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Contraceptive and Reproductive Enhancing Properties of Plant Extracts and Natural Products: Mechanisms, Efficacy, and Safety

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ABSTRACT

The dual roles of plant extracts and natural products in modulating fertility underscore their growing significance in the field of reproductive health research. These botanicals, used for centuries in diverse traditional medical systems across Asia, Africa, and Latin America, have demonstrated the ability to both promote conception and act as natural contraceptives. Their effects are often context-dependent, influenced by the plant species, dosage, preparation methods, and the individual's physiological status. Some plants, when consumed at low doses, may enhance reproductive function, while the same plant at higher concentrations may induce infertility or inhibit ovulation. This complex bioactivity makes natural products a unique and valuable focus for fertility regulation strategies. This review examines the current scientific evidence on the contraceptive and fertility-enhancing potentials of plant-based compounds, highlighting their mechanisms of action, including hormonal modulation, influence on gametogenesis, impact on implantation, immune regulation, and antioxidant activity. Key examples include Asparagus racemosus, known for its fertility-boosting effects; Carica papaya, with anti-implantation properties; Gossypol, a male contraceptive; and Moringa oleifera, valued for its antioxidant support. The review also discusses the limitations of existing studies-such as inconsistent methodologies and lack of standardized extracts-and emphasizes the need for rigorous clinical validation to ensure efficacy and safety in therapeutic applications.

Keywords: Plant extracts, Natural products, Contraception, Fertility enhancement, Reproductive health

INTRODUCTION

Fertility regulation, whether through contraceptive means or fertility enhancement, remains a central focus in global reproductive health [1]. Synthetic contraceptives and pharmacological fertility drugs, while widely available, often raise concerns about adverse effects, affordability, and long-term safety [2]. Against this backdrop, plant extracts and natural products have emerged as potential alternatives or adjuncts, offering a multifaceted approach rooted in centuries of traditional use. Numerous cultures have long employed botanicals to manage fertility—from promoting conception to achieving temporary or permanent contraception [3]. These natural agents contain bioactive compounds that act on various physiological systems, including endocrine pathways, immune regulation, and oxidative stress, thereby influencing reproductive outcomes [4]. As scientific interest in ethnopharmacology grows, there is a pressing need to systematically examine the mechanisms, efficacy, and safety of these substances. This section provides an overview of the increasing relevance of plant-based reproductive agents and sets the foundation for a more detailed exploration of their roles.

2. Historical and Ethnomedical Context

The use of plant-based remedies for fertility management is well-documented across ancient and contemporary medicinal systems [3]. In Ayurveda, plants like Shatavari (Asparagus racemosus) are used as tonics to boost female fertility, while Neem (Azadirachta indica) is employed for its contraceptive properties [5]. Traditional Chinese Medicine utilizes herbs such as Dang Gui (Angelica sinensis) to support reproductive balance [6]. Similarly, African traditional medicine includes species like Vernonia amygdalina and Kigelia africana, valued for their influence on

reproductive hormones and fertility enhancement [7]. In many indigenous practices, plant parts—roots, leaves, bark, and seeds—are prepared as decoctions, infusions, or pastes for either promoting fertility or inducing contraception. Ethnobotanical knowledge passed down through generations has guided scientific exploration into the pharmacological properties of these plants [8]. This growing recognition of the cultural and biological value of medicinal plants underscores the need to bridge traditional wisdom with rigorous scientific inquiry.

3. Mechanisms of Action

The contraceptive and fertility-enhancing effects of plant extracts and natural products can be attributed to a variety of biological mechanisms. These mechanisms often depend on the specific phytochemical profile of the plant and the physiological target within the reproductive system.

3.1 Contraceptive Mechanisms

Plants with contraceptive properties may function through one or more of the following modes:
Hormonal interference: Certain phytochemicals act as phytoestrogens or anti-androgens, altering the hypothalamic-pituitary-gonadal (HPG) axis [9]. For example, Gossypol, a polyphenolic compound from cottonseed, has been shown to suppress luteinizing hormone (LH) and follicle-stimulating hormone (FSH), inhibiting spermatogenesis [10]. Anti-implantation effects: Compounds in Carica papaya and Ricinus communis have demonstrated the ability to impair endometrial receptivity, thereby preventing implantation [11]. Gamete toxicity: Some plant extracts, such as those from Calotropis procera, exert cytotoxic effects on sperm or ova, reducing fertilization potential [12]. Ovulatory disruption: Plants like Azadirachta indica can suppress or delay ovulation by modulating the release of gonadotropins [13].

3.2 Fertility-Enhancing Mechanisms

Conversely, plants that promote reproductive capacity do so via mechanisms that support hormonal balance, gametogenesis, and reproductive tissue health:
Gonadotropin stimulation: Extracts from Asparagus racemosus and Tribulus terrestris have been reported to elevate FSH and LH levels, promoting follicular development and spermatogenesis [14].
Antioxidant activity: Moringa oleifera and Withania somnifera are rich in antioxidants that mitigate oxidative stress in reproductive tissues, improving sperm quality and ovarian function [15].
Immunomodulation: Certain botanicals help modulate the immune environment, enhancing uterine receptivity and embryo implantation [16].
Nutritional support: Many fertility-enhancing plants provide micronutrients such as zinc, selenium, and folate, essential for reproductive success [17].
Understanding these diverse mechanisms highlights the potential for natural products to serve either as standalone therapies or as complementary interventions in reproductive health. However, variations in plant species, preparation methods, and individual responses necessitate careful scientific validation and clinical evaluation.

4. Evidence from Experimental and Clinical Studies

Studies in animal models and limited clinical settings have provided useful insights into the reproductive effects of plant extracts and natural compounds. In preclinical studies, compounds such as Gossypol, derived from cottonseed, have shown strong antifertility effects [18]. For example, Gossypol significantly reduced sperm counts and motility in male rats, and its effects were often irreversible at higher doses [19]. On the other hand, plants like Withania somnifera have demonstrated fertility-enhancing effects, including increased sperm count, motility, and improved overall semen quality in rodent models [20]. Similarly, Moringa oleifera has shown promising antioxidant and androgenic effects, supporting reproductive function in both male and female animals [21]. Clinical trials are fewer but noteworthy. A controlled human trial involving Tribulus terrestris found that supplementation improved sperm motility and libido in subfertile men, with minimal side effects [22]. Another observational study with women taking Shatavari (Asparagus racemosus) suggested improvements in menstrual regularity and ovulation patterns [23]. Despite these encouraging results, many clinical studies suffer from limitations such as small sample sizes, lack of placebo control, and inconsistent extract preparation. Additionally, variations in plant part used, dosage, and participant background complicate the interpretation of results. These limitations highlight the need for large-scale, well-controlled trials to validate efficacy and establish clear dosage guidelines.

5. Safety and Toxicological Considerations

The perception that natural products are inherently safe is widespread but often misleading. While many plant-derived compounds are used safely within traditional medicine, scientific evidence reveals that some of these substances can exert toxic effects, particularly when consumed in inappropriate doses or over extended periods [24]. Reproductive toxicity is one of the most significant safety concerns associated with prolonged or unregulated use of certain botanicals [25]. For instance, chronic ingestion of extracts from Gossypium species has been associated with

reduced sperm production and motility, hormonal disruption, and in some cases, irreversible infertility in men [26]. Gossypol, the active compound in cottonseed, has demonstrated dose-dependent effects on spermatogenesis and has raised ethical and safety concerns when proposed as a male contraceptive [27]. Similarly, Ricinus communis, commonly known as castor bean, has been used traditionally for contraceptive purposes but poses serious health risks at high doses, including hepatotoxicity and nephrotoxicity [28]. Its seeds contain ricin, a highly toxic protein that can cause severe organ damage or death if ingested improperly. Although traditional preparations may dilute these effects, modern extract formulations need careful standardization to mitigate toxicity.

Furthermore, several plant extracts have been linked to systemic toxicity, allergic reactions, gastrointestinal disturbances, and teratogenic effects. Herbs rich in phytoestrogens, such as Pueraria mirifica and Glycine max (soy), when used during pregnancy without medical supervision, may interfere with fetal development due to their estrogenic effects [29]. This raises concerns about the unregulated consumption of herbal supplements marketed as fertility boosters, especially among women of reproductive age. Another safety concern involves herb-drug interactions. Some natural products can inhibit or induce cytochrome P450 enzymes, potentially altering the metabolism of prescribed drugs used in fertility treatment or other medical conditions [30]. This can either reduce drug efficacy or enhance toxicity. Unfortunately, due to the lack of regulatory oversight and standardized labeling in many countries, users are often unaware of these risks. In addition, variations in plant species, growing conditions, harvesting time, and extraction techniques result in inconsistent phytochemical profiles, complicating efforts to ensure consistent potency and safety across batches [31]. The absence of globally accepted safety standards for herbal reproductive agents further underscores the need for international collaboration in regulation and monitoring. Addressing these safety concerns requires a multi-pronged approach. Toxicological assessments should be conducted using standardized animal models to establish no-observed-adverse-effect levels (NOAELs) and identify organ-specific toxicity. Clinical safety evaluations should include adverse effect monitoring, reproductive toxicity screening, and allergenicity testing. Moreover, phytochemical analyses must be performed to identify toxic constituents and ensure quality control during formulation. Finally, public education is crucial. Many users assume that herbal products are safe because they are "natural," but this assumption can lead to misuse. Healthcare providers, pharmacists, and researchers must work together to raise awareness, guide proper usage, and report adverse effects. Regulatory agencies should also develop clearer guidelines and require safety data for herbal products marketed for reproductive use. By integrating scientific rigor with traditional knowledge and regulatory oversight, the field can evolve towards safer and more effective use of plant-based reproductive modulators.

6. Challenges and Future Directions

Despite their potential, several challenges hinder the full integration of plant-based reproductive modulators into mainstream healthcare. A major obstacle lies in the variability of phytochemical composition across different plant extracts. This variation can result from multiple factors, including plant species, geographic origin, soil composition, harvesting season, and processing methods. Such inconsistencies make it difficult to reproduce experimental findings and limit the development of standardized, commercially viable products [32]. In addition to phytochemical variability, the lack of comprehensive pharmacological data presents another challenge. Many promising plant extracts have only been evaluated in small-scale studies or animal models. Large-scale, randomized controlled trials in humans are limited, and in many cases, entirely absent [33]. This gap in clinical data prevents regulatory agencies from approving these substances for therapeutic use and limits physician confidence in recommending them to patients. Understanding interactions among multiple bioactive compounds within plant extracts also poses a challenge. Natural products often contain dozens of active constituents that may work synergistically or antagonistically [34]. Current research often isolates single compounds, potentially overlooking complex interactions that influence efficacy and safety. Advanced analytical techniques such as metabolomics and systems biology could help unravel these complex mechanisms.

Moreover, the lack of standardized dosage guidelines hampers effective clinical translation. In traditional medicine, dosages are often estimated based on empirical knowledge, but without scientific validation, there is a risk of under- or overdosing. Standardizing dosages based on clinical trials, pharmacokinetics, and toxicity profiles is essential for ensuring safety and efficacy. To overcome these challenges, future research should focus on identifying and characterizing the most promising plant species and their active constituents. Developing standardized extracts and formulations with consistent potency and quality is a priority. Collaborations between ethnobotanists, pharmacologists, toxicologists, and clinicians will be key to translating traditional remedies into scientifically validated therapies. Regulatory agencies also have a role to play in establishing clear frameworks for the evaluation, approval, and monitoring of herbal products. This includes creating guidelines for good manufacturing practices, product labeling, and post-market surveillance. Finally, public and professional education must be emphasized.

Patients and practitioners need accurate information about the benefits and risks of using plant-based reproductive agents. Establishing databases and educational platforms can help disseminate this knowledge, promoting informed decision-making.

CONCLUSION

Plant-derived products have significant potential to address fertility challenges by offering both contraceptive and fertility-enhancing benefits. Their mechanisms of action are diverse, involving hormonal, immune, and oxidative pathways. While preliminary evidence supports their effectiveness, safety concerns and methodological limitations must be addressed. With deeper scientific validation and regulatory oversight, these natural compounds could become vital components of integrative reproductive healthcare.

REFERENCES

1. Stover J, Hardee K, Ganatra B, García-Moreno C, Horton S. Interventions to improve reproductive health. In: The World Bank eBooks. 2016;95–114. doi:10.1596/978-1-4648-0348-2_ch6
2. National Academies Press (US). Contraceptive benefits and risks. Contraception and Reproduction – NCBI Bookshelf. 1989. Available from: https://www.ncbi.nlm.nih.gov/books/NBK235069/
3. Egba, Simeon Ikechukwu., Okonkwo, Chibuzor Onyinye., Ogbodo, John Onyebuchi and Eme,Dike (2020). Contraceptive Potentials of *Alstonia boonei* via Stimulation of Increased Prolactin Synthesis in Experimental Female Wistar Rats. Trends Nat. Prod. Res, 2020; 1(1): 43-50
4. Riaz M, Khalid R, Afzal M, Anjum F, Fatima H, Zia S, et al. Phytobioactive compounds as therapeutic agents for human diseases: A review. Food Science & Nutrition. 2023;11(6):2500–29. doi:10.1002/fsn3.3308
5. Alok S, Jain SK, Verma A, Kumar M, Mahor A, Sabharwal M. Plant profile, phytochemistry and pharmacology of Asparagus racemosus (Shatavari): A review. Asian Pacific Journal of Tropical Disease. 2013;3(3):242–51. doi:10.1016/S2222-1808(13)60049-3
6. Hook ILI. Danggui to Angelica sinensis root: Are potential benefits to European women lost in translation? A review. Journal of Ethnopharmacology. 2013;152(1):1–13. doi:10.1016/j.jep.2013.12.018
7. Brahmi F, Mujinga FK, Guendouze N, Madani K, Boulekbache L, Duez P. Benefits of traditional medicinal plants to African women's health: An overview of the literature. Diseases. 2025;13(5):160. doi:10.3390/diseases13050160
8. Mekonnen AB, Mohammed AS, Tefera AK. Ethnobotanical study of traditional medicinal plants used to treat human and animal diseases in Sedie Muja district, South Gondar, Ethiopia. Evidence-based Complementary and Alternative Medicine. 2022;2022:1–22. doi:10.1155/2022/7328613
9. Patisaul HB, Jefferson W. The pros and cons of phytoestrogens. Frontiers in Neuroendocrinology. 2010;31(4):400–19. doi:10.1016/j.yfrne.2010.03.003
10. Soufir JC. Hormonal, chemical and thermal inhibition of spermatogenesis: contribution of French teams to international data with the aim of developing male contraception in France. Basic and Clinical Andrology. 2017;27(1). doi:10.1186/s12610-016-0047-2
11. Memudu AE, Oluwole TJ. The contraceptive potential of Carica papaya seed on oestrus cycle, progesterone, and histomorphology of the utero-ovarian tissue of adult Wistar rats. JBRA. 2020. doi:10.5935/1518-0557.20200023
12. Singh NK, Bhushan B, Agrahari Y. An overview on the phytochemical and therapeutic potential of Calotropis procera. Pharmacological Research - Modern Chinese Medicine. 2024;11:100441. doi:10.1016/j.prmcm.2024.100441
13. Njoga UJ, Jaja IF, Onwuka OS, Ilo SU, Eke IG, Abah KO, et al. Reproductive effects of medicinal plant (Azadirachta indica) used as forage and for ethnoveterinary practices: New insights from animal models. Challenges. 2022;13(2):40. doi:10.3390/challe13020040
14. Chavda VP, Sonak SS, Balar PC, Vyas K, Palandurkar P, Mule K, et al. Reviving fertility: Phytochemicals as natural allies in the fight against non-genetic male infertility. Clinical Complementary Medicine and Pharmacology. 2024;4(1):100128. doi:10.1016/j.ccmp.2024.100128
15. Ghadimi M, Najafi A, Sharifi SD, Mohammadi-Sangcheshmeh A, Mehr MRA. Effects of dietary Moringa oleifera leaf extract on semen characteristics, fertility, and hatchability in aged broiler breeder roosters. Poultry Science. 2024;103(4):103491. doi:10.1016/j.psj.2024.103491
16. Voros C, Sapantzoglou I, Mavrogianni D, Athanasiou D, Varthaliti A, Bananis K, et al. Unlocking implantation: The role of nitric oxide, NO_2–NO_3, and eNOS in endometrial receptivity and IVF success—

A systematic review. International Journal of Molecular Sciences. 2025;26(14):6569. doi:10.3390/ijms26146569

17. Egba, Simeon I., Sunday, Godwin I and Anaduaka, Emeka G. The effect of oral administration of aqueous extract of *Newbouldia laevis* leaves on fertility hormones of male albino rats. IOSR Jornal of Pharmacy and Biological Sciences, 2014; 9(3): 61-64
18. Gadelha ICN, Fonseca NBS, Oloris SCS, Melo MM, Soto-Blanco B. Gossypol toxicity from cottonseed products. The Scientific World Journal. 2014;2014:1–11. doi:10.1155/2014/231635
19. Santana AT, Guelfi M, Medeiros HCD, Tavares MA, Bizerra PFV, Mingatto FE. Mechanisms involved in reproductive damage caused by gossypol in rats and protective effects of vitamin E. Biological Research. 2015;48(1). doi:10.1186/s40659-015-0026-7
20. Boroujeni SN, Bossaghzadeh F, Malamiri FA, Esmaeili A, Moudi E. The most important medicinal plants affecting sperm and testosterone production: a systematic review. JBRA. 2021. doi:10.5935/1518-0557.20210108
21. Zeng B, Luo J, Wang P, Yang L, Chen T, Sun J, et al. The beneficial effects of Moringa oleifera leaf on reproductive performance in mice. Food Science & Nutrition. 2019;7(2):738–46. doi:10.1002/fsn3.918
22. Khaleghi S, Bakhtiari M, Asadmobini A, Esmaeili F. Tribulus terrestris extract improves human sperm parameters in vitro. Journal of Evidence-Based Complementary & Alternative Medicine. 2016;22(3):407–12. doi:10.1177/2156587216668110
23. Yadav P, Yadav S, Vedururu SS, Kumari G. A standardized Asparagus racemosus root extract improves hormonal balance and menstrual health and reduces vasomotor symptoms in perimenopausal women: a randomized, double-blind, placebo-controlled study. Journal of the American Nutrition Association. 2025;1–11. doi:10.1080/27697061.2025.2510474
24. Ekor M. The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. Frontiers in Pharmacology. 2014;4. doi:10.3389/fphar.2013.00177
25. Roe AL, McMillan DA, Mahony C. A tiered approach for the evaluation of the safety of botanicals used as dietary supplements: An industry strategy. Clinical Pharmacology & Therapeutics. 2018;104(3):446–57. doi:10.1002/cpt.1132
26. Gadelha ICN, Fonseca NBS, Oloris SCS, Melo MM, Soto-Blanco B. Gossypol toxicity from cottonseed products. The Scientific World Journal. 2014;2014:1–11. doi:10.1155/2014/231635
27. Paunovic D, Rajkovic J, Novakovic R, Grujic-Milanovic J, Mekky RH, Popa D, et al. The potential roles of gossypol as anticancer agent: advances and future directions. Chinese Medicine. 2023;18(1). doi:10.1186/s13020-023-00869-8
28. Polito L, Bortolotti M, Battelli M, Calafato G, Bolognesi A. Ricin: an ancient story for a timeless plant toxin. Toxins. 2019;11(6):324. doi:10.3390/toxins11060324
29. Jargin SV. Soy and phytoestrogens: possible side effects. DOAJ (Directory of Open Access Journals). 2014;12:Doc18. Available from: https://doaj.org/article/89582159a8c741d188c180dbfb45158a
30. Wanwimolruk S, Phopin K, Prachayasittikul V. Cytochrome P450 enzyme mediated herbal drug interactions (Part 2). 2014. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC4464477/
31. Egba, SI., Ogbodo, JO., Ogbodo PO and Obike CA Toxicological Evaluation of Two Named Herbal Remedies Sold Across Orumba South Local Government of Anambra State, South-Eastern Nigeria. Asian Journal of Research in Biochemistry, 2017; 1(1):1-6
32. Hossain MdS, Wazed MA, Asha S, Amin MdR, Shimul IM. Dietary phytochemicals in health and disease: Mechanisms, clinical evidence, and applications—A comprehensive review. Food Science & Nutrition. 2025;13(3). doi:10.1002/fsn3.70101
33. Vaou N, Stavropoulou E, Voidarou C, Tsigalou C, Bezirtzoglou E. Towards advances in medicinal plant antimicrobial activity: A review study on challenges and future perspectives. Microorganisms. 2021;9(10):2041. doi:10.3390/microorganisms9102041
34. Caesar LK, Cech NB. Synergy and antagonism in natural product extracts: when 1 + 1 does not equal 2. Natural Product Reports. 2019;36(6):869–88. doi:10.1039/c9np00011a

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