<i>Ocimum sanctum</i>	Lamiaceae	Leaves	Phenolic Compounds	Blood sugar and hormones	Active	[45]
14	<i>Trigonella foenum graecum</i>	Fabaceae	Seed, Leaves	Quercetin, luteolin, genistein, vitexin	Reduce insulin resistance, Regulates LH and FSH levels	Active	[46]
15	<i>Curcuma longa</i>	Zingiberaceae	Rhizomes, Roots	Polyphenol extract	Insulin sensitizer, preventing the expression of vascular endothelial growth factor (VEGF)	Active	[47]
16	<i>Azadirachta Indica</i>	Meliaceae	Leaves, Bark	Quercetin, β -sitosterol, nimbin, nimbidin, nimbolide, and limonoids	Blood purifier, PI3K gene expression	Active	[48]
17	<i>Gymnema sylvestre</i>	Asclepidaceae	Roots, Leaves	Gymnemic Acid, gymnemasaponins, gymnemoside, gymnemasin	Improves glucose metabolism, YES-associated protein-1 gene (YAP1)	Active	[49]
18	<i>Berberis vulgaris</i>	Annonaceae	Fruit, Bark, Leaves, Roots, Stem,	Isoquinoline alkaloids	Improve insulin sensitivity lowering the risk of ovarian hyper stimulation syndrome	Active	[50]

19	<i>Linum sitatissimum</i>	Linaceae	Seed	Alpha- linolenic acid, secoisolariciresinol diglycoside. Soluble flax seed fibre mucilage (LRhamnose, d- Xylose, L-Galactose)	Lowers androgen level Decrease the excess testosterone which plays a crucial role in the pathogenesis of PCOS	Active	[51]
20	<i>Taraxacum officinale</i>	Asteraceae	Leaves, Stem	Extract T-1 (DE-T1), extract from the leaves	Liver detoxification, GC proliferation	Active	[52]
21	<i>Silybum marianum</i>	Asteraceae	Seed	Silymarin, silybin	Estrogen metabolism, effects on the levels of glucose, insulin, progesterone, LH, and testosterone	Active	[53]
22	<i>Urtica dioica</i>	Urticaceae	Leaves, Roots	Flavonoids, phenolic acids, carotenoids, vitamins and minerals lectins, polysaccharides, sterols	Reduce free testosterone	Active	[54]
23	<i>Trifolium pratense L.</i>	Leguminosae	Aerial parts	Isoflavones including daidzein, biochanin A, formononetin and genistein.	Phytoestrogenic Effect selective estrogen receptor modulator	Active	[55]
24	<i>Panax ginseng</i>	Araliaceae	Leaves, Roots	Ginsenosides, Saponins	Natural estrogen replacement therapy	Active	[56]
25	<i>Punica granatum</i>	Punicaceae	Seed	Folic acid, pantothenic acid, vitamins B2, C and B1, organic acids	Stimulates progesterone secretion and serum estrogen.	Active	[56]
26	<i>Rhodiola rosea</i>	Crassulaceae	Rhizomes	Phenylpropanoids, Phenylethanoid derivative, Triterpenes, Monoterpene, phenolic compounds	Adaptogen, restore ovulation	Active	[57]
27	<i>Oenothera biennis</i>	Onagraceae	Roots, Seeds Flowers,	Omega-6 fatty acids, gamma-linolenic acid	Improve fertility Premenstrual syndrome (PMS)	Active	[58]
28	<i>Cocos nucifera</i>	Arecaceae	Roots	Lupeol methyl ether, skimmidiol and isoskimmidiol	Menstrual cycle regulator regulates the blood levels of FSH and LH	Active	[55]
29	<i>Medicago sativa</i>	Fabaceae	Whole Herb, Seed Leaves.	Alkaloids, Amino acids coumestrol, genistein formononetin	Phytoestrogenic, relieving irregular menstruation, reducing heavy bleeding, clotting and inflammation	Active	[59]
30	<i>Nigella sativa</i>	Ranunculaceae	Seeds	Thymoquinones	Blood sugar regulation, hormone balance	Active	[60]
31	<i>Zingiber officinale</i>	Zingiberaceae	Rhizome Resin	γ - terpinene and terpinen-4-ol, geraniol, afarnesene, gingerol, curcumin, geraniol, neral, linalool, β -sesquiphellandrene, sabinene.	Maintain the balance of estrogen and progesterone	Active	[61]
32	<i>Matricaria chamomilla</i>	Asteraceae	Flower	Matricin , Gallic acid, apigenin, kamazelin, farnesene, coumarin derivatives.	Reduce menstrual cramps and the risk of preterm labor.	Active	[61]
33	<i>Stachys lavandulifolia</i>	Lamiaceae	Flower	Flavonoids, trenapenoids, saponins, quinine, iridoids, phenolic acids, and diterpenoids	Lowers the length and intensity of primary dysmenorrhea discomfort, induces menstruation, and is abortive.	Active	[61]
34	<i>Rubia cordifolia</i>	Rubiaceae	Root	kaempferol, <i>p</i> -coumaric acid, gallic acid and Chlorogenic Acid	Improved ovulation	Active	[62]
35	<i>Tinospora</i>	Menispermaceae	Leaves	Polyphenols, Carotenoids	Hormonal balance,	Active	[63]

	<i>cordifolia</i>				Reducing Insulin resistance		
36	<i>Bacopa monnieri</i>	Scrophulariaceae	Flowers Leaves	Bacoside A, Bacoside B	Reducing stress and inflammation linked to PCOS	Active	[64]
37	<i>Salvia officinalis</i>	Lamiaceae	Leaves	Flavonoids, rosmarinic acid	Anti-inflammatory properties	Active	[64]
38	<i>Crocus sativus</i>	Iridaceae	Flowers	Flavonoids	Potential to combat stress	Active	[64]
39	<i>Olea europaea</i>	Oleaceae	Leaf	Oleuropein	Reducing blood pressure and enhancing cholesterol profiles, Leaf extract	Active	[64]
40	<i>Hibiscus rosa-sinensis</i>	Malvaceae	Flowers	Anthocyanins vitamin C	Alleviating chronic inflammation often associated with PCOS	Active	[64]
41	<i>Rubus idaeus</i>	Rosaceae	Leaves	calcium, vitamin C, vitamin E, tannins	promoting uterine health, easing menstruation, and strengthening uterine muscles	Active	[64]
42	<i>Chrysanthemum morifolium</i>	Asteraceae	Flowers	Flavonoids, terpenoids	Hormone detoxifier, combat the oxidative stress	Active	[64]
43	<i>Pimpinella anisum</i>	Apiaceae	Fruit Flower	Estragole, limonene, pinenes	Estrogenic properties, relief of infantile gastrointestinal problems	Active	[64]
44	<i>Foeniculum vulgare</i>	Apiaceae	Seed Fruit	transanethole, α -pinene, Anethole, fenchone, 1,8-cineole, β -carotene.	Estrogenic promotes menstruation facilitates birth	Active	[66]
45	<i>Elettaria cardamomum</i>	Zingiberaceae	Fruit	Polyphenols and flavonoids such as lutein, anthocyanin and quercetin	Serum levels of inflammatory factors and their gene expression among obesities	Active	[67]

RESULT

PCOS is a prevalent metabolic and hormonal disorder that primarily affects fertile women. It is characterized by the growth of multiple small ovarian cysts and disruption of regular ovulation. The condition is further exacerbated by unhealthy lifestyle choices, genetic susceptibility, psychological stress, and exposure to endocrine-disrupting chemicals such as Bisphenol A (BPA).

Lifestyle Interventions

Lifestyle modification remains the cornerstone of PCOS management. Evidence indicates that regular exercise and a balanced diet, particularly one with a low glycemic index (GI), improve insulin sensitivity, lower circulating testosterone, regulate menstrual cycles, and support weight loss. These improvements are especially beneficial for obese PCOS patients, where weight reduction itself alleviates many clinical symptoms.

Pharmacological Therapies

Pharmacological treatment plays a significant role in cases where lifestyle measures are insufficient. Clomiphene citrate remains a first-line drug for induction of ovulation. Metformin has shown efficacy in reducing insulin resistance and restoring menstrual regularity. Corticosteroids such as dexamethasone, and anti-

androgenic agents like Flutamide, are used in resistant cases to reduce hyper androgenic features.

Surgical Management

For women unresponsive to pharmacological induction of ovulation, laparoscopic ovarian drilling (LOD) offers a surgical alternative. LOD has demonstrated success in improving fertility and restoring ovarian function, although it is typically reserved for resistant cases.

Herbal and Natural Remedies

In recent years, herbal medicine has emerged as a promising complementary therapy. More than 45 medicinal plants have been identified with potential therapeutic benefits in PCOS due to their bioactive phytoconstituents, which act through multiple mechanisms:

- Reduction of androgen levels: *Saw Palmetto*, *Mentha spicata*
- Improved insulin sensitivity: *Cinnamon*, *Fenugreek*, *Aloe vera*
- Reproductive hormone regulation: *Paeonia lactiflora*, *Ashwagandha*, *Shatavari*
- Promotion of ovulation: *Rubia cordifolia*, *Tribulus terrestris*

- Estrogen metabolism and detoxification: *Dandelion root, Milk Thistle*
- Psychological support and mood regulation: *Rhodiola rosea, Saffron, Brahmi*

These findings support the potential of herbal remedies as adjunct therapies alongside conventional treatments, addressing both the physical and psychological manifestations of PCOS. However, robust randomized controlled trials (RCTs) are still needed to validate their efficacy, establish standard dosages, and confirm long-term safety.

CONCLUSION

PCOS is a complex metabolic and endocrine syndrome with far-reaching implications for women's reproductive and overall health. Its diverse clinical features including obesity, hyperandrogenism, unbalanced menstrual cycles, insulin resistance, acne, and infertility pose diagnostic and therapeutic challenges. Moreover, the syndrome increases long-term risks of type II diabetes, CVS disease, metabolic disorder, anxiety, and depression, underlining the need for early detection and comprehensive management.

A multifaceted treatment strategy is essential:

- Lifestyle interventions form the first line of therapy and yield significant improvements.
- Pharmacological therapies restore ovulation, reduce hyperandrogenism, and improve metabolic regulation.
- Surgical approaches such as LOD provide alternatives in resistant cases.
- Herbal and natural remedies offer complementary benefits by addressing hormonal, metabolic, and psychological dimensions.

Ultimately, the integration of lifestyle modification, evidence-based pharmacological agents, and complementary herbal therapies provides the most holistic, patient-centered, and sustainable approach for managing PCOS.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Sakshi Kore contributed to conceptualization, methodology, data curation, formal analysis, writing, original draft. Suhas Awati handled conceptualization, writing review & editing, visualization & corresponding Author. Kiran Wadkar supported supervision & editing, funding acquisition. Sunil Mathapati was responsible for drafting figure and tables. All authors read and approved

the final manuscript.

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