INOSR Experimental Sciences 15(3):10-15, 2025. **ISSN: 2705-1692**
©INOSR PUBLICATIONS **INOSRES1530000**
International Network Organization for Scientific Research
https://doi.org/10.59298/INOSRES/2025/1531015

Oxidative Stress, Hormonal Response, and the Reproductive System: Therapeutic Prospects of Antioxidant-Rich Plant Extracts

Kirabo Nansubuga K.

Faculty of Science and Technology Kampala International University Uganda

ABSTRACT

Oxidative stress has emerged as a critical factor impairing reproductive function in both males and females. Elevated reactive oxygen species (ROS) levels disrupt hormonal balance, damage germ cells, and impair fertility-related pathways. An increasing body of evidence suggests that antioxidant-rich plant extracts can mitigate oxidative stress-induced reproductive dysfunctions by modulating hormonal responses and preserving reproductive organ integrity. This review explores the intricate interplay between oxidative stress, hormonal regulation, and reproductive health, emphasizing the therapeutic potential of phytochemicals with antioxidative properties. Mechanistic insights, experimental findings, and clinical implications are discussed to provide a consolidated understanding of the prospects of plant-derived antioxidants in reproductive medicine. The review concludes by highlighting future research needs for optimizing phytotherapy-based interventions in reproductive health management.

Keywords: Oxidative Stress; Antioxidants; Plant Extracts; Reproductive System; Hormonal Regulation

INTRODUCTION

The human reproductive system is remarkably sensitive to changes in the internal environment, particularly oxidative stress [1-4]. Oxidative stress occurs when the production of reactive oxygen species (ROS) exceeds the body's antioxidant defense capacity, resulting in cellular and molecular damage [5]. While moderate levels of ROS are necessary for normal reproductive processes such as sperm capacitation, oocyte maturation, and steroidogenesis, excessive oxidative stress leads to detrimental effects on fertility, embryonic development, and hormonal regulation [6]. Recent scientific attention has increasingly focused on the role of natural antioxidants in mitigating oxidative damage to the reproductive system. Among these, antioxidant-rich plant extracts have emerged as promising candidates due to their complex mixtures of bioactive phytochemicals capable of neutralizing free radicals and modulating physiological processes [7-12]. Phytochemicals such as flavonoids, carotenoids, polyphenols, and vitamins exert diverse biological activities, including antioxidant, anti-inflammatory, and hormone-modulatory effects, making them attractive therapeutic agents in reproductive medicine [13-15]. Given the rising incidence of infertility globally, estimated to affect one in six couples, there is an urgent need for safer and more effective therapeutic strategies. Plant-derived antioxidants offer the potential for non-invasive, cost-effective interventions with relatively few side effects compared to conventional synthetic drugs [16-18]. This review aims to provide a consolidated understanding of how oxidative stress impacts hormonal and reproductive functions and to explore the therapeutic prospects of antioxidant-rich plant extracts in counteracting these effects [19-22].

Oxidative Stress and Its Impact on the Reproductive System

Mechanisms of Oxidative Damage in Reproduction

Oxidative stress affects reproductive health at cellular, tissue, and systemic levels. Germ cells—spermatozoa and oocytes—are highly vulnerable to oxidative insults due to their abundant polyunsaturated fatty acids in membranes and limited intrinsic antioxidant defenses [23-25]. ROS-induced lipid peroxidation damages sperm membrane integrity, impairs motility, and compromises the acrosome reaction essential for fertilization [26-28]. In oocytes, oxidative stress impairs maturation, spindle formation, and chromosomal alignment, leading to aneuploidy and

reduced developmental potential [29-30]. At the hormonal level, oxidative stress disrupts the hypothalamic-pituitary-gonadal (HPG) axis [31-33]. Increased oxidative burden alters the pulsatile release of gonadotropin-releasing hormone (GnRH) from the hypothalamus, resulting in abnormal secretion of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) from the anterior pituitary [34-36]. Consequently, sex steroid hormone biosynthesis in the gonads becomes dysregulated, impairing processes such as folliculogenesis, spermatogenesis, and ovulation [37-39]. Moreover, oxidative stress promotes inflammatory responses within reproductive tissues, triggering cytokine release, leukocyte infiltration, and tissue remodeling [40-43]. Chronic inflammation exacerbates oxidative damage, creating a vicious cycle that leads to fibrosis, apoptosis, and diminished reproductive function [44-46]

Clinical Correlates

Several reproductive pathologies have been directly linked to oxidative stress. In males, oxidative stress is a principal contributor to idiopathic infertility, varicocele-associated infertility, and decreased sperm quality post-chemotherapy or radiation [47-49]. In females, elevated ROS levels are implicated in conditions such as polycystic ovary syndrome (PCOS), endometriosis, unexplained infertility, and recurrent pregnancy loss [50]. Clinical studies consistently report higher levels of oxidative biomarkers (e.g., malondialdehyde, 8-hydroxy-2'-deoxyguanosine) and lower antioxidant enzyme activities (e.g., superoxide dismutase, glutathione peroxidase) in infertile individuals compared to fertile controls [51-52].

Hormonal Response to Oxidative Stress

Hormones not only regulate reproductive function but are themselves susceptible to modulation by oxidative stress. ROS can affect hormone biosynthesis, secretion, receptor sensitivity, and intracellular signaling pathways [15] Gonadotropins (LH and FSH) are particularly sensitive to oxidative disruption. ROS-induced damage to the hypothalamic neurons impairs GnRH pulsatility, leading to suboptimal LH and FSH release [16]. This hormonal dysregulation culminates in impaired spermatogenesis in males and disrupted follicular development in females [16] Sex steroid hormones, including estrogen, progesterone, and testosterone, are synthesized in mitochondria-rich cells such as Leydig cells in the testes and granulosa cells in the ovaries [17]. Mitochondrial ROS impair the expression and activity of key steroidogenic enzymes like aromatase (CYP19A1) and 17β-hydroxysteroid dehydrogenase, reducing hormone synthesis [18]. For instance, oxidative damage can decrease testosterone production in males, leading to hypogonadism, and alter estrogen production in females, contributing to menstrual irregularities [19] In pathological conditions like PCOS, oxidative stress exacerbates insulin resistance and hyperandrogenism, both of which further disrupt normal reproductive hormonal balance [20]. Moreover, chronic oxidative stress elevates systemic cortisol levels through hypothalamic-pituitary-adrenal (HPA) axis activation [21]. Elevated cortisol suppresses gonadotropin release and sex steroid production, compounding reproductive dysfunction [22].

Overall, oxidative stress induces a hormonal milieu characterized by decreased gonadotropins, impaired steroidogenesis, and heightened inflammatory mediators, creating a hostile environment for successful reproduction. Addressing oxidative imbalance is thus critical to restoring hormonal harmony and reproductive competence.

Antioxidant-Rich Plant Extracts: Mechanisms of Action

Plant-based antioxidants exert their beneficial effects on reproductive health through multiple complementary mechanisms, targeting both oxidative damage and hormonal imbalances. One primary mechanism is direct scavenging of free radicals. Phytochemicals such as flavonoids (e.g., quercetin, kaempferol), polyphenols (e.g., resveratrol, catechins), and vitamins (e.g., vitamin C, vitamin E) neutralize reactive oxygen species (ROS) before they can damage lipids, proteins, or DNA in reproductive tissues [23]. By preventing oxidative damage at the cellular level, these compounds help preserve the integrity of sperm, oocytes, and reproductive organs. Another important mechanism involves the upregulation of endogenous antioxidant systems. Certain plant extracts stimulate the expression of antioxidant enzymes like superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx), enhancing the body's natural defense against oxidative stress [24]. For instance, compounds in green tea (Camellia sinensis) and pomegranate (Punica granatum) have been shown to boost these enzymes, thereby offering prolonged protection against oxidative insults [25]. Additionally, the anti-inflammatory actions of antioxidant-rich plants are crucial. Chronic inflammation is often a downstream consequence of oxidative stress in the reproductive system. Plant extracts such as those from Curcuma longa (turmeric) inhibit pro-inflammatory transcription factors like nuclear factor kappa B (NF-κB) and suppress the production of inflammatory cytokines such as TNF-α and IL-6 [26]. By reducing inflammation, these extracts help restore a conducive environment for gametogenesis and hormone secretion. Importantly, many phytochemicals also modulate hormonal pathways [27]. For example, Withania somnifera (ashwagandha) has been shown to restore normal testosterone levels in stressed males, while Vitex agnus-castus can normalize luteinizing hormone (LH) levels in females with polycystic ovary syndrome (PCOS) [28]. These dual actions—reducing oxidative stress and directly influencing hormonal regulation—make antioxidant-rich plants especially promising for treating reproductive dysfunctions.

Therapeutic Applications and Clinical Perspectives

Antioxidant-rich plant extracts hold significant promise as therapeutic agents for a variety of reproductive disorders. In males, clinical studies have reported improvements in sperm concentration, motility, morphology, and DNA integrity following antioxidant supplementation [29]. For example, supplementation with extracts from Tribulus terrestris and Eurycoma longifolia has been associated with enhanced spermatogenesis and improved hormonal profiles [30]. In females, antioxidant therapy has demonstrated potential in restoring ovulatory cycles, improving oocyte quality, and enhancing endometrial receptivity [31]. Extracts from plants such as Camellia sinensis (green tea) and Punica granatum (pomegranate) have been shown to counteract oxidative stress and improve ovarian reserve markers like anti-Müllerian hormone (AMH) levels [32]. Moreover, antioxidant supplementation during assisted reproductive technology (ART) procedures has been associated with improved fertilization rates, embryo quality, and pregnancy outcomes [33]. The therapeutic application of plant antioxidants is also being explored in age-related reproductive decline. Natural aging is accompanied by an accumulation of oxidative damage in the gonads, leading to decreased fertility [34]. Plant-derived antioxidants may slow this process by maintaining cellular redox balance and preserving hormonal output. Despite these promising findings, clinical translation faces several challenges. Variability in plant extract composition, bioavailability issues, lack of standardized dosing, and potential herb-drug interactions must be carefully addressed. Rigorous, large-scale randomized controlled trials are necessary to establish efficacy, optimize dosing regimens, and ensure safety for broader clinical use.

Future Directions

The field of antioxidant-based reproductive therapy is still evolving, and several areas merit further investigation. First, there is a pressing need for standardization and characterization of antioxidant phytoconstituents. Variability in cultivation practices, extraction methods, and plant species can lead to significant differences in bioactive compound content, impacting efficacy. Future research should also prioritize large-scale randomized clinical trials that evaluate the safety, optimal dosing, and therapeutic outcomes of plant-based antioxidant interventions across diverse populations. These trials should incorporate standardized oxidative stress and fertility biomarkers to ensure comparability. Another important direction is the exploration of synergistic effects. Combining multiple plant extracts with complementary mechanisms of action may offer superior therapeutic benefits compared to individual extracts. Identifying optimal combinations and dosages will enhance treatment efficacy. Advances in delivery systems could further improve the clinical applicability of plant antioxidants. Novel technologies such as nanoparticle encapsulation and liposomal delivery can enhance the bioavailability and targeted delivery of antioxidant compounds to reproductive tissues. Finally, personalized reproductive medicine incorporating antioxidant therapy tailored to individual oxidative profiles, hormonal imbalances, and genetic susceptibilities could revolutionize fertility treatments. Integrating omics technologies (e.g., genomics, metabolomics) will enable precision phytotherapy approaches for reproductive health.

CONCLUSION

Oxidative stress represents a major disruptor of reproductive health, affecting gamete integrity, hormonal homeostasis, and tissue function. Antioxidant-rich plant extracts offer a promising therapeutic avenue by mitigating oxidative damage, restoring hormonal balance, and improving fertility outcomes. Although current evidence is encouraging, further research is needed to overcome challenges related to standardization, bioavailability, and clinical validation. Future integration of phytotherapy into personalized reproductive medicine may transform infertility management, offering safe, effective, and natural interventions.

REFERENCES

1. Walke G, Gaurkar SS, Prasad R, Lohakare T, Wanjari M. The impact of oxidative stress on male reproductive function: exploring the role of antioxidant supplementation. Cureus. 2023. doi:10.7759/cureus.42583
2. Alum, E. U., Ibiam, U. A., Ugwuja, E. I., Aja, P. M., Igwenyi, I. O., Offor, C. E., Orji, O. U., Ezeani N. N, Ugwu, O. P. C., Aloke, C., Egwu, C. O. Antioxidant Effect of *Buchholzia coriacea* Ethanol Leaf Extract and Fractions on Freund's Adjuvant-induced Arthritis in Albino Rats: A Comparative Study. *Slovenian Veterinary Research.* 2022; 59 (1): 31–45. doi: 10.26873/svr-1150-2022.
3. Elbouzidi A, Haddou M, Baraich A, Taibi M, Hachlafi NE, Pareek A, et al. Biochemical insights into specialized plant metabolites: advancing cosmeceutical applications for skin benefits. Journal of Agriculture and Food Research. 2025;19:101651. doi:10.1016/j.jafr.2025.101651
4. Alum EU. Role of phytochemicals in cardiovascular disease management: Insights into mechanisms, efficacy, and clinical application. Phytomedicine Plus, 2025; 5(1),100695. https://doi.org/10.1016/j.phyplu.2024.100695.
5. 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

6. Drevet JR, Aitken RJ. Oxidation of sperm nucleus in mammals: a physiological necessity to some extent with adverse impacts on oocyte and offspring. Antioxidants. 2020;9(2):95. doi:10.3390/antiox9020095
7. Wang Y, Fu X, Li H. Mechanisms of oxidative stress-induced sperm dysfunction. Frontiers in Endocrinology. 2025;16. doi:10.3389/fendo.2025.1520835
8. Sasaki H, Hamatani T, Kamijo S, Iwai M, Kobanawa M, Ogawa S, et al. Impact of oxidative stress on age-associated decline in oocyte developmental competence. Frontiers in Endocrinology. 2019;10. doi:10.3389/fendo.2019.00811
9. Rotimi DE, Acho MA, Falana BM, Olaolu TD, Mgbojikwe I, Ojo OA, et al. Oxidative stress-induced hormonal disruption in male reproduction. Reproductive Sciences. 2024;31(10):2943–56. doi:10.1007/s43032-024-01662-0
10. Marques P, De Sousa Lages A, Skorupskaite K, Rozario KS, Anderson RA, George JT. Physiology of GnRH and gonadotrophin secretion. Endotext – NCBI Bookshelf. 2024.
11. Pizzino G, Irrera N, Cucinotta M, Pallio G, Mannino F, Arcoraci V, et al. Oxidative stress: harms and benefits for human health. Oxidative Medicine and Cellular Longevity. 2017;2017(1). doi:10.1155/2017/8416763
12. Potiris A, Moustakli E, Trismpioti E, Drakaki E, Mavrogianni D, Matsas A, et al. From inflammation to infertility: how oxidative stress and infections disrupt male reproductive health. Metabolites. 2025;15(4):267. doi:10.3390/metabo15040267
13. Liang J, Gao Y, Feng Z, Zhang B, Na Z, Li D. Reactive oxygen species and ovarian diseases: antioxidant strategies. Redox Biology. 2023;62:102659. doi:10.1016/j.redox.2023.102659
14. Peddireddy V, Prasad BS, Gundimeda SD, Penagaluru PR, Mundluru HP. Assessment of 8-oxo-7,8-dihydro-2′-deoxyguanosine and malondialdehyde levels as oxidative stress markers and antioxidant status in non-small cell lung cancer. Biomarkers. 2012;17(3):261–8. doi:10.3109/1354750x.2012.664169
15. Rauf A, Khalil AA, Awadallah S, Khan SA, Abu-Izneid T, Kamran M, et al. Reactive oxygen species in biological systems: pathways, associated diseases, and potential inhibitors—a review. Food Science & Nutrition. 2023;12(2):675–93. doi:10.1002/fsn3.3784
16. Marques P, De Sousa Lages A, Skorupskaite K, Rozario KS, Anderson RA, George JT. Physiology of GnRH and gonadotrophin secretion. Endotext – NCBI Bookshelf. 2024.
17. Hu J, Zhang Z, Shen WJ, Azhar S. Cellular cholesterol delivery, intracellular processing and utilization for biosynthesis of steroid hormones. Nutrition & Metabolism. 2010;7(1). doi:10.1186/1743-7075-7-47
18. Hu XQ, Song R, Zhang L. Effect of oxidative stress on the estrogen-NOS-NO-KCa channel pathway in uteroplacental dysfunction: its implication in pregnancy complications. Oxidative Medicine and Cellular Longevity. 2019;2019:1–19. doi:10.1155/2019/9194269
19. Roychoudhury S, Chakraborty S, Choudhury AP, Das A, Jha NK, Slama P, et al. Environmental factors-induced oxidative stress: hormonal and molecular pathway disruptions in hypogonadism and erectile dysfunction. Antioxidants. 2021;10(6):837. doi:10.3390/antiox10060837
20. Singh S, Pal N, Shubham S, Sarma DK, Verma V, Marotta F, et al. Polycystic ovary syndrome: etiology, current management, and future therapeutics. Journal of Clinical Medicine. 2023;12(4):1454. doi:10.3390/jcm12041454
21. Mbiydzenyuy NE, Qulu LA. Stress, hypothalamic-pituitary-adrenal axis, hypothalamic-pituitary-gonadal axis, and aggression. Metabolic Brain Disease. 2024;39(8):1613–36. doi:10.1007/s11011-024-01393-w
22. Whirledge S, Cidlowski JA. A role for glucocorticoids in stress-impaired reproduction: beyond the hypothalamus and pituitary. Endocrinology. 2013;154(12):4450–68. doi:10.1210/en.2013-1652
23. Alum EU, Nwuruku AO. and Edwin, N. Targeting Oxidative Stress in Cancer Management: The Role of Antioxidant Phytochemicals. KIU J. Health Sci., 2024; 4(2): 1-10. https://doi.org/10.59568/KJHS-2024-4-2-01
24. Zhu Y, Tian M, Lu S, Qin Y, Zhao T, Shi H, et al. The antioxidant role of aromatic plant extracts in managing neurodegenerative diseases: a comprehensive review. Brain Research Bulletin. 2025;111253. doi:10.1016/j.brainresbull.2025.111253
25. Noreen S, Hashmi B, Aja PM, Atoki AV. Phytochemicals and pharmacology of pomegranate (Punica granatum L.): nutraceutical benefits and industrial applications: a review. Frontiers in Nutrition. 2025;12. doi:10.3389/fnut.2025.1528897
26. Kim JH, Gupta SC, Park B, Yadav VR, Aggarwal BB. Turmeric (Curcuma longa) inhibits inflammatory nuclear factor (NF)-κB and NF-κB-regulated gene products and induces death receptors leading to

suppressed proliferation, induced chemosensitization, and suppressed osteoclastogenesis. Molecular Nutrition & Food Research. 2011;56(3):454–65. doi:10.1002/mnfr.201100270

27. Nisar A, Jagtap S, Vyavahare S, Deshpande M, Harsulkar A, Ranjekar P, et al. Phytochemicals in the treatment of inflammation-associated diseases: the journey from preclinical trials to clinical practice. Frontiers in Pharmacology. 2023;14. doi:10.3389/fphar.2023.1177050
28. Lopresti AL, Drummond PD, Smith SJ. A randomized, double-blind, placebo-controlled, crossover study examining the hormonal and vitality effects of Ashwagandha (Withania somnifera) in aging, overweight males. American Journal of Men's Health. 2019;13(2). doi:10.1177/1557988319835985
29. Dimitriadis F, Borgmann H, Struck J, Salem J, Kuru T. Antioxidant supplementation on male fertility—a systematic review. Antioxidants. 2023;12(4):836. doi:10.3390/antiox12040836
30. Nguyen-Thanh T, Dang-Ngoc P, Bui MH, Le-Minh T, Nguyen-Vu QH. Effectiveness of herbal medicines on male reproductive system: evidence from meta-analysis. Pharmacological Research – Modern Chinese Medicine. 2024;12:100462. doi:10.1016/j.prmcm.2024.100462
31. Tesarik J. Towards personalized antioxidant use in female infertility: need for more molecular and clinical studies. Biomedicines. 2021;9(12):1933. doi:10.3390/biomedicines9121933
32. Jang JY, Kim D, Im E, Kim ND. Therapeutic potential of pomegranate extract for women's reproductive health and breast cancer. Life. 2024;14(10):1264. doi:10.3390/life14101264
33. Budani MC, Tiboni GM. Effects of supplementation with natural antioxidants on oocytes and preimplantation embryos. Antioxidants. 2020;9(7):612. doi:10.3390/antiox9070612
34. Frungieri MB, Calandra RS, Bartke A, Matzkin ME. Male and female gonadal ageing: its impact on health span and life span. Mechanisms of Ageing and Development. 2021;197:111519. doi:10.1016/j.mad.2021.111519
35. Orji OU, Ibiam UA, Aja PM, Ugwu P, Uraku AJ, Aloke C, Obasi OD, Nwali BU. Evaluation of the phytochemical and nutritional profiles of Cnidoscolus aconitifolius leaf collected in Abakaliki South East Nigeria. World J Med Sci. 2016;13(3):213-217.
36. Enechi OC, Okpe CC, Ibe GN, Omeje KO, Ugwu Okechukwu PC. Effect of Buchholzia coriacea methanol extract on haematological indices and liver function parameters in *Plasmodium berghei*-infected mice. Glob Veterinaria. 2016;16(1):57-66.
37. Alum EU, Uti DE, Ugwu Okechukwu PC, Alum BN. Toward a cure–Advancing HIV/AIDS treatment modalities beyond antiretroviral therapy: A review. Med. 2024;103(27):e38768.
38. Obeagu EI, Bot YS, Obeagu GU, Alum EU, Ugwu Okechukwu PC. Anaemia and risk factors in lactating mothers: A concern in Africa. Int J Innov Appl Res. 2024;11(2):15-17.
39. Alum EU, Ibiam UA, Ugwuja EI, Aja PM, Igwenyi IO, Offor CE, Orji UO, Ezeani NN, Ugwu OP, Aloke C, Egwu CO. Antioxidant effect of Buchholzia coriacea ethanol leaf extract and fractions on Freund's adjuvant-induced arthritis in albino rats: A comparative study. 2022;59(1):31-45.
40. Offor CE, Ugwu Okechukwu PC, Alum EU. Determination of ascorbic acid contents of fruits and vegetables. Int J Pharm Med Sci. 2015;5:1-3.
41. Amusa MO, Adepoju AO, Ugwu Okechukwu PC, Alum EU, Obeagu EI, Okon MB, Aja PM, Samson AOS. Effect of ethanol leaf extract of *Chromolaena odorata* on lipid profile of streptozotocin-induced diabetic Wistar albino rats. IAA J Biol Sci. 2024;10(1):109-117.
42. Amusa MO, Adepoju AO, Ugwu Okechukwu PC, Alum EU, Obeagu EI, Okon MB, Aja PM, Samson AOS. Effect of ethanol leaf extract of *Chromolaena odorata* on lipid profile of streptozotocin-induced diabetic Wistar albino rats. IAA J Biol Sci. 2024;10(1):109-117.
43. Enechi YS, Ugwu OC, Ugwu Okechukwu PC, Omeh K. Evaluation of the antinutrient levels of *Ceiba pentandra* leaves. IJRRPAS. 2013;3(3):394-400.
44. Ugwu Okechukwu PC, Nwodo OFC, Joshua EP, Odo CE, Ossai EC. Effect of ethanol leaf extract of *Moringa oleifera* on lipid profile of malaria-infected mice. Res J Pharm Biol Chem Sci. 2014;4(1):1324-1332.
45. Ugwu OPC, Alum EU, Uhama KC. Dual burden of diabetes mellitus and malaria: Exploring the role of phytochemicals and vitamins in disease management. Res Inven J Res Med Sci. 2024;3(2):38-49.
46. Alum EU, Ugwu Okechukwu PC, Aja PM, Obeagu EI, Inya JE, Onyeije AP, Agu E, Awuchi CG. Restorative effects of ethanolic leaf extract of *Datura stramonium* against methotrexate-induced hematological impairments. Cogent Food Agric. 2013;9(1):2258774.
47. Offor CE, Nwankwegu FC, Joshua EP, Ugwu Okechukwu PC. Acute toxicity investigation and anti-diarrhoeal effect of the chloroform-methanol extract of the leaves of *Persea americana*. Iran J Pharm Res. 2014;13(2):651-658. PMID: 25237361; PMCID: PMC4157041.

48. Afiukwa CA, Oko AO, Afiukwa JN, Ugwu Okechukwu PC, Ali FU, Ossai EC. Proximate and mineral element compositions of five edible wild grown mushroom species in Abakaliki, southeast Nigeria. Res J Pharm Biol Chem Sci. 2013;4:1056-1064.
49. Ugwu OP, Alum EU, Ugwu JN, Eze VH, Ugwu CN, Ogenyi FC, Okon MB. Harnessing technology for infectious disease response in conflict zones: Challenges, innovations, and policy implications. Med. 2024;103(28):e38834.
50. Obeagu EI, Ugwu OPC, Alum EU. Poor glycaemic control among diabetic patients; A review on associated factors. Newport Int J Res Med Sci (NIJRMS). 2023;3(1):30-33.
51. Nwaka AC, Ikechi-Agba MC, Okechukwu PU, Igwenyi IO, Agbafor KN, Orji OU, Ezugwu AL. The effects of ethanol extracts of *Jatropha curcas* on some hematological parameters of chloroform intoxicated rats. Am-Eur J Sci Res. 2015;10(1):45-49.
52. Ezeani NN, Ibiam UA, Orji OU, Igwenyi IO, Aloke C, Alum E, Aja PM, Ugwu OP. Effects of aqueous and ethanol root extracts of *Olax subscopioidea* on inflammatory parameters in complete Freund's adjuvant-collagen type II induced arthritic albino rats. Pharmacogn J. 2019;11(1)

CITE AS: Kirabo Nansubuga K. (2025). Oxidative Stress, Hormonal Response, and the Reproductive System: Therapeutic Prospects of Antioxidant-Rich Plant Extracts. INOSR Experimental Sciences 15(3):10-15. https://doi.org/10.59298/INOSRES/2025/1531015