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AYURVEDIC PERSPECTIVE ON INSULIN RESISTANCE IN POLYCYSTIC OVARY SYNDROME

Dr. Diwiyani Ashok Patel[1]*, Dr. Pradnya Deshmukh[2]

*[1]Postgraduate Scholar, Department of Prasuti Tantra Evum Striroga, S.M.B.T. Ayurved College and Hospital, Dhamangaon, Igatpuri, Nashik, Maharashtra, India.

[2]Professor & Guide, Department of Prasuti Tantra Evum Striroga, S.M.B.T. Ayurved College and Hospital, Dhamangaon, Igatpuri, Nashik, Maharashtra, India.

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***Corresponding Author**

Dr. Diwiyani Ashok Patel

Postgraduate Scholar, Department of Prasuti Tantra Evum Striroga, S.M.B.T. Ayurved College and Hospital, Dhamangaon, Igatpuri, Nashik, Maharashtra, India.

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) is a common endocrine and metabolic disorder in women of reproductive age. Insulin resistance (IR) and compensatory hyperinsulinemia are key factors in its development, affecting 50–80% of those with the condition. These metabolic issues increase the risk of type 2 diabetes and cardiovascular disease while worsening hyperandrogenism and ovulatory dysfunction. **Objective:** This review aims to connect the modern scientific understanding of insulin resistance in PCOS with classical Ayurvedic concepts, establishing a systematic pathophysiology (*Samprapti*) and a structured management protocol. **Methods:** Classical Ayurvedic texts, including the *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, and *Kashyapa Samhita*, were reviewed alongside modern scientific literature retrieved from electronic databases such as PubMed, Google Scholar, and the AYUSH Research Portal. **Results:** Modern features of PCOS with insulin resistance correlate with Ayurvedic concepts such as *Agnimandya* (impaired metabolic fire), *Ama* (toxic metabolic waste), *Kapha-Meda Vriddhi* (excessive adipose and mucous tissue), *Srotorodha* (obstruction of microchannels), and *Apana Vata Dushti*. Treatment involves a structured approach: *Nidana Parivarjana* (avoiding causative factors), *Agni Deepana* (enhancing digestion), *Ama Pachana* (detoxification), *Srotoshodhana* (clearing channels), *Artava Janana* (inducing ovulation), and *Rasayana* (rejuvenation).

Conclusion: Integrating Ayurvedic management—such as personalized herbs, dietary changes, yoga, and *Panchakarma*—with conventional medical insights offers a comprehensive approach to addressing the metabolic and reproductive challenges of PCOS. Further clinical studies are needed to confirm these therapeutic benefits.

KEYWORDS: Polycystic ovary syndrome, Insulin resistance, Ayurveda, *Agnimandya*, *Ama*, *Artava Kshaya*, *Pushpaghni Jataharini*, Integrative medicine.

1. INTRODUCTION

Polycystic ovary syndrome (PCOS) is a highly prevalent endocrine and metabolic disorder, affecting approximately 8% to 13% of reproductive-aged women worldwide.[1,2] It is clinically characterized by a triad of hyperandrogenism, ovulatory dysfunction (oligomenorrhea or amenorrhea), and polycystic ovarian morphology.[3] While initially viewed primarily as a reproductive disorder, PCOS is now recognized as a complex metabolic syndrome with significant long-term health implications.[4]

Among the primary drivers of PCOS, insulin resistance (IR) plays a central pathophysiological role, independent of obesity.[5] Insulin resistance is defined as a subnormal biological response to a given concentration of insulin, primarily within skeletal muscle, adipose tissue, and the liver. To maintain euglycemia, the pancreatic beta-cells secrete compensatory excess insulin, resulting in chronic hyperinsulinemia.[6] This excess circulating insulin acts synergistically with luteinizing hormone (LH) on ovarian theca cells to stimulate androgen synthesis. Concurrently, it suppresses the hepatic production of sex hormone-binding globulin (SHBG), increasing free, biologically active circulating testosterone[7] . This hormonal imbalance impairs follicular development, leading to follicular arrest, multiple small subcortical cysts, and anovulation.

Although classical Ayurvedic literature does not mention "Polycystic Ovary Syndrome" by name, its clinical features correspond closely to several gynecological and metabolic conditions described in ancient texts. These include *Artava Kshaya* (deficiency of menstrual fluid), *Nashtartava* (amenorrhea), *Vandhyatva* (infertility), *Sthoulya* (obesity), and *Pushpaghni Jataharini*—a condition described by Acharya Kashyapa characterized by irregular, anovulatory cycles and excessive physical hair growth.[8]

In Ayurveda, the metabolic abnormalities of insulin resistance can be understood as a systemic dysfunction of *Agni* (the digestive and metabolic fire) leading to the accumulation of *Ama* (undigested toxic metabolites) and subsequent *Srotorodha* (channel obstruction). While conventional management rely primarily on insulin-sensitizing agents like metformin and oral contraceptives, these options may cause side effects and do not address the underlying systemic metabolic imbalance.

This review provides a comparative framework of insulin resistance in PCOS, mapping modern biochemical pathways onto Ayurvedic *Samprapti* (pathogenesis). It outlines a comprehensive treatment approach incorporating dietary (*Ahara*), lifestyle (*Vihara*), purification (*Panchakarma*), and herbal (*Shamana*) interventions.

2. Need of the Study

There is a growing clinical need to find safe, sustainable therapies that address both the reproductive and metabolic issues of PCOS. Correlating modern endocrine pathways with Ayurvedic concepts may help develop standardized, integrative protocols that improve insulin sensitivity and reproductive health.

3. MATERIALS AND METHODS

A comprehensive literature search was conducted across classical Ayurvedic texts and modern peer-reviewed scientific databases, including PubMed, Scopus, Google Scholar, and the AYUSH Research Portal.

Ayurvedic Sources: The *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, and *Kashyapa Samhita* were analysed for descriptions of *Artava*, *Artavavaha Srotas*, *Pushpaghni Jataharini*, *Agnimandya*, *Ama*, *Medoroga*, and *Yoni Vyapad*.

Modern Scientific Sources: Search terms included "Polycystic Ovary Syndrome", "Insulin Resistance", "Hyperinsulinemia", "Ayurvedic management of PCOS", "Berberine and PCOS", and "Pathophysiology of PCOS".

Inclusion Criteria: Clinical trials, systematic reviews, observational studies, and conceptual reviews published in English between 1997 and 2025 were evaluated.

Exclusion Criteria: Studies on non-insulin-resistant PCOS phenotypes and articles lacking scientific peer validation were excluded.

4. Review of Literature

Modern Perspective on Insulin Resistance in PCOS

In PCOS, insulin resistance is characterized by a post-receptor defect in insulin signaling within insulin-sensitive tissues.[9] Typically, insulin binds to its receptor, activating the insulin receptor substrate (IRS) proteins, which signal through the phosphatidylinositol 3-kinase (PI3K) and Akt pathway. This pathway regulates the translocation of Glucose Transporter-4 (GLUT-4) to the cell membrane, facilitating glucose entry.

In women with PCOS, increased serine phosphorylation of the insulin receptor and IRS-1 impairs this pathway, reducing glucose uptake into skeletal muscle and adipose tissue.[10] Consequently, the pancreas secretes excess insulin to compensate.

This hyperinsulinemia has several detrimental effects

Ovarian Hyperandrogenism: Insulin acts via its own receptor and the IGF-1 receptor in ovarian theca cells, enhancing steroidogenic acute regulatory (StAR) protein and Cyp17a1 enzyme activity, which increases testosterone synthesis.

Hepatic Suppression of SHBG: High insulin levels reduce hepatic SHBG production, increasing free, biologically active androgens in the blood.

Pituitary Dysregulation: Hyperinsulinemia increases the sensitivity of the pituitary gland to gonadotropin-releasing hormone (GnRH), raising the LH-to-FSH ratio and further driving ovarian androgen production.

Follicular Arrest: High local androgen levels inside the ovary, along with impaired insulin action, halt follicular development, leading to the accumulation of immature follicles.

[Genetic/Environmental Triggers] + [Excess Visceral Adiposity]

↓

[Insulin Receptor Defect]

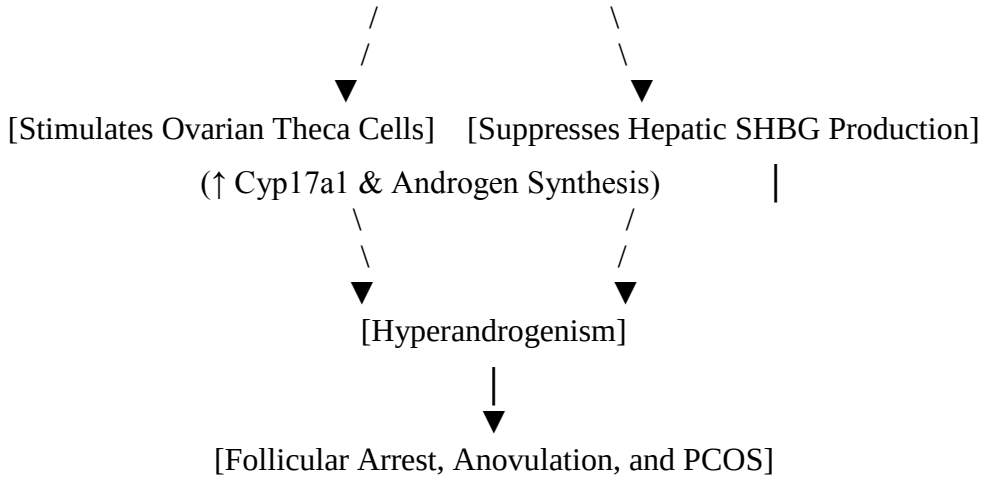
(↓ PI3K/Akt Pathway & GLUT-4 Translocation)

↓

[Insulin Resistance]

↓

[Compensatory Hyperinsulinemia]



Ayurvedic Conceptualization of Insulin Resistance in PCOS

Ayurveda views health as a state of balance between the three *Doshas* (*Vata*, *Pitta*, *Kapha*), the seven tissues (*Dhatus*), the waste products (*Malas*), and the metabolic fire (*Agni*).[11] Rather than focusing on a single organ, Ayurveda considers PCOS with insulin resistance to be a systemic metabolic disorder (*Sarvadehika Vyadhi*).

The condition is characterized by *Kapha-Meda Pradhana Tridosha Dushti* with *Apana Vata* involvement. The primary metabolic issues of insulin resistance are attributed to:

***Jatharagni Mandya* and *Dhatvagni Mandya*:** A reduction in digestive and metabolic fire, particularly affecting the metabolism of *Meda Dhatu* (adipose tissue) and *Artava Dhatu* (reproductive tissue).

***Ama Utpatti*:** Incomplete digestion and metabolic conversion produce *Ama*, a toxic, sticky substance. At a cellular level, *Ama* functions similarly to insulin resistance, blocking cell membranes and impairing hormone binding.

***Srotorodha*:** The circulation of *Ama* and excess *Kapha-Meda* leads to channel obstruction, particularly in the *Rasavaha* (nutrient-carrying), *Medovaha* (lipid-carrying), and *Artavavaha* (reproductive) *Srotas* (channels).[12] This block prevents essential nutrients (*Rasa*) from reaching the ovaries, impairing follicular development.

***Apana Vata Vaigunya*:** *Srotorodha* blocks the normal, downward flow of *Apana Vata*, which regulates menstruation, ovulation, and waste elimination. This leads to *Artava Kshaya* (irregular or scanty menses) and *Vandhyatva* (infertility).

Modern Concept	Ayurvedic Interpretation	Pathological Significance
Insulin Resistance	*Agnimandya + Ama Utpatti*	Cellular accumulation of *Ama* blocking hormone receptors.
Hyperinsulinemia	*Kapha-Meda Vriddhi*	Overproduction of secondary metabolic factors causing tissue overgrowth.
Obesity / Visceral Adiposity	*Sthoulya* / *Medoroga*	Impaired *Medas Dhatvagni* leading to accumulation of abnormal fat.
Chronic Low-Grade Inflammation	*Ama Janya Vyadhi*	Systemic toxicity and immune activation due to circulating *Ama*.
Oxidative Stress	*Dhatvagni Dushti*	Cellular-level metabolic fire failure, leading to tissue damage.
Hyperandrogenism	*Artava Vaigunya*	Impaired quality and function of the female reproductive element.
Anovulation	*Apana Vata Dushti*	Dysfunction in the downward nervous and physical force governing ovulation.
Polycystic Ovarian Morphology	*Pushpaghni Jataharini* / *Artava Srotorodha*	Accumulation of undeveloped follicles (*Beeja*) due to channel block.
Infertility	*Vandhyatva*	Inability to conceive due to poor ovulatory function and tissue quality.

Detailed Pathogenesis (*Samprapti*)

The progression of insulin-resistant PCOS is initiated by *Nidana Sevana* (causative factors):

- **Dietary (*Ahara*):** Excessive intake of sweet, heavy, cold, and oily foods (*Guru, Snigdha, Madhura, Sheeta Ahara*), refined flour, and processed foods.
- **Lifestyle (*Vihara*):** Sedentary habits (*Alpa Vyayama*), daytime sleeping (*Divaswapna*), late-night sleeping, and high stress (*Manasika Klesha*).

These causative factors reduce *Jatharagni* (digestive capacity), producing *Ama*.

This *Ama* circulates and mixes with *Kapha* and *Meda*, impairing the metabolic fires at the tissue level (*Dhatvagni Mandya*).

The accumulation of abnormal *Meda Dhatu* leads to obesity and causes *Srotorodha* (obstruction) in the *Medovaha* and *Artavavaha Srotas*. This blockage limits nutrients from reaching the *Artava Dhatu*, leading to poor follicle development (*Artava Kshaya* / *Beeja Dushti*) and preventing ovulation.

This blockage also disrupts *Apana Vata*, leading to menstrual irregularity, insulin resistance, hyperandrogenism, and metabolic syndrome.

Nidana Sevana (Ahara & Vihara causative factors)

↓

Jatharagni Mandya

↓

Ama Utpatti

↓

Ama & Kapha-Meda Dushti (Tissue toxicity)

↓

Srotorodha (Obstruction of Medovaha & Artavavaha Srotas)

↓

Meda Dhatu Vriddhi & Dhatvagni Mandya (Obesity)

↓

Apana Vata Dushti & Artava Dhatu Dushti

↓

Artava Kshaya / Beeja Dushti

↓

Anovulation and Follicular Arrest

↓

Polycystic Ovary Syndrome with Insulin Resistance

Pathological Component (*Samprapti Ghataka*)	Description
Dosha	*Kapha Pradhana Tridosha* (with *Apana Vata Dushti*)
Dushya	*Rasa, Meda, Mamsa, Artava Dhatu*
Agni	*Jatharagni Mandya, Dhatvagni Mandya* (especially *Meda* and *Artava*)
Ama	*Sama-avastha* (presence of circulating systemic *Ama*)
Srotas	*Rasavaha, Medovaha, Artavavaha Srotas*
Srotodushti	*Sanga* (obstruction)
Udbhava Sthana	*Amashaya* (stomach and upper GI tract)
Sanchara Sthana	*Rasavaha Srotas* (systemic circulation)
Adhisthana	*Ovary* (*Artavashaya*) and adipose tissue (*Meda Dhatu*)
Vyakta Sthana	Reproductive tract and metabolic tissues
Roga Marga	*Abhyantara* (internal pathway)
Roga Swabhava	*Chirakari* (chronic condition)

5. Ayurvedic Management Principles

Effective management of insulin-resistant PCOS requires correcting the underlying metabolic dysfunction, clearing channel obstructions, and restoring endocrine balance.

[Diagnosis of PCOS with Insulin Resistance]

↓

[Nidana Parivarjana]

(Avoidance of causative diet & habits)

↓

[Ahara & Vihara Correction]

(Anti-Kapha diet & regular yoga)

↓

[Agni Deepana & Ama Pachana]

(Clearing toxic systemic Ama)

↓

[Kapha-Medohara Chikitsa]

(Improving metabolic sensitivity)

↓

[Panchakarma (if clinically indicated)]

(Vamana, Virechana, or Basti)

↓

[Artava Janana & Vata Anulomana]

(Regulating ovulation & menses)

↓

[Rasayana Therapy]

(Long-term cellular rejuvenation)

1. Nidana Parivarjana (Elimination of Causative Factors)

- The first step is avoiding dietary and lifestyle factors that aggravate *Kapha* and *Meda*:
- Dietary Factors to Avoid: Refined sugars, sweets, *Maida* (refined wheat), deep-fried foods, processed bakery items, excess dairy, cold foods, and frequent snacking.

- Lifestyle Factors to Avoid: Sedentary habits, *Divaswapna* (daytime napping), late-night sleeping, lack of exercise, and chronic stress.

2. Ahara Chikitsa (Nutritional Therapy)

- Dietary interventions focus on a *Kapha-Medohara* (fat-reducing) and low-glycemic approach:
- Recommended Foods: Barley (*Yava*), millets (Jowar, Bajra, Ragi), green gram (*Mudga*), horse gram (*Kulattha*), bitter gourd, fenugreek, drumstick leaves, and green leafy vegetables.
- Restricted Foods: White rice, sugary beverages, processed foods, potatoes, and red meat.

3. Vihara Chikitsa (Lifestyle & Yoga Therapy)

- Physical activity is essential to improve insulin sensitivity and reduce *Meda* tissue:
- Exercise: 30–45 minutes of daily brisk walking or resistance exercise to increase GLUT-4 translocation in skeletal muscle.
- Yogasanas: *Surya Namaskar*, *Baddha Konasana* (Bound Angle Pose), *Bhujangasana* (Cobra Pose), *Dhanurasana* (Bow Pose), *Paschimottanasana* (Seated Forward Bend), and *Setu Bandhasana* (Bridge Pose). These poses improve circulation to the pelvic region and support ovarian function.
- Pranayama: *Anulom Vilom*, *Nadi Shodhana*, and *Kapalabhati* (if appropriate) help balance the autonomic nervous system and lower stress-induced cortisol.

4. Panchakarma (Bio-Purification)

- When indicated, systemic detoxification helps clear severe channel blockages (*Srotoshodhana*):
- Udvartana: Dry herbal powder massage using *Kapha-Medohara* herbs. This stimulates circulation, reduces subcutaneous fat, and improves metabolism.
- Vamana (Therapeutic Emesis): Indicated for *Kapha*-dominant, obese patients to clear excess *Kapha* and *Ama* from the upper body.
- Virechana (Therapeutic Purgation): Helps balance *Pitta* and *Kapha*, supports liver function, and regulates hormone metabolism.
- Basti (Medicated Enema): Particularly *Lekhana Basti* (scraping enema) or *Matra Basti* with Vata-soothing oils. Basti regulates *Apana Vata*, helping restore regular ovulation and menstrual cycles.

5. Shamana Chikitsa (Herbal Therapy)

Several Ayurvedic herbs help address insulin resistance, inflammation, and ovarian function:

Herb / Drug	Botanical Name	Ayurvedic Action	Proposed Modern Mechanism
Daruharidra	*Berberis aristata*	*Kapha-Medohara, Lekhana*	Rich in berberine; activates AMPK, improves insulin sensitivity, and reduces ovarian androgen synthesis.[13,14]
Guduchi	*Tinospora cordifolia*	*Rasayana, Ama Pachana*	Modulates immune response, reduces chronic low-grade inflammation, and lowers systemic oxidative stress.[15]
Amalaki	*Emblica officinalis*	*Rasayana, Vrishya*	Rich in vitamin C and polyphenols; reduces oxidative stress, protects pancreatic beta-cells, and improves lipid profiles.[16]
Ashwagandha	*Withania somnifera*	*Balya, Rasayana, Vata-Hara*	Acts as an adaptogen; reduces cortisol, balances the HPO axis, and improves insulin sensitivity.[17]
Guggulu	*Commiphora mukul*	*Lekhana, Medohara*	Contains guggulsterones; regulates lipid metabolism, lowers LDL, and reduces chronic vascular inflammation.
Triphala	Three Myrobalans formulation	*Deepana, Pachana, Srotoshodhana*	Improves digestion, supports a healthy gut microbiome, and aids metabolic clearance.
Shilajit	Asphaltum punjabianum	*Rasayana, Medohara*	Enhances mitochondrial energy production and cellular glucose uptake.
Shatapushpa	*Anethum sowa*	*Artava Janana, Vata-Anulomana*	Promotes follicular development, stimulates estrogenic pathways, and regulates ovulation.

6. DISCUSSION

Insulin resistance in PCOS represents a complex systemic condition where metabolic dysfunction directly impairs reproductive health. This dual pathology is well-aligned with the Ayurvedic concept of *Agnimandya* and *Ama*, which lead to *Srotorodha* and *Apana Vata* dysfunction. Rather than treating ovarian cysts as isolated local abnormalities, Ayurveda addresses the underlying metabolic fire (*Agni*) and tissue quality (*Dhatu*) to restore natural physiological function.

Integrating both medical perspectives helps clarify the role of key therapies. For example, the herb *Daruharidra* (*Berberis aristata*) is rich in berberine, an alkaloid shown to activate

adenosine monophosphate-activated protein kinase (AMPK).[14] This biochemical pathway mirrors the Ayurvedic action of *Lekhana* (scraping/clearing) and *Kapha-Medohara* (reducing fatty tissue), helping clear channel obstructions and restore cellular glucose uptake.

Similarly, the use of *Udvartana* and *Panchakarma* therapies, such as *Virechana* and *Lekhana Basti*, is designed to clear systemic *Ama* and reduce *Meda Dhatu*. This matches the modern clinical goals of reducing visceral fat and lowering circulating inflammatory cytokines (like TNF-α and IL-6) to improve insulin receptor signaling.

Clinical Strengths and Limitations

Strengths: This combined approach addresses both metabolic and reproductive aspects of PCOS. Lifestyle, dietary, and herbal interventions focus on correcting root metabolic imbalances, offering a personalized and sustainable alternative to long-term oral contraceptives or insulin sensitizers.

Limitations: Robust, large-scale, randomized controlled clinical trials evaluating standardized Ayurvedic formulations are still limited. The chemical consistency of natural herbal extracts can vary, and more studies are needed to determine safe long-term dosages when combined with conventional medicines like metformin.

Future Perspectives

- Clinical Research: Multi-center, double-blind randomized controlled trials are needed to compare standard Ayurvedic protocols with conventional treatments like metformin.
- Mechanistic Research: Preclinical studies should investigate how formulations like *Triphala*, *Guduchi*, and *Guggulu* influence the insulin signaling pathway (PI3K/Akt) and ovarian steroidogenesis.
- Standardized Diagnostics: Developing integrative diagnostic tools that combine modern metabolic markers (such as HOMA-IR, HbA1c, and lipid profiles) with Ayurvedic assessment methods (*Ashta Vidha Pariksha* and *Samprapti Ghataka* analysis) could improve treatment personalization.

7. CONCLUSION

Insulin resistance is a central metabolic driver in PCOS, contributing to reproductive complications, hyperandrogenism, and long-term cardiovascular risks. Ayurveda offers a

comprehensive framework to understand this pathology as *Agnimandya* leading to *Ama* accumulation, *Srotorodha* in the *Artavavaha Srotas*, and *Apana Vata* dysfunction.

Addressing this condition requires a multi-step approach: removing causative dietary and lifestyle factors (*Nidana Parivarjana*), improving metabolism (*Agni Deepana* and *Ama Pachana*), clearing channel blocks (*Srotoshodhana*), and using targeted herbal therapies like *Berberis aristata* and *Tinospora cordifolia*.

This holistic strategy helps improve insulin sensitivity, restore regular ovulatory cycles, and address the metabolic and endocrine aspects of PCOS. Further collaborative, well-designed clinical studies are needed to validate these integrative protocols in larger patient populations.

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