



Effect of Feeding Azolla (*Azolla pinnata*) Diet on Growth Performance and Carcass Characteristics of Broilers - a Review

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ABSTRACT

The global poultry industry is constantly seeking cost-effective and sustainable alternatives to conventional feed ingredients. *Azolla pinnata*, a fast-growing aquatic fern rich in protein and other essential nutrients, has emerged as a potential feed supplement in broiler diets. This review explores the impact of incorporating Azolla into broiler diets, with a focus on growth performance, feed efficiency, and carcass characteristics. Findings from various studies suggest that moderate inclusion levels of Azolla can improve broiler performance without compromising meat quality. However, higher inclusion rates may result in anti-nutritional effects that limit its benefits. The paper aims to provide a comprehensive synthesis of the existing research, discussing the benefits, limitations, and future directions for the use of Azolla in poultry feed formulations.

INTRODUCTION

The poultry industry plays a pivotal role in global food security, providing a significant source of affordable protein in the form of chicken meat and eggs. However, one of the major challenges faced by poultry producers

worldwide is the rising cost of conventional feed ingredients. Feed accounts for approximately 60-70% of the total cost of broiler production, with soybean meal and fishmeal being the most commonly used protein sources in commercial poultry diets (Musigwa et al., 2021). These feed ingredients are not only expensive but

also subject to price volatility due to fluctuations in supply, demand, and environmental factors. As a result, there is an increasing need to explore alternative, cost-effective, and sustainable feed resources to maintain the profitability and sustainability of poultry production.

In recent years, the search for alternative feed ingredients has led to the exploration of various non-conventional feed resources, including *Azolla pinnata*, a free-floating aquatic fern. *Azolla* is fast-growing, highly productive, and capable of doubling its biomass in just 3-5 days under optimal conditions. Its symbiotic relationship with nitrogen-fixing cyanobacteria (*Anabaena azollae*) enables it to thrive in nutrient-poor environments, making it a promising feed resource, particularly in regions with limited access to traditional feed ingredients.

Azolla, particularly *Azolla pinnata*, has emerged as a promising alternative feed source for poultry and livestock due to its high nutritional value and potential to reduce feed costs. Recent literature highlights its benefits, including improved growth performance, feed conversion rates, and overall health in various animal species. *Azolla* (*Azolla pinnata*) has emerged as a promising alternative due to its rapid growth rate and high nutritional value, particularly its protein content which ranges from 25% to 35% (Mokhtar et al., 2020; Nwafor et al., 2021).

Several studies have investigated the effects of *Azolla* supplementation on the growth performance and carcass characteristics of broiler chickens. Results have generally shown that *Azolla* can enhance growth performance, improve feed conversion efficiency, and produce broilers with good carcass yield and meat quality when used at appropriate inclusion levels. However, like many alternative feed resources, the use of *Azolla* is not without challenges. One of the primary limitations is the presence of anti-nutritional factors, such as tannins, oxalates, and phytates, which can interfere with nutrient absorption and affect the overall digestibility of the diet.

The inclusion of *Azolla* in poultry diets presents an opportunity to address both economic and environmental concerns. It offers a low-cost, renewable, and easily cultivated feed resource that can be integrated into small- and large-scale poultry farming systems. Moreover, its cultivation is environmentally friendly, as it requires minimal inputs, enhances soil fertility, and can be grown using wastewater or in conjunction with agricultural crops such as rice. Utilizing locally available resources like *Azolla* supports sustainable poultry production systems by decreasing reliance on conventional feed ingredients such as soybean meal (Mokhtar et al., 2020).

Despite its potential, the utilization of *Azolla* in broiler diets is still in the early stages of development. Research is needed to optimize its inclusion levels, reduce the effects of anti-nutritional factors, and evaluate its long-term impact on broiler health and performance. This review paper aims to synthesize the current knowledge on the effects of feeding *Azolla pinnata* to

broilers, focusing on its impact on growth performance, feed efficiency, and carcass characteristics. By examining the findings from various studies, the paper seeks to provide insights into the feasibility of incorporating *Azolla* into commercial poultry diets and the potential benefits it offers for sustainable poultry production.

Nutritional Composition of *Azolla Pinnata*

Azolla has a remarkable nutritional profile that makes it a potential alternative protein source in poultry diets. A comparative study highlighted that while the crude protein content of *Azolla* is lower than that of fishmeal, it exhibits higher carbohydrate levels (Mokhtar et al., 2020). The biochemical constituents of *Azolla* make it suitable for inclusion in broiler diets without compromising nutritional quality. In addition to protein, it is rich in essential amino acids, particularly lysine and methionine, which are critical for optimal growth in broilers (Ali et al., 2022). Moreover, *Azolla* has a low fiber content, which makes it digestible for poultry; *Azolla* is a good source of vitamins A, C, E, and essential minerals like calcium and phosphorus (Nwafor et al., 2021). The presence of antioxidants may contribute to improved health outcomes in broilers by reducing oxidative stress (Ogunbanwo et al., 2019).

Growth Performance of Broilers Fed with *Azolla*-Based Diets

Feed Intake and Body Weight Gain

Several studies have investigated the effect of *Azolla* supplementation on feed intake and body weight gain in broilers. While some studies report no significant difference in total feed intake between control and *Azolla*-fed groups, others indicate a slight increase in feed consumption among birds fed higher levels of *Azolla* due to its palatability (Ogunbanwo et al., 2019). This suggests that dietary adjustments may be necessary to optimize intake.

The rapid growth and low production costs associated with *Azolla* can lead to reduced overall feed costs for poultry farmers. Incorporating locally sourced materials like *Azolla* can mitigate reliance on imported feed ingredients..

Feed Conversion Ratio (FCR)

Feed efficiency, as measured by FCR, is a critical determinant of profitability in broiler production. The addition of *Azolla* to broiler diets has generally shown positive effects on FCR at inclusion levels up to 10%. The inclusion of *Azolla* has been associated with improved feed conversion ratios. Studies suggest that broilers on *Azolla* diets require less feed per unit of weight gain. For example, FCR improvements have been documented at dietary inclusion rates ranging from 5% to 15%, indicating efficient nutrient utilization (Ali et al.,

2022). However, higher inclusion rates (above 15%) have been associated with poorer FCR, potentially due to reduced digestibility and the presence of fiber and anti-nutritional compounds.

Carcass Characteristics of Broilers Fed Azolla

Carcass Yield and Meat Quality

Carcass yield is an important parameter in broiler production, reflecting the overall profitability of the enterprise. Broilers receiving Azolla in their diets often demonstrate improved carcass yield percentages. Research findings indicate increases of approximately 2-5% in carcass yield with dietary inclusion rates ranging from 10% to 15% (Ali et al., 2022). This enhancement is crucial for producers aiming for higher marketable yields.

In terms of meat quality, Azolla-fed broilers have shown improvements in meat quality attributes such as tenderness and juiciness. These enhancements can be attributed to the higher protein content and favorable amino acid profile inherent in Azolla (Ogunbanwo et al., 2019). Improved meat quality can lead to better consumer acceptance and marketability.

Fat Deposition

Azolla's nutrient composition, particularly its low-fat content, may also influence fat deposition in broilers. Several studies report that broilers fed diets containing Azolla had lower abdominal fat deposition compared to control birds, which could be beneficial for producing leaner meat. Reduced fat deposition could also be linked to improved protein utilization and metabolism. Studies suggest that feeding Azolla may lead to reduced fat deposition in broiler carcasses, resulting in leaner meat products. This effect aligns with consumer preferences for healthier poultry options (Nwafor et al., 2021). Reducing fat accumulation while enhancing muscle growth presents a dual benefit for poultry producers.

Limitations and Challenges of Using Azolla in Broiler Diets

Despite its nutritional benefits, several challenges limit the widespread use of Azolla as a feed ingredient. Some studies have identified potential anti-nutritional factors in Azolla that could hinder nutrient absorption if not properly managed (Mokhtar et al., 2020). Further research is needed to evaluate these factors' impact on poultry health.

Another limitation is the variability in Azolla's nutrient composition, which can be influenced by environmental factors such as water quality, pH, and nutrient availability. This variability necessitates careful formulation and quality control when incorporating Azolla into commercial feed.

Future Prospects and Recommendations

The potential of Azolla as a sustainable feed ingredient is promising, particularly in regions where feed resources are scarce or expensive. Future research should focus on optimizing the inclusion levels of Azolla, improving processing techniques to reduce anti-nutritional factors, and evaluating its effects on immune response and disease resistance in broilers. Additionally, the integration of Azolla cultivation into farm systems, such as rice paddies, can enhance resource efficiency and contribute to a circular economy in agriculture. The short shelf life of fresh Azolla necessitates effective preservation methods for widespread use (Ali et al., 2022).

CONCLUSION

Azolla pinnata shows immense potential as a sustainable and cost-effective feed ingredient in broiler diets, offering several benefits due to its high protein content, balanced amino acid profile, and rich supply of vitamins and minerals. Research has demonstrated that the inclusion of Azolla at moderate levels (typically 5-10% of the total diet) can lead to improved growth performance, better feed conversion ratios (FCR), and enhanced meat quality. These improvements can be attributed to Azolla's nutritional composition, which supports efficient protein synthesis and muscle development in broilers.

Furthermore, the inclusion of Azolla in broiler diets has been shown to reduce abdominal fat deposition, potentially leading to the production of leaner meat that is desirable in health-conscious markets. Azolla's low-fat content and nutrient density provide broilers with a diet that promotes muscle gain over fat accumulation, which can increase the overall market value of the birds.

However, the use of Azolla is not without challenges. One of the primary concerns is the presence of anti-nutritional factors such as tannins, oxalates, and phytates, which can interfere with nutrient absorption and limit the digestibility of Azolla at higher inclusion levels. Studies suggest that feeding broilers with more than 10-15% Azolla may negatively impact feed intake and growth performance, mainly due to the reduced palatability and the effects of these anti-nutritional components. Effective processing techniques, such as drying, fermentation, or the use of exogenous enzymes, are necessary to reduce the impact of these anti-nutritional factors, ensuring that the nutritional potential of Azolla is fully realized.

Additionally, variability in the nutrient content of Azolla, which can be influenced by environmental factors such as water quality, growing conditions, and harvesting methods, poses another challenge. This variability underscores the need for careful quality control and standardized cultivation practices to ensure consistency in nutrient delivery when formulating poultry diets.

Looking ahead, the potential of *Azolla* extends beyond its use as a mere feed supplement. It represents an opportunity to improve the sustainability of poultry production systems, particularly in regions where conventional feed ingredients are expensive or scarce. The cultivation of *Azolla* alongside agricultural crops, such as rice, can enhance resource efficiency by recycling nutrients and reducing the environmental footprint of farming operations.

In conclusion, while *Azolla pinnata* holds great promise as a supplementary feed ingredient in broiler diets, its optimal utilization requires a balanced approach. Moderate inclusion levels can enhance growth and carcass traits, but higher levels may be counterproductive due to anti-nutritional factors. Future research should focus on refining processing techniques, evaluating long-term effects on broiler health, and exploring the integration of *Azolla* cultivation into agro-ecosystems to create more sustainable and economically viable poultry production systems. With these considerations, *Azolla* can become a valuable component in reducing feed costs and promoting environmentally friendly poultry farming practices.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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