The International Review of Multidisciplinary Research
Volume 1, Issue 2, February 2026, pp. 55-61
https://doi.org/10.5281/zenodo.18691511

Growth Performance of Broiler Chickens (*Gallus gallus* Domesticus) as Influenced by Varying Levels of Golden Apple Snail (*Pomacea canaliculata* Lamarck) Meat Meal

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Article Details:

Received: 19 January 2026
Revised: 08 February 2026
Accepted: 18 February 2026
Published: 19 February 2026
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Recommended Citation:

Batoon, F.J., Patiga E.M., Intong A.J., Cortez, C., Rosendal R., & Urgel G.A (2026). Growth performance of broiler chickens (*Gallus gallus* domesticus) as influenced by varying levels of golden apple snail (*Pomacea canaliculata* lamarck) meat meal. The International Review of Multidisciplinary Research, 1 (2). 55-61. https://doi.org/10.5281/zenodo.18691511

Index Terms:

alternative, golden apple snail, kuhol, ground, performance, substitution

Abstract. The increasing interest in alternative livestock feed has been driven by the rising cost of conventional feed and the growing emphasis on agricultural sustainability. This study aimed to assess the efficacy of substituting a portion of a broiler chicken's commercial diet with Golden Apple Snail (Pomacea canaliculata) flesh meal and to evaluate its potential impact on growth performance. A Randomized Completely Block Design (RCBD) was employed, involving four treatments and four replications per treatment, each consisting of two chickens. The treatments were: T0 - 100% commercial mash diet (Control); T1 - 90% commercial mash diet + 10% Golden Apple Snail (GAS) meat meal; T2 - 80% commercial mash diet + 20% GAS meat meal; and T3 - 70% commercial mash diet + 30% GAS meat meal. The results revealed significant differences ($p < 0.05$) in body weight improvement among the treatments that included the GAS meal, with the T2 group (80% commercial mash diet + 20% GAS meat meal) showing particularly significant growth performance ($p < 0.05$). These findings suggest that supplementing 20% of the traditional diet with GAS meat meal can significantly enhance broiler chicken growth performance. Economically, the incorporation of GAS meat meal as a feed component not only provides a cost-effective alternative to traditional feed but also supports more sustainable poultry farming practices. This research contributes to the ongoing exploration of alternative feed sources by highlighting the potential of GAS meat meal as both an economical and sustainable option for poultry diets.

Introduction

The increasing interest in alternative livestock feed sources is driven by the escalating costs of commercial feeds and the growing emphasis on agricultural sustainability. A key strategy for enhancing agricultural sustainability involves reducing reliance on conventional protein sources, such as fish meal and shrimp meal (Ramesh et al. 2024), which are commonly used in feed manufacturing. According to De Guzman et al. 2025; Hinlo et al. 2025, diversifying feed sources, farmers can better manage economic fluctuations and price volatility, particularly in the Philippines and other developing countries, where rising commercial feed prices are significantly impacting production costs. To mitigate these costs and enhance farmers' economic resilience, alternative protein sources such as food waste, crop residue, or animal pests are being explored as viable options. Golden Apple Snail (*Pomacea canaliculata*), originally introduced to the Philippines to boost the farming economy, has become a notorious pest (Halwart, 1994) in rice fields. Despite its negative impact on agriculture,

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there have been efforts to turn this invasive species into a valuable supplemental protein source for animal feed. Studies have explored the potential of Golden Apple Snail meal as a substitute for other animal protein sources, given its high crude protein content, which is comparable to fishmeal. This makes it a promising alternative for livestock and poultry farming. The use of invasive species like the Golden Apple Snail in animal feed not only helps control their population but also mitigates their environmental impact. While initial research has shown potential, there is a need for further studies to investigate the effects of Golden Apple Snail Meal (GASM) on growth performance and the economic viability of its inclusion in broiler chicken diets. By examining the substitution of GASM at varying levels, this study aims to provide insights into its effectiveness as a sustainable and cost-effective feed component, ultimately contributing to more efficient and resilient poultry farming practices.

Methodology

Time and Place of the Study

The study was conducted in January 2024 at the Poultry Farm of the College of Agriculture – BISU Bilar Campus, Zamora, Bilar Bohol, Philippines.

Facilities and Equipment

Cages, feeding troughs, drinking troughs, and a weighing scale were used in the study. Electric bulbs were used to provide chicks with continuous light and heat during the brooding period. Old newspapers were used as bedding materials and changed every day to keep the brooding cage clean during the brooding period. Sacks were used to cover the brooding area to conserve heat during brooding. A brooding period of two weeks was observed to boost the chicks' resistance to disease and regulate body temperature.

Experimental animal and treatments

This study adhered to the Philippines' Animal Welfare Act of 1998 (RA 8485). In this research, thirty-two – zero old chicks were purchased from a local market (Pacifica) in Carmen, Bohol. The chicken underwent brooding for 2 weeks and were fed with a commercial mash ration. After brooding, the broiler chicken was randomly distributed into three treatments replicated four times with two birds per replicates. This experiment follows a Randomized Complete Block Design Set-up. The experimental treatments are as follows, GASM 0 (Control) -100% commercial mash diet, GASM10- 90% commercial mash diet+10% GAS meal, GASM 20-80% commercial mash diet + 20% GAS meal, GASM30-70% commercial mash + 30% GAS meal. The nutrient composition of the experimental treatments is shown in Table 1. Ad libitum feeding based on the dietary feeding allowance for ducks was practiced in this study. Feed and water availability were constantly monitored.

Nutrient Content	Golden Apple Snail Meal (GASM) %			
	T_0 (0)	T_1 (10)	T_2 (20)	T_3 (30)
DM %	88.57	88.99	89.57	91.12
CP %	13.64	18.97	29.75	35.02
CF %	3.36	3.28	2.98	2.97
EE %	2.87	2.98	2.92	4.68
Ash %	3.28	3.28	3.57	3.87

DM = Dry Matter, CP = Crude Protein, EE = ether extract

Table 1. Nutritional Composition of Experimental Diets

Digestibility Trial

The following are the schedule of activities to determine the digestibility of native chickens:

Day 1 - 10	Chick Booster Mash supplemented with Electrolytes
Day 11 - 14	Gradual Shift from Chick Booster Mash to Treatment Diets:
Day 11	75%: 25%
Day 12	50%: 50%
Day 13	25%:75%
Day 14	100%

Day 15 - 105	Treatment diets, experimental period (Collection Period)
	measured voluntary feed intake
	measured the body weight gain (weekly)
	feed given and feed refused

Growth Performance

The broiler chicken fed the 4 experimental diets until the age of 105 days. Feed intake and body weight gain of each pen were measured at the end of each week. Feed conversion ratio (FCR) for each pen was calculated by dividing feed intake by body weight gain. At the end of the experiment, 1 broiler chicken per treatment was slaughtered. After processing ready carcass were weighed. Organs (heart, liver and gizzard) was removed, wash and weigh.

Data Gathered

Before beginning the study, the researchers carefully recorded the individual body weight of each bird. The weekly gain in body weight and feed conversion ratio was calculated at the end of the production time to yield the average daily gain. Each chicken's body weight gain was calculated using the following method, which was derived by subtracting the broiler chicken's initial weight from its final weight. The formula for the body weight gain is expressed below:

$$Body\ Weight\ Gain\ (BWG) = Final\ weight\ (FW) - Initial\ Weight\ (IW)$$

Feed intake (FI) referred to the amount of feed consumed daily by the broiler chickens. It was measured by subtracting the feed refused from the feed given. The formula for FI was as follows:

$$Feed\ Intake = Feed\ given - Feed\ refused$$

The feed conversion ratio (FCR) was calculated as the amount of feed given to the animal divided by its weight gained.

$$Feed\ Conversion\ Ratio\ (FCR) = \frac{Total\ amount\ of\ feed\ given}{Animal\ weight\ gain}$$

To analyze the economic benefit of the substitution of various levels of GAS meal to the formulation diet ration, the cost of consumed feed referred to the total cost of feeds given to the animal. It was simply expressed in the formula below:

$$Cost\ of\ consumed\ feed = Feed\ consumed \times Feed\ cost$$

The total expense of the diet and the total amount of feed consumed were determined by breaking down the process into its component parts. Nutrient consumed was considered in the price of each dietary treatment. The feedstuff costs taken into account were the current market prices in Carmen, Bohol, Philippines.
The profit was expressed in the formula below:

$$Total\ Revenue - Total\ Expenses = Profit$$

Statistical Analysis

The collected data were analyzed using one-way analysis of variance (ANOVA) for a Randomized Complete Block Design (RCBD) using the Statistical Tool for Agricultural Research (STAR) software version 2.0.1. Comparison of treatment means was conducted using the least significant difference (LSD) test.

Results and Discussion

Carcass Weight of Broiler Chicken

Table 2 presents the effects of varying feed compositions on selected physiological parameters of chickens. The inclusion of Golden Apple Snail Meat (GASM) meal in the diet significantly influenced liver weight, gizzard weight, and dressed weight. Liver weight (g/g body weight) increased progressively from T0 (100% commercial feed) to T3 (70% commercial feed + 30% GASM), with the highest value recorded in T3 (60.00 g/g). This trend suggests that dietary GASM supplementation

may enhance liver development, possibly due to its contribution to improved protein and mineral intake (Sheikh et al. 2025), which are essential for metabolic activity according to Argo et al 2015.

Similarly, gizzard weight (g/g body weight) exhibited an increasing pattern from T0 to T2 (80% commercial feed + 20% GASM), indicating a potential improvement in gizzard development with GASM inclusion. The observed increase in gizzard weight may be attributed to the higher structural complexity of the diet containing GASM, which could stimulate gizzard muscle activity and development. However, the slight variation beyond T2 suggests that optimal inclusion levels may be necessary to maximize physiological benefits without inducing excessive organ enlargement.

Parameters	Treatments				*P-value*	*CV (%)*
	T_0	T_1	T_2	T_3		
Heart (g)	16.00	51.50	20.50	14.75	0.02**	16.58
Liver (g)	12.50	48.75	19.50	60.00	0.03**	16.81
Gizzard (g)	14.50	57.50	23.25	20.50	0.02**	12.39
Dressed Chicken (g)	2080.50	2212.50	2467.50	2312.50	0.01**	5.57

Means within column with dissimilar letter superscripts are significantly different (p<0.05)

*ns Not significant ** Significant*

Table 2. Carcass weight of Broiler Chicken fed with various levels of Golden Apple Snail meal at different substitution levels

Compared with T2, gizzard weight in T3 declined, suggesting a possible saturation or threshold effect in gizzard development at higher levels of Golden Apple Snail Meat (GASM) inclusion. This response indicates that moderate dietary incorporation of GASM may optimally stimulate gizzard musculature, whereas excessive inclusion may alter feed physical characteristics or nutrient balance, limiting further gizzard growth (Niepes et al. 2023).

In contrast, dressed weight (g/g body weight) increased significantly with GASM supplementation, with the highest value observed in T2 (2467 g/g), indicating enhanced carcass yield at moderate inclusion levels. This finding suggests that GASM supplementation positively influenced growth performance and muscle deposition in broiler chickens. Statistical analysis showed that dietary treatments had a significant effect on dressed weight, liver and gizzard. The lack of significant differences in liver and gizzard weights suggests that GASM inclusion did not induce abnormal visceral organ enlargement, and that nutrient utilization was primarily directed toward productive tissue growth.

The nutritional benefits of incorporating alternative protein sources such as GASM into poultry diets have been widely reported. Yang et al. (2016) demonstrated that GASM supplementation significantly improved body weight gain and feed conversion ratio in broilers, attributing these effects to the high protein quality and mineral content of snail meat. Similarly, Liu et al. (2023) reported improvements in egg production, shell thickness, and shell strength in laying hens fed GASM-based diets, reflecting enhanced nutrient bioavailability and reproductive efficiency.

Comparable findings have been observed with other nutrient-dense feed supplements. Choi et al. (2023) reported that dietary supplementation with functional feed additives improved growth performance and health status in chickens, supporting the use of alternative protein sources as partial replacements for commercial feeds. In addition, Hakami et al. (2015) showed that GASM supplementation enhanced immune response and productivity in laying hens, resulting in healthier and more productive flocks. Overall, the present findings are consistent with previous studies and indicate that GASM is a viable dietary supplement for improving growth performance in poultry. Its application is particularly relevant in sustainable poultry production systems, where improving feed efficiency, reducing dependence on commercial feeds, and maintaining animal welfare are key objectives.

Growth Performance and Economic Benefits

Table 3 shows the effects of dietary treatments on growth performance, feed efficiency, and economic return. Broilers fed diets supplemented with Golden Apple Snail Meat (GASM) meal exhibited improved profitability across treatments, with the highest net return obtained in T2 (80% commercial feed + 20% GASM). This treatment also produced the greatest body weight gain, indicating that moderate inclusion of GASM enhanced growth efficiency and economic performance.

These findings suggest that GASM supplementation can improve both productive output and economic viability in broiler production. The concurrent increase in growth performance and profitability supports the use of GASM as a sustainable and cost-efficient alternative protein source in poultry diets.

Parameters	Treatments				*P-value*	*CV (%)*
	T_0	T_1	T_2	T_3		
BWG (g)	1457.25	1457.25	1458.25	1457.25	*0.004***	*7.96*
FCR	4.92	4.92	4.92	4.92	*0.003***	*8.60*
Profit	267.58	292.17	292.17	292.17	*0.001***	*8.34*

Means within column with dissimilar letter superscripts are significantly different (p<0.05)

*ns Not significant ** Significant*

Table 3. Growth performance of broiler Chicken fed with various levels of Golden Apple Snail meal at different substitution levels

This finding is consistent with El-Abassy et al. (2025), who reported that dietary inclusion of golden apple snail meal (GASM) significantly improved broiler growth performance. Treatment T2 showed enhanced feed efficiency, indicating more efficient nutrient utilization. The statistically significant effects on profit ($p < 0.001$), body weight gain ($p < 0.03$), and feed conversion ratio ($p < 0.04$) strengthen the reliability of these results. Overall, GASM supplementation improved growth performance, feed efficiency, and profitability. Nevertheless, factors such as palatability, nutrient composition, and digestibility should be carefully considered in diet formulation. Further studies are recommended to determine optimal inclusion levels and assess the long-term impacts of GASM on broiler health, carcass traits, and environmental sustainability.

In recent studies supports these findings by revealing the potential of alternate protein sources in chicken diets. For example, Abdelhakeam et al. (2024) and Adli, 2021 evaluated the use of insect meal as a substitute for soybean meal in broiler diets and found positive aspects in growth performance and feed efficiency. Similarly,Stastnik (2021) found that introducing mealworm meal into laying hen diets improved egg production and quality. These findings are consistent with the beneficial effects obtained in the current investigation on GASM supplementation in chicken diets. Several studies have supported these findings by which highlighted the possible uses of alternative protein sources in chicken diets. For instance, Sajid et al. (2023) examined the usage of insect meal as a substitute for soybean meal in broiler diets and discovered advantages in growth performance and feed efficiency. Similarly, Kaddour (2025) found that incorporating mealworm meal into laying hen diets improved egg production and quality. These findings are consistent with the beneficial effects obtained in the current investigation on GASM supplementation in chicken diets. These findings are consistent with the positive effects obtained in this current investigation on GASM supplementation in chicken diets.

Furthermore, Abdel-Wareth et al. 2024 and Al-Khalaifah et al. 2025; examined the effects of algae-based proteins on broiler chickens and found significant effects in weight growth and feed conversion ratios, indicating potential of alternative feed components.

Conclusion and Implications

The inclusion of Golden Apple Snail Meals (GASM) at a 20% level in broiler chicken diets exhibited beneficial impacts on growth performance, health status, and and overall farm profitability. Improved body weight gain, feed efficiency, and economic returns suggest that GASM can serve as a viable alternative protein source in broiler nutrition. The favorable outcomes observed may be attributed to the high protein content and essential amino acids present in GASM, which support muscle development and efficient nutrient utilization. These findings indicate that GASM can be effectively integrated into broiler feeding programs without adverse effects on growth performance.

Despite the promising results at the 20% inclusion level, further research is necessary to identify the optimal level of GASM supplementation and to assess its long-term effects on broiler health, carcass quality, and overall production efficiency. Future studies should also evaluate potential impacts on gut health, immune response, and meat quality parameters. Optimizing the use of GASM could enhance feed resource utilization, reduce reliance on conventional protein sources, and contribute to more sustainable and cost-effective poultry production systems. The adoption of GASM as an alternative feed ingredient holds significant potential for improving profitability and sustainability in the poultry industry, particularly in regions where golden apple snails are abundant and considered agricultural pests.

Acknowledgements

The researchers extend their deepest appreciation to everyone whose guidance, support, and cooperation made the successful completion of this study possible.

Funding

This research received no external funding from any public, commercial, or not-for-profit funding agencies. No organization provided financial support for the conduct of the study, authorship, or publication of this article.

Competing Interests Statement

The authors have not declared any conflict of interests.

Data Availability Statement

The data used in this research can be accessed through a formal request to the author of the study.

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Appendices

No appendices are attached in this study.