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Full Length Research

Growth performance of two chicken breeds fed guava (*Psidium guajava*) leaf meal as a natural alternative to antibiotic growth promoter

S. M. Adefioye[1]*, D. F. Apata[1], M. O. Adesina[1] and A. L. Ambali[2]

[1]Department of Animal Production, Kwara State University, Malete, Nigeria.
[2]Kwara State Ministry of Livestock Development, Ilorin, Nigeria.

*Corresponding author. Email: sheriffadefioye@gmail.com; Tel: +234 803 240 0319.

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ABSTRACT: The potential of phytogenic compounds such as guava (*Psidium guajava)* leaf meal can be harnessed as a non-antibiotic alternative in promoting growth performance in chicken. Therefore, this study was undertaken to assess the growth performance characteristics of two chicken breeds fed guava leaf meal (GLM) as a natural alternative to antibiotic growth promoters. GLM was screened for phytochemicals. A total of 180 chicks were subjected to 6 dietary treatments replicated 3 times in a 2 x 6 factorial layout of breed type (Noiler or broiler) and GLM and Oxy-tetracycline supplementation (0 g/kg GLM 5 g/kg Oxy-tetracycline, 5 g/kg GLM, 10 g/kg GLM, 15 g/kg GLM or 20 g/kg GLM) for 5 weeks. The data were subjected to a two-way factorial analysis using the Statistical Package for the Social Sciences (SPSS) version 27 for Windows. The results showed that tannins, phenols, saponins, resin and quinone are phytochemicals found in abundance in GLM, while phlobatamins were absent. The growth performance of Noiler and broiler revealed that broiler chicken had significantly higher growth performance characteristics compared to Noiler. Broilers fed 10g GLM had comparable growth performance to the control group with an average daily gain of 50.26 g and a growth rate of 33.17%. Broiler also converted feed better than Noiler, with the former having a feed conversion ratio of 1.45. The growth rate was more pronounced at weeks 3 and 4. The interaction effect of chicken breeds and GLM supplementation was significant on the growth performance characteristics. In conclusion, the GLM improved the growth performance of the broilers better than the Noiler. Broiler chicken consumed more feed and had better feed conversion than Noiler. 10 g/kg GLM in the broiler diet had comparable growth performance to the Oxy-tetracycline control group.

Keywords: Antibiotic growth promoter, Broiler, growth performance, guava leaf meal, Noiler.

INTRODUCTION

The increase in Nigeria's population poses a threat to food and nutrition security and has resulted in more demand for animal-derived food products. To feed this growing population, there is a need for a corresponding increase in food production (Huang and Ukpong, 2019). Poultry production is gaining popularity in developing countries, including Nigeria, due to its role in bridging the protein malnutrition, economic empowerment of smallholder farmers and fits well in the farming systems commonly practised (Dilger *et al.*, 2016; Ajala *et al.*, 2020). The poultry industry contributes significantly to animal protein consumption and to human nutrition and global food security (Rashid *et al.*, 2020). Broilers are fast-growing birds with high feed efficiency, reaching the required market weight of 2 kg and above, within five and six weeks of age (Obienyem *et al.*, 2023). Noiler chicken is a dual-purpose chicken initiated and developed in Nigeria, specifically designed to meet the needs of smallholder farmers by providing both meat and eggs (Tallentire *et al.*, 2016). The breed is a cross between broiler chickens and local Nigerian breeds, combining the desirable traits of both. It has the resistance traits of cockerels and some meat characteristics of broilers, hence grows quickly like the broiler but not as much as the broiler, and the female

lays many eggs like the conventional layers.

Growth performance in animals has always been of research interest and a major driving force in animal research. Growth is a complex biological process that is induced by differential development rates of body muscles and tissues (Bamidele *et al.*, 2019). The esteemed importance of growth performance or indices in animal production has led to the use of growth-promoting substances such as antibiotics to promote and accelerate the growth and ensure quick turnover. However, antibiotics pose serious threats to human health due to their residual effects on meat products and the development of antibiotic-resistant bacteria in humans Mehdi *et al.*, 2018). Thus, the use of these antibiotics as growth promoters are being discouraged due to high-cost implications, side effect issues and the risk of accumulation of residue in animal tissues, which could have harmful effects on human health upon consumption (Solanki *et al.*, 2022). Attempts at addressing these challenges have focused on the exploitation of natural herbal plants with potential capability of serving as growth promoters and immune boosters, leveraging on their inherent properties such as antioxidants, anti-microbial, and anti-inflammatory properties among others (Talukder *et al.*, 2017; Sarker *et al.,* 2020). This trend has triggered the search for alternative means to produce animals at reduced cost using natural growth and health promoters known as photobiotics.

Pisidium guajava – a plant-based photobiotic, is a well-known tropical tree cultivated mainly for fruit. It is an evergreen shrubby tree with a widespread network of branches. All the body parts of the guava plant, as well as the by-products, have been used for nutritional and medicinal purposes (Takeda *et al.*, 2022). There is a paucity of information on the use of Guava Leaf meal (GLM) as a natural alternative to antibiotic growth promoters in chicken breeds, the subject of this study.

MATERIALS AND METHODS

Procurement and preparation of *Psidium guajava* leaf meal

Fresh leaves of the plant (*Psidium guajava*,) were collected within Ilorin metropolis, Kwara State, Nigeria. The leaves were washed with clean water to remove debris and spread thinly on a flat, clean surface (to prevent spoilage by moisture condensation) and allowed to dry at room temperature for two weeks. The dried plant materials were pulverized separately into powder using an electric blender, sieved using a 2mm sieve and then stored in an airtight container until use (Ladipo *et al.*, 2010).

Experimental animals, dietary treatment, management and design

This research work was carried out at the Poultry Unit of the Kwara State University Teaching and Research Farm, Malete, Nigeria, situated on Latitude 8.71°N and Longitude 4.44°E in Moro Local Government Area of Kwara State, Nigeria. One hundred and eighty (180) chicks comprising 90 Noiler and 90 Broiler breeds, respectively, were used for this study. The birds were divided randomly into 6 treatment groups at 3 replicates per group, thus giving 5 birds per replicate. The birds were subjected to 6 dietary treatments replicated 3 times in a 2 x 6 factorial layout of breed type (Noiler or broiler) and GLM and Oxy-tetracycline supplementation (0 g/kg GLM 5 g/kg Oxy-tetracycline, 5 g/kg GLM, 10 g/kg GLM, 15 g/kg GLM and 20g/kg GLM) for 5 weeks. The birds were subjected to standard brooding management and vaccination. They were fed broiler pre-starter diet for 4 weeks and subsequently fed finisher diet. Feed and water were given *ad libitum.* Commercial feeds were used as basal diets and GLM were mixed manually with basal diet at the rate of 5, 10, 15 and 20 grams in T3, T4, T5 and T6 groups, respectively, for all the three phases highlighted above, while T1 group (fed only basal diet + 0g GLM serving as negative control) and T2 group (basal diet + synthetic antibiotic serving as positive control).

Growth performance

Daily feed intake

Feed consumption was recorded daily. The difference between the feed served and the leftover gives the feed intake per day. The data obtained was used to get daily feed intake (DFI), weekly feed intake (WFI) and Total feed intake (TFI).

Body weight gain

Data on weight were collected every week. Initial weights of the birds/chickens were taken at the beginning of the trial and subsequently weekly for 6 weeks using a weighing scale (Camry, UK). The data obtained were used to get daily weight gain (DWG) and Total weight gain (TWG) according to Atansuyi *et al*. (2018)

Feed conversion ratio (FCR)

FCR was calculated at the end of the experiment according to Atansuyi *et al*. (2018)
using the formulae:

$$\mathrm{FCR} = \frac{\text{Total feed intake (g)}}{\text{Total weight gain (g)}}$$

Where: Total weight gain = Final weight - Initial weight

Data analysis

Data was subjected to a two-way factorial analysis using SPSS version 27 for Windows.

RESULTS

Phytochemical screening of Guava Leaf Meal

Table 1 shows phytochemical screening of Guava Leaf Meal. The phytochemical qualitative abundance of Guava leaf indicates that Tannin, Phenol, Saponin, Resin and Quinone were abundantly present (+++) in the leaf, while flavonoid and steroid were moderately present (++). Alkaloid, Glycoside and Terpenoid were slightly present (+) while Phlobatamin (-) was absent in the leaf.

Table 1. Phytochemical screening of guava leaf.

Phytoconstituents	Qualitative abondance
Tannins	+++
Phenols	+++
Alkaloids	+
Saponins	+++
Flavonoids	++
Glycosides	+
Terpenoids	+
Phlobatamins	-
Steroids	++
Resins	+++
Quinones	+++

Key: + slightly present, ++ moderately present, +++ highly present, - not present.

Growth performance of Noiler and Broiler chicken fed diets containing Guava Leaf Meal (GLM) for 5 weeks

The growth performance of the Noiler and broiler chickens fed diets containing Guava Leaf Meal (GLM) for 5 weeks indicates a significant ($P<0.05$) breed effect on all growth parameters evaluated (Table 2). Broiler chicken had significantly ($P<0.05$) higher performance relative to Noiler chicken in final body weight (2447.22 g vs 983.39 g); in total weight gain (2407.48 g vs 948.56 g); average daily weight gain (68.79 g vs 27.10 g), and growth rate (39.19 vs 31.03). While broiler chicken consumed more feed over the period, with total feed intake of 2699.57 g as compared to 1840.80 g recorded in Noiler, the broiler chicken equally had a better utilisation of the feed with a feed conversion ratio of 1.14 compared to 1.99 in Noiler chicken. There was a significant ($p<0.05$) effect of varied inclusion level of Guava Leaf Meal (GLM) on growth performance characteristics. Birds fed 5 g Oxytet (antimicrobial growth promoters (AGP)) had the best growth performance characteristics. However, birds fed 10g of GLM had comparable final weight, total body and average weight gain with the 5 g Oxytet group.

The efficiency of feed utilisation was also best in birds fed 5g Oxytet with 1.22 FCR. The feed conversion ratio of birds fed 10g GLM was, however, similar (1.45 FCR) to birds fed 5g Oxytet. There was significant interaction of breed and GLM on total feed intake and feed conversion ratio.

The interaction effect of chicken breed and GLM on feed intake in Noiler and broiler chickens (Figure 1) indicates that inclusion of 5g Oxytet lowers the feed intake in Noiler, whereas it increases feed intake in broiler. The interaction effect of breed of chicken and GLM on feed conversion ratio (Figure 2) indicates that birds fed 0g GLM had poor feed utilisation in Noiler, whereas broilers fed the same diet had the best feed utilisation. 5g Oxytet, when given to Noiler, reduced the FCR significantly, whereas the reverse is the case in broiler when compared to the 0g GLM

The cumulative rate of growth in Noiler and broiler chicken (Figure 3) indicates similar growth patterns in the two breeds of chicken. However, there was a higher growth rate in broiler compared to Noiler. While in both breeds, the growth rate between week 1 to week 3 was slow, there was, however, a sharp rise in growth rate at week 3, indicating a point of inflexion till week 4, before the growth rate slowed down again up till week 5.

The weekly rate of growth in birds fed a varied inclusion level of GLM is presented in Figure 4. While week 2 to week 3 had the lowest growth rate across all inclusion levels of GLM, week 3 to week 4 had the highest growth rate across all inclusion levels. It would be noted, however, that 5 g Oxytet had the highest level of growth in weeks 1 to 2 and week 3 to 4, followed by birds fed 0g GLM with the second-best rate of growth between week 3 and 4. This was also followed by birds fed 10g GLM with a higher growth rate at weeks 1 – 2 and 3 – 4.

DISCUSSION

Phytochemicals contribute significantly to protection against degenerative diseases and have disease-preventive properties (Ladipo *et al.*, 2010). Moderate presence of flavonoids, and high presence of phenols, tannin and saponin as reported in this study is consistent with the findings of Adamu *et al.* (2021) who also reported moderate presence of flavonoids and high presence of phenols, tannin and saponin in guava leaf. The presence of tannins, saponins, steroids, flavonoids, phenol, alkaloids, glycosides, terpenoids, steroid, resin and quinone has also been reported in Guava leaf by Millones-Gómez *et al.* (2020) and Kumar *et al.* (2021). Phenolics and flavonoids demonstrate many biological activities, such as antioxidants (Bouaziz *et al.*, 2015), antimicrobial, anticancer, anti-inflammatory and wound healing properties (da Gama *et al.*, 2014), while steroids are known to have antibacterial, insecticidal and cardiotonic properties (Iqbal *et al.*, 2015).

Thus, the use of guava leaves as an alternative to synthetic antimicrobial growth promoters, as done in the current study, is appropriate since it contains antibacterial and antioxidant properties. The growth performance of the

Table 2. Growth performance in Noiler and broiler chicken fed Guava Leaf Meal for 5 weeks.

Factors		Growth performance traits						
		Initial body weight (g)	**Final body weight (g)**	**Total body weight gain (g)**	**Average daily weight gain (g)**	**Total feed intake (g)**	**Feed conversion ratio**	**Growth rate (%)**
Breed	Noiler	34.83 ± 0.72	983.39^{b} ± 29.48	948.56^{b} ± 29.63	27.10^{b} ± 0.85	1840.80^{b} ± 54.31	1.99^{a} ± 0.10	31.03^{b} ± 1.41
	Broiler	39.74 ± 0.26	2447.22^{a} ± 63.73	2407.48^{a} ± 63.84	68.79^{a} ± 1.82	2699.57^{a} ± 46.77	1.14^{b} ± 0.04	36.19^{a} ± 0.89
Guava Leaf Meal	0 g	35.48 ± 1.61	1811.17^{ab} ± 402.52	1775.68^{ab} ± 400.97	50.73^{ab} ± 11.46	2196.25 ± 135.52	1.57^{ab} ± 0.30	35.91^{a} ± 2.48
	5 g oxytet	36.98 ± 1.22	1848.33^{a} ± 332.38	1811.35^{a} ± 331.45	51.75^{a} ± 9.47	2122.53 ± 323.86	1.22^{c} ± 0.13	37.30^{a} ± 0.65
	5 g	39.75 ± 1.26	1698.50^{abc} ± 350.92	1658.75^{abc} ± 350.27	47.39^{abc} ± 10.01	2297.98 ± 275.73	1.60^{ab} ± 0.17	33.26^{ab} ± 0.92
	10 g	36.03 ± 1.48	1795.00^{ab} ± 308.14	1758.97^{ab} ± 306.72	50.26^{ab} ± 8.76	2307.05 ± 162.32	1.45^{bc} ± 0.16	33.17^{ab} ± 1.20
	15 g	36.73 ± 1.93	1540.67^{c} ± 290.52	1503.93^{c} ± 288.69	42.97^{c} ± 8.25	2297.90 ± 168.79	1.74^{a} ± 0.22	32.77^{ab} ± 2.54
	20 g	38.73 ± 0.34	1598.17^{bc} ± 340.71	1559.43^{bc} ± 340.56	44.56^{bc} ± 9.73	2399.40 ± 233.47	1.79^{a} ± 0.24	29.25^{b} ± 3.21
Breed x GLM		Ns	Ns	Ns	Ns	*	*	Ns

Values are presented mean ± SEM. Mean within column, within factor with different superscript. ^{abcdef} are significantly different ($p < 0.05$). Guava leaf meal (GLM) in grams/kg feed, Oxytet = Oxytetracycline, Ns = not significant, * = significant.

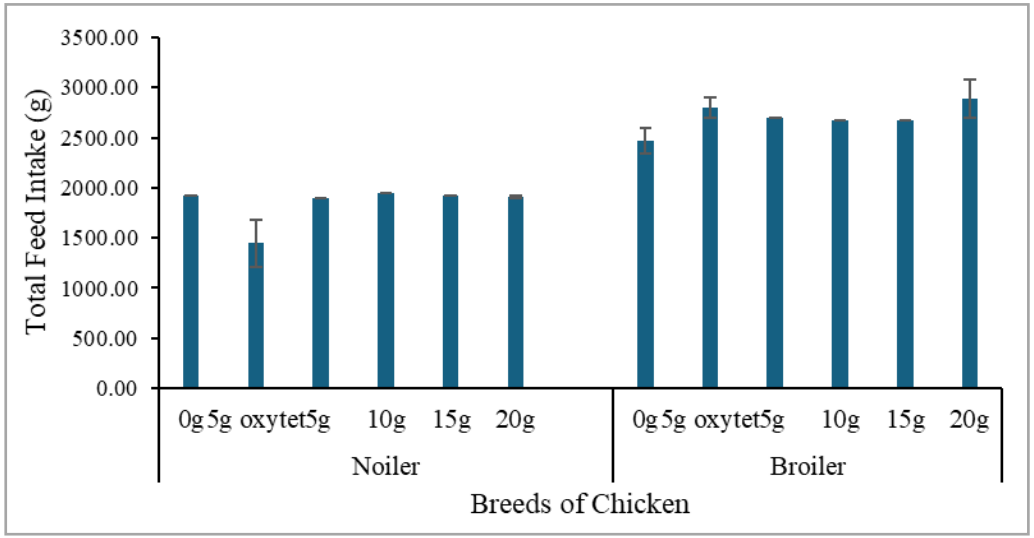

Figure 1. Interaction effect of breed and guava leaf meal on total feed intake in Noiler and Broiler chickens.

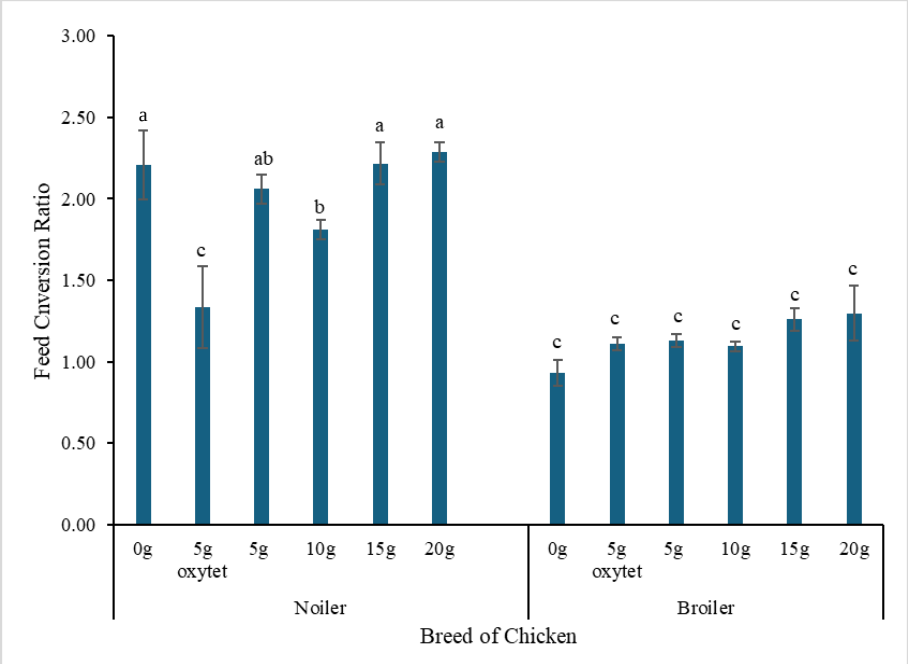

Figure 2. Interaction effect of breed and guava leaf meal on feed conversion ratio in Noiler and Broiler chickens.

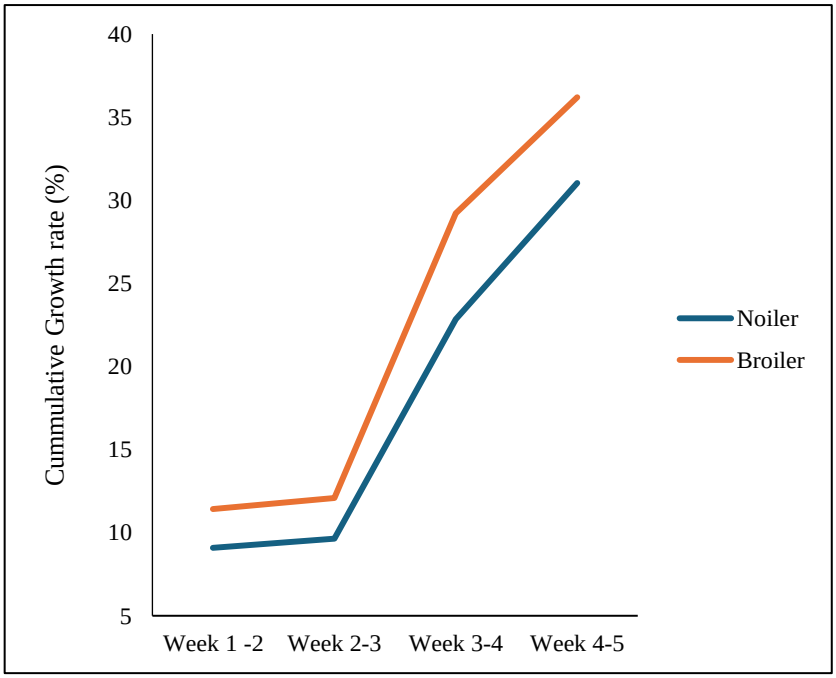

Figure 3. Cumulative growth rate in Noiler and Broiler chickens over 5 weeks period.

Noiler and broiler chickens fed diets containing GLM for 5 weeks indicates a significantly high breed effect on all growth parameters evaluated. Broiler chicken had higher performance relative to Noiler chicken in growth performance, suggesting that broiler made a judicious utilisation of dietary treatments and thus considerable nutrients got absorbed and assimilated by the birds, leading to a higher growth rate in broiler compared to the

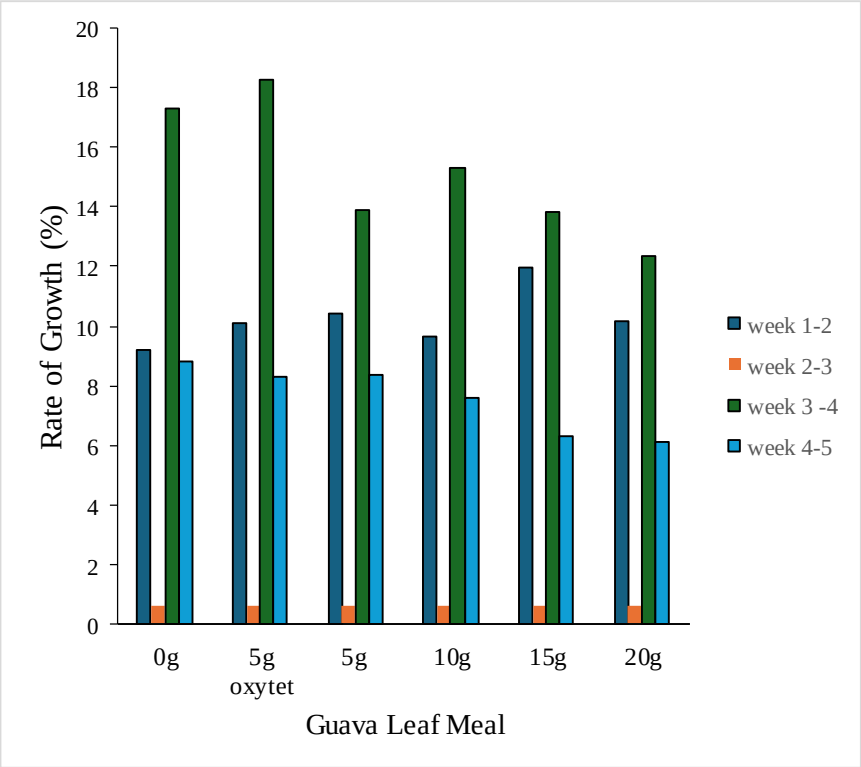

Figure 4. Rate of growth in Noiler and Broiler chickens fed guava leaf meal over a 5-week period.

Noiler throughout the period of the feeding trial. Broiler chicken consumed more feed over the trial period than Noiler. This suggests that broiler chicken is genetically endowed for better utilisation of feed compared with Noiler, which might have been responsible for the better growth performance recorded in broiler compared to Noiler (Mohsen *et al*., 2021).

The best performance recorded in birds fed 5 g Oxytet (AGP) is not surprising, as it indicates the potency of synthetic antibiotics in driving or ensuring better performance in birds. However, the appreciable performance observed in birds fed with 10g GLM suggests that GLM has a positive effect on the growth performance of birds. This indicates that GLM had growth growth-promoting effect on the Birds/Chickens and that the stated level was well tolerated by the birds. This agreed with the observation of Rahman *et al.* (2013), who also reported no deleterious effect of GLM on broiler chicken investigated. Thus, it can be inferred that GLM-supplemented diets were palatable, acceptable, non-hazardous and displayed growth-promoting potential to broiler birds. Daing *et al.* (2021) had earlier observed a higher body weight gain in the guava leaf meal supplemented group as compared to the control.

The better feed conversion efficiency observed in birds fed 10g GLM is also similar to the findings of Abang *et al.* (2023), who reported that GLM enhanced feed and protein conversion efficiency in the basal diets of broiler chicken. According to Anon (2011), FCR is a measure of how well a flock converts feed intake into live weight, and any factor which reduces feed intake, growth, or health of the broiler will worsen flock FCR. The interaction effect of breed of chicken and GLM on feed intake in Noiler and broiler chickens indicates that inclusion of 5 g Oxytet lowers the feed intake in Noiler, whereas it increases feed intake in broiler. The interaction effect of breed of chicken and GLM on feed conversion ratio indicates that birds fed 0g GLM had poor feed utilisation in Noiler, whereas broilers fed the same diet had the best feed utilisation. This further suggests that broilers have broader feed consumption potency compared to Noiler, which may be selective and conservative. The observed differences in the response of these two breeds of meat-type chicken could be attributed to nutrigenetic effect, where some genotypes showed varied response to supplied nutrients because of genotype x environment interaction.

The significant effect of varied inclusion level of Guava Leaf Meal (GLM) on growth performance characteristics recorded in this study indicates that Guava Leaf Meal had positive effects on the growth performance of both the broiler and Noiler chickens.

The cumulative rate of growth in Noiler and broiler chicken indicates similar growth patterns in the two breeds of chicken. However, there was a higher growth rate in

broiler compared to Noiler. This may be attributed to the superior genetic composition of the broiler chicken compared to the Noiler chicken. While in both breeds, the growth rate between week 1 to week 3 was shred, there was, however, a sharp rise in growth at week 3, indicating a point of inflexion till week 4, before the growth rate shrank down again up till week 5.

It can be observed that while week 2 to week 3 had the lowest growth rate across all inclusion levels of GLM, week 3 to week 4 had the highest growth rate across all inclusion levels. This is similar to the observation of Llanes (2022), who reported that broilers' acclimation period is from day 1 to 14. As such, the birds might be able to make judicious utilisation of the nutrients in the feed. This is consistent with the findings of Rahman *et al.* (2013), who observed that the broiler fed diet with 4.5 % guava leaf meal utilised their diet efficiently and maintained FCR that was comparable to the positive control.

The comparable growth performance indices in terms of final body weight, final body weight gain, average daily weight gain, feed conversion ratio, and growth rate in broilers fed 10g GLM and 5 g Oxytet indicate that 10 g GLM could be used as a natural alternative to antibiotic growth promoters.

Conclusion

It was concluded that the GLM improved the growth performance of the broilers better than the Noiler. Broiler chicken consumed more feed and had better feed conversion than Noiler. 10g/kg GLM in the broiler diet had comparable growth performance to the Oxy-tetracycline control group. Guava leaf meal, administered at 10 g/kg of feed, is effective as a natural alternative to synthetic antibiotics for promoting growth and is therefore recommended in the diet of chickens.

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COMPETING INTEREST

The authors have declared that no competing interest exists.

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