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The Role of Nutrient-Rich Natural Products in Modulating Reproductive Hormones: A Comprehensive Review

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ABSTRACT

Reproductive hormones play a critical role in human fertility, sexual development, menstrual regulation, and general reproductive health. Emerging evidence suggests that nutrient-rich natural products, particularly those derived from plants and whole foods, can significantly influence the production, regulation, and activity of key reproductive hormones such as estrogen, progesterone, testosterone, luteinizing hormone (LH), and follicle-stimulating hormone (FSH). This review examines the modulatory effects of bioactive compounds, including phytoestrogens, flavonoids, antioxidants, vitamins, and trace minerals, present in various natural products. Specific attention is given to dietary components such as soy, flaxseed, maca root, fenugreek, and functional foods rich in micronutrients like zinc, selenium, and vitamin D. The mechanisms through which these compounds interact with hormonal pathways, such as influencing hormone receptor binding, enzyme modulation, and endocrine feedback loops, are also discussed. Clinical and preclinical studies are reviewed to highlight both the therapeutic potential and limitations of natural products in managing reproductive hormone imbalances, fertility issues, and related disorders such as polycystic ovary syndrome (PCOS) and andropause. The review concludes with a discussion of translational challenges and future directions in integrating natural products into reproductive health strategies.

Keywords: Natural products, Reproductive hormones, Nutritional content, Phytoestrogens, Fertility

INTRODUCTION

Reproductive health is a fundamental aspect of human biology, governed largely by the endocrine system and its production of key reproductive hormones [1]. These hormones, which include estrogen, progesterone, testosterone, follicle-stimulating hormone (FSH), and luteinizing hormone (LH), play essential roles in regulating sexual development, gametogenesis, menstrual cycles, libido, pregnancy, and fertility in both males and females [2]. Any disruption in the balance of these hormones can result in clinical conditions such as polycystic ovary syndrome (PCOS), infertility, irregular menstrual cycles, and reduced libido, among others [3]. In recent years, there has been growing interest in the use of natural products as therapeutic or supportive interventions for hormonal regulation [4]. These natural products, ranging from whole foods and herbs to plant-derived extracts, are rich in bioactive compounds and micronutrients that exhibit potential hormone-modulating properties. With the limitations and side effects associated with synthetic hormonal therapies, such as hormone replacement therapy (HRT) and fertility drugs, attention has turned to safer, nutrition-based alternatives that work through the body's natural biochemical pathways. This review focuses on the role of nutrient-dense natural products in modulating reproductive hormones. It examines the types of bioactive compounds found in these products, their underlying mechanisms of action, and their potential clinical benefits. By synthesizing data from preclinical and clinical studies, this review aims to highlight how diet and plant-based compounds can serve as non-pharmacological tools in improving reproductive health.

2. Reproductive Hormones and Their Regulation

The endocrine system, through a complex network involving the hypothalamus, pituitary gland, and gonads, regulates reproductive function via the hypothalamic-pituitary-gonadal (HPG) axis [5]. This axis controls the synthesis and release of hormones such as gonadotropin-releasing hormone (GnRH), which prompts the pituitary

gland to secrete FSH and LH. These hormones, in turn, act on the ovaries in females and the testes in males to stimulate the production of estrogen, progesterone, and testosterone [6]. Estrogen and progesterone primarily regulate the menstrual cycle, ovulation, and pregnancy [7]. Estrogen also plays a vital role in bone health, cardiovascular function, and lipid metabolism [7]. Progesterone prepares the uterus for implantation and maintains pregnancy [6]. Testosterone is the principal male sex hormone, responsible for the development of male secondary sexual characteristics, sperm production, and libido, but it is also present in smaller amounts in females and contributes to muscle mass and mood regulation [8]. The balance of these hormones is influenced by multiple factors, including age, genetics, stress, and critically, nutritional status. Micronutrient deficiencies and poor dietary patterns have been linked to hormonal imbalances and infertility. For instance, zinc and selenium are essential for testosterone synthesis and sperm motility, while vitamin D is involved in ovarian follicle development and testosterone regulation [9]. This hormonal-nutritional interplay sets the foundation for exploring how natural products rich in specific nutrients and phytochemicals may contribute to reproductive hormone regulation.

3. Bioactive Compounds in Natural Products and Their Hormonal Effects

Natural products, especially those derived from plants, are rich sources of bioactive compounds that influence hormonal activity through various biochemical pathways [10]. Among the most studied are phytoestrogens, flavonoids, saponins, and polyphenols. These compounds can interact with hormone receptors, alter enzyme activity involved in hormone synthesis, and modulate intracellular signaling pathways [10].

Phytoestrogens, found abundantly in soy, flaxseed, and legumes, are plant-based compounds that structurally resemble human estrogen and can bind to estrogen receptors [11]. The most well-known phytoestrogens include isoflavones such as genistein and daidzein, and lignans such as secoisolariciresinol diglucoside) (SDG [12]. Depending on endogenous estrogen levels, these compounds can either exert weak estrogenic effects or act as antagonists, thereby helping to restore hormonal balance in conditions like menopause or estrogen dominance.

Flavonoids, present in citrus fruits, berries, and tea, exert antioxidant and anti-inflammatory effects, which are important for maintaining hormonal health [13]. Some flavonoids have been shown to inhibit aromatase, an enzyme responsible for converting androgens into estrogens, thus influencing estrogen and testosterone balance. For example, quercetin and apigenin have demonstrated potential in regulating ovarian and testicular hormone production in animal models [14].

Saponins, found in plants like fenugreek and ginseng, have been linked to increased testosterone levels and improved libido in men [15]. Maca root, a tuber native to Peru, contains macamides and other bioactive components believed to support endocrine function and enhance fertility without altering systemic hormone levels drastically [16].

Polyphenols such as resveratrol and curcumin may also play a role in regulating reproductive hormones. These compounds have demonstrated protective effects against oxidative stress in reproductive tissues and may modulate hormone receptor expression [17]. Their influence on insulin sensitivity is also relevant, especially in conditions like PCOS, where metabolic and hormonal pathways are tightly linked [17].

4. Micronutrients and Hormonal Health

In addition to phytochemicals, many natural products are rich in essential micronutrients that are vital for hormonal synthesis and regulation [18]. These include trace minerals, vitamins, and amino acids that serve as cofactors for hormone-producing enzymes or influence hormone receptor sensitivity.

Zinc is a key mineral required for testosterone synthesis and sperm production. It also supports the activity of numerous enzymes involved in reproductive processes [19]. Zinc deficiency has been linked to hypogonadism in men and menstrual irregularities in women [20].

Selenium plays a critical role in antioxidant defense within the testes and ovaries, protecting reproductive tissues from oxidative damage [21]. It is also involved in the regulation of thyroid hormones, which are closely interconnected with reproductive hormones [22].

Vitamin D is increasingly recognized for its role in reproductive health. Receptors for vitamin D are present in the ovaries, uterus, placenta, and testes [23]. Adequate vitamin D levels have been associated with improved follicular development in women and testosterone production in men [24]. In women with PCOS, vitamin D supplementation has shown potential in improving ovulatory function and reducing hyperandrogenism [25].

B vitamins, especially B6, B9 (folate), and B12, are essential for hormone metabolism and the synthesis of neurotransmitters that influence reproductive function [26]. Folate is also crucial for DNA synthesis in gametes and early embryonic development, making it indispensable for fertility and healthy pregnancy outcomes [27].

Together, these micronutrients and bioactive compounds present in natural products offer a comprehensive nutritional approach to supporting hormonal balance and reproductive health.

5. Natural Products in Clinical Context

The use of nutrient-rich natural products in clinical settings related to reproductive health has gained momentum due to their safety profile, affordability, and accessibility. Several human and animal studies have examined the impact of diet and plant-based supplementation on hormonal regulation and fertility outcomes in both sexes. Three common clinical conditions where these interventions have been particularly relevant include polycystic ovary syndrome (PCOS), male infertility, and menopausal hormone imbalance.

In women with PCOS, a condition marked by hyperandrogenism, insulin resistance, and menstrual irregularities, dietary modifications that incorporate phytoestrogen-rich foods like soy and flaxseed have demonstrated significant benefits [28]. These natural compounds can help reduce circulating androgen levels and improve ovulatory function. For example, isoflavone supplementation has been shown in randomized controlled trials to improve insulin sensitivity and normalize menstrual cycles [29]. Additionally, antioxidant-rich fruits and vegetables help mitigate oxidative stress, which is often elevated in PCOS, thereby supporting endocrine and metabolic recovery [30].

Male reproductive health also benefits from the inclusion of nutrient-dense natural products. Zinc and selenium supplementation have consistently improved sperm motility, morphology, and overall semen quality [31]. Clinical studies report that men with low testosterone levels often exhibit improvements in libido, energy, and sperm parameters after supplementing with herbs such as ginseng, fenugreek, or maca root [32]. Maca, in particular, has been used traditionally to enhance sexual performance and fertility and is now being investigated for its potential to increase serum testosterone without disrupting endogenous hormonal balance [33]. Menopausal health represents another area where natural products have shown promise. As estrogen levels decline, women often experience symptoms such as hot flashes, night sweats, mood swings, and vaginal dryness [34]. Phytoestrogens, particularly from soy, have been shown to alleviate many of these symptoms by exerting mild estrogenic activity at estrogen receptors [35]. This provides a natural alternative to hormone replacement therapy (HRT), which, while effective, carries risks such as cardiovascular disease and breast cancer. Supplementation with vitamin E, omega-3 fatty acids, and calcium in menopause has also been beneficial in maintaining hormonal equilibrium and bone health [36]. These findings demonstrate that natural products offer real-world benefits for a range of reproductive health conditions. However, patient responses can vary due to genetic, lifestyle, and environmental factors, highlighting the need for individualized approaches in nutritional therapy [37].

6. Mechanisms of Hormonal Modulation by Natural Products

The biological mechanisms through which natural products influence reproductive hormone regulation are diverse and often multi-targeted. Unlike synthetic drugs that typically act on a single receptor or enzyme, the compounds found in natural foods and herbs exert broader effects on hormonal signaling pathways, metabolism, and gene expression.

One key mechanism is receptor binding. Phytoestrogens, due to their structural similarity to estradiol, can bind to estrogen receptors (ER-alpha and ER-beta) in various tissues [38]. This receptor interaction can lead to estrogenic or anti-estrogenic effects depending on endogenous hormone levels and receptor distribution. This is particularly relevant in menopause and estrogen-sensitive conditions, where these compounds help restore receptor balance without causing overstimulation. Another major pathway involves enzyme modulation. Enzymes like aromatase (which converts testosterone into estrogen) and 5-alpha-reductase (which converts testosterone into dihydrotestosterone) are critical to hormonal homeostasis [39]. Natural products such as flavonoids (e.g., apigenin) and plant sterols have been found to inhibit or modulate the activity of these enzymes, thereby adjusting hormonal synthesis at the source [40]. Additionally, some natural compounds affect feedback regulation within the hypothalamic-pituitary-gonadal axis [41]. Certain adaptogens, including ashwagandha and Rhodiola, are believed to modulate stress-induced hormonal disruptions by influencing cortisol levels, which indirectly impact reproductive hormone release [42].

Antioxidants in natural products also play a role by reducing oxidative stress in reproductive organs, preserving hormone-producing cells, and improving the functional integrity of endocrine tissues [43]. This is especially important in aging individuals and patients with chronic inflammation, where oxidative damage impairs hormone production and receptor sensitivity.

7. Limitations and Challenges

Despite the promising potential of natural products in modulating reproductive hormones, there are several challenges that limit their widespread clinical adoption. One of the primary concerns is variability in bioactive compound content. Factors such as growing conditions, harvesting time, storage, and processing methods can significantly influence the potency and composition of herbal and food-derived products [44]. Another issue is the limited number of high-quality clinical trials. Many existing studies are small-scale, observational, or conducted in

animals. Although they provide valuable insights, there is a need for more randomized, placebo-controlled human trials to establish safety, efficacy, and standardized dosing. Variability in individual response, due to genetic polymorphisms or gut microbiota composition, also complicates the generalization of findings. Moreover, the potential for interactions with pharmaceutical drugs cannot be overlooked. For example, phytoestrogens may interfere with medications like tamoxifen, while herbal supplements such as ginseng may potentiate the effects of anticoagulants or immunosuppressants [45]. Education and guidance from healthcare providers are essential when integrating natural products into therapeutic regimens [46]. Another challenge lies in regulatory oversight. Many natural products are marketed as supplements rather than drugs, and thus are not subject to the same rigorous testing for purity and efficacy [47]. This raises concerns about contamination, adulteration, and misleading health claims.

8. Future Directions

Future research should aim to standardize the formulation, dosage, and delivery systems for natural products with proven hormonal effects. Advances in nutrigenomics and metabolomics offer exciting possibilities for understanding individual responses to these compounds, paving the way for personalized nutrition in reproductive medicine. In addition, interdisciplinary collaborations between nutritionists, endocrinologists, botanists, and pharmacologists will be essential to bridge the gap between traditional knowledge and modern scientific validation. There is also a pressing need to expand research in underrepresented populations, including men, adolescents, and individuals in low-resource settings where natural products are more accessible than synthetic pharmaceuticals.

Public health policies should support the integration of evidence-based natural therapies into mainstream reproductive healthcare. This includes the development of clinical guidelines, professional training programs, and consumer education initiatives to ensure informed and safe use. Finally, exploring the synergistic effects of combined nutrients and herbal constituents may yield more potent and targeted hormonal therapies. Formulations that combine micronutrients with plant-derived compounds tailored to the hormonal needs of different life stages may redefine the future of reproductive health management.

CONCLUSION

Nutrient-rich natural products offer a multifaceted approach to supporting and modulating reproductive hormones across a wide spectrum of health needs. Through their diverse bioactive compounds, they interact with hormonal receptors, enzymes, and regulatory systems to influence fertility, sexual health, and endocrine balance. While scientific interest and traditional use support their role, more rigorous clinical research and regulatory oversight are needed to harness their full therapeutic potential. As part of an integrative strategy, natural products may help bridge gaps in reproductive healthcare, especially in contexts where access to conventional treatments is limited or contraindicated.

REFERENCES

1. Green R, Eckstrand KL, Faeder M, Tilstra S, Ufomata E. Affirming care for transgender patients. Medical Clinics of North America. 2023;107(2):371–84. doi:10.1016/j.mcna.2022.10.011
2. Nedresky D, Singh G. Physiology, luteinizing hormone. StatPearls – NCBI Bookshelf. 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK539692/
3. Shukla A, Rasquin LI, Anastasopoulou C. Polycystic ovarian syndrome. StatPearls – NCBI Bookshelf. 2025. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459251/
4. Uti DE, Atangwho IJ, Alum EU, Egba SI, Ugwu OPC, Ikechukwu GC. Natural Antidiabetic Agents: Current Evidence and Development Pathways from Medicinal Plants to Clinical use. Natural Product Communications. 2025;20(3). doi:10.1177/1934578x251323393
5. Acevedo-Rodriguez A, Kauffman AS, Cherrington BD, Borges CS, Roepke TA, Laconi M. Emerging insights into hypothalamic-pituitary-gonadal axis regulation and interaction with stress signalling. Journal of Neuroendocrinology. 2018;30(10). doi:10.1111/jne.12590
6. Orlowski M, Sarao MS. Physiology, follicle stimulating hormone. StatPearls – NCBI Bookshelf. 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK535442/
7. Thiyagarajan DK, Basit H, Jeanmonod R. Physiology, menstrual cycle. StatPearls – NCBI Bookshelf. 2024. Available from: https://www.ncbi.nlm.nih.gov/books/NBK500020/
8. Egba, SI., Omeoga, HC., Oriaku CE., Jacobs EC., Nnabugwu FC., Lazarus JC and Echem EN. Down-regulatory Influence of Methanol and Aqueous Root Extracts of Sphenocentrum jollyanum on Some Fertility Hormones and the Effect on Testicular Size of Wistar Albino Rats. Annual Research and Review in Biology, 2017; 18(3): 1-8.

9. Qazi IH, Angel C, Yang H, Zoidis E, Pan B, Wu Z, et al. Role of selenium and selenoproteins in male reproductive function: A review of past and present evidences. Antioxidants. 2019;8(8):268. doi:10.3390/antiox8080268
10. Chaachouay N, Zidane L. Plant-derived natural products: A source for drug discovery and development. Drugs and Drug Candidates. 2024;3(1):184–207. doi:10.3390/ddc3010011
11. 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
12. Canivenc-Lavier MC, Bennetau-Pelissero C. Phytoestrogens and health effects. Nutrients. 2023;15(2):317. doi:10.3390/nu15020317
13. Ochulor Okechukwu C., Njoku Obioma U., Uroko Robert I and Egba Simeon I. Nutritional composition of *Jatropha tanjorensis* leaves and effects of its aqueous extract on carbon tetrachloride induced oxidative stress in male Wistar albino rats. Biomedical Research 2018; 29(19): 3569-3576
14. Sirotkin AV, Harrath AH. Apigenin as a promising agent for enhancing female reproductive function and treating associated disorders. Biomedicines. 2024;12(10):2405. doi:10.3390/biomedicines12102405
15. Smith SJ, Lopresti AL, Teo SYM, Fairchild TJ. Examining the effects of herbs on testosterone concentrations in men: A systematic review. Advances in Nutrition. 2020;12(3):744–65. doi:10.1093/advances/nmaa134
16. Del Carpio NU, Alvarado-Corella D, Quiñones-Laveriano DM, Araya-Sibaja A, Vega-Baudrit J, Monagas-Juan M, et al. Exploring the chemical and pharmacological variability of Lepidium meyenii: A comprehensive review of the effects of maca. Frontiers in Pharmacology. 2024;15. doi:10.3389/fphar.2024.1360422
17. Maggio EL, Zucca C, Grande M, Carrano R, Infante A, Bei R, et al. Polyphenols regulate the activity of endocrine-disrupting chemicals, having both positive and negative effects. Journal of Xenobiotics. 2024;14(4):1378–405. doi:10.3390/jox14040077
18. Espinosa-Salas S, Gonzalez-Arias M. Nutrition: Micronutrient intake, imbalances, and interventions. StatPearls – NCBI Bookshelf. 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK597352/
19. Fallah A, Mohammad-Hasani A, Colagar AH. Zinc is an essential element for male fertility: A review of Zn roles in men's health, germination, sperm quality, and fertilization. 2018. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6010824/
20. Nasiadek M, Stragierowicz J, Klimczak M, Kilanowicz A. The role of zinc in selected female reproductive system disorders. Nutrients. 2020;12(8):2464. doi:10.3390/nu12082464
21. Qazi IH, Angel C, Yang H, Pan B, Zoidis E, Zeng CJ, et al. Selenium, selenoproteins, and female reproduction: A review. Molecules. 2018;23(12):3053. doi:10.3390/molecules23123053
22. Gorini F, Sabatino L, Pingitore A, Vassalle C. Selenium: An element of life essential for thyroid function. Molecules. 2021;26(23):7084. doi:10.3390/molecules26237084
23. Grundmann M, Von Versen-Höynck F. Vitamin D – roles in women's reproductive health? Reproductive Biology and Endocrinology. 2011;9(1):146. doi:10.1186/1477-7827-9-146
24. Trummer C, Pilz S, Schwetz V, Obermayer-Pietsch B, Lerchbaum E. Vitamin D, PCOS and androgens in men: A systematic review. Endocrine Connections. 2018;7(3):R95–113. doi:10.1530/EC-18-0009
25. Wu MH, Lin MW. The role of vitamin D in polycystic ovary syndrome. The Indian Journal of Medical Research. 2015;142(3):238. doi:10.4103/0971-5916.166527
26. Ibiam, U. A., Aja, P. M., Orji, O. U., Nwamaka, N. N., Ugwu, O. P. C. Comparative analysis of chemical composition of *Buchholzia coriacea* ethanol leaf-extract, aqueous and ethylacetate fractions. *Indo Am J Pharm Sci.* 2018; 5(7):6358- 69. doi: 10.5281/zenodo.1311171
27. Alum, E. U., Aja, W., Ugwu, O. P. C., Obeagu, E. I., Okon, M. B. Assessment of vitamin composition of ethanol leaf and seed extracts of *Datura stramonium*. *Avicenna J Med Biochem.* 2023; 11(1):92-97. doi:10.34172/ajmb.2023.2421.
28. Najdgholami Z, Sedgi FM, Ghalishourani SS, Feyzpour M, Rahimlou M. Flaxseed intervention and reproductive endocrine profiles in patients with polycystic ovary syndrome: An open-labeled randomized controlled clinical trial. Frontiers in Endocrinology. 2025;16. doi:10.3389/fendo.2025.1531762
29. Kuryłowicz A. The role of isoflavones in type 2 diabetes prevention and treatment—A narrative review. International Journal of Molecular Sciences. 2020;22(1):218. doi:10.3390/ijms22010218

30. Yuan J, Li Z, Yu Y, Wang X, Zhao Y. Natural compounds in the management of polycystic ovary syndrome: A comprehensive review of hormonal regulation and therapeutic potential. Frontiers in Nutrition. 2025;12. doi:10.3389/fnut.2025.1520695
31. Fallah A, Mohammad-Hasani A, Colagar AH. Zinc is an essential element for male fertility: A review of Zn roles in men's health, germination, sperm quality, and fertilization. 2018. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6010824/
32. Smith SJ, Lopresti AL, Teo SYM, Fairchild TJ. Examining the effects of herbs on testosterone concentrations in men: A systematic review. Advances in Nutrition. 2020;12(3):744–65. doi:10.1093/advances/nmaa134
33. Del Carpio NU, Alvarado-Corella D, Quiñones-Laveriano DM, Araya-Sibaja A, Vega-Baudrit J, Monagas-Juan M, et al. Exploring the chemical and pharmacological variability of Lepidium meyenii: A comprehensive review of the effects of maca. Frontiers in Pharmacology. 2024;15. doi:10.3389/fphar.2024.1360422
34. Santoro N, Epperson CN, Mathews SB. Menopausal symptoms and their management. Endocrinology and Metabolism Clinics of North America. 2015;44(3):497–515. doi:10.1016/j.ecl.2015.05.001
35. Egba S I., Omodamiro, Olorunsola D., Obike, J C and Ali, S E. Influence on some female fertility hormonal response in wistar albino rats: Possible contraceptive role for methanol leaf extract of *Ocimum gratissimum*? Journal of Chemical and Pharmaceutical Research, 2015; 7(5): 889-898
36. Erdélyi A, Pálfi E, Tűű L, Nas K, Szűcs Z, Török M, et al. The importance of nutrition in menopause and perimenopause—A review. Nutrients. 2023;16(1):27. doi:10.3390/nu16010027
37. Nienaber-Rousseau C. Understanding and applying gene–environment interactions: A guide for nutrition professionals with an emphasis on integration in African research settings. Nutrition Reviews. 2024. doi:10.1093/nutrit/nuae015
38. Lecomte S, Demay F, Ferrière F, Pakdel F. Phytochemicals targeting estrogen receptors: Beneficial rather than adverse effects? International Journal of Molecular Sciences. 2017;18(7):1381. doi:10.3390/ijms18071381
39. Handelsman DJ. Androgen physiology, pharmacology, use and misuse. Endotext – NCBI Bookshelf. 2020. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279000/
40. Hasnat H, Shompa SA, Islam MdM, Alam S, Richi FT, Emon NU, et al. Flavonoids: A treasure house of prospective pharmacological potentials. Heliyon. 2024;10(6):e27533. doi:10.1016/j.heliyon.2024.e27533
41. Acevedo-Rodriguez A, Kauffman AS, Cherrington BD, Borges CS, Roepke TA, Laconi M. Emerging insights into hypothalamic-pituitary-gonadal axis regulation and interaction with stress signalling. Journal of Neuroendocrinology. 2018;30(10). doi:10.1111/jne.12590
42. Liao LY, He YF, Li L, Meng H, Dong YM, Yi F, et al. A preliminary review of studies on adaptogens: Comparison of their bioactivity in TCM with that of ginseng-like herbs used worldwide. Chinese Medicine. 2018;13(1). doi:10.1186/s13020-018-0214-9
43. Kaltsas A. Oxidative stress and male infertility: The protective role of antioxidants. Medicina. 2023;59(10):1769. doi:10.3390/medicina59101769
44. Alum EU, Uti DE, Egba SI, Ugwu OP-C, Aja PM. The Role of Phytochemicals in Age-Related Cognitive Decline: A Natural Solution for Brain Health. *Natural Product Communications*. 2025;20(6). doi:10.1177/1934578X251350761
45. Muyumba NW, Mutombo SC, Sheridan H, Nachtergael A, Duez P. Quality control of herbal drugs and preparations: The methods of analysis, their relevance and applications. Talanta Open. 2021;4:100070. doi:10.1016/j.talo.2021.100070
46. Obasi DC, Abba JN, Aniokete UC, Okoroh PN, Ugwu OPC, Uti DE. (2025). Endogenous Plant signals and human Health: Molecular mechanisms, ecological functions, and therapeutic Prospects. Biochemistry and Biophysics Reports, 43(2025):102114.
47. Thakkar S, Anklam E, Xu A, Ulberth F, Li J, Li B, et al. Regulatory landscape of dietary supplements and herbal medicines from a global perspective. Regulatory Toxicology and Pharmacology. 2020;114:104647. doi:10.1016/j.yrtph.2020.104647

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