Performance characteristics of broiler chickens fed varying levels of fresh waterleaf (*Talinum triangulare*)

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ABSTRACT

Background and Objective: Continuous attempts have been made to reduce the cost of feed in broiler production by using unconventional feed resources. However, there is a paucity of information on the use of fresh waterleaf (*Talinum triangulare)* as a potential source of feed ingredients. Thus, this study was conducted to evaluate the performance of broiler birds fed varying levels of waterleaf.

Methodology: In a six-week study, waterleaf (T1: 0 g/kg, T2: 5 g/kg, and T3: 10 g/kg) was added to a basal diet formulated to meet the requirements of the broiler chicken. One hundred and fifty (150) day-old Arbor Acres broiler chickens were randomly allotted to the three dietary treatments with five replicates per treatment and 10 birds per replicate in a completely randomized design (CRD) experiment.

Main Results: Values obtained from the proximate composition of the diets were not significant ($P > 0.05$) influenced by the dietary addition of the waterleaf, except for crude protein (CP), crude fiber (CF), and metabolizable energy (ME) which all increased with the addition of waterleaf. The highest values of CP (21.43 ± 0.41%), CF (3.52 ± 0.02%), and ME (3,085.03 ± 8.47 kcal/kg) were recorded in diet T3. Performance parameters (weeks 1–3) were significantly ($P < 0.05$) influenced except for the initial weight and feed conversion ratio (FCR). However, birds fed diet T1 had the best weight gain (590.86 ± 3.44 g) and total feed intake (973.34 ± 11.10 g). The weight gain, daily weight gain, and final weight of birds fed diet T2 and T3 were statistically the same for weeks 1–6 but higher than those on diet T1, with the best FCR (1.67 ± 0.02) from birds fed diet T2.

Conclusions: This study demonstrates that waterleaf has the potential to improve bird growth performance and FCR and could be considered a promising feed ingredient in broiler production. Therefore, it could be recommended that broiler farmers incorporate 5 g/kg of waterleaf in the diet of their broiler chickens for optimal growth and performance.

Keywords: Arbor Acre broiler, unconventional materials, vegetable, weight gain

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INTRODUCTION

Feed costs have been reported to constitute approximately 60–75% of the total production expenses in poultry production, especially when intensive systems of management are practiced, and conventional feedstuffs are used (Mak *et al*., 2022). The escalating expenses associated with traditional feed ingredients have been a driving force behind the continuous quest for alternative feed sources to lower the overall cost of feed, retain the production performance of the birds, and maximize profit (Nworgu *et al*., 2014). Thus, in addressing this challenge, some features have been set to be a guide in exploring alternative feed ingredients, which include, cost-effectiveness, incurring little or no cost of processing, absence of antinutrients, locally and readily available, and not in stiff competition with humans as all been said to be an attribute of any viable material to serve as alternative to conventional feed sources (Akande *et al*., 2007; Ayeni *et al.,* 2022).

In tropical regions, some green leafy plants and vegetables have been seen to have the potential to contribute to the nutrient pool in the diets of livestock. They can be considered as a potential replacement for conventional feed supplements (Adegbenro *et al*., 2012), as they have been reported to be abundant in nature, have accessible protein, and are economical with no additional cost of processing (Fasuyi, 2006). One such underutilized vegetable is waterleaf (*Talinum triangulare*).

It is an indigenous vegetable available in the tropical region for about nine months a year without irrigation, contributing substantially to nutritional food security in many rural African communities (Nworgu *et al*., 2014). According to Adekanmi *et al*. (2020), it contains an appreciable amount of crude protein (28.82–32.22%), crude fiber (8.50–9.30%), ash (2.46–3.26%), nitrogen-free extracts (1.38–2.18%), dry matter (19.55–23.15%), and carbohydrate (55.34–56.54%). Also, some mineral content reported include phosphorus (196.50 mg/100g), potassium (156.60 mg/100g), sodium (80.60 mg/100g), zinc (10.50 mg/100g), iron (0.65 mg/100g), and copper (0.12 mg/100g; Agunbiade *et al*., 2015). Furthermore, studies have revealed that *T. triangulare* leaves contain notable quantities of beneficial compounds like vitamin C, vitamin E, omega-3 fatty acids, soluble fibers (pectin), carotenoids (β-carotene), flavonoids, and alkaloids, while maintaining low levels of potentially harmful substances such as tannins and saponins (Aja *et al*., 2010; Ikewuchi *et al*., 2017). This implies that *T. triangulare* leaves hold significant potential to contribute to the nutrient composition of the diet and enhance the well-being of both livestock and humans.

In the words of Nworgu *et al*. (2014), using waterleaf in the diets of broilers and other poultry can significantly reduce feed costs, and improve feed conversion and the health status of birds. With this in mind, this study aims to explore the potential and establish the optimal addition level of waterleaf (*T. triangulare*) in broiler chickens' diets using the birds' performance as response criteria.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Poultry Unit of The Federal University of Technology Akure, Teaching and Research Farm, Ondo State, Nigeria, situated on latitude 7.491780°N, longitudes 4.944055°E and 5.82864°E, with annual temperature range of 27 to 38 °C. It receives between 1,300 and 1,650 mm of precipitation annually (Daniel, 2015).

Sourcing and Formulation of Experimental Diets

Conventional feed ingredients such as maize, soybeans, premixes, and bone meal were procured from a well-regarded feed mill within the Akure metropolis. A basal diet was formulated to meet the NRC requirement for broiler chicken both at the starter and finisher phases of the experiment. Fresh waterleafs were harvested within the vicinity of The Federal University of Technology Akure. They were allowed to wilt overnight to reduce moisture content before being chopped and incorporated into the basal diet at different levels. The basal diet was thereafter divided into three portions with the addition of waterleaf at 0, 5, and 10 g/kg feed and designated as diet T1, T2, and T3, respectively. The gross composition of the basal feed is shown in Table 1, while the proximate composition of the waterleaf is presented in Table 2.

Experimental Design and Management of Experimental Birds

A total of one hundred and fifty (150) day-old Arbor Acre broiler chickens were sourced from a reputable hatchery in Ibadan, Oyo state, Nigeria. The birds were randomly allotted to the three dietary treatments (T1, T2, and T3). Each treatment consists of five replicates with ten birds per replicate in a completely randomized design

(CRD) experiment. Experimental diets and water were served *ad libitum*. All management practices, such as routine vaccination and drug administration, were carried out according to standard procedures.

Feed Analysis and Data Collection

The proximate composition of the experimental diets and waterleaf was analyzed according to the standard procedures of AOAC (1995). The metabolizable energy (ME) of the diets was calculated using the formula described by Peuzenga (1985). During the six-week feeding trial, data were collected on feed intake, weight changes, and feed conversion ratio (FCR) which were used as response criteria to evaluate the performance of the birds.

Statistical Analysis

All data obtained were subjected to a one-way analysis of variance (ANOVA), where significant differences were found. Duncan's new multiple range test was used to separate the mean at $P < 0.05$ using the SPSS package version 26. The standard error was determined for each mean using the same statistical package.

Table 1 Gross composition of basal diet fed to broiler chicken both at starter and finisher phases of the experiment

Ingredient	Quantity (kg)
Maize	55.00
Ground nut cake	22.00
Soya bean meal	10.00
Wheat offal	6.00
Fish meal	4.00
Bone meal	1.25
Lysine	0.50
Methionine	0.75
Salt	0.25
Premix	0.25
Total	100.00

Table 2 Proximate composition of waterleaf

Ingredient	Mean
Moisture content (%)	6.92 ± 0.62
Crude protein (%)	24.45 ± 1.04
Crude fiber (%)	8.20 ± 0.55
Crude fat (%)	3.86 ± 0.18
Ash content (%)	5.76 ± 0.47
Carbohydrate (%)	50.81 ± 2.33
Total (%)	100.00

Note: All values are the mean of triplicate samples. Mean ± standard error.

RESULTS AND DISCUSSION

The proximate composition of the experimental diets is shown in Table 3. All parameters evaluated were not significantly (P > 0.05) influenced by the addition of waterleaf except crude protein (21.06 ± 0.34 to 21.43 ± 0.41%), crude fiber (3.19 ± 0.01 to 3.52 ± 0.02%), and ME (3,013.03 ± 7.56 to 3,085.03 ± 8.47 kcal/kg) which were observed to increase with increased addition of waterleaf from diet T1 to T3. The recorded dry matter content ranges from 93.43 ± 0.98 to 93.51 ± 0.69%, which was higher than the values (87–91%) reported by Nworgu *et al*. (2014) when broiler chicken feed was supplemented with a waterleaf meal. The higher the dry matter content, the higher the voluntary intake by the birds. This also reveals that the feed can be stored for a longer period without growing molds nor the nutrients deteriorate rapidly, especially the protein and fat content in the feed. The increase in the crude protein and fiber in the diets could be attributed to the protein and fiber content of waterleaf, which has been reported by Adekanmi *et al*. (2020) to contain about 28.82–32.22% CP and 8.50–9.30% CF. The crude protein values obtained from the experimental diets (21.06 ± 0.34 to 21.43 ± 0.41%) were also comparable with the values reported by Nworgu *et al*. (2014) and Agboola *et al*. (2018), who stated that broiler chicken requires about 19–25% CP to support muscle development, synthesis of cellular fluids, and other metabolic activities within their body (Fasuyi, 2022). Thus, the crude protein in the diet is adequate to support the growth of the birds. The metabolizable energy ranges from (3,013.03 ± 7.56 to 3,085.03 ± 8.47 kcal/kg) which was higher than the values (2,610–2,850 kcal/kg) reported by Agboola *et al*. (2018). Hence, it is able to supply the energy needed for basic activities and excess stored in the liver and muscles in the form of glycogen. The calcium and phosphorus content were in the appropriate proportion of ratio 2:1 for proper growth and health of the bones as there was no clinical manifestation of bone malformation nor abnormalities which may manifest in the form of rickets, osteoporosis, or lameness during the feeding trial of this experiment. The two major amino acids in broiler nutrition, methionine, and lysine, were sufficient to support the immune-modulatory role, ameliorate the effect of stress, and serve as precursors for other essential compounds within the cell (Bouyeh, 2012). All nutrients were adequate to support the needs of the birds as they were in line with the NRC (1994) standard. It was also observed that waterleaf has the potential to contribute and improve basic nutrients necessary for the growth and health status of the birds without any adverse effects, which was similar to the observation of Aja *et al*. (2010).

Table 3 Proximate composition of experimental diets containing varying levels of waterleaf fed to broiler chicken

Parameter	T1 (control)	T2 (5 g/kg)	T3 (10 g/kg)	P-value
Dry matter (%)	93.51 ± 0.69	93.48 ± 1.58	93.43 ± 0.98	0.07
Crude protein (%)	21.06 ± 0.34^{b}	21.22 ± 0.45^{ab}	21.43 ± 0.41^{a}	0.04
Crude fiber (%)	3.19 ± 0.01^{b}	3.23 ± 0.01^{b}	3.52 ± 0.02^{a}	0.03
Calcium (%)	1.39 ± 0.02	1.42 ± 0.02	1.44 ± 0.01	0.08
Phosphorus (%)	0.66 ± 0.01	0.67 ± 0.01	0.67 ± 0.01	0.09
Methionine (%)	0.43 ± 0.02	0.43 ± 0.02	0.44 ± 0.01	0.52
Lysine (%)	1.02 ± 0.02	1.02 ± 0.03	1.03 ± 0.03	0.72
ME (kcal/kg)	3,013.03 ± 7.56^{c}	3,051.06 ± 8.90^{b}	3,085.03 ± 8.47^{a}	0.04

Note: ^{a,b,c} Means within the same row with differemt superscript differ (P < 0.05)

The performance characteristics (weeks 1–3) of broiler chicken fed varying levels of dietary waterleaf (*T. triangulare)* are shown in Table 4. All parameters were statistically different (P < 0.05) except for the initial weight and FCR. The highest (590.86 ± 3.44 g) weight gain was obtained from birds fed diet T1, and the least (563.31 ± 0.63 g) value was recorded from birds fed diet T2. The final weight gain, daily weight gain, and feed intake had the highest values from birds fed diet T1, while the best (1.64 ± 0.01) FCR was obtained from birds fed diet T3.

These findings suggest that the addition of waterleaf in broiler chicken diets at the starter phase does not have a notable effect on improving growth and feed utilization. At the end of the starter phase, final weight gain, daily weight gain, and feed intake were highest in birds fed diet T1, which suggests that the birds at this early stage of life might not have the capacity to utilize waterleaf maximally as a result of their underdeveloped digestive system. This was similar to the report of Olafadehan *et al*. (2020), who fed broiler chicken Rolfe leaf. The suboptimal growth observed in the young broiler chickens may be linked to inefficient nutrient utilization in the waterleaf, possibly due to certain nutrients not readily assimilated by the chicks. The FCR showed a noteworthy improvement, with birds on diet T3 achieving the most favorable FCR of 1.64 ± 0.01. However, it was statistically the same compared to 1.65 ± 0.01 in birds fed 0 and 5 g/kg of waterleaf. The findings of this study align with the observations made by Etela *et al*. (2007), who also noted that chickens placed on diets incorporated with waterleaf exhibited superior performance, particularly in terms of achieving a more favorable FCR when compared to other groups.

Table 4 Performance characteristics (weeks 1–3) of broiler chicken fed varying levels of waterleaf

Parameters	T1 (control)	T2 (5 g/kg)	T3 (10 g/kg)	P-value
Initial weight (g)	39.59 ± 0.01	39.62 ± 0.11	39.56 ± 0.09	0.884
Final weight (g)	630.45 ± 7.68^{a}	602.93 ± 1.46^{c}	614.48 ± 4.71^{b}	0.002
Weight gain (g)	590.86 ± 3.44^{a}	563.31 ± 0.63^{c}	574.92 ± 2.07^{b}	0.001
Daily weight gain (g/day)	28.14 ± 0.16^{a}	26.83 ± 0.03^{c}	27.38 ± 0.10^{b}	0.001
Total feed intake (g)	973.34 ± 11.10^{a}	929.22 ± 4.42^{b}	941.25 ± 3.13^{b}	0.003
Daily feed intake (g/day)	46.35 ± 0.53^{a}	44.25 ± 0.21^{b}	44.82 ± 0.15^{b}	0.003
Feed conversion ratio	1.65 ± 0.01	1.65 ± 0.01	1.64 ± 0.01	0.617

Note: ^{a,b,c} Means within the same row with differemt superscript differ (P < 0.05)

The effect of waterleaf addition on the total performance (weeks 1–6) of broiler birds is shown in Table 5. Body weight gain, final weight, daily weight, and FCR were observed to improve significantly (P < 0.05) with the inclusion of waterleaf in the broiler's diet. The diet containing 10 g/kg of waterleaf (T3) had the highest total feed intake (2,451.58 ± 7.89 g; Figure 1A), weight gain (1,451.18 ± 3.31 g; Figure 1B), while diet T2 recorded the least FCR (1.67 ± 0.02; Figure 1C) as compared to other treatments.

Table 5 Performance characteristics (weeks 1–6) of broiler chicken fed varying levels of waterleaf

Parameters	T1 (control)	T2 (5 g/kg)	T3 (10 g/kg)	P-value
Initial weight (g)	39.59 ± 0.01	39.62 ± 0.11	39.56 ± 0.09	0.884
Final weight (g)	1,457.68 ± 3.11^{b}	1,482.86 ± 5.99^{a}	1,490.74 ± 3.32^{a}	0.001
Weight gain (g)	1,418.09 ± 3.11^{b}	1,443.24 ± 5.93^{a}	1,451.18 ± 3.31^{a}	0.001
Daily weight gain (g/day)	33.76 ± 0.07^{b}	34.36 ± 0.14^{a}	34.55 ± 0.08^{a}	0.001
Total feed intake (g)	2,426.89 ± 10.04	2,406.73 ± 23.41	2,451.58 ± 7.89	0.162
Daily feed intake (g/day)	57.78 ± 0.24	57.30 ± 0.56	58.37 ± 0.19	0.162
Feed conversion ratio	1.71 ± 0.01^{a}	1.67 ± 0.02^{b}	1.69 ± 0.01^{ab}	0.004

Note: ^{a,b} Means within the same row with differemt superscript differ ($P < 0.05$)

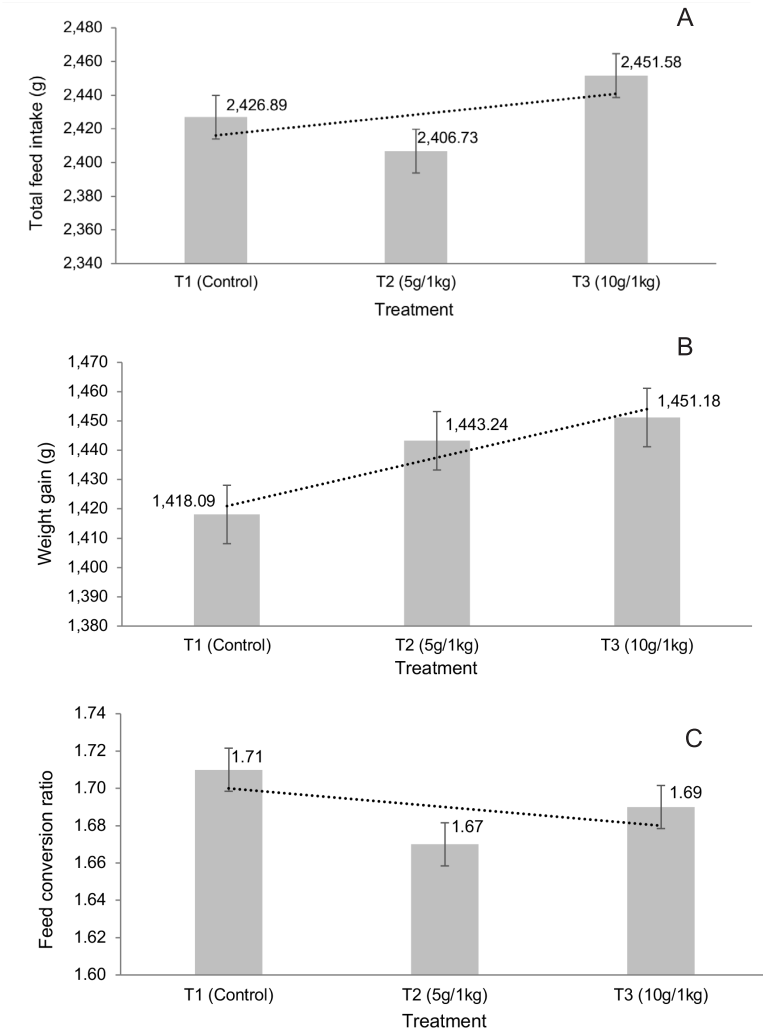

Figure 1 Total feed intake (A), total weight gain (B), and feed conversion ratyion of of broiler fed varying levels of dietary waterleaf

This increase in weight gain can be attributed to better digestibility and nutrients present in this enticing leaf, which boosts growth efficiency, as previously reported by Nworgu *et al*. (2014), Sanda and Oyinane (2015), and Ekine *et al*. (2020). The values reported in this study for final weight and weight gain from weeks 1–6 were lower than the values reported by Ekine *et al*. (2020) when broiler chickens were fed different levels of dietary waterleaf but can be compared with the value reported by El-Tazi (2014) as this variation might be attributed to differences in breed, age, nutrition and other factors during the feeding trial. This outcome could potentially be linked to the better content of crude fiber in the diets, which tends to support better digestion and absorption of nutrients, as suggested by Onu and Aniebo (2011). The reduced weight gain observed in the birds fed with the control diet could be attributed to the absence of waterleaf in the diet, which resulted in reduced crude protein, fiber, and ME in the diet as compared to other diets, pointing to the fact that waterleaf has the potential to improve the nutrient value of feed and contribute to the growth rate of the birds. This finding supports the thought that waterleaf has the potential to improve protein quality, enhance the digestion process, and can be used as an effective supplement in broiler feed to improve their feed efficiency, as noted by Nworgu *et al*. (2015). Incorporation of waterleaf into the diets led to notable improvements in weight gain, final weight gain, and FCR from weeks 1–6, consistent with the findings of Nworgu *et al*. (2007).

CONCLUSIONS

In broiler production systems, farmers may consider the use of waterleaf as it proves to be a valuable reservoir of quality nutrients capable of improving feed intake and utilization, weight gain, and lowering the FCR. However, for optimum performance and considering the best FCR obtained from this study, it is therefore recommended that broiler farmers should include 5 g/kg of waterleaf in the diet of their broiler chickens to lower the FCR and for better performance of birds.

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