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Potentials of Tropical Plant Leaves and Seeds in Chicken Nutrition and their Effects on Spermatozoa Quality and Egg Production. A review

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Abstract

The projected increase in the global human population to about 9 billion by 2050 has intensified concerns over food security and the need for a corresponding rise in food production. In particular, greater availability of foods of animal origin is required to avert future food shortages. Poultry production, which has the potential to meet much of this growing demand, is increasingly constrained by the high and rising cost of conventional feed ingredients, thereby underscoring the need to develop and utilize locally available feed resources. Consequently, there is growing interest, especially among livestock farmers in developing countries, in exploiting the nutritional potential of the leaves and seeds of tropical browse plants. Numerous studies have shown that leaf and seed meals from tropical plants are rich sources of essential nutrients and beneficial phytochemicals. Evidence from previous research indicates that their inclusion in poultry diets can enhance chicken performance. However, their wider application in animal feeding has been limited by the presence of antinutritional factors (ANFs), which negatively affect nutrient utilization and animal health. This review therefore examines the biochemical composition of leaf and seed meals of tropical browse plants, their mechanisms of action, available methods for detoxifying their ANFs and their effects on chicken reproduction.

Keywords: Composition, Chickens, Feeding; Novel, feeds, Reproduction.

Introduction

Poultry production is among the fastest-growing livestock sectors worldwide and plays a vital role in improving food security, income generation, and nutritional status, particularly in developing countries. Chickens are preferred because of their rapid growth, efficient feed conversion, short production cycle, and ability to adapt to diverse production systems. Poultry meat and eggs are rich sources of high-quality protein, essential amino acids, vitamins, and minerals necessary for human health. With the global population expected to surpass nine billion by 2050, the demand for poultry products will increase substantially, thereby requiring improvements in productivity and reproductive efficiency within poultry production systems (FAO, 2020; Marappan *et al*., 2024). Reproductive performance is a key determinant of efficiency and profitability in poultry production, especially in breeder enterprises where fertility, hatchability, and egg production directly influence output. In male chickens, semen quality traits such as sperm concentration, motility, viability, morphology, and semen volume are crucial indicators of reproductive potential and fertilization success. Likewise, in females, egg production, egg quality, fertility, and hatchability depend on proper reproductive physiology supported by adequate nutrition. Poor reproductive performance results in reduced chick output, inefficient breeding programs, and economic

losses (Tutubalang *et al*., 2022; Ghadimi *et al*., 2024).

Nutrition remains one of the most critical factors influencing reproductive health and performance in poultry. Conventional diets rely heavily on maize, soybean meal, fish meal, and synthetic additives. However, rising costs, limited availability, and competition for these ingredients have increased production expenses, particularly in tropical and developing regions. This situation has intensified the search for alternative, affordable, and locally available feed resources capable of sustaining productivity and reproductive efficiency (Ogbuewu and Mbajiorgu, 2024; Gafer *et al*., 2023). Leaf and seed meals of tropical plants have gained attention as promising alternative feed ingredients and natural supplements. Tropical regions are endowed with diverse plant species whose leaves and seeds contain substantial amounts of crude protein, essential amino acids, vitamins, minerals, and fatty acids. Plants such as *Moringa oleifera*, *Indigofera* spp., *Tithonia diversifolia*, *Mimosa pudica*, and *Eurycoma longifolia* have been widely studied for their nutritional and medicinal properties. These resources are generally inexpensive, readily available, and environmentally sustainable, making them suitable for inclusion in poultry diets (Suripta *et al*., 2023; Marappan *et al*., 2024).

Beyond their nutritive value, tropical plant leaves and seeds are rich in bioactive phytochemicals, including flavonoids, tannins, alkaloids, saponins, carotenoids, and phenolic compounds. These substances possess antioxidant, antimicrobial, anti-inflammatory, and endocrine-modulating properties that can positively influence reproductive physiology in poultry. Oxidative stress is a major factor that impairs sperm quality, reducing motility, viability, and fertilizing capacity. Antioxidant-rich plant materials help counteract oxidative damage by scavenging free radicals, stabilizing sperm membranes, and protecting sperm DNA (Tvrdá *et al*., 2021; Ghadimi *et al*., 2024). Several studies have demonstrated improvements in semen quality of male chickens following dietary supplementation with tropical plant leaves and seeds. For instance, *Moringa oleifera* leaf meal or extracts significantly enhanced sperm concentration, motility, progressive motility, and viability in breeder males, effects attributed to improved antioxidant status and hormonal balance during spermatogenesis (Tutubalang *et al*., 2022; Marappan *et al*., 2024). Similarly, Suripta et al. (2023) reported significant improvements in semen quality parameters of free-range chickens supplemented with *Mimosa pudica* leaf extract.

Processing methods, particularly fermentation, further enhance the reproductive benefits of tropical plant materials by improving nutrient availability, reducing anti-nutritional factors, and increasing the bioavailability of phytochemicals. Mustaqim and Jannah (2021) showed that fermented *Indigofera* sp. and *Eurycoma longifolia* leaf-based diets significantly improved semen quality in Arabic chickens, highlighting the importance of appropriate processing techniques for maximizing the benefits of plant-based feed resources (Ogbuewu and Mbajiorgu, 2024). In female chickens, dietary inclusion of tropical plant leaves and seeds has been associated with improved egg production, egg quality, fertility, and hatchability. Enhancements such as increased egg weight, stronger shell thickness, better yolk quality, and improved fertility outcomes have been reported. These effects are linked to improved nutrient utilization, enhanced antioxidant status, and positive modulation of reproductive hormones, including follicle-

stimulating hormone and luteinizing hormone (Gafer *et al*., 2023; Ikpoh *et al*., 2025).

Despite these advantages, the use of tropical plant leaves and seeds must be carefully managed because of anti-nutritional factors such as tannins, phytates, oxalates, and saponins. High inclusion levels may adversely affect growth performance and reproductive organ development. For example, excessive inclusion of *Tithonia diversifolia* leaf meal has been reported to impair testicular development in cocks, emphasizing the need to establish safe and optimal inclusion levels (Ogbuewu and Mbajiorgu, 2024). Therefore, appropriate processing methods and controlled dietary incorporation are essential. From a sustainability perspective, the utilization of tropical plant leaves and seeds supports environmentally friendly and cost-effective poultry production. These resources reduce dependence on imported feed ingredients, lower production costs, and minimize environmental pollution associated with synthetic additives. Moreover, replacing antibiotic growth promoters with plant-based alternatives contributes to public health by reducing the risk of antimicrobial resistance (Gafer *et al*., 2023; FAO, 2020). The objective of this review was to evaluate the potential of selected tropical plant leaves and seeds as dietary components in chicken nutrition and to assess their effects on spermatozoa quality and egg production.

Public Health Importance of the Study

Public health is strongly influenced by the safety, quality, and availability of foods of animal origin, particularly poultry products such as eggs and chicken meat, which are consumed by people across all socio-economic groups. Eggs, in particular, are among the most affordable sources of high-quality protein, essential amino acids, vitamins, and micronutrients required for human growth and development. Consequently, improvements in egg production and fertility in chickens have direct implications for food security, nutritional adequacy, and public health, especially in developing countries where malnutrition and protein deficiency remain prevalent (FAO, 2020; Marappan *et al*., 2024).

A major public health concern in contemporary poultry production is the extensive use of synthetic feed additives, hormones, and antibiotic growth promoters to enhance productivity and reproductive performance. The routine inclusion of antibiotics in poultry diets has been closely linked to the emergence of antimicrobial resistance (AMR), which constitutes a serious global health threat. Resistant microorganisms and antibiotic residues may be transmitted to humans through the consumption of poultry products or via environmental pathways, thereby reducing the effectiveness of antibiotics used in human medicine (WHO, 2021; Ogbuewu and Mbajiorgu, 2024). In this context, the incorporation of tropical plant leaves and seeds into chicken diets presents a natural and safer alternative to synthetic additives and antibiotics. Many tropical plants possess antimicrobial, antioxidant, and immunomodulatory properties that enhance bird health and reproductive performance without contributing to antibiotic resistance. Their use can reduce dependence on antibiotics, minimize drug residues in eggs and meat, and ultimately promote safer food for human consumption (Gafer *et al*., 2023; Ghadimi *et al*., 2024).

Oxidative stress in poultry not only compromises reproductive efficiency but also affects the quality and safety of poultry products consumed by humans. Poor reproductive performance often leads to inefficient production systems, higher production costs, and reduced availability and affordability of eggs and meat. Tropical plant

leaves and seeds, which are rich in natural antioxidants such as flavonoids, polyphenols, carotenoids, and vitamins A, C, and E, help mitigate oxidative stress, support healthier reproductive systems, and improve egg quality. Eggs produced under such conditions may exhibit enhanced nutritional value, thereby contributing positively to human nutrition and public health (Tvrdá *et al*., 2021; Santos and Teixeira, 2020).

Moreover, improving egg fertility and hatchability through natural dietary strategies increases chick output and flock sustainability, ensuring a steady supply of poultry products to meet the demands of a growing population. A reliable supply of eggs and chicken meat is essential for combating food insecurity and reducing dependence on imported animal protein, particularly in low- and middle-income countries where poultry production serves as both a major livelihood and a critical source of nutrition (FAO, 2020; Tutubalang *et al*., 2022). The public health relevance of this approach also extends to environmental health. Utilizing locally available tropical plant leaves and seeds as feed ingredients supports environmentally sustainable poultry production by reducing reliance on imported feeds, lowering carbon emissions associated with transportation, and minimizing waste. Sustainable food production systems are fundamental to long-term public health, given the strong links between environmental degradation, climate change, food safety, and disease patterns (Gafer *et al*., 2023; Ogbuewu and Mbajiorgu, 2024).

Additionally, eggs produced through natural dietary supplementation strategies may possess enhanced nutritional and functional qualities. Diets enriched with tropical plant materials have been associated with improved yolk pigmentation, increased antioxidant content, and more favorable fatty acid profiles. Such improvements may contribute to reduced risks of chronic diseases, including cardiovascular disorders, when these eggs are consumed as part of a balanced diet (Marappan *et al*., 2024; Ikpoh *et al*., 2025). Thus, the benefits of improved poultry nutrition extend beyond production efficiency to encompass broader human health promotion and disease prevention.

Rationale for the Study

The growing demand for poultry products, particularly eggs and chicken meat, fuelled by rapid population increase and heightened awareness of the nutritional value of animal protein, has intensified the need for efficient, safe, and sustainable poultry production systems. Reproductive efficiency, reflected in superior sperm quality in males and optimal egg production in females, is a central determinant of productivity in poultry enterprises. However, reproductive performance in chickens is frequently limited by inadequate nutrition, oxidative stress, disease pressure, and the escalating cost of conventional feed ingredients, especially protein sources and synthetic additives (FAO, 2020; Marappan *et al*., 2024). Traditionally, poultry production has depended heavily on synthetic growth promoters, hormones, and antibiotics to enhance productivity and reproductive performance. Although these inputs may provide short-term benefits, their long-term use has generated serious concerns related to antimicrobial resistance, drug residues in poultry products, and potential risks to human health. Consequently, global health and agricultural authorities have emphasized the urgent need for natural, safe, and sustainable alternatives to synthetic feed additives in animal production systems (WHO, 2021; Gafer *et al*., 2023). This situation provides strong justification for exploring plant-based feed resources capable of improving reproductive performance while ensuring food safety.

Tropical plant leaves and seeds offer considerable promise because of their abundance, low cost, and rich nutritional and phytochemical profiles. Species such as *Moringa oleifera*, *Indigofera* spp., *Tithonia diversifolia*, *Mimosa pudica*, and *Parquetina nigrescens* contain essential amino acids, minerals, vitamins, and a wide range of biologically active compounds that support reproductive functions. Their phytochemicals, including flavonoids, polyphenols, saponins, and natural antioxidants, have been reported to stimulate spermatogenesis, enhance sperm motility and viability, regulate reproductive hormones, and promote egg formation and fertility in poultry (Tvrdá *et al*., 2021; Ghadimi *et al*., 2024). An additional motivation for this line of research arises from the economic constraints faced by poultry farmers, particularly in developing countries, where feed costs account for 60–70% of total production expenses. Profitability is therefore highly vulnerable to fluctuations in the prices of conventional feed ingredients. The incorporation of locally available tropical plant leaves and seeds as partial replacements or supplements in poultry diets can substantially reduce feed costs while maintaining or even improving reproductive performance. This strategy not only enhances farm profitability but also encourages the utilization of underexploited indigenous plant resources, thereby supporting rural livelihoods and sustainable agricultural development (Ogbuewu and Mbajiorgu, 2024; Tutubalang *et al*., 2022).

Despite increasing evidence of the benefits of tropical plant-based diets, considerable variability exists among studies due to differences in plant species, processing methods, inclusion levels, and the physiological responses of chickens. Some plant materials contain antinutritional factors that may impair nutrient utilization and reproductive performance if not properly processed or incorporated at appropriate levels. This underscores the need for systematic and comprehensive evaluation of different tropical plant leaves and seeds to establish safe, effective, and standardized feeding strategies that optimize spermatozoa quality and egg production (Ikpoh *et al.*, 2025; Gafer *et al*., 2023). Furthermore, enhancing reproductive efficiency through natural dietary interventions contributes to environmental sustainability by reducing production waste, improving resource-use efficiency, lowering greenhouse gas emissions associated with inefficient systems, and decreasing dependence on imported feed ingredients. Sustainable poultry production is therefore increasingly recognized as a cornerstone of resilient food systems that support long-term food security, public health, and environmental integrity (FAO, 2020; Ogbuewu and Mbajiorgu, 2024).

Overview of Tropical Plant Leaves and Seeds in Poultry Nutrition

The incorporation of tropical plant leaves and seeds into poultry nutrition has attracted increasing interest in recent years, largely driven by the rising cost of conventional feed ingredients and the need for sustainable alternatives. Plants such as *Moringa oleifera (*Miracle tree or drumstick tree), *Gongronema latifolium (*Utazi (Igbo), Arokeke Yoruba), *Parquetina nigrescens (*Bullock vine), *Indigofera* spp (Indigo plant)., and *Tithonia diversifolia (*Tree marigold) are abundant in tropical regions and are recognized for their rich nutritional composition. They supply valuable amounts of protein, vitamins, minerals, and bioactive compounds that support growth, health, and reproductive functions in chickens (Ogbuewu and Mbajiorgu, 2020).

Tropical plant leaves and seeds are particularly important because they can serve as partial substitutes for costly protein sources

such as soybean meal and fish meal. When properly processed, these plant materials provide appreciable levels of crude protein, essential amino acids, and metabolizable energy suitable for poultry feeding. Their utilization therefore contributes to feed security, lowers production costs, and reduces reliance on imported feed ingredients (Tutubalang *et al*., 2022).

In addition to their nutritional contributions, tropical plant leaves and seeds possess notable medicinal and functional properties that promote poultry health. Many contain antioxidants, antimicrobial agents, and immune-modulating compounds that enhance disease resistance and improve tolerance to environmental stress (Gafer *et al*., 2023). This combination of nutritional and health-promoting benefits makes tropical plants highly attractive as natural feed additives in poultry production systems.

Recent studies have further highlighted their potential to improve reproductive performance, particularly in enhancing sperm quality and egg production. This growing body of evidence supports the increasing shift toward natural, plant-based feed additives that can enhance fertility and productivity while minimizing dependence on synthetic growth promoters and antibiotics (Marappan *et al*., 2024).

Nutritional Composition of Tropical Plant Leaves and Seeds

The nutritional composition of tropical plant leaves and seeds shows considerable variation depending on plant species, stage of maturity, and processing methods. In general, leaves of tropical plants such as *Moringa oleifera* and *Indigofera* spp. are characterized by high crude protein contents, typically ranging from 20% to 30%, which makes them valuable protein supplements in poultry diets (Ikpoh *et al*., 2025). They also provide essential amino acids required for the development and proper functioning of reproductive tissues.

Beyond protein, tropical plant leaves and seeds are important sources of vitamins, particularly vitamins A, C, and E, which play critical roles in maintaining reproductive health. Vitamin E is especially significant because of its antioxidant function, protecting sperm cells from oxidative damage and thereby enhancing fertility in poultry (Ghadimi *et al*., 2024). In addition, essential minerals such as calcium, iron, zinc, and selenium present in these plants contribute to spermatogenesis, hormone regulation, and egg formation. Seeds of many tropical plants further provide beneficial fatty acids that improve energy supply and support hormonal balance in chickens. Unsaturated fatty acids are vital for maintaining the structural integrity of sperm cell membranes and for improving egg quality traits, including yolk lipid composition (Ogbuewu and Mbajiorgu, 2020). Nevertheless, some seeds contain anti-nutritional factors that can limit nutrient utilization if not properly managed.

To address this challenge, various processing techniques such as drying, soaking, fermentation, and grinding are employed to enhance nutrient availability and reduce anti-nutritional compounds. Among these, fermentation has proven particularly effective, as it improves protein digestibility and increases the bioavailability of minerals in tropical plant-based feed ingredients (Mustaqim and Jannah, 2021).

Phytochemicals and Bioactive Compounds in Tropical Plants

Phytochemicals are naturally occurring bioactive compounds in plants that exert important physiological effects beyond their basic nutritional value. Tropical plant leaves and seeds are rich in flavonoids, phenolic compounds, alkaloids, saponins, and tannins,

all of which contribute to their positive influence on reproductive performance in poultry. A major function of these compounds is their antioxidant activity, through which they protect reproductive cells against oxidative stress. Oxidative stress is a key factor impairing sperm quality and egg fertility, as reactive oxygen species can damage sperm membranes and DNA, resulting in reduced motility and fertilizing capacity. Antioxidant-rich tropical plants help neutralize these reactive molecules, thereby preserving sperm viability and functionality (Ghadimi *et al*., 2024). In addition to their antioxidant effects, certain phytochemicals play a role in regulating endocrine functions by stimulating the secretion of reproductive hormones. Bioactive compounds present in plants such as *Moringa oleifera* and *Parquetina nigrescens* have been reported to enhance levels of testosterone and follicle-stimulating hormone, which are essential for spermatogenesis and ovulation processes (Akinola *et al*., 2025).

Despite these benefits, phytochemicals must be used judiciously, as excessive intake can lead to toxicity, reduced feed intake, or adverse physiological effects. Therefore, establishing optimal dietary inclusion levels is crucial to maximizing their reproductive advantages while safeguarding the health and performance of poultry (Gafer *et al*., 2023).

Effects of Tropical Plant Leaves and Seeds on Spermatozoa Characteristics

Spermatozoa quality is a critical determinant of fertility in poultry breeding systems, and key parameters such as semen volume, sperm motility, concentration, viability, and morphology are strongly influenced by dietary composition and nutritional status. Several studies have shown that chickens fed diets incorporating tropical plant materials exhibit significant improvements in these semen quality traits (Akintunde *et al*., 2020). In particular, the inclusion of *Moringa oleifera* leaf or seed meal has been reported to enhance sperm motility and sperm concentration in both indigenous and exotic chicken breeds. These beneficial effects are largely attributed to the plant's rich antioxidant content and essential micronutrients, which promote proper testicular development and support sperm maturation processes (Tutubalang *et al*., 2020).

Further evidence suggests that fermentation of tropical plant feed resources can amplify their positive effects on reproductive performance. Fermentation improves nutrient digestibility, increases mineral bioavailability, and reduces anti-nutritional factors. For example, Arabian chickens fed fermented *Indigofera* spp. and *Eurycoma longifolia* leaf-based diets showed higher sperm motility and a greater proportion of morphologically normal spermatozoa compared with birds fed conventional diets (Mustaqim and Jannah, 2021). Nevertheless, the response to tropical plant inclusion in poultry diets is influenced by several factors, including breed, age, physiological status, and the level of dietary inclusion. Excessive incorporation of these plant materials may adversely affect semen quality, often due to high fiber content or the presence of residual anti-nutritional compounds. This underscores the importance of precise formulation and controlled inclusion levels to maximize reproductive benefits without compromising semen quality or overall bird performance (Poku *et al*., 2023).

Suripta, Astuti, and Nurtanti (2023) investigated reproductive limitations commonly observed in free-range male chickens, particularly poor semen quality, which constrains fertility and flock productivity. They evaluated the potential of *Mimosa pudica* leaf extract as a natural alternative to synthetic reproductive enhancers. Using a completely randomized

design, eighteen adult free-range cocks were assigned to six treatment groups receiving graded levels of the extract. Semen samples were collected and analyzed for macroscopic and microscopic parameters under controlled conditions. Key performance metrics included semen volume, sperm concentration, motility, viability, viscosity, color density, and pH. The study found that supplementation between 0.50 and 2.00 cc significantly improved sperm concentration, motility, and viability, while semen volume and pH remained unaffected. The authors concluded that *Mimosa pudica* leaf extract contains bioactive compounds capable of enhancing spermatogenesis and sperm function, providing a safe, cost-effective, and sustainable reproductive enhancer for free-range poultry systems. Tutubalang *et al*. (2022) evaluated the effects of high inclusion levels of *Moringa oleifera* leaf meal on reproductive traits in locally bred chickens while monitoring growth performance. Eighty Potchefstroom Koekoek chickens (equal numbers of hens and roosters) were fed isoenergetic and isonitrogenous diets containing 0% or 70% moringa leaf meal. Data included growth indices, semen quality parameters, and hatchability traits. Evaluation metrics comprised growth performance, sperm concentration, sperm velocity, motility, progressive motility, semen pH, hatchability, and day-old chick weight. High inclusion of moringa leaf meal significantly improved sperm velocity, concentration, motility, hatchability, and chick weight without compromising growth performance. The study concluded that *Moringa oleifera* leaf meal is nutritionally adequate and functionally effective for supporting both reproductive efficiency and growth.

Ghadimi *et al*. (2024) investigated age-related declines in semen quality, fertility, and hatchability in broiler breeder roosters by supplementing diets with *Moringa oleifera* leaf extract as a natural antioxidant. Twenty-four aged roosters were allocated to four treatment groups receiving graded extract levels for ten weeks. Data collected included semen quality traits, oxidative stress markers, antioxidant capacity, reproductive hormones, fertility, and hatchability. Metrics included sperm concentration, total and progressive motility, membrane integrity, malondialdehyde levels, total antioxidant capacity, testosterone, fertility, and hatchability. Supplementation at 200 μL/kg significantly improved antioxidant status, hormonal balance, semen quality, fertility, and hatchability, with no effect on body weight or semen volume. The study concluded that moringa leaf extract effectively mitigates age-related reproductive decline via antioxidant and endocrine regulation. Mustaqim and Jannah (2021) explored the effects of fermented tropical leaf-based feeds on semen quality in Arabic chickens, focusing on *Indigofera* spp. and *Eurycoma longifolia* leaves. A completely randomized design with four dietary treatments was used, and semen was collected on day 30 of the feeding trial. Primary data included semen volume, sperm motility, sperm concentration, and viability. Fermentation was applied to improve nutrient digestibility and reduce anti-nutritional factors. Results indicated that birds fed fermented leaf combinations exhibited significantly better semen quality compared to those on conventional feed, with optimal responses observed at moderate inclusion levels. The authors concluded that fermented tropical leaves are a sustainable source of protein and phytochemicals that enhance male reproductive performance.

Poku Jr. *et al*. (2023) examined the combined effects of dietary *Moringa oleifera* leaf meal and seasonal variation on sperm quality in Pearl Guinea fowl cocks. A 3 × 4 factorial arrangement in a completely randomized design generated data across different seasons and inclusion levels. Methodology included

dietary supplementation, seasonal reproductive assessments, semen analysis, and statistical evaluation via a General Linear Model. Performance metrics included sperm motility, sperm count, semen pH, percentage of normal spermatozoa, and seasonal reproductive indicators. Results showed that increasing moringa inclusion improved sperm count, semen pH, and normal sperm percentage, although excessive inclusion reduced motility. Seasonal factors also independently influenced sperm characteristics. The study concluded that *Moringa oleifera* leaf meal enhances sperm quality and quantity, with reproductive outcomes further modulated by environmental conditions.

Influence of Tropical Plant Based Diets on Egg Production and Fertility

Egg production and fertility are key economic traits in poultry production, as they directly determine profitability and productivity. Adequate nutrition and sound reproductive health play fundamental roles in influencing egg number, egg weight, fertility, and hatchability. When incorporated at appropriate levels, tropical plant leaves and seeds have been reported to exert positive effects on these reproductive parameters (Ikpoh *et al*., 2025). For instance, layers fed diets supplemented with *Moringa oleifera* leaves or seeds have shown improvements in both internal and external egg quality traits, including enhanced yolk pigmentation, increased albumen height, and greater shell thickness. These benefits are attributed to improved nutrient supply and the antioxidant protection of reproductive tissues, which supports optimal egg formation and quality (Tutubalang *et al*., 2022). In addition, fertility and hatchability rates have been observed to increase in birds receiving tropical plant-based supplements. Improved semen quality in males, together with enhanced ovarian function and egg viability in females, contributes to higher fertilization efficiency and better embryo survival (Mercy *et al*., 2024). However, not all responses are uniformly positive. Some studies have reported neutral or even adverse effects at excessive inclusion levels, underscoring the importance of balanced dietary formulation. Maintaining appropriate energy and protein ratios is essential to sustain optimal egg production and reproductive performance when tropical plant materials are incorporated into poultry diets (Marappan *et al*., 2024).

Ikpoh *et al*. (2025) addressed declining reproductive efficiency and suboptimal nutritional status in laying hens by assessing the dietary inclusion of *Moringa oleifera* leaves and seeds as multifunctional feed supplements. A six-week feeding trial divided laying hens into control and treatment groups receiving 5%, 10%, or 20% moringa leaf and seed materials. Data were collected on egg quality traits, meat quality, blood biochemical indices, and reproductive hormone concentrations. Metrics included internal and external egg quality, serum follicle-stimulating hormone and luteinizing hormone levels, protein profiles, minerals, vitamins, and haematological parameters. Results demonstrated significant improvements in egg quality, reproductive hormone secretion, nutrient status, and meat quality in supplemented birds. The study concluded that *Moringa oleifera* leaves and seeds function as effective natural supplements for enhancing both nutrition and reproductive performance in laying poultry.

Challenges, Safety, and Future Prospects of Tropical use in Poultry Diets

Despite their numerous advantages, the incorporation of tropical plant leaves and seeds into poultry diets is constrained by several challenges. These include wide variations in nutrient composition, the presence of anti-nutritional factors, and the

lack of standardized processing methods, all of which hinder their consistent and reliable utilization (Ogbuewu and Mbajiorgu, 2020). In addition, safety concerns arise from the presence of certain plant compounds that may impair nutrient absorption or exert toxic effects when consumed at high levels. Consequently, long-term feeding trials are essential to determine safe inclusion rates and to evaluate any residual effects on poultry products intended for human consumption (Gafer *et al*., 2023).

Current research is therefore increasingly directed toward the development of advanced processing techniques such as fermentation, enzyme supplementation, and nano-encapsulation. These approaches have the potential to enhance nutrient availability, improve the stability and delivery of bioactive compounds, and reduce the impact of anti-nutritional factors, thereby increasing the overall efficiency and safety of tropical plant-based feed additives (Gafer *et al*., 2023).

In summary, tropical plant leaves and seeds possess considerable potential as sustainable feed resources capable of improving spermatozoa quality and egg production in poultry. With continued research, appropriate processing technologies, and careful dietary management, their wider adoption in poultry production systems can be achieved, contributing to more efficient, safe, and environmentally sustainable poultry nutrition.

Conclusion and Recommendations

The use of leaf and seed meals from tropical plants in chicken diets presents a promising and sustainable strategy for improving reproductive performance, particularly spermatozoa quality and egg production. Evidence from recent studies shows that tropical plants such as *Moringa oleifera, Gongronema latifolium, Parquetina nigrescens, Mimosa pudica, and Indigofera species* contain valuable nutrients and bioactive compounds. These include essential amino acids, vitamins, minerals, antioxidants, and phytochemicals that positively influence spermatogenesis, semen quality, fertility, hatchability, and egg production in chickens. When included at appropriate levels, these plant resources enhance sperm motility, sperm concentration, sperm viability, egg fertility, and overall reproductive efficiency. The review further highlights that tropical plant leaves and seeds offer a viable alternative to expensive conventional feed ingredients. Their use is particularly relevant in developing countries where feed cost remains a major constraint to poultry production. Beyond economic benefits, these plant-based feed resources contribute to improved animal health by reducing oxidative stress and supporting hormonal balance involved in reproduction. Studies reviewed from 2020 onward consistently demonstrate that moderate inclusion levels yield beneficial outcomes, while excessive inclusion may negatively affect performance due to anti-nutritional factors.

Despite their high potential, the utilization of tropical plant leaves and seeds in poultry diets requires careful processing and dosage control. Anti-nutritional factors such as tannins, phytates, oxalates, and saponins may limit nutrient availability if not properly managed. Processing methods such as drying, fermentation, soaking, and extraction have been shown to reduce these limitations and improve bioavailability. Therefore, the successful adoption of these feed resources depends on appropriate processing techniques and scientifically determined inclusion levels. In conclusion, tropical plant leaf and seed meals represent an effective, affordable, and sustainable approach to enhancing spermatozoa quality and egg production in chickens. Their integration into poultry nutrition supports improved reproductive

performance, food security, and sustainable livestock production. Based on the findings of this review, it is recommended that:

I. Poultry farmers should adopt the use of tropical plant leaves and seeds in chicken diets at scientifically recommended inclusion levels to enhance spermatozoa quality and egg production.
II. Feed ingredients derived from tropical plants such as *Moringa oleifera, Gongronema latifolium, Parquetina nigrescens,* and *Indigofera* species should be properly processed through methods such as fermentation, soaking, drying, or extraction to reduce anti-nutritional factors.
III. Extension services and agricultural advisory bodies should organize training programs to educate poultry farmers on appropriate processing techniques, dosage levels, and safe utilization of tropical plant feed resources.
Iv. Researchers should conduct further studies to determine optimal inclusion levels for different tropical plant species across various chicken breeds, production stages, and management systems.
V. Policy makers and livestock development agencies should support research, feed innovation, and the promotion of locally available tropical plant resources to reduce feed costs, improve reproductive efficiency, and strengthen food security in tropical regions.

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