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Review Article

Comprehensive Review on Management of PCOS Using Herbal Drugs

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The underlying symptoms of polycystic ovarian syndrome (PCOS), a diverse endocrine condition that affects women, include ovarian cysts, anovulation, and endocrine variance. The World Health Organization (WHO) estimates that PCOS affects about 116 million women globally (3.4%). Ovulatory dysfunction, hyperandrogenism, and polycystic ovaries are its hallmarks. Conventional treatments often employ pharmacological interventions that address symptoms but may have fewer adverse effects. Consequently, there is growing interest in herbal medicinal plants and formulations as supplemental or alternative treatments for PCOS. The safety and effectiveness of several herbal treatments that have historically been used to treat PCOS are examined in this review. Every herb listed in this review has special advantages. A. This review provides a thorough understanding of PCOS, including its causes and symptoms. Additionally, it investigates PCOS medication formulations like as syrups, pills, capsules, and nano drug delivery systems. Studies show that these herbal remedies can reduce testosterone, improve insulin resistance, and restore regular menstruation with fewer side effects than traditional medication.

Keywords: PCOS, Herbal Drugs, ovulatory dysfunction, hyperandrogenism, polycystic ovaries, insulin resistance.

INTRODUCTION

PCOS, also known as PCOD, is a condition where a woman's hormones are not balanced. If left untreated, it can eventually result in major health issues like diabetes and heart disease. It is a prevalent reproductive endocrine disorder characterized by distinctive polycystic ovarian morphological changes, including the accumulation of numerous immature follicles. It affects a significant pro portion of women of reproductive age globally, with an incidence ranging from 10 to 13%. According to the World Health Organization (WHO) estimation over 116 million women (3.4%) are affected by PCOS worldwide. It is typified by polycystic ovaries, hyperandrogenism, and ovulatory dysfunction. Pharmacological interventions that treat symptoms but may have fewer side effects are frequently used in conventional treatments. As a result, interest in herbal medicinal plants and formulations as additional or alternative PCOS therapies is developing. This disorder has several underlying symptoms, such as obesity or increased weight, high blood pressure, diabetes, dysfunction of the lipid profile, dandruff on the scalp or oily skin, dark colored patches on the skin of the neck and under the arms, acne, generally chronic pelvic pain, increased levels of male hormones resulting in thinning hair, male pattern baldness, excessive hair growth on the body and face, and, in the case of women, frequent, irregular bleeding, no or infrequent ovulation; and immature follicles.

Etiology of PCOS:

Table 1 Etiology of PCOS

Factor Type	Details
Environmental Factors	• Unhealthy diet rich in advanced glycation end products (AGEs) • Physical inactivity • Increased Body Mass Index (BMI) • Exposure to environmental chemicals during childhood
Epigenetic Factors	• Intrauterine exposure to excess androgens • Maternal hypertension • Diabetes during fetal development • Maternal smoking • Maternal stress • Maternal obesity
Hereditary Factors	• Family history of PCOS • Increased risk in individuals with PCOS-affected relatives
Genetic Factors	• Single nucleotide polymorphisms (SNPs) in genes involved in: – Steroidogenesis – Ovarian theca cell functioning – Hypothalamic hormone regulation – Pituitary hormone secretion

Pathophysiology of PCOS:

1. PCOS and Endocrinology

❖ H-P-O Axis Disorder

The hypothalamic–pituitary–ovarian (H-P-O) axis regulates reproductive hormones. In PCOS, disrupted GnRH pulsatility leads to elevated LH, reduced FSH, and impaired ovulation.

❖ Elevated Levels of AMH

Anti-Müllerian Hormone (AMH) is secreted by ovarian follicles. In PCOS, AMH levels are abnormally high, inhibiting follicle maturation and contributing to anovulation.

❖ Hyperandrogenism

This refers to excess androgen (male hormone) levels in females, causing symptoms like acne, hirsutism, and alopecia. It's a hallmark of PCOS and linked to disrupted LH/FSH balance.

❖ Hyperprolactinemia

An elevated level of prolactin hormone, which may co-occur with PCOS and contribute to ovulatory dysfunction. Its exact role in PCOS remains under investigation.

2. PCOS and Metabolism

❖ Insulin Resistance and Hyperinsulinemia

Insulin resistance means cells don't respond well to insulin, leading to high blood sugar. In PCOS, this triggers excess insulin production (hyperinsulinemia), which worsens androgen excess and metabolic dysfunction.

❖ Dyslipidaemia

A lipid imbalance marked by high triglycerides, elevated LDL (“bad” cholesterol), and low HDL (“good” cholesterol). Common in PCOS, it increases cardiovascular risk.

3. PCOS and Inflammation

❖ Low-Grade Chronic Inflammation

PCOS is associated with persistent, mild inflammation. Elevated markers like CRP, IL-6, and TNF-α suggest immune system involvement in its pathogenesis.

❖ Hyperhomocysteinaemia

High levels of homocysteine, an amino acid linked to inflammation and vascular dysfunction. In PCOS, it may impair fertility and exacerbate insulin resistance.

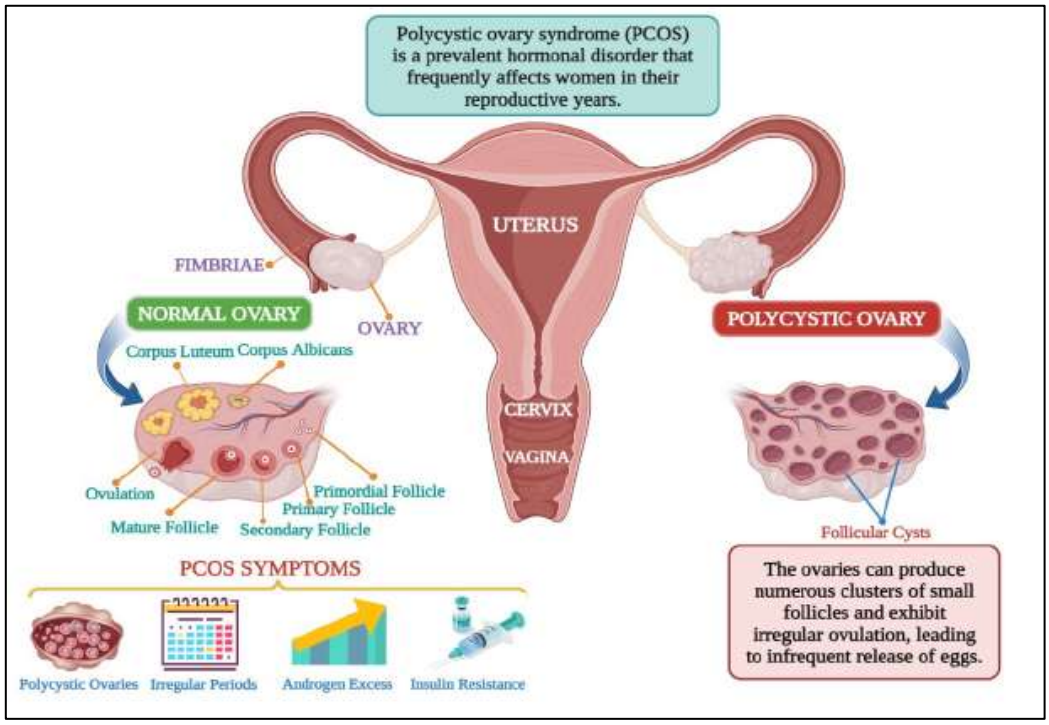

Figure 1: Normal ovary and polycystic ovary

Treatment:

Currently, there is no pharmaceutical treatment available that can provide a cure for the syndrome. However, certain medications are employed to manage the clinical symptoms associated with PCOS. Treatment options primarily involve making lifestyle modifications such as engaging in physical exercise and achieving weight loss. Medications, including birth control pills, can help regulate the menstrual cycle and manage symptoms like acne and excessive hair growth. Hair removal and acne treatment techniques can also be utilized.

Non-Pharmacological Methods:

It is crucial to remember that few therapy modalities successfully address every facet of PCOS since the precise underlying cause of the condition is yet unknown. Even when symptoms are apparent, a woman's desire for fertility may sometimes keep her from getting treatment. Correcting anovulation, reducing insulin resistance, and inhibiting the effects of androgens on target tissues should be the goals of treatment. Losing weight can help obese PCOS sufferers in a number of ways. Losing extra weight helps lower levels of insulin, luteinizing hormone (LH), and androgen. Additionally, it helps control ovulation, increasing the likelihood of becoming pregnant.

Table 2 non-pharmacological consideration

Category	Component	Description / Effects
Overview	Nature of PCOS	Multifactorial disorder with unclear etiology; no single therapy addresses all aspects
Treatment Goals	Correction of Anovulation	Helps restore normal ovulatory cycles
	Reduction of Insulin Resistance	Improves metabolic and hormonal balance
	Suppression of Androgen Effects	Reduces symptoms like hirsutism and acne
Lifestyle Modification	Weight Reduction	Particularly beneficial in obese patients

	Effect on Insulin	Decreases insulin levels
	Effect on LH	Reduces luteinizing hormone (LH) levels
	Effect on Androgens	Lowers androgen concentrations
	Ovulation	Helps restore normal ovulation
	Fertility	Improves chances of pregnancy
Clinical Considerations	Fertility Desire	Treatment may depend on patient's reproductive goals
	Treatment Delay	Some women may delay treatment despite symptoms

Pharmacological Methods:

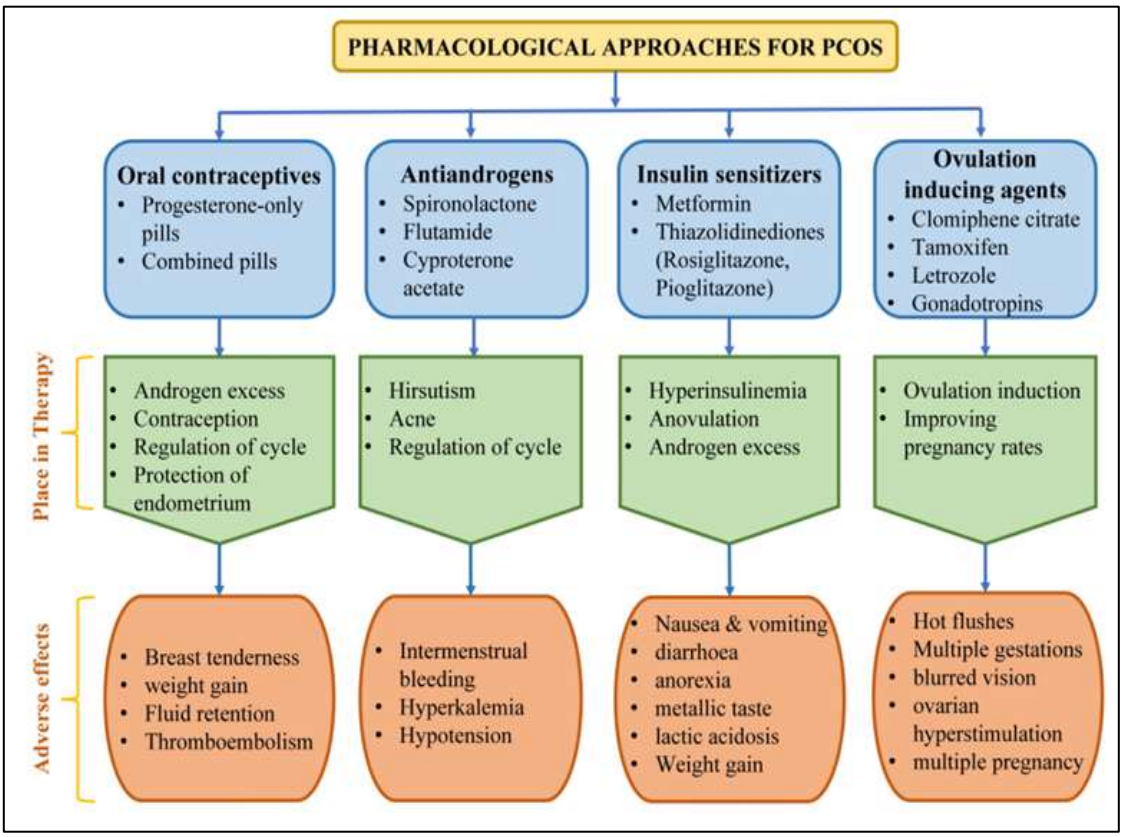

Figure 2 Pharmacological approaches for PCOS

Impact of Herbal medicines Methods

Natural products from various sources play a key role in healthcare, notably in the pharmaceutical, cosmetic, agro, and medical industries. The phrase "herbs" in commerce refers to any plant, plant component, or extract that is utilized for flavouring, scenting, or for therapeutic reasons. Customary herbal medications are organic substances that have been utilized to remedy a range of maladies with little to no industrial processing. Natural products have recently become popular due to their putative therapeutic benefits and negligible negative effects. Phytochemicals produced from medicinal herbs and plants provide an essential approach for researching and identifying novel pharmacological medications. Numerous therapeutic plants have been demonstrated to have a variety of pharmacological effects on important health conditions like as antimicrobial, antidiabetic, antioxidant, and anticancer properties. Plants can be utilized to treat a wide range of illnesses because they serve as stores for a variety of phytochemicals. Alkaloids, flavonoids, terpenoids, phenolic acids, and other compounds are examples of these chemicals. The various medicinal qualities of these compounds may be explained by their unique chemical composition and mode of action. Due to their potential therapeutic benefits and minimal side

effects, natural products have recently gained popularity. Traditional herbal remedies are becoming more and more prominent in global health discourse.

Common Herbal Drugs:

1. Liquorice
2. Shatavari
3. Turmeric
4. Flaxseeds
5. Fennel
6. Cinnamon
7. Chamomile
8. Chaste Tree
9. Aloe vera

Liquorice:

scientifically known as *Glycyrrhiza glabra L.* from the *Fabaceae* family, has been used for centuries as a natural remedy. Traditionally, it's been taken to help heal wounds, ease pain, soothe coughs, and treat stomach issues like gastritis. The root contains several beneficial compounds—including flavonoids, sterols, gums, starches, and essential oils. Some of these, such as sterols and phytoestrogens, may help lower triglyceride and cholesterol levels. Its most important active compound is glycyrrhizin, which is about 50 times sweeter than regular sugar. Glycyrrhizin blocks the enzyme 11β-HSD2, which causes it to act similarly to mineralocorticoids. By slowing down how glucocorticoids are broken down in the body, it increases their levels in the bloodstream. This rise in glucocorticoids can boost insulin release and help lower blood sugar. A recent study looked at how a hydroalcoholic extract of liquorice root affected blood sugar, triglycerides, and cholesterol in 50 rats with polycystic ovary syndrome (PCOS). The animals were divided into different groups: a healthy control group, a group treated with letrozole to induce PCOS, and two groups that received liquorice extract after the letrozole. The letrozole group showed significantly higher blood sugar levels compared to the normal group ($p < 0.01$). However, the groups treated with liquorice extract had lower blood sugar levels, though the difference wasn't statistically significant ($p > 0.05$). There were no major differences in triglyceride or cholesterol levels among any of the groups. Overall, the study suggests that liquorice root extract may help reduce some diabetes-related symptoms associated with PCOS, particularly by lowering blood sugar levels.

Figure 1 : Liquorice

Shtavari:

Shatavari (*asparagus racemosus*) is part of the *Liliaceae* family. Shatavari is one of the most used herbs in traditional ayurvedic medicine. The dried roots of Shatavri are used because of their high levels of saponins (2–5%), steroidal glycosides (0.1–0.2%), Liquorice (Glycyrrhiza glabra) may assist with PCOS by its anti-androgen effects. Studies on women taking 3.5g of a standardized liquorice flavonoid (0.1–0.3%), and polysaccharides (20–30%). Its roots contain high number of phytoestrogens, which helps in managing the menstrual cycle, encouraging healthy ovarian follicle development, and restoring normal reproductive functions. Beyond its benefits for reproductive health, it also strengthens mucosal cytoprotective, immunity, offers diuretic and tonic effects. It's reported that it can help in the breakdown of ovarian cysts also helps to manage hyperinsulinemia, It also prevents formation of new cysts. One of its Active components saponins is

known to assist in maintaining uterine mobility, easing for managing painful bleeding during pre-menopause and supporting uterine muscles, after a miscarriage. Daily intake of Shatavari helps in managing stress levels, thickening of endometrium, decreasing hirsutism hence enhance overall health of ovaries. In ayurvedic practice, it is one among the six significant rasayanas, which are known for enhancing overall health, cellular vitality, and boosting immunity. Studies show that Shatavari has positive effects for women with PCOS. Research suggests that a daily intake of Shatavri can help to manage hormones, regulate menstrual cycle.

Figure 2: Shatavri

Turmeric:

Curcumin, the main polyphenol found in turmeric (*curcuma longa*), shows considerable promise as a treatment for PCOS due to its various pharmacological benefits. Studies suggest that curcumin has antioxidant, anti-inflammatory, antihyperlipidemic, and insulin-sensitizing effects, which can help regulate hormonal balance, enhance menstrual regularity, and heal ovarian structure. Clinical evidence indicates that curcumin supplementation may reduce blood sugar levels, lower insulin resistance, decrease hyperandrogenism, and avoid the risk of obesity, with results similar to those seen with metformin but typically with fewer side effects. Moreover, curcumin enhances insulin sensitivity, helps regulate testosterone levels, normalizes progesterone and oestradiol, and supports ovulation and egg quality. Innovations in formulations techniques, such as nanotechnology can be used for polyherbal combinations, which are designed to overcome curcumin's low oral bioavailability and enhance its clinical effect. While curcumin has potential as supplement for PCOS

Figure 3: Turmeric

Flaxseeds:

Limum usitatissimum, the scientific name for flax, belongs to the Linaceae family. High amounts of fiber, protein, and fat can be found in flaxseed. In addition to vitamins A, B, D, and E, minerals, and amino acids, flaxseed normally contains 30–40% fat, 20–25% protein, 20–28% fiber, 4–8% moisture, and 3–4% ash. Linolenic acid, omega-3 fatty acids, lignans, and mucilage are all abundant in flaxseed oil.

Research indicates that polycystic ovaries raise androgen levels, which can result in obesity, menstruation problems, and hirsutism. A 31-year-old lady with PCOS was studied to determine how consuming 30 grams of flaxseed per day affected her hormone levels. The patient ingested 83% of the recommended flaxseed dosage throughout a four-month period. Prior to and following the follow-up period, height, weight, and fasting blood samples were measured. The body mass index, insulin, serum testosterone, and free serum testosterone were significantly decreased, according to the results. Additionally, the patient claimed less hirsutism, which was consistent with lower androgen levels.

Figure 4 : Flaxseeds

Funnel:

Foeniculum vulgare is the scientific name for fennel, a herbaceous plant that is a member of the *Apiacea*e family. Because fennel is an estrogenic substance, it is used in traditional medicine to treat a variety of digestive, endocrine, reproductive, and menstrual issues. Fennel and its constituents have antibacterial, antifungal, antioxidant, antithrombotic, anti-diabetic, and anti-tumour qualities. In rats with PCOS, the effects of metformin and fennel on uterine tissue and serum levels of progesterone and oestrogen were examined. The results showed that in PCOS rats, fennel decreased oestrogen and uterine epithelial thickness while increasing progesterone and uterine endometrial thickness. Therefore, fennel may shield the uterine tissue of rats with PCOS.

Figure 5 : Funnel

Cinnamon:

Some of the most important and historic herbal remedies used in traditional medicine is *Cinnamomum zeylanicum*, or cinnamon, which belongs to the the *Lauraceae* family of plants. The plant's skin is one of its many sections, and its volatile oil, which includes ingredients like cinnamon aldehyde, eugenol, and safrole, has numerous therapeutic uses. In one study, 15 women with PCOS took 333 mg of oral capsules containing cinnamon extract three times a day for eight weeks. Insulin sensitivity tests were performed on the patients prior to and following the administration of cinnamon extract. The results showed that the patients insulin levels dramatically dropped two hours after

consuming cinnamon extract. Patients' insulin levels were lowered by cinnamon because it increased phosphatidylinvestyl 4-kinase activity.

Figure 6 : Cinnamon

Chamomile:

The scientific name for chamomile is *Chamomilla matricaria*, and it belongs to the *Asteraceae* family of perennial plants. Flavonoid chemicals and antioxidants with unique anti-inflammatory properties can be found in chamomile extract, including gallic acid, kamazelin, farnesene, matricin, coumarin derivatives, apigenin, and choline. Chamomile's antispasmodic properties lessen women's risk of preterm labour and menstrual cramps. Because chamomile stimulates leukocytes, it is used to treat skin issues like eczema. Thirty adult Wistar rats were used in the study to find out how chamomile affected PCOS. Two groups of animals were created: The first group served as the control group, and the second group received an injection of estradiol valerate to induce PCP. For 10 days, the PCOS rats received intraperitoneal injections of chamomile alcoholic extract at several concentrations (25, 50, and 75 mg/kg). Tests on tissue and hormones revealed that chamomile could boost LH secretion, increase the number of uterine follicles, and lessen PCOS symptoms in ovarian tissue.

Figure 7 : Chamomile

The Chaste tree:

Vitex agnus-castes L., the scientific name for the chaste tree, is a member of the *Verbenaceae* family. Iridoids, flavonoids, alkaloids, glycosides, and steroids are the most significant chemical components found in the woody limbs, leaves, and fruits of Vitex agnus-castus. The primary components of this plant's various portions are flavonoids. The extract from Vitex agnus-cactus possesses anti-inflammatory and wound-healing properties. Its leaves' essential oil exhibits antibacterial properties against both gram-positive and gram-negative bacteria. This plant's extract treats premenstrual syndrome, a high estragon-dependent hormonal imbalance, and lessens its symptoms. The quantity and balance of sex hormones are altered by the Vitex agnus-castus extract. Additionally, the plant extract alters the ratio of

estrone to progesterone, converting oestrogen into progesterone. 93 women who intended to become pregnant within the following six to thirty-six months were split into two groups: a control group and a group that received vitamins, minerals, and Vitex agnus-castus extract through diet. After three months, the Four of the forty women in the control group became pregnant, compared to fourteen of the fifty-three women who received the supplemental diet. 500–1000 was the suggested dosage. A study on how Vitex agnus-castus fruit hydroalcoholic extract affects sex hormone alterations in PCOS The findings demonstrated that the PCOS patients' levels of progesterone and estrogen dropped following letrozole therapy. When this plant extract was administered to PCOS patients, the serum levels of progesterone increased and testosterone decreased, but the levels of estradiol and DHEA remained unchanged. By metabolizing testosterone and changing it into estradiol, the plant extract may also boost the activity of the aromatase enzyme and lower testosterone levels. Women's early luteal phase progesterone levels spiked and their menstrual cycles resumed as usual.

Figure 8: Chasteberry

Aloe vera:

Aloe vera, also known as *Aloe arborescens*, is a perennial herbaceous plant in the *Liliaceae* family. This plant contains vitamins A, C, and E. It also has antioxidant properties due to the reduction in lipid peroxidation. Aloe vera is rich in nutrients and minerals, as well as salicylic acid, enzymes, tannins, and polysaccharides. Aloe vera gel's polysaccharide components have anti-inflammatory and reparative properties. These substances are also antimicrobial and antibacterial. The study explored the effects of aloe vera gel on PCOS in rats. Female rats were induced with PCOS by administering letrozole orally for 5 months. Afterward, they were given 1 ml of aloe vera gel daily for 45 days. The study evaluated the rats' oestrous cycle, glucose sensitivity, and steroidogenic activity. The results showed that aloe vera gel, combined with a stimulant, prevented the development of PCOS in the rats. Aloe vera gel protects against PCOS by restoring ovarian steroid balance and modifying steroidogenic activity, attributed to plant compounds like phytosterols and Phyto phenols. It also inhibits 3β-HSD enzyme activity and regulates estradiol formation.

Figure 9 : Aloe vera

Synthesis of Evidence

- **Insulin sensitivity and metabolic indices:**

Myo-inositol, curcumin, cinnamon, berberine, fenugreek and green tea show consistent signals of lowering fasting insulin, HOMA-IR or improving lipids in multiple small RCTs and meta-analyses. The strength of evidence is highest for myo-inositol and moderate for cinnamon and green tea; berberine shows promise with some trials suggesting similar short-term effects to metformin.

• **Menstrual regularity and ovulation**:

RCTs show that MI and certain herbal extracts (Vitex, fenugreek, and berberine) improve menstrual cyclicity and ovulatory rates; however, the quality of the evidence varies and the outcome measures (clinical vs. biochemical ovulation) are different. In assisted reproduction settings, some formulations that combine MI with DCI or other nutraceuticals demonstrate better ovulation and pregnancy outcomes.

• **Results for hyperandrogenic symptoms**

Hirsutism, acne are conflicting; some studies found reductions in biochemical androgens (liquorice components) or hirsutism scores (fenugreek, flaxseed), but the degree and clinical significance varied.

• **Weight and body composition:**

The most reliable evidence for a slight reduction in weight in PCOS cohorts is found in green tea and flaxseed; results for cinnamon are inconsistent. The main strategy for long-term weight loss is still changing one's lifestyle.

Formulation types

Herbal products tested or described for PCOS span traditional preparations and modern dosage forms; reviews and experimental reports document decoctions, whole-herb and solvent extracts, standardized capsule extracts, polyherbal powders, syrups and investigational nanoparticle systems. Clinical and preclinical literature explicitly reports use of formula decoctions and concentrated extracts, while preclinical/dissertation and patent documents describe powders/chooranam and many oral dosage formats respectively

1. **Decoction**: Traditional multiherb boiled preparations used in formula studies and clinical practice

2. **Tea/infusion** Simple hot-water extracts used historically and in some experimental settings

3. **Aqueous or hydroalcoholic extracts**: Concentrated extracts used as investigational agents and for producing standardized products

4. **Standardized extract capsules/tablets**: Commercial or patented standardized extracts delivered orally in capsule/tablet form in clinical trials

5. **Powdered polyherbal formulations**: Classical chooranam/powder forms used in preclinical models and traditional systems

6. **Syrups and oral solutions**: Liquid oral formulations developed for palatability or preclinical use

7. **Nanoparticle or coated systems**: Experimental approaches to improve delivery (for example chitosan-coated nanoparticles) appear in preclinical work.

DISCUSSION:

Numerous herbal and nutraceutical products can positively influence metabolic, endocrine, and (in certain situations) reproductive outcomes in PCOS, according to an increasing amount of preclinical and clinical research. Agents that enhance insulin signalling (inositol's, berberine, cinnamon), lower oxidative stress and inflammation (curcumin, green tea), or alter steroidogenic pathways (liquorice, fenugreek, Moreover, there is insufficient information on the long-term safety, pregnancy safety, and interactions with traditional fertility drugs. When there is evidence to support their benefits, herbal remedies may be best used as supplements to traditional medical therapy and lifestyle changes, or

as alternatives for patients who are intolerant of conventional medications. However, this should only be done after counselling regarding the scant evidence and problems with quality control. Clinical practice should emphasize individualized care: evaluate PCOS phenotype, metabolic risk, fertility desires, concomitant medications, and preferences; if herbal/nutraceutical therapy is considered, use standardized products with defined dosages, monitor metabolic/hormonal parameters, and avoid unmonitored combinations. Because the composition and danger of contamination of supplements can vary greatly, regulatory supervision and improved pharmacovigilance are required.

CONCLUSION:

Nutraceuticals and herbal medications have the potential to improve insulin resistance, metabolic profiles, and menstrual regularity in the treatment of PCOS. With supporting evidence for curcumin, cinnamon, green tea, fenugreek, flaxseed, liquorice, and berberine, myo-inositol has the most robust and reliable evidence basis. However, there are currently insufficient long-term safety data, inconsistent trial designs, and product standards that make it impossible to completely substitute proven treatments. To determine the best indications, dosage, safety, and clinical integration for CAM usage in PCOS, high-quality RCTs, standardized formulations, and integrated clinical guidelines are desperately needed.

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