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ASSESSMENT OF *Parkia biglobosa* LEAF MEAL AS A PARTIAL REPLACEMENT FOR SOYBEAN MEAL IN BROILER CHICKEN DIETS

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Abstract
A six-week study was conducted to evaluate the potential of *Parkia biglobosa* leaf meal (PBLM) as a partial substitute for soybean meal in broiler chicken diets. A total of 120-day-old broiler chicks were allocated to four dietary treatments, each comprising 30 chicks, based on weight equalization. The study employed a completely randomized design with three replicates. Four diets were formulated, designated as diet 1 (0% PBLM - control), diet 2 (5% PBLM), diet 3 (10% PBLM), and diet 4 (15% PBLM). The growth performance parameters were significantly affected ($P < 0.05$) by the inclusion of PBLM, except for the feed conversion ratio, which remained unaffected. Across the treatment groups, body weight gain (from 903.40g to 112.83g) and feed intake (from 719.63g to 795.03g) decreased progressively. The haematological values did not differ significantly ($P > 0.05$) among the treatment groups, although numerically higher values were observed with increasing levels of PBLM in the diets. Liver function indicators were notably affected ($P < 0.05$) by the inclusion of leaf meal, showing improved values in chicks fed diets containing PBLM. With the exception of the 5% PBLM group, alkaline phosphatase (ALP) and alanine aminotransferase (ALT) levels progressively decreased with increasing levels of PBLM in the diets, while the opposite trend was observed in aspartate aminotransferase (AST) values. The study suggests that PBLM can serve as an alternative protein source in broiler chicken diets, particularly at a low level of inclusion (5%), without compromising the performance and health of the birds.
Keywords: Alternative feed resources; Antioxidants; Haematology, Performance, sustainability, serum-biochemistry.

INTRODUCTION

The persistent global challenge of hunger and food insecurity, surpassing the projected 30 percent mark for 2020, continues to escalate annually, particularly affecting low-income countries and children under five (WHO, 2022). Consequently, hunger stands as the leading global cause of mortality, making the UN's Sustainable Development Goal 2 (SDG 2) paramount in its aim to eradicate worldwide hunger by 2030. To enhance agricultural productivity, particularly in developing nations, SDG 2 emphasizes doubling the agricultural productivity and incomes of small-scale food producers, ensuring sustainable food production systems, implementing resilient agricultural practices, and advancing technology and gene banks for plants and livestock.

Broiler chicken production aligns well with the objectives of SDG 2, given its short production cycle, high turnover rate, and numerous health benefits associated with its meat. Promoting broiler production is crucial for achieving SDG 2, as it presents one of the swiftest means to address the global deficit in animal protein (Chiekezi et al., 2022).

However, the primary challenge in broiler chicken production lies in the high cost of feed, which accounts for approximately 70% of the total production cost. With a shortage of traditional feed sources, urgent research into non-traditional and alternative feed sources is imperative (Alshelmani et al., 2016; Singh, 2018). In this regard, agricultural by-products, residues, and leaves play a crucial role.

Various plant leaves and leafy vegetables have been studied and found to possess aromatic properties akin to antibiotic growth promoters, which positively influence the gut microbiota composition and intestinal morphology of chickens. Additionally, broilers require a small amount of fiber in their diets to maintain active gastrointestinal tracts (GIT) and gizzards (Jiménez-Moreno et al., 2010).

Parkia biglobosa, a multipurpose tree legume found across many African countries, offers significant potential as an alternative feed source. With fermentable seeds known as iru/dawadawa, *Parkia biglobosa* is highly valued as a condiment for soup. The tree's abundant foliage, often overlooked, holds immense nutritional value, containing multivitamins and abundant minerals beneficial to both livestock and humans (Alalade et al., 2016).

The seed of *P. biglobosa* has been advocated for broiler chickens up to 50% as a replacement for soyabean meal without causing any adverse effect on the performance and blood profile of the birds (Aderemi et al., 2017), while Ogundipe et al. (2017) and Kakagida et al. (2021) recommended 15%. Inclusion of 5% *P. biglobosa* leaf meal in feed was adjudged to be beneficial to noiler chickens (Animashahun et al., 2022), while Alagbe (2019) was of the opinion that inclusion of *P. biglobosa* leaf meal does not have influence ($P < 0.05$) the blood profile of broiler chickens.

The literature on the use of *P.biglobosa* leaf meal in the diets of monogastric animals are very scarce, therefore, this study assess and evaluate the inclusion of *P biglobosa* leaf in the diets of broiler chickens.

Materials and Methods

Experimental site and duration of the study

The experiment was conducted at the Poultry Unit of Landmark University Teaching and Research Farm in Omu-Aran, Kwara state, Nigeria for six weeks. The laboratory work was carried out in the Nutrition Laboratory of Animal Science Department of the University.

Sources and Procurement of Ingredients

Parkia biglobosa leaves were harvested from Landmark University's Teaching and Research Farm. The leaves were dried in the open air to ensure that the nutrients in the leaves were retained. The dried leaves were then grounded mechanically with electric blender to make *P. biglobosa* leaf meal (LBLM).Other feed ingredients were purchased from Offa, Kwara State, Nigeria.

Experimental birds, Management and Design

This study utilized 120 Ross day-old unsexed broiler chicks procured from a reputable farm. The chicks were allocated into four treatment groups, each with three replicates, employing a Completely Randomized design. Prior to commencing brooding, the lighting fixtures and

demarcations within the chicken house were appropriately installed. The housing facilities, feeding troughs, and water sources underwent thorough cleaning and sanitation procedures.
Throughout the six-week feeding trial, the chicks were provided ad libitum access to feed and portable water. The experimental diets were administered to the chicks from day one until the conclusion of the experiment. Additionally, the experimental birds received recommended vaccinations, and standard medication and management practices were implemented during the feeding study, adhering to established standards for animal care and welfare.

Experimental Diets

In this investigation, a two-phase feeding regimen was employed, wherein starter diets were administered to the birds during the initial four weeks, succeeded by two weeks of finisher diets. Across both phases, four distinct experimental diets were utilized. Diet 1 functioned as the control, containing *Parkia biglobosa* (*P. biglobosa*) leaf meal, while diets 2 to 4 integrated graded levels of *P. biglobosa* leaf meal, spanning concentrations of 5%, 10%, and 15% respectively.
The crude protein content of the diets ranged from 22.13% to 17.47% for the starter phase and from 18.82% to 14.1% for the finisher phase. Likewise, the calculated metabolizable energy ranged from 3137 kcal/kg to 3127 kcal/kg for the starter diets and from 3050 kcal/kg to 3039 kcal/kg for the finisher diets. The detailed compositions of the diets are outlined in Table 1 below.

Growth Performance Indices Determination

The birds were given a measured quantity of feed every day and on the following day the left over were removed and measured to evaluate the feed intake by the experimental birds.
Weight gain was determined on weekly basis.

Weekly weight gain (g) = Final weight – Initial weight

$$\text{Feed conversion ratio} = \frac{\textbf{Quantity of feed consumed}}{\textbf{Weight gain}}$$

Haematological and Serum-biochemical Indices Determination

At the end of the trial, one bird was chosen at random from each treatment. Two sets of blood samples were drawn from the brachial vein of each bird, and phlebotomy was carried out after proper restrain. The vein was punctured at approximately 10–20° angle using a 25-gauge, 1” needle, and blood withdrawn slowly. In the first set, the blood was collected into EDTA-laden bottles for haematological analysis using an automated Mindray BC 2800.
The second set of blood for the serum biochemical indices (such as glucose, cholesterol, total bilirubin, albumin, urea, creatine, total protein, alkaline phosphatase (ALP), alanine amino transaminase (ALT) and aspartate aminotransferase (AST) was collected into plain sample bottles and then the blood was tested using the colorimetric method with BIOBASE BK-F96PRO spectrophotometer.

Data Analysis

The present study used a Completely Randomized Design (CRD), and the results were subjected to one-way Analysis of Variance (ANOVA). The Duncan Multiple Range Test, which is included in the IBM SPSS Statistics 20 software, was used to find significant differences between treatment means.

Table 1: Diets compositions of broiler chickens

Ingredients (%)	Inclusion levels of *Parkia biglobosa* leaf meal							
	Starter				Finisher			
	0%	5%	10%	15%	0%	5%	10%	15%
Maize	58.00	58.00	58.00	58.00	58.00	58.00	58.00	58.00
Maize Offal	0.00	0.00	0.00	0.00	9.00	9.00	9.00	9.00
SBM	38.00	36.10	34.20	32.30	29.00	28.05	26.10	24.65
PBLM	0.00	1.90	3.80	5.70	0.00	1.45	2.90	4.35
Fish meal	2.00	2.00	2.00	2.00	0.80	0.80	0.80	0.80
Bone meal	0.50	0.50	0.50	0.50	1.00	1.00	1.00	1.00
Premix	0.30	0.30	0.30	0.30	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.10	0.10	0.10	0.10
Methionine	0.25	0.25	0.25	0.25	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Toxin binder	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Calculated analysis								
CP (%)	22.13	21.04	19.85	18.66	18.82	17.63	16.44	15.25
ME (kcal/kg)	22.13	21.04	19.85	18.66	3050	3047	3045	3042

PBLM = Parkia biglobosa leaf meal; CP = Crude protein; ME = Metabolizable energy

Results and Discussion

Growth Performance

The growth performance indicators, except for the feed conversion ratio, were significantly influenced ($P < 0.05$) by the incorporation of PBLM into the diets. As the level of PBLM increased in the diets, the values tended to decrease. This outcome mirrors the findings of Akintomide et al. (2021), who observed a progressive decline in growth performance values with the inclusion of sweet potato leaf meal in broiler chicken diets at levels ranging from 0% to 15%. Similarly, Oloruntola (2018) noted the highest growth performance among experimental birds fed the control diet compared to those fed Gliricidia leaf meal. The diminished growth performance observed in chickens fed PBLM could stem from the lower energy content associated with leafy and vegetable meals (Ebabhi & Adebayo, 2022).

Furthermore, the reduction in feed intake with higher levels of PBLM in the broiler diet in our study aligns with the findings of Gudiso et al. (2019), who reported a decrease in feed intake with increasing levels of *Acacia angustissima* leaf meal in broiler diets. Smith et al. (2003) proposed that decreased feed intake could be attributed to lower palatability and aversive post-ingestive feedback due to nutritional insufficiency, such as tannin-protein complexes, leading to reduced protein availability. Additionally, the fiber content in PBLM may have contributed to reduced feed intake by causing stomach bulkiness due to decreased feed digestibility and intestinal impaction, ultimately resulting in poor broiler growth performance (Gadzirayi et al., 2012).

Interestingly, our study indicated that the inclusion of PBLM in the diets did not significantly affect the feed conversion ratio (P > 0.05). This finding is consistent with the results obtained by Onunkwo & George (2015) when *Moringa Oleifera* leaf meal was incorporated into broiler diets.

Table 2: Performance indices of broiler chickens fed diets containing Parkia biglobosa leaf meal

Parameters (g)	Inclusion levels of *P. biglobosa* leaf meal in the diets			
	0%	5%	10%	15%
Final weight	1163.58 ± 4.26^{a}	1094.00 ± 2.84^{ab}	1029.27 ± 2.94^{b}	943.73 ± 3.16^{c}
Total weight gain	1122.83 ± 3.78^{a}	1053.37 ± 2.36^{ab}	988.67 ± 2.80^{b}	903.40 ± 3.91^{c}
Total feed intake	1391.55 ± 2.54^{a}	1359.93 ± 1.92^{a}	1379.23 ± 1.96^{a}	1259.63 ± 9.86^{b}
Feed conversion ratio	1.24±0.05	1.29±0.03	1.39±0.01	1.39±0.06

a, b, c = Means on the same row but with different superscripts are significantly different (P < 0.05)

Haematological Profile Assessment

When investigating the potential toxicity of supplemented compounds or plant extracts on experimental animals, hematological tests are of utmost importance as they can help assess both physiological and pathological conditions in the animals (Oloruntola et al., 2016).

In the present study, no significant differences (P > 0.05) were observed in the hematological parameters evaluated. All hematological blood parameters examined were within normal limits for chickens, indicating the absence of anemia among the birds. However, higher numerical values were recorded as the level of PBLM increased in the diets. Similar findings were reported by Akintomide et al. (2021) in their study involving sweet potato leaf meal in broiler chicken diets.

According to Thrall et al. (2012), the normal hematological readings observed in this study suggest that the nutrients in the diets were adequate for hematopoiesis. This also may implies that the inclusion of PBLM in the diets of broiler chickens may not have a negative impact on their blood or pose any health hazards to the birds.

These results are consistent with the findings of Chinko et al. (2020), who reported numerically higher but insignificant percentages in the hematological values of Wister rats treated with *Amaranthus hybridus* (smooth pigweed). Additionally, the present study supports the hypothesis that leaf meal stimulates hematopoiesis (Chinko et al., 2020). It is believed by researchers that leafy and vegetable meals are low in fat and carbohydrates, rich in multivitamins, macro and micro minerals, dietary fiber, antioxidants, and phytochemicals (Alagbe, 2017; Manjaniq et al., 2017; Ebabhi & Adebayo, 2022). These inherent potentials in leaf meals aid in hematopoiesis, improve animal and human health by enhancing immune status, and eliminate free radicals from the system, thereby reducing the incidence of disease outbreaks. Therefore, it may be concluded that *P. biglobosa* leaf possesses medicinal properties with great potential for hematopoiesis (Saleh et al., 2021).

However, the results of this study contradict previous studies by Tijani et al. (2015) and Aikpitanyi and Egweh (2020), who found significant differences in the hematological parameters of broiler chickens fed varying leaf meal diets. Differences in management practices, age, gender, and strain might account for the variation (Olaniyi et al., 2012; Etim et al., 2013).

Table 3: Haematological evaluation

Parameters	Inclusion levels of *P. biglobosa* leaf meal in the diets			
	0%	5%	10%	15%
Erythrocyte ($10^6/\mu l$)	2.35 ± 0.05	2.35 ± 0.60	2.40 ± 0.20	2.45 ± 0.15
Haematocrit (%)	26.00 ± 0.50	26.50 ± 2.00	26.50 ± 0.50	27.00± 1.00
Haemoglobin (g/dl)	2.90 ± 0.40	2.90 ± 0.30	2.95 ± 0.20	2.98± 0.20
Leukocytes ($10^9/l$)	10.80 ± 0.00	11.20 ± 1.00	11.05 ± 0.75	10.95± 0.05

Serum Biochemical Indices Assessment

The biochemical parameters, except for alanine aminotransferase (ALT) and aspartate aminotransferase (AST), were not influenced ($P > 0.05$) by the inclusion of PBLM in the diets (refer to Table 4).

The similar values ($P > 0.05$) observed for cholesterol, total protein, albumin, and creatinine were consistent with the findings of Rubio et al. (2019), who reported that adding *Piper cubeba* ethanolic extract to birds' meals had no impact on these parameters. The total protein results across the diets in our study were consistent with those obtained by Abdel-Fattah et al. (2008) when broiler chickens were fed an alternative protein source (Moringa leaf meal). Interestingly, the inclusion of *Parkia biglobosa* leaf meal in our study resulted in reduced cholesterol levels in the birds. This finding aligns with the results of Reddy et al. (2017), who demonstrated that a polyphenol extract of *Moringa oleifera* leaf had a significant cholesterol-lowering effect in rats, potentially benefiting consumers' health by reducing the risk of diabetes, high blood pressure, and cardiovascular disease (Carson et al., 2020). However, our study's cholesterol results were in contrast to those of Owosibo et al. (2013), who observed significant differences in cholesterol levels in Marshal broiler chicks fed leaf meal.

The urea level was numerically higher in the control diet, consistent with the findings of Nath et al. (2016). This suggests that the inclusion of PBLM does not interfere with the normal functioning of the kidney and liver in the animal.

Alanine phosphatase (ALP), ALT, and AST concentrations serve as diagnostic tools to identify signs of liver injury or dysfunction (Alhidary et al., 2016). Our study found that ALT and AST levels were within the normal range, indicating that the health of the experimental birds was not adversely affected by the leaf meal. This finding is consistent with the results of Abdulbasit et al. (2020), who observed improved blood activity of ALT and AST in broiler chickens fed varying amounts of *Persicaria odorata* leaf meal. Comparable tendencies were identified in broiler chicks fed diets containing pawpaw and bamboo leaf meals (Oloruntola et al., 2018). Additionally, as the quantity of dietary PBLM inclusion increased, ALT decreased, indicating no adverse effects on the birds' liver parenchyma. High levels of ALP have been associated with liver damage, bone diseases, and overactive parathyroid glands (Ghazanfar and Qureshi, 2013). Elevated levels of ALT and AST in the blood may indicate various diseases or conditions, including hepatitis, liver cirrhosis, inflammation, and cancer, reflecting liver cell damage (Ghazanfar and Qureshi, 2013).

Table 4: Serum biochemical indices

Parameters	Inclusion levels of *P. biglobosa* leaf meal in the diets			
	0%	5%	10%	15%
CHO (mmol/l)	4.25±0.45	4.00 ±0.10	3.90 ±0.10	3.95±0.15
TP (g/l)	47.00 ±1.00	46.50 ±0.50	47.00 ±1.00	47.00 ±2.00
Albumin (g/l)	21.50 ±0.90	20.05±0.45	20.70 ±0.50	19.90 ±0.50
Creatine µmol/l	73.00±1.00	64.50 ±3.50	68.50 ±2.50	62.50 ±2.50
Urea (mmol/l)	4.10 ±0.00	3.85±0.05	3.95±0.05	3.70 ±0.00
ALP (µ/l)	260.50 ±5.50	95.00±21.0	190.5± 5.50	130.00±4.00
ALT (µ/l)	12.50 ±2.30^{a}	5.70 ±1.20^{b}	7.15±0.75^{b}	5.20 ±0.10^{c}
AST (µ/l)	11.45±0.25^{a}	6.45±0.95^{b}	11.65±3.95^{a}	11.55±0.55^{a}

*a, b, and c = Means on the same row but with different superscripts are significantly different (P < 0.05). CHO = cholesterol; TP = total protein; TB = total bilirubin; ALP = alkaline phosphatase***;** *ALT = Alanine amino transferase; AST = Aspartate amino transferase.*

CONCLUSION

This study showed that 15% PBLM enhances the haematological profile with hypocholesterolemic properties; however, inclusion level of this leaf meal in the feed should not exceed 5% in order not to jeopardize the growth performance of the chickens. Overall, the inclusion of PBLM in broiler diets did not negatively impact the health and biochemical profile of the birds. Haematological and biochemical parameters remained within normal limits, suggesting that PBLM could be a viable dietary component without posing health hazards to the birds. Further research is warranted to explore the potential benefits and optimal inclusion levels of PBLM in broiler diets. Additionally, studies investigating long-term effects and the economic feasibility of using PBLM in poultry production systems would be valuable for practical implementation and sustainability.

Recommendations for future research

1. Long-term studies: Conducting long-term studies to evaluate the effects of PBLM inclusion in broiler diets over extended periods can provide insights into any potential long-term impacts on growth, health, and performance.
2. Multiple breeds and ages: Including multiple breeds and age groups of broiler chicks in future studies would enhance the generalizability of the findings and provide a broader understanding of the potential effects of PBLM across different populations.
3. Comprehensive parameters: Expanding the scope of evaluation to include additional parameters such as carcass characteristics, immune response, gut health, and sensory

evaluation would provide a more holistic assessment of the suitability of PBLM as a feed ingredient in broiler diets.

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