Food Research 6 (5) : 256 - 265 (October 2022)
Journal homepage: https://www.myfoodresearch.com

FOOD RESEARCH

FULL PAPER

Performance and blood profile of Noiler chickens fed diets containing graded levels of *Parkia biglobosa* leaf meal

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Article history:
Received: 1 July 2021
Received in revised form: 16 August 2021
Accepted: 29 November 2021
Available Online: 8 October 2022

Keywords:
Noiler chick,
Parkia biglobosa,
Performance,
Blood profile,
Agro-industrial residues

DOI:
https://doi.org/10.26656/fr.2017.6(5).475

Abstract

A study was undertaken for 56 days to determine the growth performance and blood profile of Noiler chicks fed diets with different levels of *Parkia biglobosa* leaf meal (PBLM) as a partial replacement of soya bean meal (SBM). A total of ninety-six unsexed Noiler day-old chicks were allotted into four dietary groups of 24 chicks with three replicates of eight per group based on weight equalization using a Completely Randomized experimental design. Group 1 containing 0% PBLM (control), groups 2 to 4 had SBM replaced at 5% 10% and 15% in their diets respectively. Data were collected on feed intake, weight gain, feed conversion ratio, feed cost reduction, haematological and serum indices. Results showed that PBLM had an effect ($p<0.05$) on the growth performance, feed cost reduction, and blood profiles. There was better performance up to 10% PBLM but the performance declined significantly at a higher inclusion level. There was an improvement in the haematological parameters up to 10% PBLM inclusion. The AST and ALP increased significantly with the increased level of PBLM while the total protein, albumin, cholesterol and glucose reduced with the increased level of PBLM: nevertheless, there were no influences ($P > 0.05$) on the protein and albumin values. The result of this study, therefore, suggested that soya bean meal in Noiler chick diets can be replaced by up to 10% of PBLM without harmful effects on the growth and blood profile.

1. Introduction

The poultry industry is the major competitor with human feed resources leading to an escalated cost of production (Chandrasekaran, 2014). The current trend in animal nutrition is having readily available alternatives, less competitive, low production cost, and poultry health -friendly (Iji *et al*., 2017; Tanimo *et al*., 2020).

WorldoMeter (2020) estimated Nigeria population to be 210,568,792 with an annual growth rate of 2.58%, therefore, there is a need to reduce the generation cycle of poultry production with the aim of achieving the animal protein requirement of the population. There is also a need for low-cost feed input and breed with high meat and egg production.

Noiler is a dual-purpose chicken breed developed in Nigeria by Amo Farm Sieberer Hatchery. This breed is easier to raise and manage, high survival rate has less susceptibility to diseases, is rugged in nature and is resistant to harsh weather conditions. They are affordable chicken breeds and cheaper to maintain. They can scavenge for food and water just like indigenous breeds.

Leaf meals have been recorded to have ample protein, vitamins and antioxidants (Rama Rao *et al*., 2019). The incorporation will reduce the dependency on expensive conventional protein sources and bring down the cost of production (Sugiharto *et al*., 2019). The presence of antioxidants and bioactive substances may improve the well-being and vitality of the chickens (Sugiharto *et al*., 2019). As reported by Sow *et al*. (2010), consumers have higher preference for meat from chickens fed with leaf meal because of the better organoleptic/sensory indices. Faustman *et al.* (2010) also reported that leaf meal incorporation in chicken diets improves the antioxidative status of the meat. Different species of green and leguminous vegetables are propagated over around 71.2 million hectares of arable land in Nigeria, and they can be used as a substitute for conventional protein resources (Essiet and Solomon, 2013). According to Ndelekwute *et al.* (2018) and Sugiharto *et al*. (2019), the major limiting factors to using leaf meals in poultry production are elevated fibre

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eISSN: 2550-2166
Published by Rynnye Lyan Resources

content, anti-nutritive factors and poor palatability which can be resolved by the right processing methods (Martens *et al*., 2012). Blood profile is an excellent indicator of nutritional and physiological status (Peres *et al*., 2014; Etim *et al*., 2014), hence it should be considered when adding additional feed resources to livestock diets.

Parkia biglobosa tree is a deciduous plant in the Fabaceae family well distributed in the Tropics (Heymann *et al*., 2012). The tree is important for its fermentable seeds (Orwa *et al*., 2010), however, every part of the tree is important to humans, especially for medicinal and nutritional purposes (Di Cagno *et al*., 2016; Okpara and Ugwuanyi, 2017). The nutritional components of the *P. biglobosa* crude are protein (CP) 13.15 – 18.40%, ether extract (EE) 1.90 – 8.11%, ash 8.20 – 13.60%, crude fibre (CF) 17.97 – 18.90%, calcium (Ca) 0.34 – 0.35%, phosphorus (P) 0.35%, magnesium (Mg) 0.18- 0.35%, potassium (K) 0.12 - 0.82%, iron (Fe) 16.13 – 26.33ppm, zinc (Zn)5.30 – 66.75ppm, manganese (Mn)17.98pm, copper (Cu) 2.26ppm and sodium (Na) 21.45ppm (Soetan *et al*., 2014; Alalade *et al*., 2016; Afolayan *et al*., 2020).

There is a paucity of documented work on the use of *P. biglobosa* leaf meal in broiler diets. This study aimed at evaluating the effect of feeding *P. biglobosa* leaf on the performance and blood profile of Noiler chickens thereby increasing the available knowledge on both the *P. biglobosa* leaf and the Noiler birds.

2. Materials and methods

2.1 Location of research

The feed trial was executed at Landmark University Teaching and Research farms, while the laboratory analyses were done at the Animal Science Nutrition Laboratory, Landmark University, Omu Aran, Kwara State, Nigeria for a period of 8 weeks.

2.2 Sources of ingredients

The *P. biglobosa* leaves were collected from Landmark University Teaching and Research Farm while other feed ingredients were procured from Omu Aran town.

2.2.1 Parkia biglobosa leaf meal preparation

To avoid losing some critical nutrients, *P. biglobosa* leaves were harvested and air-dried to equal weight with the greenish colour intact. The air-dried leaves were ground (3 mm sieve size) and stored in sealed plastic buckets until they were added to the feed.

2.3 Experimental design and animal management

A total of ninety-six unsexed Noiler day-old chicks were sourced from Amo farm, Awe, Oyo State, Nigeria. The chicks were randomly assigned to one of four nutritional treatments based on their weight, with each treatment group consisting of three replicates of eight chicks in a completely randomized experimental design. Diet 1 had 0% *P. biglobosa* leaf inclusion (control) while diets 2, 3 and 4 had the inclusion of the test ingredient at graded levels of 5%, 10% and 15% respectively. The chicks were grown in a traditional open-sided deep litter house that was kept clean. Throughout the experiment, the animals were fed and watered as needed, and their medication and vaccination schedules were adhered to. Standard ethical and animal welfare guidelines were strictly followed throughout the project. The birds had full access to the experimental foods and clean water during the feeding study. The diets (Table 1) were formulated to contain 21.19 – 23.48% crude protein and 2825 - 2846 kcal/kg metabolizable energy.

Table 1. Experimental diets composition (on dry matter basis)

Ingredients (%)	Inclusion levels			
	Diet 1 (0%)	Diet 2 (5%)	Diet 3 (10%)	Diet 4 (15%)
Maize	56.00	56.00	56.00	56.00
Soya bean meal	38.00	36.10	34.20	32.30
Parkia biglobosa	0.00	1.90	3.80	5.70
Fish meal	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00
Premix	0.30	0.30	0.30	0.30
Lycine	0.10	0.10	0.10	0.10
Methonine	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30
Toxin binder	0.10	0.10	0.10	0.10
Calculated analysis				
Crude protein %	23.48	22.97	22.43	21.99
Metabolizable energy (kcal/kg)	2825	2832	2839	2846

2.4 Response criteria

2.4.1 Proximate components of Parkia biglobosa leaf

The dry matter, moisture, crude protein (CP), crude fibre (CF), ether extract (EE), and ash of the *P. biglobosa* leaf were determined using AOAC (2014). Briefly, CP was determined by the Kjeldahl nitrogen (N) method and the CP was calculated with the formula:

$$\%\ CP = \%\ N \times 6.25$$

EE was determined with the Soxhlet method. 1g of the sample is carefully wrapped in Whatman filter paper and inserted into the Soxhlet tube that was 75% filled with petroleum ether for semi-continuous solvent extraction. This was boiled until a clear solution was observed. Ether extract content was measured by the weight loss of the sample. For ash determination, 1 g of sample was weighed into the dried weighed crucibles. The crucible containing the sample was then transferred into the muffle furnace for 4 hrs at 550°C. Ash content was calculated thus:

$$\%\ Ash = \frac{(\text{Weight of empty crucible} + \text{ash}) - (\text{Weight of empty crucibles})}{\text{Weight of the Sample}} \times 100$$

2.4.2 Performance characteristics

Feed intake (daily) and weight gain (weekly) were taken which were then used to calculate the feed conversion ratio (FCR) as shown below:

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

2.4.3 Haematological and biochemical parameters

Two sets of blood samples were obtained from the brachial veins at the end of the feed trial. Blood for haematological indices was drawn from each replicate using aseptic syringes and needles and placed in EDTA-coated bottles before being processed on an automated Mindray BC 2800. The erythrocyte indices (mean corpuscular haemoglobin, mean corpuscular volume, and mean corpuscular haemoglobin concentration) were calculated using the packed cell volume (PCV), haemoglobin (Hb), and red blood count (RBC).

The MCV shows the mean red cell volume measured in cubic micron (μ^3).

$$MCV = \frac{PCV}{RBC} \times 10$$

MCH shows the amount of Hb per cell expressed in picogram (pg).

$$MCH = \frac{Hb\ (g/100\ mL)}{RBC} \times 100$$

MCHC is the concentration of Hb in the RBC juxtaposed with the concentration of Hb in 100 mL of whole blood expressed in percentage.

$$MCHC = \frac{Hb\ (g/100\ mL)}{PCV} \times 100$$

For the biochemical indices, the second set of blood was collected into plain sample bottles with the aid of the colourimetric method from the specific reagent kits with BIOBASE BK-F96PRO spectrophotometer.

2.4.4 Economy of production

The feed cost reduction of replacing the SBM with PBLM was calculated. Other expenses on drugs, vaccines and litter were common for all the treatments.

2.5 Statistical analysis

All the generated data were analyzed via One-Way Analysis of Variance (ANOVA) using SPSS version 13 edition (SPSS, 2006). The means were separated using Duncan Multiple Range Test.

3. Results and discussion

3.1 Proximate components of Parkia biglobosa leaf meal

The proximate components of PBLM (Table 2) demonstrate that the CP, CF, EE, and ash values obtained in this investigation were lower than those obtained by Soetan *et al.* (2014) but higher than those reported by Alalade *et al.* (2016). These differences may be due to the age and variety of the leaves, geographical location, climate and methodologies and instruments used. In comparison to some other leaf meals that have been successfully used in the poultry industry, the PBLM shows very good nutritive potential. The CP from the study at hand is higher than those of the moringa and scent leaves (Mahima *et al.*, 2014; Okunlola *et al.*, 2019). However, the CP in this study is lower than those of centrosema, bitter leaf and syndrenella leaf (Nworgu and Fasogbon, 2007; Okunlola *et al.*, 2019; Suwignyo *et al.*, 2020). For the EE, the value in PBLM is higher than those of centrosema, moringa and scent leaves (Nworgu and Fasogbon, 2007; Mahima *et al.*, 2014; Okunlola *et al.*, 2019) but lower than those of bitter leaf (Okunlola *et al.*, 2019) and syndrenella (Suwignyo *et al.*, 2020). The ash value for PBLM in this study is higher than the stated values for syndrenella, bitter leaf, centrosema and moringa leaves. This connotes that PBLM has the potential to be used in poultry feed.

Table 2. Proximate composition of *P. biglobosa* leaf

Parameters	Values (%)
Moisture	17.58
Dry matter	82.42
Crude protein (CP)	17.88
Ether extract (EE)	5.62
Crude fibre (CF)	17.15
Ash	11.90

eISSN: 2550-2166

3.2 Growth performance

As indicated in Table 3, the inclusion of *P. biglobosa* influenced (P < 0.05) the growth performance traits with the exemption of feed conversion ratio. This is similar to Ani *et al.* (2013) who included *Gongronema latifolium* leaf in the broiler chickens' diet. Higher feed intake was observed as the level of the test ingredient increased. It may be due to the reduction of CP level as the test ingredient increased. This finding backs up the findings of Kakengi *et al*. (2007), who found increased feed consumption in egg-typed chickens fed diets containing up to 20% Moringa leaf. Broilers fed diets containing up to 10% *Ipomoea asarifolia* leaf consumed more feed (Ekenyem and Madubuike (2006). However, the findings of this study differ from those of Tokofai *et al*. (2021), who found a decrease in feed intake when *Vernonia amygdalina* leaf meal was fed to broiler chicks, which he attributed to the bitterness of the leaf meal.

The weight gain increased as the *P. biglobosa* increased in the diet up to 10% inclusion level then drop at the 15% inclusion level. The highest weight gain (14.57 g/bird/day) and the best FCR (2.24) were observed at the 10% inclusion level. Tokofai *et al*. (2021) found that including *Vernonia amygdalina* leaf meal improved weight gain and FCR at all levels. Oghenebrorhie and Oghenesuvwe (2016) discovered a similar trend in broiler hens fed moringa leaf diet. However, the former and latter authors' inclusion rates of 1–3% and 1–8%, respectively, are lower than those employed in the current study (5 -15%). The drastic drop in the weight gain at 15% of *P. biglobosa* leaf might be a result of the high level of an anti-nutritional factor at that level of inclusion (Erdaw and Beyene, 2019). Ramah *et al*. (2020) reported that high tannin group chickens had decreased daily gain, final body weight, daily feed intake and relative weights of lymphoid organs. It could also be due to the higher fibre content of the diets at 15% PBLM which might have impaired nutrient digestibility and absorption (Lattimer and Haub, 2010). This result showed that inclusion levels up to 10% of PBLM, resulted in better performance of the chicken while the growth performance was adversely affected at a higher level.

3.3 Haematological Indices

One of the most effective ways to evaluate the health status of animals is through haematological indices (Oloruntola *et al*., 2015). A haematological analysis is necessary to assess the suitability and quality of the novel non-conventional feed ingredients for the animal before they are incorporated into the feed (Attia *et al*., 2018).

The result of haematological parameters (Table 4) shows that the indices were affected (P < 0.05) by the inclusion of PBLM in the feed while the MCV and MCHC were not affected (P > 0.05) by *P. biglobosa* leave*s* in the feed.

The highest values for most of the haematological indices were observed at 10% PBLM inclusion, while the highest values for all the erythrocytes indices were observed at 5% PBLM inclusion. The generally higher values of haematological indices observed in PBLM chickens are indicative of better utilization, absorption and assimilation of the nutrients into the circulatory system of the chickens (Onu, 2010). The above observation is similar to that of Basit *et al*. (2020). All the values obtained for MCV and MCHC were statistically similar irrespective of the inclusion level of the PBLM in the diets. At 10% PBLM inclusion, the highest values for most haematological indices were recorded, while at 5% PBLM inclusion, the highest values for all erythrocyte indices were observed. The values for all the haematological and erythrocyte indices obtained in the study at hand fell within the acceptable levels for healthy chickens as reported by Bounous and Stedman (2000) and Okeudo *et al*. (2003)

Previous workers had earlier reported that incorporating leaf meals into poultry diets enhances the haematological indices of the birds (Abbas *et al*., 2018;

Table 1. Experimental diets composition (on dry matter basis)

Parameters	Inclusion levels				
	Diet 1 (0%)	Diet 2 (5%)	Diet 3 (10%)	Diet 4 (15%)	SEM
Initial live weight (g/bird)	45.08	45.06	45.07	45.08	2.08
Final live weights (g/bird)	851.48^{a}	857.06^{a}	860.99^{a}	841.96^{ab}	4.85
Daily weight gains (g/bird/day)	14.40^{ab}	14.50^{a}	14.57^{a}	14.23^{b}	0.51
Total feed Intake	1815.52^{ab}	1826.72^{b}	1829.52^{b}	1848.00^{a}	2.35
Feed intake (g/bird/day)	32.42^{b}	32.62^{ab}	32.67^{ab}	33.00^{a}	0.53
Feed conversion ratio	2.25	2.25	2.24	2.32	0.21
Cost of feed/kg (₦)	152.0^{a}	147.8^{b}	143.6^{c}	139.5^{d}	2.02
% Mortality	8.33	0.00	8.33	4.16	0.40

Values are presented as mean. Values with different superscripts within the same row are significantly different (P < 0.05). SEM: standard error of mean.

Table 4. Haematology indices of Noiler chickens fed diets containing graded level of *Parkia biglobosa* leaves

Parameters	Inclusion levels				
	Diet 1 (0%)	Diet 2 (5%)	Diet 3 (10%)	Diet 4 (15%)	SEM (±)
RBC($\times10^{12}$/l)	2.23±0.07[a]	2.28±0.09[a]	2.42±0.05[a]	1.41±0.12[b]	0.08
HB (g/dl)	7.67±0.12[b]	8.20±0.06[a]	8.33±0.13[a]	5.13±0.15[c]	0.11
PCV (%	28.40±1.10[a]	29.70±0.25[a]	30.57±0.41[a]	18.37±0.99[b]	0.69
MCV (fl)	127.44±4.64	133.77±2.45	125.94±3.88	138.63±9.99	4.24
MCH (pg)	35.04±1.09[b]	36.80±0.61[ab]	34.43±1.19[b]	38.63±0.60[a]	0.87
MCHC (g/dl)	27.07±0.96	27.64±0.31	27.27±0.51	28.65±1.65	0.86
WBC ($\times10^9$/l)	200.40±1.48[b]	198.47±1.74[b]	206.40±1.30[a]	142.23±1.07[c]	1.40

Values are presented as mean±SD. Values with different superscripts within the same row are significantly different (P < 0.05). RBC: Red blood cells, HB: Haemoglobin, PCV: Packed Cell volume, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular haemoglobin concentration, WBC: White blood cells.

Basit *et al*., 2020), however, Odetola *et al*. (2012) and Tijani *et al*. (2015) observed a reduction in the haematological indices of chickens fed moringa containing diets. The results of this study tend to suggest that *P. biglobosa* leaf possesses such "blood tonic effects" and supports haematopoiesis which may be due to its high content of minerals and vitamins (Olumide *et al*., 2018). Olugbemi *et al.* (2010), reported that RBC is responsible for the transportation of CO_2 and O_2 in the blood and also manufactures Hb. Therefore, higher values in the birds fed PBLM indicate a greater potential for this function and a better state of health. PBLM had no effect (P > 0.05) on PCV values between the control diets and those fed diets 2 and 3 (5% and 10% PBLM groups), although the values generally increased numerically with the increased PBLM level. This may indicate the absence of toxic factors in the PBLM as haematocrit (PCV) is an index of toxicity (Onu and Aniebo, 2011).

The WBC count in birds fed PBLM (with the exception of the 5% PBLM inclusion level) was equivalent to the WBC count in birds fed a control diet. The inclusion of *P. biglobosa* leaves in this study may thus indicate that the animal's health and ability to combat illness were not jeopardized (Oloruntola *et al*., 2018). Previous workers have attributed the variations in avian haematological blood values to the physiological condition of the birds (Islam *et al*., 2004; Attia *et al*., 2015).

3.4 Serum biochemical indices

From the result of biochemical indices shown in Table 5, the PBLM in the diet affected (P<0.05) the AST and ALP, glucose and serum cholesterol while the total protein and serum albumin were not (P>0.05) affected. There is no particular trend in the effect of the test ingredients on the serum biochemical indices analyzed. The liver possesses enzymes to carry out its functions of detoxification and elimination of harmful substances from the body. These enzymes (ALT, ALP and AST) are important in the determination of the proper functioning of the liver (Ambrosy *et al*., 2015). Pathological and or impaired cells or tissues may lead to the elevated concentration of liver enzymes (Giannini *et al*., 2005). Hepatopathies, according to Giannini *et al*. (2005), can have biochemical manifestations such as high AST and ALT levels, as well as moderate abnormalities in -glutamyl transpeptidase and ALP levels.

ALP is a homodimeric enzyme that participates in bile production while AST concentration gives the picture of the hepatocyte integrity. Generally, the inclusion of the PBLM tends to increase the AST and ALP, though the lowest values were observed at 15% PBLM inclusion. This correlates with the report of Basit *et al*. (2020). The values of AST and ALP obtained in

Table 5. Biochemical indices of Noiler birds fed *Parkia biglobosa* leaf meal

Parameters	Inclusion levels			
	Diet 1 (0%)	Diet 2 (5%)	Diet 3 (10%)	Diet 4 (15%)
AST (u/l)	56.75±1.63[ab]	60.00±2.89[ab]	66.67±0.4.41[a]	50.00±2.89[b]
ALP (u/l)	365.91±4.52[c]	900.73±2.25[a]	595.40±1.85[b]	480.87±3.51[c]
TP (g/dl)	4.25±0.07	4.05±0.17	4.18±0.10	4.01±0.10
ALB (g/dl)	3.55±0.23	3.26±0.15	3.11±0.07	3.42±0.19
Glucose(mmol/l)	177.90±1.89[a]	156.72±1.32[ab]	159.35±0.67[ab]	153.47±2.19[b]
CHOL	95.37±2.31[a]	95.13±0.81[a]	91.23±1.56[b]	79.54±3.67[c]

Values are presented as mean±SD. Values with different superscripts within the same row are significantly different (P < 0.05). CHOL: Cholesterol, AST: Aspartate aminotransferase, ALB: Albumin, T.BIL: Total bilirubin, ALP: Alkaline phosphatase, TP: Total protein the current study are lower than the limit obtained by Meluzzi *et al*. (1992) but higher than those observed by Tijani *et al*. (2015) who observed a reduction in the AST of birds fed diets containing moringa leaf meal. However, the values of ALP in this present study were similar to those of Odunitan-Wayas *et al*. (2018).

Dietary protein has been shown to have an impact on total protein and its components (Obikaonu *et al*., 2012). The test ingredient in this study did not affect ($P > 0.5$) the total protein and albumin, but generally, the values reduced as PBLM increased in the diets. The reduction in the protein and its fraction could be a result of the anti-nutrients in the test ingredient (Odetola *et al*., 2012). The total protein and serum albumin, on the other hand, were within normal levels for hens (Meluzzi *et al*., 1992). The observations in this present study for protein and serum albumin were similar to observations by Obikaonu *et al*. (2012) and Tijani *et al*. (2015) who incorporated neem and moringa leaves respectively into broiler diets. Basit *et al*. (2020) and Tokofai *et al.* (2021), who showed that broiler chicken fed *Persicaia odorata* leaf meal had greater total protein and serum albumin levels, disagree with the current finding. The factor responsible for these differences could be the different types of leaves used in the studies.

The inclusion of PBLM has an irregular effect on serum cholesterol, but it is generally reduced ($P < 0.05$) as PBLM increases. This supports the findings of Alnidawi *et al*. (2017) and Abbas *et al.* (2018), who found that increasing moringa levels in poultry diets lowers total cholesterol. The efficacy of bitter leaf meal to lower cholesterol was reported by Owen and Amakiri (2011) and Tokofai *et al.* (2021). The test ingredient may increase the activity of the enzyme catalase, which is required for cholesterol esterification, resulting in lower serum cholesterol in chicken given PBLM.

A high level of cholesterol is risky and a predisposing factor to cardiovascular disease. The values of serum cholesterol in this study fall within 87-192 mg/m reported for chickens (Meluzzi *et al*., 1992). This also means that the inclusion of PBLM inclusion in Noiler diets will not impair the reproductive, adrenal and nervous tissues. Apart from the fact that cholesterol is a major component of the nervous tissue, its role as a vital constituent of adrenal hormones and pituitary hormones cannot be overemphasized.

Similar to the observation in the cholesterol level, PBLM in the Noiler chicken diets reduced the glucose level. This contradicts Obikaonu *et al*. (2012)'s findings that neem leaf meal induces hyperglycemia, but it agrees with Basit *et al*. (2020)'s findings that broiler hens fed *Moringa oleifera* leaf meal has higher levels of AST, ALP, glucose, and cholesterol.

3.5 Economy of PBLM inclusion in the diets

The result of the evaluation of the economy of production, specifically the feed cost reduction is shown in Figure 1. As the number of test ingredients increased, the cost of making a kilogramme of feed decreased. This is consistent with past research that has used alternative feed additives. (Nworgu *et al.,* 2015). Also, an increase in the level of PBLM in the diets decreased the feed cost per kilogram of weight gain. Similar to the trend in the growth performance, feed cost reduction per kg weight gain was highest at 10% PBLM. The fall in the feed cost reduction per kg weight gain at 15% level could be due to higher feed intake at this level which consequently erased the benefit of the low cost of feed per kg (Nworgu *et al*., 2015).

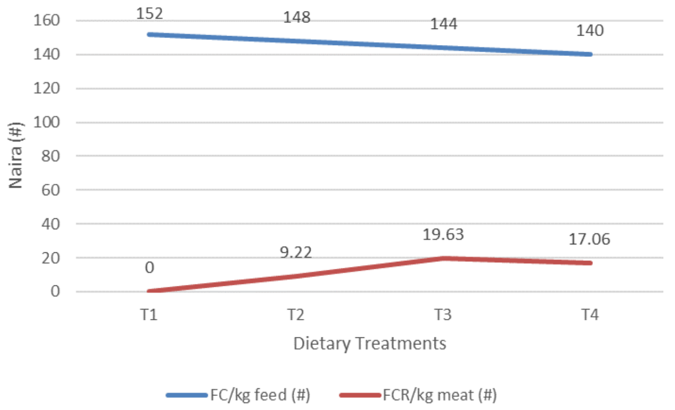

Figure 1. Economy of incorporating *P. biglobosa* leaf in Noiler chicken's diets
Legend:
FC/kg feed (#) = cost of one kilogramme of feed in Naira (#);
FCR/kg meat (#) = feed cost reduction per kilogramme weight gain in Naira (#)

4. Conclusion

From this study, *P. biglobosa* leaf meal can be included in Noiler chicks' diets up to 10% for improved growth performance, feed conversion ratio, and feed cost reduction without hampering the haematological and serum biochemistry of the chicks. It is recommended that further study should be carried out on the fermentation process to alleviate the effect of anti-nutritive factors in the leaf.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

Indicate any source of funding or other contributors to the work in a single paragraph and kept at the minimum.

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