



Herbal Approaches for Managing Polycystic Ovary Syndrome (PCOS): Mechanisms of Action and Therapeutic Potential.

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Abstract:

This review examines the use of herbal interventions for managing Polycystic Ovary Syndrome (PCOS), a prevalent endocrine disorder in reproductive-aged women. PCOS involves hormonal imbalances, metabolic irregularities, and ovarian dysfunction. Conventional treatments have limitations, prompting exploration of alternative options. Herbal medicine, known for its holistic approach, offers potential effectiveness with favorable safety profiles. The review delves into PCOS symptoms, causes, involved organs, histological features, and Ayurvedic herbal remedies. By understanding the mechanisms of action, this review contributes to the growing evidence supporting the integration of herbal interventions into PCOS treatment regimens for a comprehensive and multi-targeted approach.

Key-words

Polycystic Ovary Syndrome (PCOS), Herbal interventions, Hormonal balance, Menstrual irregularities, Insulin resistance, Fertility.

Introduction

Polycystic Ovary Syndrome (PCOS) stands as one of the most prevalent endocrine disorders affecting reproductive-aged women globally [3]. Characterized by a complex interplay of hormonal imbalances, metabolic irregularities, and ovarian dysfunction, PCOS poses a significant challenge to both patients and healthcare practitioners [3,5]. While conventional treatments offer symptomatic relief, their limitations and potential side effects have driven the exploration of alternative therapeutic options, including herbal interventions [5,7]. Herbal medicine has been an integral part of healthcare systems for centuries, offering a holistic and often gentler approach to managing various health conditions [6,9,15]. The use of herbal drugs for the treatment of PCOS has garnered substantial attention in recent years due to their potential effectiveness and relatively favorable safety profiles [2,7]. Unlike conventional pharmaceuticals, herbal remedies offer a diverse array of bioactive compounds that target multiple aspects of PCOS pathophysiology simultaneously [8,9]. The purpose of this review article is to provide an in-depth analysis of the current state of knowledge regarding herbal drugs used in the management of PCOS [5,7]. By exploring the mechanisms of action through which these botanical agents exert their effects, we aim to shed light on their therapeutic potential and contribute to the growing body of evidence supporting their integration into PCOS treatment regimens [5].

Symptoms

The symptoms of Polycystic Ovary Syndrome (PCOS) can vary widely among individuals, presenting a complex constellation of endocrine, metabolic, and reproductive disturbances [3]. PCOS is a heterogeneous disorder, often characterized by the following clinical manifestations [3,5,7]:

Menstrual Irregularities:

One of the hallmark symptoms of PCOS is irregular menstrual cycles. Women with PCOS experience infrequent, absent, or prolonged menstrual periods, often due to anovulation (lack of ovulation) [2,7].

Hyperandrogenism:

Increased androgen levels, commonly known as "male hormones," can lead to an hormonal imbalance resulting in hirsutism, marked by excessive facial and body hair, the onset of acne, and the manifestation of masculine traits, including pattern baldness known as androgenic alopecia [8,14].

Polycystic Ovaries: As the name suggests, PCOS is characterized by the presence of multiple small cysts on the ovaries, which can be visualized through ultrasound.

However, not all women with PCOS will necessarily have this feature [2,6].

Metabolic Abnormalities: Many women with PCOS experience metabolic disturbances, including insulin resistance, which can lead to weight gain, abdominal obesity, and an increased risk of type 2 diabetes. These factors contribute to an

increased risk of cardiovascular disease [8,11].

Weight Gain: PCOS is often associated with weight gain and obesity, which can exacerbate insulin resistance and further complicate the hormonal imbalance [3,12].

Skin Issues: In addition to acne, PCOS cause skin-related problems such as acanthosis nigricans (dark, thickened patches of skin) and skin tags [3,6].

Mood Changes: Some individuals with PCOS experience mood swings, anxiety, and depression, potentially influenced by hormonal imbalances and the psychological impact of the condition [5,9].

Fertility Challenges: Due to irregular ovulation or anovulation, PCOS is a common cause of infertility. Women with PCOS struggle to conceive naturally and often require medical intervention [9].

Sleep Disturbances: Sleep apnea and disrupted sleep patterns can occur in individuals with PCOS, potentially linked to metabolic and hormonal imbalances [3,9].

Cardiovascular Risks: PCOS is associated with an increased risk of cardiovascular diseases, including high blood pressure, high cholesterol levels, and an elevated risk of heart disease [10,9].

Reproductive Complications: PCOS can increase the risk of complications during pregnancy, including gestational diabetes, preeclampsia, and preterm birth [3,10].

Causes of PCOS:

The exact causes of Polycystic Ovary Syndrome (PCOS) are not fully understood, but a combination of genetic, hormonal, and environmental factors is believed to play a role in its development. Several contributing factors have been identified [3]:

1. Genetic Predisposition:

There appears to be a strong genetic component to PCOS. Women who have a familial background of PCOS are at a higher risk of experiencing the condition. Specific genes related to insulin signalling, hormone production, and metabolism are thought to be involved [3,10].

2. Hormonal Imbalances:

PCOS is characterized by disruptions in the normal hormonal balance. Increased concentrations of androgens, including testosterone (male hormones) and luteinizing hormone (LH), are commonly observed in women with PCOS. These imbalances can disrupt the menstrual cycle and lead to the development of cysts on the ovaries [10,11].

3. Insulin Resistance:

Insulin, a hormone responsible for regulating blood sugar levels, often faces resistance in many women with PCOS. In such cases, the body's cells do not respond effectively to insulin. Insulin resistance can lead to higher insulin levels, which in turn contribute to increased androgen production by the ovaries [3,10].

4. Inflammation:

Chronic low-grade inflammation is believed to play a role in PCOS. Inflammation can contribute to insulin resistance and disrupt normal ovarian function [8,14].

5. Environmental Factors:

Excessive weight and obesity are associated with a higher risk of PCOS. Adipose (fat) tissue can produce hormones and chemicals that influence insulin sensitivity and hormone levels. Environmental factors such as diet and exposure to endocrine-disrupting chemicals also contribute [7,8,11].

6. Prenatal Factors:

Some research suggests that prenatal factors, such as exposure to high levels of androgens in the womb, influence the development of PCOS later in life [8,15].

7. Lifestyle Factors:

Sedentary lifestyle, poor diet, and stress exacerbate insulin resistance and hormonal imbalances, contributing to the development and progression of PCOS [7].

8. Gut Microbiota:

Emerging research suggests a potential link between gut health and PCOS. Alterations in gut microbiota composition influence inflammation, metabolism, and hormonal regulation [6,8].

Organs involved in PCOS:

Polycystic Ovary Syndrome (PCOS) primarily affects the reproductive and endocrine systems, with several organs playing significant roles in its development and manifestation.

The key organs involved in PCOS include [11,14]:

1. **Ovaries:** The ovaries are central to the development of PCOS. In women with PCOS, the ovaries often contain multiple small follicles that fail to mature and release eggs during the menstrual cycle. These follicles can accumulate, forming cyst-like structures [13,15].

2. **Hypothalamus:** The hypothalamus is a region of the brain that regulates various bodily functions, including the menstrual cycle. Dysregulation of the hypothalamic-pituitary-ovarian (HPO) axis can lead to abnormal hormonal signaling and disrupted ovulation [4].

3. **Pituitary Gland:** The pituitary gland produces hormones that influence various processes, including the release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH). In PCOS, elevated levels of LH relative to FSH can contribute to androgen production by the ovaries [2].

4. **Adrenal Glands:** The adrenal glands, located on top of each kidney, also play a role in androgen production. In PCOS, the adrenal glands can produce excess androgens, contributing to the hyperandrogenism characteristic of the condition [7].

5. **Pancreas:** The pancreas produces insulin, a hormone that regulates blood sugar levels. Insulin resistance, a common feature of PCOS, leads to elevated insulin levels. Insulin resistance can contribute to both metabolic abnormalities and increased androgen production [7].

6. **Adipose Tissue (Fat Cells):** Adipose tissue is not an organ per se, but it plays a significant role in PCOS. Fat tissue produces hormones and chemicals that can influence insulin sensitivity and hormone production. Excessive weight and obesity are associated with a higher risk of PCOS and can exacerbate its symptoms[11].

7. **Liver:** The liver is involved in the metabolism of hormones, including androgens and insulin. It plays a role in maintaining hormonal balance and clearing excess hormones from the bloodstream[5].

8. **Gastrointestinal System:** Emerging research suggests a potential link between gut health and PCOS. Alterations in gut microbiota composition influence inflammation, metabolism, and hormonal regulation[16].

Histological Features of PCOS:

Histological features refer to the microscopic characteristics observed in tissue samples under a microscope. In the context of Polycystic Ovary Syndrome (PCOS), histological examination of ovarian tissue can reveal specific changes that are associated with the condition. It's important to note that while certain histological features are commonly seen in PCOS, not all individuals with PCOS will exhibit the same histological findings. The following are some of the histological features often observed in PCOS[17]:

1. **Ovarian Follicles:** One of the defining histological features of PCOS is the presence of multiple small follicles in the ovaries. These follicles, often referred to as "cysts," are actually immature follicles that have not developed properly. These small follicles can accumulate within the ovaries, giving rise to the characteristic appearance of "polycystic" ovaries [1].

2. **Theca Cell Hyperplasia:** Theca cells are a type of ovarian cell that produces androgens (male hormones). In PCOS, there is often an increase in the number and size of theca cells, leading to excessive androgen production. This contributes to the hormonal imbalances seen in PCOS[18].

3. **Luteinized Granulosa Cells:** Granulosa cells are another type of ovarian cell that plays a role in follicle development. In PCOS, these cells can become "luteinized," meaning they take on characteristics similar to those seen during the luteal phase of the menstrual cycle. This can result in the production of excess androgens and disruption of normal follicle development[1].

4. **Stromal Hyperplasia:** The ovarian stroma refers to the tissue that supports the follicles and contains blood vessels and connective tissue. In PCOS, there can be an increase in the amount of ovarian stromal tissue, contributing to the enlarged appearance of the ovaries[3].

5. **Fibrosis:** Some individuals with PCOS exhibit fibrosis (formation of fibrous tissue) within the ovaries. Fibrosis can impact ovarian function and contribute to the development of cysts[11].

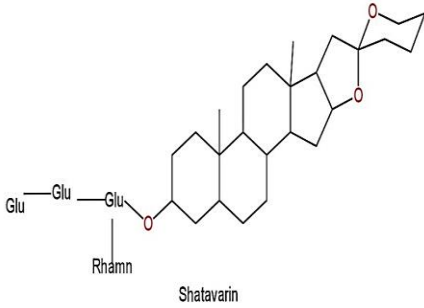
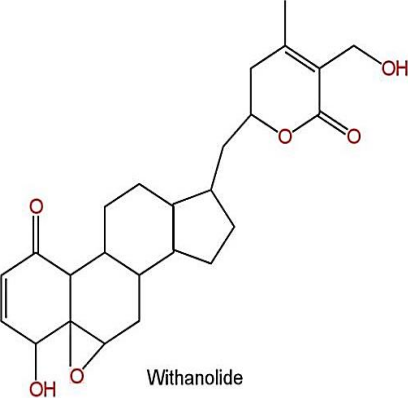
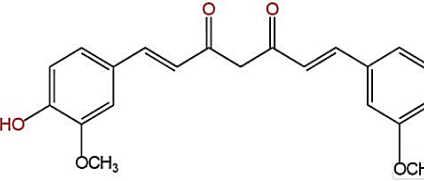
6. **Inflammation:** Inflammation within the ovarian tissue has been observed in some cases of PCOS. This inflammation contribute to insulin resistance and hormonal mbalances[10].


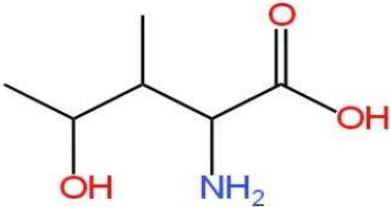
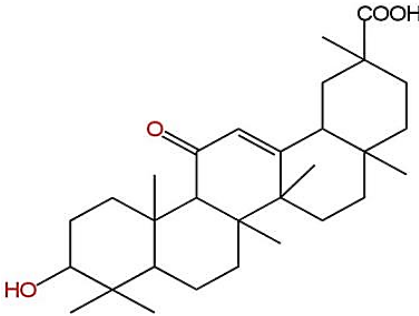
7. **Disrupted Follicle Growth:** Histological examination reveal a lack of mature, fully developed follicles in some individuals with PCOS. Instead, there be an abundance of small, poorly developed follicles[12].

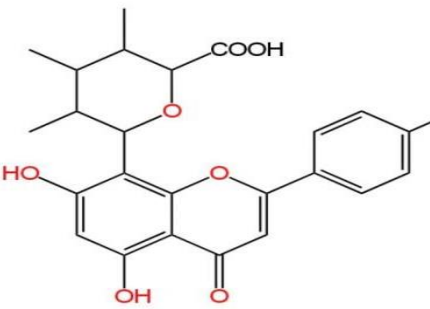
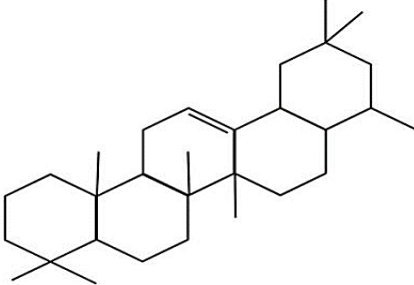
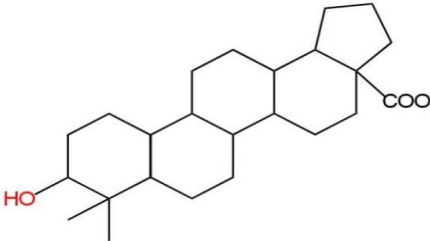
Ayurvedic herbal remedy for PCOS:

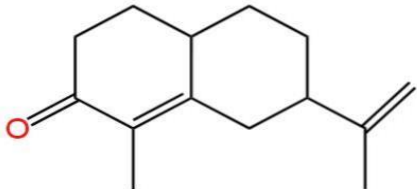
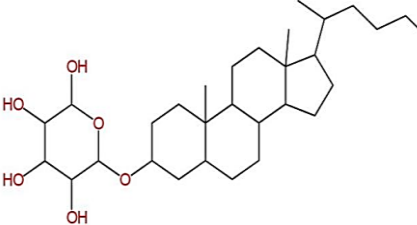
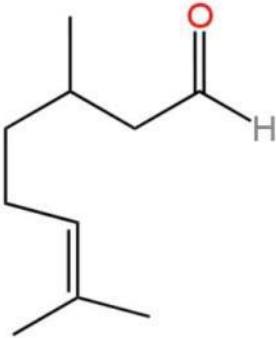
Ayurveda, an ancient system of medicine that originated in India, provides a comprehensive and holistic approach to healthcare that includes herbal remedies. In the context of Polycystic Ovary Syndrome (PCOS), Ayurvedic practitioners recommend various herbs and herbal formulations to help manage symptoms and promote hormonal balance. It's important to note that Ayurvedic treatments are individualized based on the person's unique constitution (dosha) and imbalances, so consulting a qualified Ayurvedic practitioner is recommended before using any herbal remedies. Here are a few Ayurvedic herbs that are commonly used for PCOS[15]:

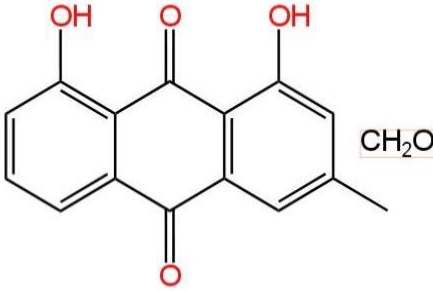
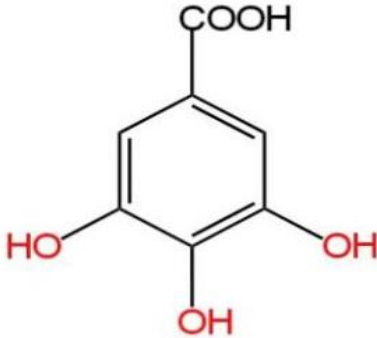
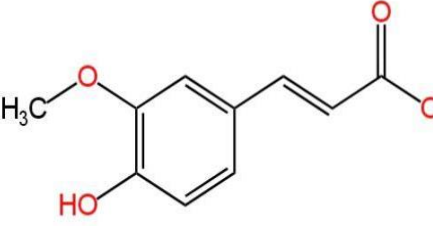
Sr. no.	Herbs	Chemical constituents	Mechanism of action
1.	[17] Shatavari <i>Asparagus racemosus</i> Asparagaceae	<ul style="list-style-type: none"> • Steroidal • Saponins • Mucilage • Alkaloids • Rutin • Shatavarin • Asparagine 	<ul style="list-style-type: none"> ▪ Hormonal Balance: <ul style="list-style-type: none"> - Shatavari's phytoestrogens interact with estrogen receptors. - Potential to reduce androgen excess in PCOS. ▪ Insulin Sensitivity: <ul style="list-style-type: none"> - Shatavari have anti-diabetic and insulin-sensitizing effects. - Beneficial for managing PCOS-related insulin resistance. ▪ Anti-Inflammatory Activity: <ul style="list-style-type: none"> - Shatavari possesses anti-inflammatory properties. - Reduce inflammation associated with PCOS. ▪ Ovulation and Menstrual Regulation: <ul style="list-style-type: none"> - Shatavari's hormonal effects support regular menstrual cycles. - Potential to aid ovulation, addressing PCOS-related irregularities.

		 <p style="text-align: center;">Shatavarin</p>	
<p>2.</p>	<p>[18] Ashwagandha <i>Withania somnifera</i> Solanaceae</p>	<ul style="list-style-type: none"> • Withanone • Withanoside IV • Withanoside V • Sitoindosides • Benzoic acid  <p style="text-align: center;">Withanolide</p>	<ul style="list-style-type: none"> • Hormonal Regulation: <ul style="list-style-type: none"> - Ashwagandha's adaptogenic properties regulate hormonal imbalances. - Reduce androgen excess common in PCOS. <ul style="list-style-type: none"> • Insulin Sensitivity: <ul style="list-style-type: none"> - Ashwagandha have anti-diabetic and insulin-sensitizing effects. - Improving insulin sensitivity manage PCOS-related insulin resistance. • Stress Management: <ul style="list-style-type: none"> - Ashwagandha's adaptogenic properties help cope with stress. - Reducing stress alleviate hormonal imbalances and insulin resistance. • Weight Management: <ul style="list-style-type: none"> - Studies suggest ashwagandha's role in weight management. - reduce body weight and improve body composition, crucial in PCOS. • Lipid Profile: <ul style="list-style-type: none"> - Ashwagandha's lipid-lowering effects benefit managing dyslipidemia in PCOS.
<p>3.</p>	<p>[19] Turmeric <i>Curcuma longa</i> Zingiberaceae</p>	<ul style="list-style-type: none"> ▪ Curcuminoids ▪ Curcumin ▪ Demethoxycurcumin ▪ Bisdemethoxycurcumin ▪ Turmerones ▪ Turmerin ▪ Essential oils  <p style="text-align: center;">Curcumin</p>	<ul style="list-style-type: none"> ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Curcumin in turmeric reduces chronic inflammation associated with PCOS. - Alleviates symptoms like insulin resistance and hormonal imbalances. ▪ Antioxidant Activity: <ul style="list-style-type: none"> - Turmeric's curcumin provides antioxidant protection. - Neutralizes free radicals, supporting cellular health and mitigating PCOS-related complications. ▪ Hormonal Regulation: <ul style="list-style-type: none"> - Turmeric indirectly contributes to hormonal balance. - Reducing inflammation and oxidative stress helps modulate hormone levels, including elevated androgens. ▪ Anti-Androgenic Effects: <ul style="list-style-type: none"> - Research suggests curcumin has anti-androgenic effects. - Helps reduce symptoms related to elevated androgens in PCOS, such as acne and hirsutism. ▪ Lipid Profile Improvement: <ul style="list-style-type: none"> - Curcumin positively impacts lipid metabolism. - Benefits managing dyslipidemia, a common concern in women with PCOS.

<p>4.</p>	<p>[20] Cinnamon</p> <p><i>Cinnamomum verum</i></p> <p>Lauraceae</p>	<ul style="list-style-type: none"> • Cinnamaldehyde • Eugenol • Cinnamic acid • Beta-caryophyllene  <p>Linalool</p>	<ul style="list-style-type: none"> ▪ Insulin Sensitivity: <ul style="list-style-type: none"> - Cinnamon improves insulin sensitivity in PCOS. - Enhances insulin signaling, aiding glucose uptake. ▪ Blood Glucose Regulation: <ul style="list-style-type: none"> - Regulates blood glucose levels. - Stabilizes blood sugar, reducing post-meal spikes in PCOS. ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Cinnamon reduces chronic inflammation in PCOS. - Alleviates associated symptoms. ▪ Ovulation and Menstrual Regularity: <ul style="list-style-type: none"> - Cinnamon restore menstrual regularity. - Improves insulin sensitivity for better ovulation in PCOS. ▪ Hormonal Balance: <ul style="list-style-type: none"> - Contributes to hormonal balance. - Reduces elevated androgen levels in PCOS. ▪ Antioxidant Properties: <ul style="list-style-type: none"> - Cinnamon's antioxidants neutralize free radicals. - Positively impacts overall health, managing PCOS complications.
<p>5.</p>	<p>[21] Fenugreek</p> <p><i>Trigonella foenum-graecum</i></p> <p>Fabaceae</p>	<ul style="list-style-type: none"> • Trigonelline • 4-hydroxyisoleucine • Diosgenin • Vitexin • Rutin  <p>4-Hydroxyisoleucine</p>	<ul style="list-style-type: none"> ▪ Hormonal Balance: <ul style="list-style-type: none"> - Fenugreek regulates hormones, addressing elevated androgens in PCOS. ▪ Insulin Sensitivity: <ul style="list-style-type: none"> - Improves insulin sensitivity, reducing androgen production in PCOS. ▪ Blood Sugar Regulation: <ul style="list-style-type: none"> - Stabilizes blood sugar by slowing carbohydrate digestion. ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Contains compounds with potential anti-inflammatory properties. ▪ Ovulation and Menstrual Regularity: <ul style="list-style-type: none"> - Restores regular ovulatory cycles, linked to improved hormonal balance. ▪ Weight Management: <ul style="list-style-type: none"> - Supports weight management by influencing insulin and blood sugar. ▪ Fertility Support: <ul style="list-style-type: none"> - Enhances fertility through improved hormonal balance and regular cycles.
<p>6.</p>	<p>[22] Licorice</p> <p><i>Glycyrrhiza glabra</i></p> <p>Fabaceae</p>	<ul style="list-style-type: none"> • Glycyrrhizin • Anethole • Polysaccharides • Triterpenoids • Isoflavonoids  <p>Glycyrrhetic acid</p>	<ul style="list-style-type: none"> ▪ Hormonal Regulation: <ul style="list-style-type: none"> - Licorice's phytoestrogens interact with estrogen receptors, influencing hormonal balance. ▪ Glucose Regulation: <ul style="list-style-type: none"> - Studied for positive effects on glucose metabolism; caution due to cortisol impact. ▪ Caution and Considerations: <ul style="list-style-type: none"> - Glycyrrhizin in licorice raises cortisol, worsening insulin resistance in PCOS. ▪ Hypertension Risk: <ul style="list-style-type: none"> - Glycyrrhizin can lead to sodium retention, raising blood pressure; caution in hypertension.
<p>7.</p>	<p>[13] Chasteberry Tree</p>	<ul style="list-style-type: none"> • Flavonoids • Iridoids • Essential oils • Diterpenoids 	<ul style="list-style-type: none"> ▪ Hormonal Regulation: <ul style="list-style-type: none"> - Chaste Tree influences hormone production via the pituitary gland.

	<p><i>Vitex agnus-castus</i></p> <p>Verbenaceae</p>	<ul style="list-style-type: none"> • Vitexin • Agnuside  <p>Vitexin</p>	<ul style="list-style-type: none"> - Helps regulate LH to FSH ratio disrupted in PCOS. <ul style="list-style-type: none"> ▪ Prolactin Regulation: <ul style="list-style-type: none"> - Normalizes prolactin levels, supporting ovulation and menstruation. ▪ Supporting Corpus Luteum Formation: <ul style="list-style-type: none"> - Aids in corpus luteum formation, crucial for progesterone production. ▪ Regulating Menstrual Cycles: <ul style="list-style-type: none"> - Influences hormonal balance, restoring regular cycles in PCOS. ▪ PMS and Premenstrual Symptoms: <ul style="list-style-type: none"> - Alleviates premenstrual symptoms, addressing hormonal fluctuations.
<p>8.</p>	<p>[15] Gymnema</p> <p><i>Gymnema sylvestre</i></p> <p>Apocynaceae</p>	<ul style="list-style-type: none"> • Gymnemic acids • Saponins • Flavonoids • Quercetin • Kaempferol  <p>Gymnemic acid</p>	<ul style="list-style-type: none"> ▪ Sweet Taste Suppression: <ul style="list-style-type: none"> - Gymnema's compounds block sweetness receptors, reducing appeal of sweet foods. ▪ Blood Sugar Regulation: <ul style="list-style-type: none"> - Gymnema reduces sweetness perception, aiding blood sugar control and curbing cravings. ▪ Reducing Sugar Absorption: <ul style="list-style-type: none"> - Inhibit sugar absorption, preventing rapid blood sugar spikes after meals. ▪ Insulin Sensitivity: <ul style="list-style-type: none"> - Studied for enhancing insulin sensitivity, crucial for blood sugar control. ▪ Beta-Cell Function: <ul style="list-style-type: none"> - Gymnema support beta cell health and insulin production. ▪ Appetite Regulation: <ul style="list-style-type: none"> - Gymnema's sweetness reduction helps control cravings, supporting weight management.
<p>9.</p>	<p>[15] Lodhra</p> <p><i>Symplocos racemose</i></p> <p>Symplocaceae</p>	<ul style="list-style-type: none"> • Tannins • Flavonoids • Quercetin • Gallic acid • Betulinic acid  <p>Betulinic Acid</p>	<ul style="list-style-type: none"> ▪ Hormone Modulation: <ul style="list-style-type: none"> - Lodhra regulates menstrual cycles and hormonal imbalances in PCOS. ▪ Anti-Inflammatory Properties: <ul style="list-style-type: none"> - Contains compounds with potential anti-inflammatory effects ▪ Ovulation Support: <ul style="list-style-type: none"> - Traditionally aids ovulation and fertility, promoting regular cycles in PCOS. ▪ Digestive Health: <ul style="list-style-type: none"> - Traditionally supports digestive health, indirectly influencing hormone balance.
<p>10.</p>	<p>[15] Musta</p> <p><i>Cyperus rotundus</i></p> <p>Cyperaceae</p>	<ul style="list-style-type: none"> • Cyperene • Cyperol • Cyperotundone • Cyperotundene • Cyperone 	<ul style="list-style-type: none"> - Hormonal Balance: <ul style="list-style-type: none"> - Musta regulates hormones, aiding in PCOS symptom management. - Anti-Inflammatory Properties: <ul style="list-style-type: none"> - Contains compounds with anti-inflammatory effects. - reduce inflammation associated with PCOS symptoms. - Digestive Health: <ul style="list-style-type: none"> - Ayurvedic use supports digestion, indirectly influencing hormone balance.

		 <p style="text-align: center;">Cyperone</p>	
11.	<p>[15] Bitter Melon</p> <p><i>Momordica charantia</i></p> <p>Cucurbitaceae</p>	<ul style="list-style-type: none"> • Charantin • Momordicin • Vicine • Polypeptide-P • Steroids • Alkaloids  <p style="text-align: center;">Charantin</p>	<ul style="list-style-type: none"> ▪ Insulin Sensitivity: <ul style="list-style-type: none"> - Bitter melon improves insulin sensitivity, vital for PCOS. ▪ Blood Sugar Regulation: <ul style="list-style-type: none"> - Enhances glucose metabolism, positively impacting blood sugar levels. ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Exhibits anti-inflammatory properties, potentially reducing PCOS-related inflammation. ▪ Hormonal Balance: <ul style="list-style-type: none"> - Indirectly contributes to hormonal balance through improved insulin sensitivity. ▪ Weight Management: <ul style="list-style-type: none"> - Supports weight management by enhancing insulin sensitivity and blood sugar control.
12.	<p>[15] Lemon Balm</p> <p><i>Melissa officinalis</i></p> <p>Lamiaceae</p>	<ul style="list-style-type: none"> • Citronellal • Geranial • Linalool • Rosmarinic acid • Flavonoids • Polyphenols  <p style="text-align: center;">Citronellal</p>	<ul style="list-style-type: none"> ▪ Stress Reduction: <ul style="list-style-type: none"> - Lemon balm's compounds, like rosmarinic acid and polyphenols, have mild sedative and anxiolytic effects. - Modulates GABA neurotransmitters, calming the central nervous system. ▪ Hormonal Balance (Indirectly): <ul style="list-style-type: none"> Stress reduction by lemon balm indirectly contributes to hormonal balance. - Mitigates chronic stress impact on the endocrine system and hormonal imbalances. ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Lemon balm's rosmarinic acid demonstrates anti-inflammatory properties. - Reducing inflammation is associated with PCOS symptoms, positively impacting overall health. ▪ Sleep Support: <ul style="list-style-type: none"> - Lemon balm's mild sedative effects promote relaxation. - Influences neurotransmitters like GABA, potentially improving sleep quality ▪ Digestive Comfort: <ul style="list-style-type: none"> - Traditionally used for digestive support. - Lemon balm's polyphenols ease digestive discomfort.
13.	<p>[23] Aloe Vera</p> <p><i>Aloe barbadensis miller</i></p> <p>Asphodelaceae</p>	<ul style="list-style-type: none"> • Polysaccharides • Anthraquinones • Acemannan • Aloe-emodin • Aloin 	<ul style="list-style-type: none"> ▪ Hormonal Regulation: <ul style="list-style-type: none"> - Dong Quai's phytoestrogens may interact with estrogen receptors, potentially contributing to hormonal balance. ▪ Uterine Muscle Relaxation: <ul style="list-style-type: none"> - Believed to have a muscle-relaxing effect on uterine smooth muscle, aiding in menstrual cramp relief. ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Contains compounds like ferulic acid with potential anti-inflammatory properties. ▪ Menstrual Cycle Regularity:

		 <p style="text-align: center;">Aloe Emodin</p>	<ul style="list-style-type: none"> - Traditionally used to help regulate the menstrual cycle, potentially impacting PCOS symptoms.
14.	<p>[24] Amalaki <i>Emblica officinalis</i> Phyllanthaceae</p>	<ul style="list-style-type: none"> • Vitamin C (ascorbic acid) • Tannins • Flavonoids • Ellagic acid • Gallic acid  <p style="text-align: center;">Gallic Acid</p>	<ul style="list-style-type: none"> ▪ Antioxidant Activity: <ul style="list-style-type: none"> - Amalaki's antioxidants neutralize free radicals, reducing oxidative stress linked to PCOS. ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Compounds in Amalaki have anti-inflammatory properties, potentially alleviating PCOS-related inflammation. ▪ Insulin Sensitivity: <ul style="list-style-type: none"> - Amalaki may improve insulin sensitivity, addressing a key feature of PCOS. ▪ Hormonal Modulation: <ul style="list-style-type: none"> - Phytochemicals in Amalaki may influence hormonal balance, supporting reproductive health. ▪ Liver Function Support: <ul style="list-style-type: none"> - Amalaki supports liver health, aiding in detoxification, which can impact metabolic aspects of PCOS.
15.	<p>[15] Dong Quai <i>Angelica sinensis</i> Apiaceae</p>	<ul style="list-style-type: none"> • Ferulic acid • Ligustilide • Angelic acid • Essential oils • Polysaccharides  <p style="text-align: center;">Ferulic Acid</p>	<ul style="list-style-type: none"> ▪ Phytoestrogenic Activity: <ul style="list-style-type: none"> - Dong Quai contains phytoestrogens, plant compounds with estrogen-like effects. - Interaction with estrogen receptors may contribute to hormonal balance, addressing imbalances in PCOS. ▪ Blood Circulation Enhancement: <ul style="list-style-type: none"> - Believed to have vasodilatory effects, improving blood circulation. - Enhanced circulation may support reproductive health and alleviate menstrual cramps. ▪ Anti-Inflammatory Effects: <ul style="list-style-type: none"> - Compounds in Dong Quai, like ferulic acid, exhibit anti-inflammatory properties. - Reduction of inflammation may positively impact PCOS symptoms. ▪ Uterine Muscle Relaxation: <ul style="list-style-type: none"> - Dong Quai is traditionally used for its muscle-relaxing effects on uterine smooth muscle. - May help ease menstrual cramps and support reproductive health. ▪ Hormonal Modulation: <ul style="list-style-type: none"> - Phytoestrogens in Dong Quai may contribute to hormonal balance. - Potential regulation of estrogen levels may influence PCOS symptoms.

Conclusion:

In summary, Polycystic Ovary Syndrome (PCOS) poses a complex challenge, and while conventional treatments offer relief, their limitations drive the exploration of alternative approaches, notably herbal interventions. This review has highlighted the diverse symptoms, contributing factors, and histological features of PCOS. Herbal medicine, particularly Ayurvedic remedies, emerges as a promising, personalized, and multi-targeted strategy.

Integrating herbal interventions into PCOS management holds significant potential, emphasizing the need for further research and collaborative efforts to enhance comprehensive

care for individuals with PCOS.

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