A Review on the Development of a Standardized Synbiotic Polyherbal Functional Food for Metabolic and Hormonal Health in Women with PCOS

Deepadharshini M., and Dr. P. Vidya

Department of Nutrition and Dietetics, Vellalar College for Women (Autonomous), Thindal, Erode – 638102, Tamil Nadu, India

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ABSTRACT

Polycystic ovary syndrome (PCOS) is a common endocrine and metabolic disorder characterized by reproductive dysfunction, hyperandrogenism, insulin resistance and menstrual irregularities. Growing interest in food-based interventions has encouraged research into functional foods containing probiotics, prebiotics and plant-derived bioactive compounds. Synbiotics combine live microorganisms with substrates that support beneficial microbial activity, potentially influencing glucose regulation, lipid metabolism and inflammatory pathways. Polyherbal ingredients such as cinnamon, fenugreek, turmeric, ginger, shatavari and ashwagandha have also been investigated for their potential metabolic, antioxidant and reproductive effects. Nutrient-rich ingredients, including garden cress, moringa, amla and flaxseed, may further contribute dietary fibre, minerals, vitamins and other bioactive compounds. This review summarizes the evidence concerning PCOS, synbiotic functional foods and selected herbal ingredients, highlighting their potential incorporation into a standardized functional food. Further research is required to establish formulation stability, probiotic viability, safety, sensory acceptability and clinical effectiveness.

Keywords: PCOS, synbiotic functional food, polyherbal formulation, probiotics, metabolic health, hormonal health.

INTRODUCTION

PCOS is a multifactorial endocrine disorder affecting women of reproductive age. Its manifestations include irregular menstruation, hyperandrogenism, ovulatory dysfunction and metabolic abnormalities, including insulin resistance and dyslipidaemia. Globally, PCOS is estimated to affect approximately 10–13% of reproductive-aged women, with many cases remaining undiagnosed [1,2].

Insulin resistance, chronic low-grade inflammation, oxidative stress and alterations in gut microbial composition may contribute to the metabolic and reproductive features of PCOS [1,3]. These associations have increased interest in nutritional interventions that complement conventional management.

Probiotics, prebiotics, synbiotics and plant-derived bioactive compounds have been investigated for their potential effects on insulin sensitivity, glucose regulation, lipid metabolism and selected hormonal outcomes. Combining these components in a standardized functional food may offer a practical approach for further investigation, although its clinical benefits must be established through controlled studies [4–7].

METHODOLOGY

This narrative review examines published research on PCOS, gut microbiota, synbiotics, functional foods and selected polyherbal ingredients. Relevant literature includes original research, systematic reviews, meta-analyses and clinical guidelines. The findings are organized according to metabolic, hormonal, antioxidant, anti-inflammatory and reproductive outcomes. Evidence limitations and the need for formulation standardization and clinical validation are also considered.

Role of Probiotics and Gut Microbiota in PCOS

Gut microbiota may influence host metabolism, intestinal barrier function, inflammation and hormonal signalling. Alterations in microbial composition and microbial metabolites have been associated with insulin resistance and other metabolic features of PCOS; however, these associations do not establish a direct causal relationship [3,4].

Probiotics and prebiotics have been investigated for their potential effects on glycaemic control, insulin resistance and lipid profiles. Reviews of clinical trials report improvements in selected metabolic and hormonal markers following some probiotic or synbiotic interventions, although results vary according to the strains, doses, intervention periods and participant characteristics [4–6].

Synbiotics combine live microorganisms with selectively utilized substrates that confer a health benefit. Inulin and fructooligosaccharides (FOS) are examples of prebiotic ingredients used in functional food formulations [7]. Fermented foods such as yogurt provide a potential delivery matrix, but the viability of probiotic strains and the stability of the finished product must be verified.

Synbiotic And Polyherbal Functional Foods In PCOS

Synbiotic functional foods

Synbiotic foods combine probiotics and prebiotic substrates to support beneficial microbial activity. Clinical evidence suggests possible improvements in fasting glucose, insulin resistance, selected lipid parameters and certain hormonal markers in women with PCOS. Nevertheless, findings remain heterogeneous, and synbiotic foods should be considered investigational complementary approaches rather than established treatments [4–6].

Yogurt-based formulations may provide a convenient food matrix for incorporating selected probiotic strains and prebiotic ingredients. Product development should consider microbial viability, physicochemical stability, safety, shelf life and sensory acceptability [7].

Polyherbal functional foods

Polyherbal formulations combine plant-derived ingredients with potentially complementary biological activities. Their proposed relevance to PCOS includes effects on glucose metabolism, oxidative stress, inflammation and reproductive function. However, evidence varies considerably among ingredients, and the effects of individual herbs cannot automatically be attributed to their combined formulation.

Cinnamon: Cinnamon has been investigated for its potential effects on glycaemic regulation and insulin resistance. A systematic review and meta-analysis reported possible improvements in glycaemic control among women with PCOS, although findings depend on the preparation, dose and duration of supplementation [8].

Fenugreek: Fenugreek seeds contain saponins, flavonoids and other bioactive compounds associated with glucose and lipid metabolism. Preliminary clinical and experimental findings suggest possible metabolic and reproductive benefits, but additional controlled trials are needed to establish efficacy and safety in PCOS [9–11].

Turmeric (curcumin): Curcumin has antioxidant and anti-inflammatory properties. Experimental studies and clinical trials have investigated its potential effects on inflammatory markers, insulin resistance, glycaemic control and lipid profiles in PCOS. Differences in formulation and bioavailability limit direct comparisons between studies [12–14].

Ginger: Ginger contains gingerols and shogaols, which have been studied for antioxidant and metabolic activities. Experimental and limited human evidence suggests possible effects on selected reproductive and metabolic parameters; further PCOS-specific clinical research is required [15,16].

Shatavari: *Asparagus racemosus* contains steroidal saponins and other phytochemicals traditionally associated with women's health. Preliminary experimental evidence suggests potential metabolic effects, but animal findings cannot establish clinical effectiveness in women with PCOS [17,18].

Ashwagandha: *Withania somnifera* contains withanolides and has been investigated for antioxidant and stress-related effects. However, direct evidence supporting its effectiveness for PCOS is insufficient, and its safety, dose and potential interactions require assessment before inclusion in a functional food intended for this population [19,20].

CONCLUSION

Synbiotic and polyherbal functional foods represent promising areas for research into complementary nutritional approaches to PCOS. Probiotic, prebiotic and selected plant-derived interventions have shown potential benefits for some metabolic, inflammatory and hormonal outcomes, but the strength of evidence varies. A standardized yogurt-based formulation may offer a practical food delivery system for further investigation. Nevertheless, its development requires careful ingredient selection, quality control, probiotic viability assessment, sensory evaluation and safety testing. Well-designed randomized controlled clinical trials are essential to determine whether the combined product provides meaningful and sustained benefits for women with PCOS. Such foods should complement, not replace, evidence-based clinical care.

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