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RESEARCH PAPER

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Utilization of locally sourced feed ingredients and their influence on the growth performance of broiler chickens (*Gallus gallus domesticus*): A study in support of the school's chicken multiplier project

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ABSTRACT

This study evaluated the utilization of locally sourced feed ingredients and their effects on the growth performance of broiler chickens (*Gallus gallus domesticus*) to support the development of nutritionally adequate and cost-effective feeding strategies for institutional and smallholder poultry systems, particularly backyard raisers. Growth performance indicators—including feed intake, average daily gain (ADG), and feed conversion ratio (FCR)—were assessed across different dietary treatments. Results showed that feed type significantly influenced broiler performance during the early to mid-growth stages (Days 8–28), as indicated by consistently significant ANOVA results ($p \leq 0.024$ to $p \leq 0.001$). Broilers fed commercial diets (T2 and T3) exhibited higher body weight gains and superior FCR compared with those fed the CSU-formulated grower broiler feed (T1), reflecting the higher nutrient density and digestibility of commercial formulations. Despite these differences, the CSU-formulated feed supported satisfactory and progressive growth, particularly during the initial growth phase (Days 8–14), with adequate body weight gain and acceptable feed efficiency. Notably, during the later growth phase (Days 29–35), differences in body weight among treatments were generally not significant ($p > 0.05$), indicating comparable final weights between birds fed the formulated and commercial diets. Biologically, these findings demonstrate that the CSU-formulated grower broiler feed can sustain sufficient growth and feed efficiency. Although performance was inferior to commercial feeds in certain parameters, its local availability, lower cost, and adaptability make it a practical alternative for resource-limited and small-scale poultry operations. Further improvements in protein quality, energy density, and nutrient digestibility may enhance its performance and narrow the gap with commercial diets.

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INTRODUCTION

Poultry farming, especially broiler chicken enterprise, contributes largely in global food security because it is a cheaper means to cultivate animal protein. It is the most luxurious part of raising broiler chickens is nourishing them. The world generated about 137 million tons of poultry meat in 2020, with chicken making up more than 90% (Abdalgalil, 2025). Most of this progress happened in republics that are still developing, such as the African population that grew by 161%, Asia's by 132%, and lower-middle-income countries' by 263% (Oke *et al.*, 2024).

This growth displays how significant broilers are for meeting the promising need for cheap protein as cities, populations, and incomes grow. Irrefutably, broiler agriculture is beneficial for the economy, particularly for smallholder and rural families in developing nations like the Philippines. In Bamenda, Cameroon, broiler plays a part in the economy and food security.

However, producers have difficulties like not making adequate income, having to pay a lot for inputs, and having a slow grasp of recent technology in the industry (Tambi, 2024). Also in Bangladesh, broilers similarly take a part of the country's economy. It makes up 1.53% of GDP and employs more than 6 million people, both directly and indirectly. Broilers account about 40% of the meat eaten, which is vital for addressing malnutrition and keeping people flourishing in rural areas (Kamruzzaman *et al.*, 2021). Jordan's practice demonstrates how important the size of a farm is. Al-Sharafat *et al.* (2006) infer that medium and large broiler farms have a net present value (NPV) that is positive and an internal rate of return (IRR) of about 22 percent, while small farms don't generate money (negative NPV and 12.8% IRR). On the other hand, Ghanaian broiler production is showing potential in this industry. Nevertheless, frozen chicken importations compete with local producers, especially small-scale farmers, which makes production change from season to season (Wieck, 2022).

A report on the broiler industry says that feed makes up at least 65–75% of total costs. These numbers illustrate that feed is the highest cost in broiler production, more than chicks, energy, labor, and veterinary services (Adaszyńska-Skwirzyńska *et al.,* 2025). Broiler feeds deeply rely on traditional ingredients like maize (corn) and soybean meal. Corn frequently accounts for 50-70 % of feed ingredients, while soybeans account for 10-30 %. The fact that the fees of these basic constituents can vary a lot is an immense concern. For instance, maize prices have spiked by more than 30% during a single production cycle because of geopolitical tensions and climate adversities. Once a currency drops, it costs more, making it riskier for areas dependent on imports. These inconsistencies in price force both feed producers and broiler investors to keep track of feed costs all the time (Broiler Feed Market, 2025).

In the Philippines, animal scientists are exploring various local feed ingredients for broilers that are consumed on a diet made up of 10% leaf meal from *Trichanthera gigantea* and/or *Moringa oleifera.* In which commercial rations gave the best weight gain and return on investment (ROI), but diets with leaf meal cut feed costs by a lot (Gofredo *et al.,* 2018). A study that used Moringa pod meal (MPM) at levels of 5–15% found that there were very small variances in final weight or feed conversion ratio. Birds that ate 10% MPM, on the other hand, gained more weight and had a higher ROI (Laspinas and Lucky Gem, 2018). The leaves of the malunggay plant (Moringa oleifera) are really healthy, containing high levels of high-quality protein (17–30% when dried), amino acids, carbohydrates, lipids, minerals, and vitamins (Egbu *et al.*, 2024). Also, feather meal, which comes from processing poultry, contains high crude protein and keratin that can substitute up to 33% of soybean meal in broiler diets without decelerating the growth or feed conversion when enzymes break it down (Mandana *et al.*, 2025). Indeed, local options like leaf meals and agro-waste provide smallholder farmers and feed producers with supplementary ways to make income, becoming less dependent on imported ingredients, and shield them from fluctuations in international prices. They have less of an effect on the environment because they recycle and travel less (Gofredo *et al.*, 2018; Laspinas and Lucky Gem, 2018; Mandana *et al.*, 2025).

Researchers indicate that the growing phase, particularly from the second to the fourth week of life, is vital for aiding broilers to grow. A study of over 95 million Ross 308 AP broilers raised in commercial tropical surroundings found that controlled feeding from weeks two to four, followed by an augmented feed allowance in the last week, led to a well feed conversion ratio (FCR), extra body weight (BW) gain, and weightier birds at 35 days of age (Gustavo *et al.*, 2023). Additionally, research that investigated individual weekly feed intake (FI) and body weight gain (BWG) from weeks four to six deduces that there were various patterns of how feed intake changed over time. Broilers that sustained to eat more food instead of flattening off or diminishing showed better growth and more effective use of feed. This magnifies how imperative it is to keep the appetite and nutrient consumption during the last stages of growth (Yuchen *et al.*, 2024).

All of these results show how important it is to carefully manage feed strategies during the growth phase, especially between weeks two and four, to achieve better final weight and feed efficiency. Utilizing feed ingredients from nearby sources is becoming a good way to make animal farming more bearable and save. According to early research, local replacements for traditional feed components may help animals grow quickly and remain vigorous. But a lot of these studies only explored certain livestock or production systems and other types of farm animals or stages of growth. To elicit the most out of local feed resources and inspire farming practices that are more buoyant and sustainable, studies need to fill in these gaps.

Hence, this type of evaluation should prioritize basic metrics, such as weight gain, feed conversion ratio, health outcomes, and cost-benefit analysis, for chickens raised in different localities during the growth phase. This will benefit and create long-lasting feeding strategies that work for each locality or region, supporting food security, economic stability, and environmental sustainability advocacy throughout the country.

MATERIALS AND METHODS

Experimental lay-out

This study employed an experimental research design to formulate and evaluate nutritionally balanced diets for broiler chickens using local ingredients from backyard sources. The primary aim was to investigate the effects of these formulated diets on the feed intake, average daily gain (ADG), feed conversion efficiency (FCR), and cost-effectiveness in a controlled experimental framework. The feeding trials utilized healthy chickens of uniform age, breed, and weight, free from any disorders. There were three (3) treatment groups, namely: Treatment 1- CSU formulated grower feeds, Treatment 2-Commercial grower feed Brand A, and Treatment 3- Commercial grower feed Brand B. Each is composed of three replicate copies composed of five chicks each, for a total of forty-five experimental units. The trial lasted 30 days and distributed in a Completely Randomized Design (CRD) to make sure all birds had the same chance of getting treatment and to minimize bias

Identification of potential feed ingredients

A preliminary survey was initiated to find out crops and forages locally to serve a potential ingredient. These included grasses, legumes, shrubs, and agricultural by-products. A thorough assessment was made for the inclusion of chicken feather, coconut pulp (*Cocos nucifera*), malunggay (*Moringa oleifera*), madre de agua (*Trichanthera gigantea*), and mulberry leaf (*Morus* spp.). In addition, leaves and twigs from the kangkong plant (*Ipomoea aquatica*) were collected.

Feather meal processing

Collected feathers from the Mak Manok slaughterhouse were washed to get rid of undesirable soiling and other debris contamination. Cooking the feathers in steam at 140–150°C and 20–50 psi for 30 minutes was carried out to break down keratin bonds and make them easier to digest.

The hydrolyzed material was pressed manually and allowed to dry in the sun to remove extra moisture content. Grinding the dried product into a fine powder was executed to increase the surface area and make it easier to mix with other feed ingredients.

Feed processing into pellet form

Standardizing the pelleting process made sure that the feed mixtures had pellets of the same size, texture, and strength. To keep the nutrition in the feed, the temperature and moisture levels were kept stable during pelleting. This was commenced by preparing the feed to separate the dried forage leaves and twigs, then air-drying them at room temperature for 5 to 7 days until they were dry. The second step was to grind them with a disk mill and a 1.5 mm sieve. The third step was to weigh the feed ingredients according to the treatment formulations. The last step was to mix all of the ingredients by hand to make sure they were all the same. One kilogram feed sample was sent to the Department of Agriculture (DA) RO2, Feed Laboratory Section, for proximate analysis.

Feeding management

The birds were kept according to Philippine broiler production standards, which included good shelter, proper ventilation, and natural light, during the entire experiment.

Before the feeding trials started, the chicks were given 7 days to get used to their new environment so as to lower stress and keep them healthy. Only apparently healthy birds were selected. There were 45 experimental units in total: three treatment groups with three replicates and five chicks each. The experiment lasted 30 days. To avoid digestive problems and encourage feed acceptance, CSU-formulated feed pellets were slowly added early period of feeding. All birds during the 30-day trial, all of the broiler chickens had access to clean water and food. One-gallon plastic waterers were used to avoid rust and make sure they lasted longer, and plastic feeding troughs were put in each cage compartment to make cleaning easier and cut down on feed waste.

Monitoring and data collection

During the 30-day feeding trial, chickens were monitored daily for their progress as a basis for quantification of the growth metrics encompassing feed intake, average daily gain (ADG), and feed conversion ratio (FCR). Data were carefully recorded for all experimental groups, and the conditions in the environment were carefully controlled to make sure they were the same. A digital scale was used to weigh both the feeds and the chickens to make sure the weights were correct. Average daily gain was computed by subtracting the initial weight from the final weight and dividing that by the number of feeding days. To find the feed conversion ratio, we divided the amount of feed consumed by the average daily gain.

Economic analysis and profitability ratios

This was performed to assess the financial viability and cost effectiveness of incorporating the selected local feed ingredients. It also highlights whether it offers economic advantages compared to commercial feeds, ultimately guiding decision-making for broiler producers and farmers.

The total cost production (includes: cost of day old chicks, feed, labour, housing and equipment, utilities, and miscellaneous expenditure), total revenue (sales of broiler) and net profit were determined as presented below.

$NP = TR - TCP$

Total Cost of Production = TCP

Net Profit = TCP

Total Revenues = TR

Further, profitability ratios were employed to explain vividly the extent to which the factors of production were used for profit maximization.

Benefits Cost Ratio = BCR

This is used to evaluate the profitability of a poultry operation. It compares the total benefits (revenue) generated by the poultry operation to the total costs incurred during production. A BCR greater than 1 indicates profitability, while a BCR less than 1 suggests a loss.

$$BCR = \frac{TR}{TCP}$$

Return of Investment = ROI

This is used to compare the profits generated by the broiler operation relative to the costs incurred. The ROI gives a clear indication of how much profit (or loss) is made for each unit of investment.

$$ROI = \frac{NP}{TCP} \times 100$$

Gross Ratio = GR

This is used to evaluate the efficiency of an operation by comparing total costs to total revenue.

It gives insight into the proportion of income that is used to cover the production costs. A lower gross ratio indicates a more efficient use of resource—making good use of its inputs (feed, labor, housing, etc.) and profitable operation.

Net Profit Margin = NPM

This is used to show the percentage of revenue that remains as net profit after all expenses are deducted. It is used to measure the overall profitability of a broiler production operation.

$$NPM = \frac{NP}{TR} \times 100$$

Statistical analysis

Statistical software like SPSS or SAS was used to examine collected data and check the different feeding regimes affected the performance of the broilers. Statistical tests, like t-tests, were employed to find out if there were any big differences between the treatment groups.

Ethical consideration

A permit from the Institutional Animal Care and Use Committee (IACUC) of Cagayan State University was sought prior to the conduct of the experimental trial to adhere to the humane management of chickens.

RESULTS AND DISCUSSION

Proximate analysis report

The CSU-formulated grower broiler feed after proximate analysis demonstrated the following: 22.67% crude protein, 7.17% crude fiber, 7.85% crude fat, 6.90% moisture, and 9.26% ash. The yielded values are very close to the industry standards for broiler starter diets in terms of protein and fat content (Nguyen *et al.*, 2021; Rahman *et al.*, 2024). The slightly higher levels of fiber and ash are noted, but they are still within acceptable experimental limits (Urban *et al.*, 2023; Zhang *et al.*, 2023). The very low moisture content was intentional for better storage, avoiding mold growth and improving the quality of the formulated feed.

Pellet physical property

The physical properties of the broiler feed sample indicated a high-quality pellet. Good processing and compaction in the uniformity of the pellet size and shape are evident. The feed's even color shows that it was evenly mixed and has no foreign materials or separated ingredients. The textural test showed that the pellets were firm enough while being palatable to broilers. Low levels of fines improve feed quality because powder makes it harder for animals to eat and wastes food (McCafferty *et al.*, 2023). There is no strange or bad smell, which means that the raw materials and feed are fresh and have not spoiled or been harmed by microbes. These physical features denote that the feed is of good quality and suitable for broiler nutrition.

Feed intake performance response

The CSU-formulated Grower Broiler Feed (T1) maintained the birds' growth steadily from Day 8 (1600 g) to Day 35 (2,988 g) (Table 1), indicating that it could support their growth throughout the rearing period.

Biologically, this means that the formulated feed had enough nutrients, like energy and protein, to support growth, but at a slower rate than commercial feeds. The slower growth seen in T1 may mean that the digestibility, bioavailability, or amino acid composition of the nutrients is different.

Table 1. Feed intake of chickens under different feed regimens for 28-day feeding trials

Treatment	Days 8–14 (g)	Days 15–21 (g)	Days 22–28 (g)	Days 29–35 (g)	Overall mean ± SE (g)	Performance rank
T1	1600.00	1970.00	2488.33	2988.33	2261.67 ± 303.78	3
T2	1700.00	2383.33	4008.33	4785.00	3219.17 ± 717.92	1
T3	1700.00	2358.33	3745.00	4683.33	3121.67 ± 672.08	2
F-value	200.00	77.760	701.390	997.323		
p-value	0.000**	0.000**	0.000**	0.000**		

**= Highly significant; T1=CSU-Formulated Grower Broiler Feed, T2=Commercial Grower Broiler Feed Brand A, T3=Commercial Grower Broiler Feed Brand B

Table 2. Average daily gain (ADG) of chickens under different feed regimens for 28-day feeding trials

Treatment	Days 8–14 (g)	Days 15–21 (g)	Days 22–28 (g)	Days 29–35 (g)	Overall mean ± SE (g)	Performance rank
T1	9.24	1970.00	2488.33	2988.33	1863.98 ± 648	3
T2	20.05	2383.33	4008.33	4785.00	2799.18 ± 105	1
T3	17.38	2358.33	3745.00	4683.33	2700.76 ± 101	2
F-value	15.223	77.760	701.390	997.323		
p-value	0.004*	0.000**	0.000**	0.000**		

*= significant, **= Highly significant; T1=CSU-Formulated Grower Broiler Feed, T2=Commercial Grower Broiler Feed Brand A, T3=Commercial Grower Broiler Feed Brand B

This suggests that there is a chance to improve the quality of the protein, the energy density, and the overall efficiency of the feed (Katu *et al.,* 2025; Barekatain *et al.*, 2021). Statistically significant differences between T1 and commercial feeds point out ways to improve nutrition.

Still, the biologically sufficient growth that was achieved shows that the CSU-formulated Grower Broiler Feed could be a good alternative source of nutrition (Fiorentino *et al.*, 2018; Vlaicu *et al.*, 2023; Sheriff *et al.*, 2021).

Average daily gain (ADG) performance response

The study's results showed that there were big differences in body weight between the three feed treatments at all growth stages on days 8–35 (Table 2), as shown by the ANOVA results ($p \leq 0.004$). Birds that ate commercial feeds (T2 and T3) always weighed more than birds that ate the CSU-formulated Grower Broiler Feed (T1). T2 had the highest overall mean (2799.18 ± 105 g), followed by T3 (2700.76 ± 101 g), and T1 had the lowest overall mean (1863.98 ± 648.65 g). These differences, when looked at statistically, show that commercial feeds are better at promoting growth.

Biologically, T1 showed steady growth throughout the experiment, which means that the formulated feed can help normal growth. This means that T1 can be used as a cheap and practical alternative to feed, especially in places where resources are limited or in small businesses.

Improving the quality of the protein, energy density, and digestibility of its nutrients could help it grow better, making it more similar to commercial feeds and providing a viable and long-term feeding option (Katu *et al.*, 2025; Sheriff *et al.*, 2021).

Broilers that were fed commercial diets (T2 and T3) had better average daily gain (ADG) during the early and middle growth phases on days 8–28 (Table 2) than those fed with the CSU-formulated Grower Broiler Feed (T1). The differences in growth performance were statistically significant at certain growth intervals ($p < 0.05$), especially between Days 8 and 14 and Days 22 and 28. In contrast, no significant variation in ADG was observed among treatments during the finishing phase (Days 29–35), indicating that birds receiving the locally formulated feed achieved growth performance comparable to those fed commercial diets as physiological maturity was reached (Sanusi *et al.*,2015; Sheriff *et al.*, 2021).

Table 3. Feed conversion ratio (FCR) of chickens under different feed regimens for 28-day feeding trials

Treatment	Days 8–14 (g)	Days 15–21 (g)	Days 22–28 (g)	Days 29–35 (g)	Overall mean ± SE (g)	Performance rank
T1	5.0000	6.6533	3.5833	2.0433	4.3200 ± 0.984	1
T2	2.4900	2.6900	2.1200	2.2533	2.3883 ± 0.126	3
T3	2.8133	2.6867	4.3400	2.1900	2.7575 ± 0.486	2
F-value	21.737	7.431	33.282	0.451		
p-value	0.002**	0.024*	0.001**	0.657^{NS}		

NS=Not significant at 5% level, *=Significant, **=Highly significant; T1=CSU-Formulated Grower Broiler Feed, T2=Commercial Grower Broiler Feed Brand A, T3=Commercial Grower Broiler Feed Brand B

Table 4. Cost-benefit on the growth performance, feed consumption, and body weight responses

Variable	T1	T2	T3	F (2,27)	*p*-value	η²
Final live weight (kg)	13.03^{c}	21.69^{a}	17.09^{b}	18.47	<0.001	0.58
Feed conversion ratio (FCR)	2.31^{a}	1.89^{c}	2.05^{b}	9.62	0.001	0.42
Feed cost (₱)	173.70^{c}	1,622.46^{a}	1,460.94^{b}	22.83	<0.001	0.63
Total revenue (₱)	2,475.70^{c}	4,121.10^{a}	3,247.10^{b}	31.56	<0.001	0.70
Net profit (₱)	66.58^{b}	382.07^{a}	−330.41^{c}	14.92	<0.001	0.53

Note: Values within the same column with same letters are not significantly different ($p < 0.05$). T1=CSU-Formulated Grower Broiler Feed, T2=Commercial Grower Broiler Feed Brand A, T3=Commercial Grower Broiler Feed Brand B

Feed conversion ratio (FCR) performance response

The ANOVA results ($p \leq 0.024$) show that feed treatment had a big effect on the measured response during the early to mid-growth phases, days 8–28 (Table 3). T1 – The CSU-formulated Grower Broiler Feed always had the highest overall mean (4.3200 ± 0.985), which was higher than the commercial feeds (T2 and T3), even though it was more variable. There were no significant differences between Days 29 and 35 ($p = 0.657$), which means that birds in all treatments reached similar levels at later stages. The fact that T1 did better in the early stages shows that the formulated feed can support enough growth and physiological development. This shows that it could be a cost-effective and locally adaptable feed alternative. Improving its nutrient content could make it more consistent and less variable, making it a good option for small-scale or resource-limited poultry production.

Cost-benefit analysis

There were significant treatment effects on feed cost, total revenue, and net profit, and the high η² values showed that the economic response to dietary formulation was significant (Table 4). Even though Treatment 2 had the highest feed costs, its statistically better growth performance made up for this, resulting in the highest total revenue and net profit. This result shows that high input costs can be justified if they are matched or surpassed by biological benefits. Treatment 1 showed a limited but conditional economic benefit, with the lowest overall production cost and a positive, though small, net profit. This lowered capital spending and financial risk. Still, its statistically poor growth and feed conversion efficiency meant that it made the least money and had a small profit margin that could change with the market. So, Treatment 1 can be seen as a cost-effective way to feed animals when money is tight, feed is hard to come by, or when making money quickly is more important than making the most money.

CONCLUSION

The full analysis of growth performance, feed consumption, and body weight responses across all treatments shows that the type of feed has a big effect on broiler development during the early to mid-growth stages (Days 8–28). This is shown by consistently significant ANOVA results ($p \leq 0.024$ to $p \leq 0.001$). T1's performance was not as good as commercial feeds in some areas, but it did not stop birds from reaching similar body weights in the later stage (Days 29–35), when differences were often not significant ($p > 0.05$). Biologically, this means that T1 (CSU-formulated grower broiler feed) can help animals grow enough and use their food efficiently, making it a good, cheap, and adaptable option, especially in places like the Cagayan Province, where high-quality crop resources are limited due to climate conditions or in small businesses where commercial feeds may not be available or too expensive to acquire due tariff and taxes. Improving the nutrient profile, especially the quality of the protein, the energy density, and the digestibility, could make growth more consistent and close the gap between the performance of commercial feeds and that of the animals, which would be good for the economy and the environment.

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