

REVIEW PAPER ON CLITORIA TERNATEA AS A POTENTIAL HERB IN POLYCYSTIC OVARY SYNDROME

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ABSTRACT

Polycystic ovary syndrome (PCOS) is a common and heterogeneous endocrine-metabolic disorder associated with ovulatory dysfunction, hyperandrogenism and, in many patients, polycystic ovarian morphology. Insulin resistance, oxidative stress, chronic low-grade inflammation, abnormal lipid metabolism and altered reproductive signaling may contribute to the clinical features of the syndrome. Because PCOS has multiple interacting mechanisms, there is growing interest in plant-derived compounds that may act on more than one pathway. *Clitoria ternatea* L., commonly known as butterfly pea or blue pea, is a Fabaceae plant traditionally used in Asian systems of medicine and as an edible flower and natural food colorant. Its flowers contain polyacylated anthocyanins called ternatins, together with flavonol glycosides, phenolic compounds and other phytochemicals. Reviews and experimental studies report antioxidant, antidiabetic, anti-inflammatory, lipid-modulating and other biological activities of *C. ternatea* extracts. A randomized crossover study in healthy men found that an acute *C. ternatea* flower beverage increased plasma antioxidant capacity and, when consumed with sucrose, reduced postprandial glucose and insulin responses.

Animal studies have also reported antihyperglycemic, antioxidant, hepatoprotective, anti-obesity and antidyslipidemic effects.

KEYWORDS

Clitoria ternatea ; butterfly pea; blue pea; polycystic ovary syndrome; PCOS; anthocyanins; ternatins; flavonoids; oxidative stress; insulin resistance; inflammation; herbal medicine; phytochemicals.

INTRODUCTION

1. BOTANICAL AND ETHNOMEDICINAL BACKGROUND

The botanical importance of *C. ternatea* extends beyond its flower color. The species belongs to the legume family Fabaceae and has been described as a perennial twining or climbing herb. It is adapted to tropical and subtropical environments and has been used in agriculture as forage and in traditional practices. The roots, leaves, seeds and flowers have all been investigated, although their chemical composition and pharmacological profiles are not identical. Consequently, evidence obtained from a root preparation should not automatically be transferred to a flower tea or a standardized flower extract. Traditional medicinal uses have included preparations for digestive complaints, fever, inflammation, skin conditions and other ailments. Traditional use is valuable as a source of research hypotheses, but it does not by itself establish

clinical efficacy. Historical descriptions also vary between regions and preparations. A scientific review must therefore separate ethnomedical observations from controlled experimental evidence.

2. POLYCYSTYS OVARY SYNDROME RELEVANT TO HERBAL RESEARCH

PCOS is characterized by a complex interaction between genetic susceptibility, endocrine signaling, metabolic factors, adipose tissue, inflammation and environmental influences. Hyperandrogenism is a central feature for many patients. Increased androgen exposure can interfere with normal follicular development and ovulation. Insulin resistance and compensatory hyperinsulinemia may amplify ovarian androgen production in susceptible individuals. The result can be a self-reinforcing cycle involving metabolic and reproductive abnormalities. Oxidative stress has also been discussed in PCOS pathophysiology. Reactive oxygen species are produced during normal cellular metabolism, but excessive oxidative stress can damage lipids, proteins and nucleic acids. Ovarian tissue is metabolically active and sensitive to changes in redox balance.

3. RATIONALE FOR STUDYING *C. TERNATEA* IN POLYCYSTYS OVARY SYNDROME

The rationale for examining *C. ternatea* in PCOS can be organized around four interconnected areas: antioxidant activity, glucose and insulin regulation, lipid metabolism, and inflammation. These areas overlap with several biological disturbances observed in PCOS. The plant's anthocyanins and flavonoids provide a plausible chemical basis for some of these activities, while experimental studies provide preliminary functional evidence.

Anthocyanins are water-soluble pigments belonging to the flavonoid family. *C. ternatea* is unusual because it contains highly acylated anthocyanins called ternatins. Their molecular structures contribute to the flower's intense color and stability. Laboratory studies have reported antioxidant activity of *C. ternatea* anthocyanin extracts in provide a mechanistic hypothesis worth testing chemical and cellular systems .

Morphological Features

- **Growth Form:** A twining, slender vine/climber reaching 0.5–3 m long.
- **Leaves:** Pinnate with typically 5–7 elliptic to lanceolate leaflets, 2.5–5 cm long.
- **Flowers:** Solitary and large—approximately 4–5 cm long—usually blue, sometimes white or pink, with a papilionaceous structure.
- **Pods & Seeds:** Linear-oblong, somewhat pubescent pods measuring 6–12 cm containing 6– 10 seeds; seeds are 4.5–7 mm long, often mottled, olive to dark brown or black.
- **Roots:** Possess deep root systems and nodules for nitrogen fixation, aiding in soil Enhancement.

Phytoconstituents of *Clitoria ternatea* (Butterfly Pea)

- **Biomass Yield**

Produces up to 30 tons of dry matter per hectare per year under favorable conditions.

- **Mineral Content**

Rich source of calcium, making it suitable for formulation of herbal calcium- rich drinks.

- **Proteins**

Contains antifungal proteins, which contribute to its antimicrobial activity

Other Reported Constituents (from literature)

- **Flavonoids** (e.g., quercetin, kaempferol, rutin) → antioxidant, anti- inflammatory
- **Anthocyanins** (ternatins – responsible for the blue color) → antioxidant, neuroprotective.
- **Triterpenoids & Saponins** → adaptogenic, anti-diabetic.
- **Alkaloids & Tannins** → antimicrobial, anti-stress.

JHHHOxidativeirelevantoPCOS, so these findings provide a mechanistic hypothesis worth testing.

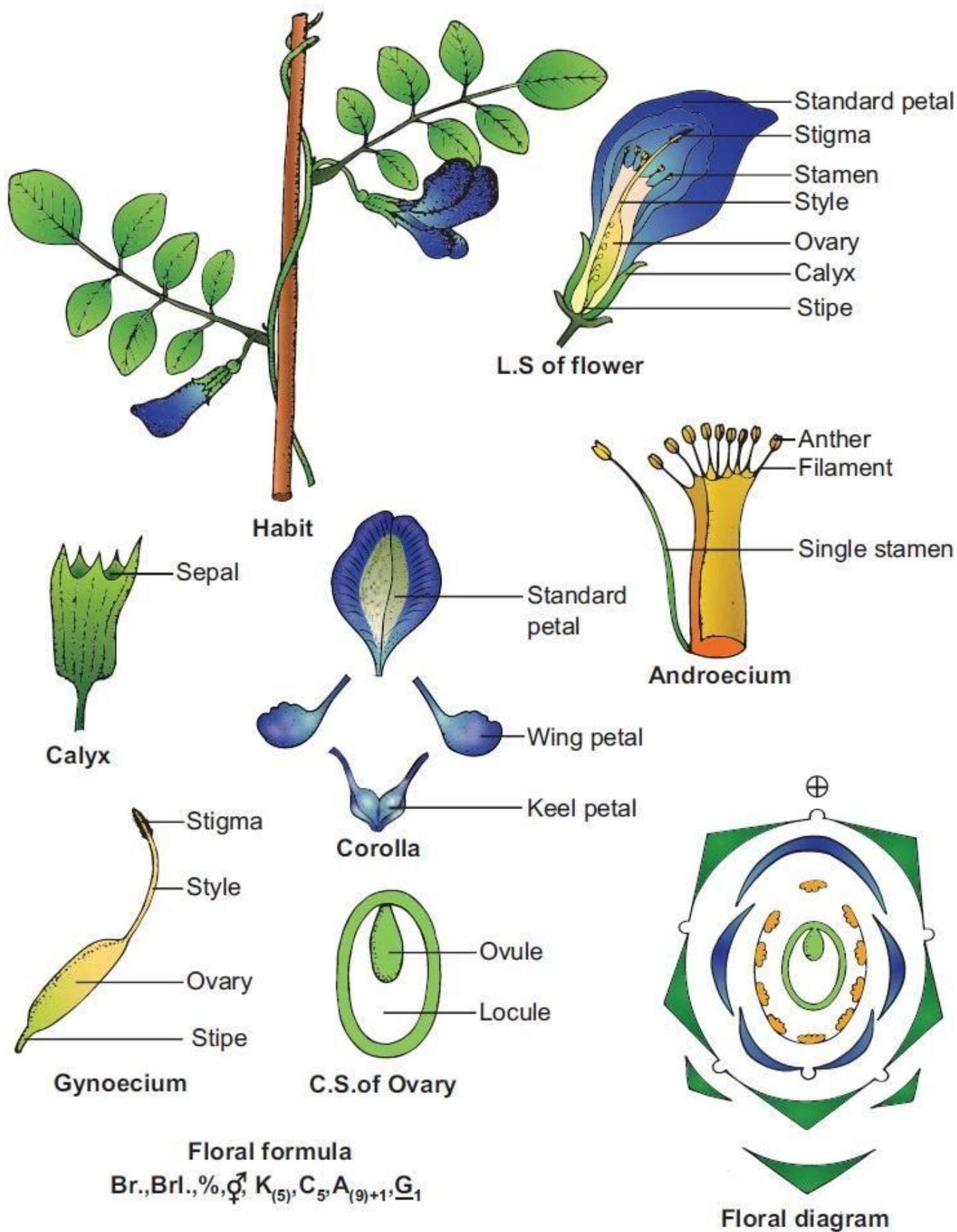
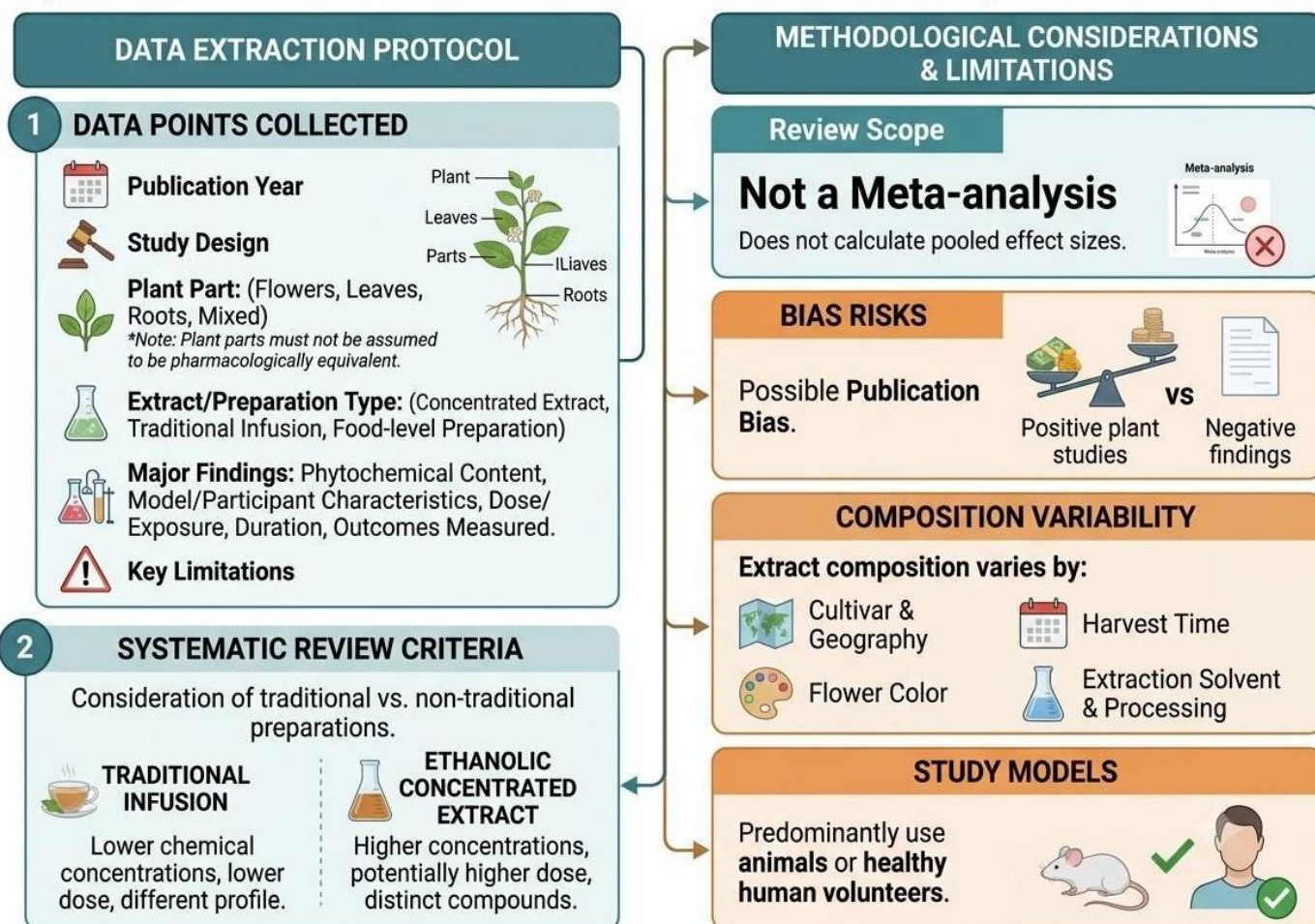


Figure 5.13: *Clitoria ternatea*

❖ MATERIALS AND METHODS

The overall methods of materials for the preparations and formulations of clitoria terinitia in which the following the pathway such as systematic data extraction process and methodological framework such as data extractions protocol and methodological considerations and limitations .

Systematic Data Extraction Process & Methodological Framework



❖ Taxonomical classifications :



Class	Magnoliopsida
Sub Class	Rosidae
Order	Fabales
Family	Fabaceae
Genus	Clitoria
Species	ternatea.
Botanical name	<i>Clitoria ternatea</i> L.
Common name	Asian pigeon wings

The taxonomical classifications of the clitoria ternatea in which the above as a much pharmacognostic are important.

1. PHYTOCHEMISTRY

❖ Major Phytochemical Groups

- ❖ The pharmacological interest of *C. ternatea* is closely related to its diverse phytochemical composition. Studies of the flower have identified anthocyanins, flavonol glycosides, phenolic compounds and other secondary metabolites. The exact composition varies with plant material and extraction procedure. A review of flower extraction studies reported kaempferol, quercetin and myricetin glycosides together with several anthocyanin derivatives .

❖ ANTIOXIDANT ACTIVITY

Antioxidant activity is one of the most consistently reported properties of *C. ternatea* flowers. Extracts have shown radical-scavenging and reducing capacity in several laboratory assays. Anthocyanins and flavonoids are likely contributors, although the contribution of individual compounds depends on the extraction process and biological context.

REPRODUCTIVE AND OVARIAN RELEVANCE

The most important question for a PCOS-specific herbal candidate is whether it improves reproductive outcomes. Relevant outcomes include menstrual regularity, ovulation, biochemical or clinical hyperandrogenism, ovarian morphology and pregnancy or live birth when fertility is the treatment goal.

Direct reproductive evidence for *C. ternatea* is currently much less developed than its antioxidant and metabolic evidence. Recent computational studies have examined *C. ternatea* compounds against reproductive hormone receptors. One study investigated interactions with the follicle stimulating hormone receptor using molecular docking . Another recent in silico study examined potential interactions with the luteinizing hormone receptor and reported favorable binding of several plant compounds.

1. EVIDENCE SUMMARY

Evidence area	Main observation	Evidence type	Relevance to PCOS
Phytochemistry	Anthocyanins/ternate ns, flavonol glycosides and Phenolics are reported.	Chemical/review	Provides plausible bioactive constituents.
Antioxidant	Increased antioxidant capacity and reduced oxidative markers in experimental/huma n non-PCOS studies.	In vitro, animal, small human trial	Potentially relevant to oxidative stress in PCOS.
Glucose/insulin	Antihyperglycemic effects in diabetic animals; acute postprandial effects in healthy men.	Animal + human	Potential metabolic relevance; no proof of PCOS efficacy.
Lipids/obesity	Changes in body weight and lipid parameters in high- fat-diet animals.	Animal	Potential cardiometabolic relevance.
Inflammation	Some experimental models show reduced inflammatory markers.	Animal/review	Mechanistically plausible but clinically unproven.

Reproductive effects	Docking studies and an early pilot reproductive study provide preliminary signals.	In silico + small clinical pilot	Most important research gap remains controlled PCOS trials.
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❖ Quality-Control Parameters

- Botanical authentication and voucher specimen documentation.
- Standardization of total anthocyanins and selected marker compounds.
- Control of moisture, storage conditions and light exposure because anthocyanins are sensitive to processing.

For future PCOS trials, the exact preparation should be described in enough detail that another laboratory can reproduce it. Researchers should report plant part, botanical authentication, extraction solvent, extraction ratio, marker-compound concentrations, dose, administration route and storage conditions.

❖ OVERALL INTERPRETATION

The available literature provides a coherent but incomplete picture. *C. ternatea* is chemically rich, particularly in anthocyanins and flavonol glycosides. Its extracts demonstrate antioxidant activity, and several experimental studies indicate antidiabetic, anti-inflammatory and lipid-related effects. Human evidence exists for acute metabolic and antioxidant responses in healthy men. Early reproductive research has also begun, including molecular docking studies and a small clinical pilot of a traditional root preparation.

The relevance to PCOS is biologically reasonable because PCOS involves metabolic and reproductive pathways that overlap with the observed activities of the plant. In particular, insulin resistance, oxidative stress and inflammation can contribute to the PCOS phenotype. If *C. ternatea* improves these processes in humans with PCOS, reproductive benefits could potentially follow.

RESULTS

❖ Botanical Profile and Plant Description

Clitoria ternatea L. is a member of the Fabaceae family. It is a perennial climbing herb with compound leaves and showy papilionaceous flowers. The commonly encountered blue flower form is the best-known source of the natural pigment used in beverages and food products. The plant is distributed widely in tropical regions and is cultivated in several countries. Its ability to grow under warm conditions and its use as a forage legume have contributed to its agricultural importance .

❖ Traditional Uses

Traditional medicine has used different parts of *C. ternatea* for a variety of conditions. Historical Ayurvedic literature and ethnobotanical reports describe uses involving cognition, digestion, inflammation and other complaints. Some traditional preparations have also been associated with reproductive uses. Such records provide hypotheses for pharmacological research, but traditional use cannot substitute for randomized clinical evidence.

CONCLUSION

Clitoria ternatea L. is a medicinal and edible plant with a diverse phytochemical profile and a growing body of experimental research. Its flowers are particularly rich in anthocyanins known as ternatins, together with flavonol glycosides and other phenolic constituents. The plant also contains cyclotides and other specialized compounds that contribute to its biological interest.

Evidence from in vitro and animal studies indicates antioxidant, antihyperglycemic, anti-inflammatory, hepatoprotective, anti-obesity and lipid-modulating activities. A small randomized crossover study in healthy men found acute improvements in antioxidant capacity and changes in postprandial glucose and insulin responses following flower extract consumption. These findings are relevant to PCOS because oxidative stress and metabolic abnormalities can occur in the syndrome.

Nevertheless, direct evidence for the use of *C. ternatea* in PCOS remains limited. Computational studies involving reproductive hormone receptors are hypothesis-generating, while early clinical reproductive evidence comes from a small pilot study using a specialized root formulation.

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