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Growth performance of broiler chickens fed with ariwat (*Tetrastigma harmandii* Planch) leaf meal

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Abstract

The study evaluated the growth performance of broiler chickens fed ariwat (*Tetrastigma harmandii* Planch) leaf meal, in line with SDGs 2 (Zero Hunger) and 12 (Responsible Consumption and Production). A total of 200 three - day old chicks were distributed into five dietary treatments and replicated four times with 10 broilers per replication laid out in a Complete Randomized Design (CRD). The study found that ariwat leaf meal had a nutritional value of 12.78% crude protein, 25.33% crude fiber, 3.97% crude fat, 17.75% moisture, 20.18% ash, 1.07% calcium, and 0.76% phosphorus. The addition of varying levels of ariwat leaf meal in the broiler chicken ration has a significant effect on body weight, growth in weight, FCR, and FCE, although there are no significant differences in feed consumption. Furthermore, the inclusion of 9% ariwat leaf meal resulted in an average return of Php 225.18, indicating the possible use of ariwat as a feed additive in broilers and thus recommended.

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Introduction

The chicken is the most exploited species of poultry, which is utilized for food production in the world. Scientific researchers have been done on this species for the past centuries and it is still the focus of the present and future experimentation (Lagua, 2015). Broiler chickens have been selected for their rapid growth rate as well as for high productivity and meat yield in short period of time (Miluzzi *et al.*, 2019). The success of broiler production dependents upon supplying the birds with feed of the highest achievable quality (Aviagen 2019). Chicken meat is leaner, lower in fat, cholesterol, and higher in protein. It is also a good source of essential vitamins and minerals, including B vitamins, iron, and zinc, (Fernandez *et al.*, 2018) Broiler chicken meat has commercially been preferred due to its juiciness, distinct flavor, texture, and tenderness (PCAARRD 2016; Arreza, 2019). Broiler chicken meat, a nutritious and affordable food source, can help combat hunger and malnutrition, directly contributing to the Standard Development Goals (SDG) 2: Zero Hunger. Beyond its nutritional benefits, broiler chicken farming contributed to sustainable agriculture and rural development. These birds are well-adapted to local environments and require minimal inputs, making them a suitable option for small-scale farmers and backyard producers; they also support local economies, and reduce our reliance on imported poultry products (Wong *et al.*, 2017; DA, 2021). Broiler chicken farming can create jobs and generate income for rural communities, contributing to economic development. It is a valuable food resource that offers numerous benefits, from its nutritional value to its contribution to sustainable agriculture, farming and consumption created a more resilient and equitable food system (Mananghaya, 2017) which is directly related to the attainment of SDG 8- Decent Work and Economic Growth.

According to the Philippine Statistics Authority (PSA), as of September 30th, 2023, the total chicken inventory in the Philippines reached 202.82 million birds. It indicates a growing preference for chicken meat in the Philippine market (PSA, 2024). Despite of the increase production of poultry in the Philippines, there is still rising prices of chicken meat in the local markets (Menxias, 2024), the increased production costs, including higher prices for imported feed additives and the impact of poultry diseases and the raising demands of poultry products led to the additional importation of chicken meat in the country (Halili, 2024).

According to the Bureau of Animal Industry (BAI), the Philippines have significantly increase in chicken meat imports in the first five months of 2024, with a 4.98% jump from 172.64 million kg in 2023 to 181.23 million kg this year. This means that chicken meat now makes up a substantial 34.5% of the country's total meat imports in major suppliers from Brazil, the US, and Australia (Gomez, 2022).

The poultry industry plays a crucial role in meeting the growing global demand for animal protein (FAO, 2024). Chicken, as the most widely consumed poultry species, has long been a staple food source worldwide. Scientific research into chicken production has been ongoing for centuries, and continues to be a focus of contemporary and future investigations (Lagua, 2015; Giridhar Arthrey, 2020; Fuller *et al.*, 2020). As the demand for poultry products continues to rise, there is an increasing opportunity to promote the production of broiler chickens, especially in both intensive and extensive production systems that align with consumer preferences for sustainable and ethically raised poultry. Broiler chickens are particularly well-suited for rapid growth rate within the short period of time. This makes them a valuable asset for small-scale farmers and rural communities (Leongbudnark *et al.*, 2024; Dapanas and Niepes, 2024).

Optimal nutrition is essential for maximizing poultry performance, health, and welfare. Feed is the single largest expense in poultry farming, often representing 70% of the total cost of production (Alltech, 2024). Feed ingredients significantly impact poultry production efficiency and product quality. However,

the poultry industry faces challenges due to the high cost of conventional feed ingredients (Tufarelli *et al.*, 2018). Many of which are not grown domestically. This has led to increased reliance on imported feed, further driving up production costs (FAO, 2024). To improve and sustain the poultry sector, and meet the increasing demand for chicken meat while reducing feed costs, researchers are exploring such resources which could address the issue using alternative and cost-effective feed ingredients that are readily available in the country (Melesse *et al.*, 2013; Thirumalaisamy, 2019).

Exploring alternative feed sources, such as indigenous leaves, can offer sustainable and cost-effective solutions for poultry nutrition (Nor *et al.*, 2022). However, addressing the issue of high-cost feeds is crucial for supporting the growth and efficiency of the poultry production sector. Strategies such as exploring alternative feed sources, optimizing feed formulations, and enhancing feed efficiency can alleviate financial strain on poultry farmers and promote sustainable production (DA, 2022). Hence, the Ariwat leaves have been stated for its potential use for developing various products such as food supplements, fertilizers, and animal feeds. An analysis of the proximate and elemental composition of young and mature leaves revealed a rich source of essential nutrients. The leaves contained a substantial number of macronutrients, including: Crude protein, Crude fat, Crude fiber, in addition, the leaves were packed with micronutrients, such as: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca, Manganese (Mn), Iron (Fe), Zinc (Zn), and Copper (Cu) (Opeña *et al.*, 2021).

Therefore, ariwat plants shows a potential feed ingredient for livestock, however, the use of ariwat plants as a feed ingredient for livestock has not been thoroughly investigated.

Utilizing indigenous plants for animal feed promotes resource efficiency, thus aligning with SDG 12 (Responsible Consumption and Production). It also contributes to SDG 2 (Zero Hunger) by increasing food security through improved animal productivity and potentially supports SDG 15 (Life on Land) by promoting sustainable agricultural practices.

Materials and methods

Two hundred 3-day old broiler chicks were randomly distributed to five (5) treatments and replicated four times with 10 birds per replication. The broiler chicks were fed with 5 dietary treatments of ariwat Leaf Meal (ALM) which described as follows: Treatment 1- 0% ALM, Treatment 2- 3% ALM, Treatment 3- 6% ALM, Treatment 4- 9% ALM, and Treatment 5- 12% ALM.

The experimental poultry house was designed wherein the experimental animals was reared under a confinement production system with a total area of 5×15 meters square. The housing facility measuring 5×15×3.5 meters square is constructed with locally available materials such as bamboo, lumber, lona, sacks, nets, and chicken wire etc., was used in the experimental poultry house. The experimental cage measuring 5×15 meters was buildup with 3 by 10 meters subdivided into 20 pens measuring 1.5×2 meter each.

Proper hygiene and sanitation were observed throughout the study. All facilities and other materials such as feeders and drinkers were cleaned and disinfected with disinfectant diluted in water following the manufacturer's guidelines before the start of the study, this was done to eliminate the disease-causing microorganisms and prevent the birds from the diseases.

Fresh ariwat leaves was collected and gathered manually near from the streams in the forest of Jones and, Echague, Isabela. The leaves were thoroughly cleaned and air dried using a plastic net after harvested. The dried leaves will then be pulverized using an electric pulvurizer machine. Sample was sent to DA-CVIAL, Tuguegarao City for the proximate and mineral analysis of the leaves. The pulverized ariwat powders are weighted using a digital scale and thoroughly mix up with other feed

formulation using the appropriate amount of ariwat leaves for each treatment.

The experimental diet was formulated to meet the recommended nutrients for broilers following the standard set by PCCARD Philippine Recommends for Poultry and Livestock Feed Formulation

The chickens were fed ad libitum until they reach 4th week of age and considering the sudden rise of temperature the feeding was restricted during day time to avoid the birds from unnecessary death caused by heat stress and high blood due to heat index.

The introduced feed was weighted and recorded daily in each pen for every treatment and the left-over feed was also weighted and recorded. The drinking water of the birds was always made fresh and available at all times.

Data gathered

The growth performance of broiler chicken in 5 dietary treatments were evaluated in terms of body weight, gain in weight, feed consumption, feed conversion ratio and feed conversion efficiency.

The income over feed and chick cost was computed to determine the economic profitability of the birds per treatment. All data gathered was analyzed using the Analysis of Variance following Complete Randomized Design. The statistical software for Agricultural Research (STAR 2.0) was used to analyzed the data gathered. The Least Significant Differences (LSD) was also used to compare treatment means.

Results and discussion

The proximate and mineral analysis was done at the Department of Agriculture-Cagayan Valley Integrated Agricultural Laboratory, Tuguegarao City. Proximate analysis revealed nutritional content of ariwat leaves with 12.78% crude protein, 25.33% crude fiber, 3.97% crude fat, 17.75% moisture, 20.18% ash and mineral analysis with 1.07% calcium and 0.76% phosphorus. The nutritional and mineral analysis test method and reference method and nutritional contents is shown in the Table 1.

Table 1. Proximate and mineral analysis test method

Proximate and mineral analysis	Test method	Reference method	Nutritional contents %
Crude protein	Semi-automatic Kjeldahl method	AOAC official method 984.13	12.78
Crude fiber	ANKOM filter bag technique	In-house method	25.33
Crude fat	ANKOM filter bag technique	In-house method	3.97
Moisture	Gravimetric method	AOAC official method 934.0	17.75
Ash	Gravimetric method	AOAC official method 942.05	20.18
Calcium	Atomic absorption	AOAC official method 368.08	1.07
Phosphorus	Spectrophotometry method	AOAC official method 965.17	0.76

The temperature recorded was 25°C±3 and a relative humidity of 40- 60%.

Table 2. Growth performance of broiler chicken fed with ariwat leaf meal (ALM) (g per bird)

Production performance	Treatments of ALM levels						
	1 (0%	2 (3%)	3 (6%)	4 (9%)	5 (12%)	CV (%)	Pr(> F)
Initial weight (g)	79.57	79.50	79.52	79.52	79.52	0.18	0.96
Final weight (g)	1901.72^{b}	1910.00^{b}	1922.15^{ab}	2002.25^{a}	2008.66^{a}	2.98	0.04
Total gain in weight (g)	1822.14^{b}	1830.50^{b}	1842.97^{ab}	1922.72^{a}	1929.14^{a}	3.11	0.05
Total feed consumed (g)	3602.13	3576.40	3551.60	3481.30	3576.11	2.60	0.43
FCR	1.90^{a}	1.87^{ab}	1.84^{abc}	1.74^{c}	1.78^{bc}	3.78	0.03
FCE	52.80^{c}	53.41^{bc}	54.16^{bc}	57.57^{a}	56.22^{ab}	3.91	0.03

Note: Means with the same letter are not significantly different.

The final weight, total gain in weight, FCR, and FCE of the broilers fed with different levels of ariwat leaf meal showed a significant difference among the treatments, however non-significant differences were observed in the feed consumption of the birds which is presented in Table 2.

Final weight

Significant differences were observed among the treatments on the final weight of the broilers with a mean value ranging from 1901.72 to 2008.66 grams. Treatments 4 (9% ALM) and 5 (12% ALM) are comparable with each other with a mean value of 2002.25 and 2008.66 but not significantly different to treatment 3 (6% ALM) with a mean value of 1922.15.

Treatment 1 (0% ALM) and 2 (3% ALM) are statistically the same with a mean value of 1901.72 and 1910.00 but not significantly different to treatment 3 and significantly different to treatment 4 and 5.

Total gain in weight

The total gain in weight of the broilers at Treatments 4 and 5 with the mean value of 1922.72 and 1929.14 are comparable with each other but not significantly different from treatment 3 with a mean value of 1842.97. Treatment 1 and 2 with a mean value of 1822.14 and 1830.50 are comparable with each other but not significantly different to treatment 3 and significantly different to treatments 4 and 5.

Total feed consumption

Statistically, the cumulative feed consumption of the broilers showed a non-significant difference among the treatments with a mean value ranging from 3481.30 to 3602.13 grams.

The treatment 1 with 0% ariwat leaf meal obtained the highest feed consumption among the treatments while the treatment 4 with 9 % of ariwat leaf meal has the lowest feed consumption in between the treatments.

Feed conversion ratio

Significant differences were observed among the treatments in the FCR of the broilers, were treatment 1 with a mean value of 1.90 is not significantly different to 2 and 3 with a mean value of 1.87 and 1.84. The treatment 2 and 3 has no significant differences with each other but significantly different from 4 and 5. Treatment 4 and 5 is comparable with each other but not significantly different from treatment 3.

Feed conversion efficiency

Statistically the treatment 4 with a mean value of 57.57 is not significantly different from treatment 5 with the mean value of 56.22. The treatment 5, 3, and 2 has no significant differences with the mean value of 56.22, 54.16, and 53.21. Treatment 1 with a mean value of 52.80 has no significant differences with treatment 2 and 3 but significantly different from treatment 4 and 5.

The significant differences in growth performance parameters of the broilers in terms of final weight, total gain in weight, FCR and FCE indicates the potential of ariwat leaf meal inclusion on feed formulation of broiler chicken. The higher percentage of ariwat inclusion in the feed formulation obtains the highest weight of the broilers. However, the FCR and FCE of the birds at treatment 4 with 9 % of ariwat leaf meal obtained the lowest FCR, and highest FCE which has the most effective level of inclusion among the treatments, the positive effects of the leaf-based meal improve the performance of the birds in terms of body weight, gain in weight FCR and FCE. Since this study was the first to investigate the potential of ariwat in animal feed, further investigation is advised for a better conclusive result.

Furthermore, in relation to the results of the study, (Song, 2024) concluded that *Tetrastigma hemsleyanum*, one of the close-related species of ariwat, promote growth, enhance body immunity and improved intestinal tissue morphology of Chongron patridge chicken.

Table 3. Return above feed and chick cost (per bird)

Particulars	T1	T2	T3	T4	T5
Final weight	1.90	1.91	1.92	2.00	2.01
Return for broiler	342.31	343.80	346.05	360.41	361.56
Cost of chicks	42.00	42.00	42.00	42.00	42.00
Price of broiler per kilo	180.00	180.00	180.00	180.00	180.00
Cost of starter	29.88	28.91	28.05	27.16	28.60
Cost of finisher	68.63	67.92	66.78	65.51	66.13
Total amount of ariwat in kg	---	0.54	1.07	1.57	2.15
Cost of ariwat	---	2.70	5.35	7.85	10.75
Total feed consumed kg	3.60	3.58	3.55	3.48	3.58
Total cost of feed	99.42	97.74	95.40	93.23	95.45
Income over feed and chick cost	200.89	204.06	208.65	225.18	224.11

180/kg of broiler chicken; 5 Php of ariwat/kg; T1-formulated feeds (FF)+0%ALM-27.60Php/; T2-FF3%ALM -27.33Php/kg; T3FF+6%ALM-26.86Php/kg; T4-FF+9%ALM-26.78Php/kg; T5FF+12%ALM-26.69Php/kg.

According to (Tan, 2022) One of the major constituents of all *Terastigma* species is flavonoids. Flavonoids provide the ability to support bird health while improving the nutritional quality of poultry meat and eggs by changing the profile of fatty acids and reducing cholesterol content. Zheng (2023) also stated *Tetrastigma* also have polysaccharides and monosaccharides. These substances can strengthen the villi and intestinal metabolism of poultry, improve their intestinal health, and take the role of antibiotics to strengthen the body's immunological regulatory system.

Income over feed and chick costs

The income over feed and chick cost is presented in Table 3. The income was computed based on the final weight of the broilers which is multiplied by the prevailing price of the broilers at 180 Php/kg less the expenses of feeds and chicks. The income over feed and chick cost obtains the highest return at Treatment 4 (9%ALM) with 225.18 Php, followed by Treatment 5 (12%ALM) with 224.11 Php, Treatment 3 (6% ALM) with 206.65 Php, Treatment 2 with 204.06 Php, and Treatment 1 with the lowest return of 200.89 Php.

Conclusion

Result of the study reveals that the different levels of ariwat leaf meal significantly affect the body weight, gain in weight, FCR and FCE of the broiler chicken, however no significant differences on the feed consumption. The inclusion of 9% ariwat leaf meal on the ration of the broiler chickens generated highest return Php 225.18, which indicates the potential use of ariwat as feed ingredient in broilers, hence recommended.

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