Response of Finisher Broilers to Graded levels of Ash treated African Locust Bean (*Parkia biglobosa*) hull meal

.

ABSTRACT

|  |
| --- |
| **Aims:** This study investigated the effects of feeding Ash-treated African locust beans hull meal partially replacing palm kernel meal on growth performance, haematology, morphometric traits, thermo regulatory indices, Carcass and gut organs of broiler chicken. **Place and Duration of Study:** The study was conducted at the Poultry unit of the Department of Animal Health and Production Technology Experimental farm, Kogi State Polytechnic, Itakpe that is within Latitude 070 36’ 20’’N of the equator and Longitude 060 18’ 35”E of the Greenwich Meridian. The feeding trial lasted for 8 weeks.**Methodology:** One hundred and twenty Arbor acre broiler birds were randomly assigned to three experimental diets in which Ash treated African locust beans pulp replaced palm kernel cake at 0 % (T1), 25% (T2) and 50% (T3). The experimental diets were replicated four times with 10 birds per replicate in a completely randomized design (CRD) for a 196 days feeding trial. **Results:** At the end of the trial, birds on T3 diet (50% ATPBH) recorded the least values (*P*<0.05) for final weight gain and daily weight gain compared to birds on T2 and control diets (T1) that had similar (P>0.05) values. Red Blood Cell (RBC) count was significantly (P<0.05) higher in T2 (2.02 x106/l) and T3 (1.97 x 106/l) compared to T1 (1.79x106/l) indicating enhancement of the immune system. Cost of feed per kg of diet (#726.78) and reduction in cost of feed per kg (#15.62) was least in diet containing 50% inclusion level. The birds fed diets T2 and T3 had similar (P>0.05) dressing % values (65.00 and 66.19%) that was lower than that obtained for birds on control diet (70.61%). Morphometric indices and physiological parameters showed similar responses across dietary treatments.**Conclusion:** These findings showed that birds fed 25% Ash treated *Parkia biglobosa* hull (ATPBH) based diet had the best performance. Therefore, Ash treated *Parkia biglobosa* can be included in broiler chicken diets up to 25% level at finisher phase as replacement for Palm kernel meal, without any adverse effect on bird’s performances. |

*Keywords:* Ash treated *Parkia* hull; broilers; feed; immune; Supplementation; weight gain

1. INTRODUCTION

The demand for protein and energy sources such as soybean, ground nut and Palm kernel products by human and industries as raw materials as well as livestock feed has led to its scarcity. The scenario has further stimulated the high cost of livestock feeds, which now bedeviled the livestock industry, and this has an effect on the quantity of dietary protein available for the physiological and mental development of the populace [1]. Therefore, there is a need to harness alternative sources as viable options to the conventional sources. This is necessary and urgent to rescue the livestock industry and promote sustainable livestock [2]. One of the ways to go about this is to take advantage of agro-processing waste, enhance its value and harness it as a formidable substitute to the ever increasing cost of animal protein sources often used as ingredients for livestock feed, especially poultry [3]. One of such waste is the African locust bean (*Parkia biglobosa*) hull.

The African locust bean (*Parkia biglobosa*) tree is a leguminous crop peculiar to the tropics, particularly the North Central geographical zone in Nigeria. It’s a perennial tree that is not cultivated but it’s found in populations of two or more in the savannah regions of West Africa [4]. *Parkia* is an important tree species that provide edible products and income to rural households [5]. The mature seeds known as bean, that comes from the *Parkia* pods have been harvested and processed into fermented product known as `iru`, `Dawadawa` and `ogiri` in the Yoruba, Hausa and Igbo languages of Nigeria [6]. This food product is rich in protein and some beneficial health components [5]. As such, they are used throughout sub-Saharan Africa for seasoning traditional soups [7]. In Nigeria, they are sold either fresh or dried, serving as a nutritious spice or condiment in cooking [4]. They may be used as an ingredient in the preparation of various stews, soups and sauces for the consumption of cereals [5]. They can also be pressed into cakes or used in alcoholic beverages and coffee substitutes known as `Sudan coffee ` or `Café ne` gre` [8]. The ground seeds are mixed with Moringa *(Moringa oleifera*) leaves to prepare a sauce and doughnuts [6]. *Parkia* fruit pulp and seeds are rich in sucrose, carbohydrate, lipids, proteins and amino acids, with high concentration of glutamic acid [9].

Academic findings have examined other applications of African locust bean seeds and related aspects such as storage, preservation, processing, cooking duration, and packaging techniques [7, 8]. In addition, Ajegena [4] and Dada & Akinmoladun [5] reported the proximate nutritional value of *Parkia* seeds as 13.15% Crude protein, 57.38% moisture, 42.62 % dry matter, 1.90% Ether extract, 17.97% Ash and 18.2% crude fibre. Furthermore, African locust bean hull that remains a waste in the processing of seeds at processing site has proximate composition of 25.14% Crude protein, 11.91 % moisture, 7.96% ether extract, 49.26% crude fibre and 2.88% ash [10, 11]. In view of this, the crude fibre content of *Parki*a hull is high and there is the need for it to be reduced to a bearable amount for its use in Monogastric diet. Fermentation has been reported as one of the viable means of reducing crude fibre content of agro-by products and enhances crude protein content [5, 8].

Akintobi *et al.* [11] and Osuntokun *et al*. [12] also validated the antibacterial properties and antimicrobial efficacy of *Parkia biglobosa* seeds which may be associated with the constitutive phytochemicals (alkaloids, tannins, flavonoids, Saponins, steroids, glycosides) and also due to bacteriocins produced by Lactic acid bacteria and some strain inherent in the fermented substrate [11]. These bioactive however, lock up nutrients in feeds, making them unavailable [13]. hence, there is a need for processing. Yisah *et al.* [10] demonstrated the use of moist wood ash as fermenting substrate for *Parkia biglobosa* hull, and this not only reduced the fibre content of substrates from 45.5% to 15.52% but, also improved the Crude protein content.

It is envisaged in the present study that the crude fibre content and utilization of *Parkia* hull will be enhanced by fermentation process with the use of moist ash as fermentating substrate. A gap exists in the understanding of how Ash treated African locust bean hull affect growth performance, physiological response and haematological status. Therefore, this present study was conducted to investigate the effect of ash treated *Parkia biglobosa* hull meal on growth performance, physiological status, haematological parameters, carcass quality, morphometric indices and bio-economics of broilers. Our results may provide a practical basis for the application of *Parkia* hull as replacement for Palm kernel meal.

2. material and methods

**2.1 Experimental Location**

The study was conducted at the Department of Animal Health and Production Technology, School of Agricultural Technology (SOAT), Kogi State Polytechnic, Itakpe Campus. Itakpe is sited at Okehi Local Government Area of Kogi State within the Latitude 070 36’ 20’’N of the equator and Longitude 060 18’ 35”E of the Greenwich Meridian. It has an average annual temperature of 25.60C, average annual rainfall of 1,917 mm and 74.5 relative humidity. Itakpe has two alternating seasons of wet and dry [14].

**2.2 Sourcing, Preparation and Processing of African locust Bean (Parkia biglobosa) hull*.***

African Locust Bean (*Parkia biglobosa*) hull was sourced from processing site within Itakpe metropolis. The *Parkia* hull (35 Kg) was sorted to remove impurities, cleaned off dirt’s, washed and fermented with 5 kg wood ash in 5 liters water kept in air tight container for 21 days. It was then air dried, sieved with 2.55 mm mesh, crushed in a hammer mill and stored in polythene bags until when needed. Other ingredients were bought from open market at Lokoja, Kogi State.

**2.3 Experimental Diets**

Three experimental diets for finisher phase were formulated in which Ash treated African locust beans fruit hull replaced Palm Kernel Cake meal at 0% (Control), 25% and 50% coded as T1, T2 and T3. The proportions of other ingredients were held respectively constant to achieve an iso-nitrogenous diets of 18% Crude Protein and metabolizable energy of 2,900 Kcal/kg to meet the bird’s requirements. The percentage composition of the experimental diets is presented in Table 1.

**Table 1: Ingredients and Nutrient Composition of Experimental Diets (%DM basis)**

|  |
| --- |
|  **Levels of Inclusion of *Parkia* hull**  |

 **Parameters T1 T2 T3**

|  |  |  |  |
| --- | --- | --- | --- |
| Maize | 50.00 | 50.00 | 50.00 |
| Soybean Meal  | 25.05 | 25.05 | 25.05 |
| Palm Kernel cake | 12.50 | 9.37 | 6.25 |
| ATPB Hull | 0.00 | 3.13 | 6.25 |
| Maize offal  | 9.75 | 9.75 | 9.75 |
| Limestone  | 1.50 | 1.50 | 1.50 |
| Bone meal  | 0.55 | 0.55 | 0.55 |
| Lysine | 0.15 | 0.15 | 0.15 |
| Methionine  | 0.15 | 0.15 | 0.15 |
| \*Vitamin Premix | 0.20 | 0.20 | 0.20 |
| Salt  | 0.15 | 0.15 | 0.15 |
| **Total**  | **100.00** | **100.00** | **100.00** |
| **Nutrients Composition** |  |  |  |
| Metabolizable energy (Kcal/kg) | 2936.01 | 2940.68 | 2944.44 |
| Crude protein (%) | 18.00 | 18.07 | 18.14 |
| Crude fibre (%) | 5.00 | 5.14 | 5.28 |

**2.4 Experimental Design and bird’s Management**

One hundred and thirty (130) day old Arbor acre broiler birds were purchased from Chi hatchery Ibadan, Oyo State, Nigeria. Prior to their arrival, the brooding house was cleaned, washed and disinfected a week ahead. Litter materials (wood shavings) were spread on the floor two days before the arrival of the chicks. Charcoal pots were used as source of heat and electric bulb (200 watts) as lighting. At arrival, the chicks were provided with water containing glucose, anti-stress and multi-vitamins. The chicks were brooded conventionally on a deep litter floor. Olams Ultima super starter commercial feed having a proximate composition of 24% Crude protein, 5% Crude fibre, 7 % Ether extract and 3,200 Metabolizable energy; and cool water were supplied *ad libitum* to the birds throughout the starter phase. Routine vaccination (Lasota, Gumboro) and medications were also administered.

At the Finisher phase, one hundred and twenty birds (120) with similar weight (435 ± 10 g) were randomly selected, weighed and allotted to the three dietary treatments in a Completely Randomized Design with forty birds per treatments and four replicates of ten birds per replicate. A period of one week was provided for acclimatization to feed. Birds were then fed the experimental diets for 3 weeks.

**2.5 Growth performance response**

**The following growth performance parameters were examined**

***W*eight gain**: The birds were weighed at the beginning (initial weight) of the feeding trial and subsequently on a weekly basis afterward, the initial live weight of birds were subtracted from their final live weight to obtain their weight gain.

**Feed Intake**: Weighed quantities of feed were provided daily and the leftovers from the feed was weighed at the end of every week to obtain weekly feed intake which was divided by the number of experimental days to obtain the average daily feed intake.

**Feed conversion ratio** (FCR) was calculated as the ratio of feed intake to body weight gain of the birds.

**2.6 Bio-economics of feed**

Data were collected daily for feed intake, weight gain of birds from which feed conversion ratio and feed: gain were computed as ratio of average daily feed intake to average daily weight gain per groups. Cost of total feed consumed (#) and feed cost per weight gain were derived as the product of total feed consumed (kg) and feed cost while, feed cost/kg (#/Kg) was computed using the product of market prices of the feedstuffs used to formulate the test diets over the weight of feed consumed. The cost of Ash treated African locust bean hull (ATPBH) was estimated as proportion of the hull of seeds to the total cost of the fruit and the cost of a little financial motivation given to children collecting the hulls plus the cost of ash, and water used for fermenting following the procedure reported by Agbana *et al*. [3].

**2.7 Haematological Parameters**

At the end of the feeding trial, blood samples were collected randomly from two birds per replicate via the wing vein using sterile syringes. The blood were introduced into EDTA tubes for haematological analyses. Packed Cell Volume (PCV) was determined by the Wintrobe micro haematocrit method, Haemoglobin Concentration (Hb) was measured using the cyanmethemoglobin method, Red Blood Cell Count (RBC) and White Blood Cell Count (WBC) were determined using a haemocytometer. Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) were calculated using standard formulas based on PCV, Hb, and RBC values.

MCV = Haematocrit (Vol. of PCV) x 10 / RBC in Million per mm3

MCH = Haemoglobin per 100 ml x 10 / RBC (millions per mm3)

MCHC = Haemaglobin per 100 ml x 100 / Haematocrit (Vol. %)

**2.8 Physiological Parameters Determination**

At the end of the feeding trial, a total of 60 birds randomly selected from a pool of 120 birds were restrained and examined for thermoregulatory parameters of pulse rate and rectal temperature. The physiological parameters were recorded as:

**Rectal Temperature:** a digital thermometer was used in the determination of the rectal temperature of the bird by inserting the tip into the vent of the chicken for a period of one minute (60 Seconds), using a stop watch between 6:00 – 8.00 am.

**Pulse Rate:** This was done by the use of a stethoscope which was placed under the wing of the chicken and the pulse counted for a minute (60 Seconds) using a stop watch between 6.00 – 8.00 am.

**2.9 Morphometric traits**

Studies on morphometric via linear body measurements of each birds were recorded weekly by careful and humane handling of the birds. The linear body measurements were taking using centimetre graduated measuring tape after restraining. The following parameters were evaluated:

**Thigh length:** This was taken from the beginning of the fibula to the hock joint.**Shank length:** This was taken from the beginning of the hock joint to the last ring before the tarsal or meta-tarsal digit.**Breast Width:** This was taken from the point of depression to the sharp edge.**Wing Length:** Distance between the tip of the phalanges and the coracoids-humerus joint.**Body Length:** The distance between the base of the neck and pygostlye.

The body traits were measured using tailor's (cm) tape and body weight with weighing scale.

**2.10 Carcass and internal organ weight**

At the end of the feeding trial, a bird per each replicate was selected at random, supplied with only water for 8 hours to empty the crops before being slaughtered. The birds were scalded, plucked, dressed and the internal organs of birds (gizzard, heart, liver, kidney, crop and small intestine) were removed and weighed using electronic scale (Shimadzu model 115c). Plucked weights were determined and calculated as the proportion of the ratio of carcass weight to live weight. The carcass was cut into retail primal parts (back, drumstick, breast, thigh, and wings) and weighed as recommended by United State Department Agriculture [15].

**2.11 Analysis**

All data collected during the investigation were subjected to one way analysis of variance using SPSS 2018 statistical package and significant means differences (P<.05) were compared and separated by least square means.

3. results and discussion

**3.1 Growth performance response**

Table 2 shows the performance of finisher broilers fed graded levels of ash treated *Parkia biglobosa* hull meal. The final weight and daily weight gain of birds ranged from 1669.0g to 1501.00g and 45.54g to 43.84g, respectively; and differs significantly (*P<*.05) among treatments. Birds on T3 diet (50% ATPBH) recorded the least value compared to T2 and control diets (T1) that have similar values. The better growth response in birds on 25% ATPBH supplemented diets that competed with birds on the control (T1) diet could infer better feed utilization due to increased endogenous digestive enzymes secretion [9], as the bioactive in ATPBH might have ratified diets utilization and act as promoter. In contrast, Shuaibu *et al*. [17] observed no significant effect (*P*>.05) of dietary supplementation of *Parkia* seed meal based diet on weight gain, feed intake and FCR in broilers. The disparity in observed results may be due to either geographical or species differences, as Shuaibu et al [17] conducted research with crossbred strain of broilers under temperate environmental conditions while, this experiment was carried out under tropical weather conditions.

**Table 2:** **Growth response of finisher broilers to varying levels of ash treated *Parkia hull meal.***

|  |
| --- |
|  **Treatments**  |

**Parameters T1 T2 T3 SEM *P*-value**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial weight gain (g) Final weight gain (g)Daily weight gain (g) |  719.101669.00a 45.54a |  697.001652.00b45.46 b | 710.001501.00c 43.81c | 0.230.270.43  | 0.478 0.0010.004 |
| Final feed intake (g) | 2517.33 | 2492.10 | 2491.05 | 0.22 | 0.421 |
| Aver.Daily feed intake | 119.95  | 118.67 | 118.62 | 4.12 | 0.753 |
| Feed conversion ratio  | 2.72c  | 2.61b   | 2.58a   | 2.38  | 0.004 |

 *a,b,c Means with different superscripts across the row are significantly (P<.05), T1= 0% Ash-treated Parkia biglobosa hull inclusion, T2 = 25% Ash-treated Parkia biglobosa inclusion, T3=Ash-treated Parkia biglobosa inclusion hull inclusion, and SEM = Standard Error of Mean.*

**3.2 Bio-economics**

Table 3 shows the bio-economics of supplementing ash treated African locust bean hull (ATPBH) meal in diets of finisher broilers. The cost of feed per kg of the diets and reduction in cost of feed per kg diet differed significantly (*P*<.05) among treatments and decreased with increasing levels of ash treated African locust bean hull inclusion. Thus, diet containing 50% inclusion level of ATPBH had the lowest cost of feed per kg (#726.78) and highest reduction in cost of feed per kg ((#15.63) while, higher feed cost was incurred on birds consuming the control diet (T1). Suggesting reduction in the total cost of feed consumed and feed cost (#) by birds as ash treated *Parkia biglobosa* hull dietary inclusion increased. This transcends to moderate intake of feed and increased incorporation of low cost ATPBH in the diets. This agrees with the reports of Agbana *et al*. [3] who observed a decreased in cost of feed (#) and cost of feed/kg weight gain in diets of rabbits fed an increased inclusion levels of parboiled mango seed kernel meal. Studies reported low cost of #46.00/kg for *Parkia biglobosa* hull meal over #125.00/kg soybean meal representing 64% cost effectiveness [10]. Thus, the observed cost differentials per kg infer financial gain with ATPBH meal based diets. Therefore, ash treated *Parkia biglobosa* hull can be compared with otherprotein sources.

**Table 3: Bio-economics of finisher broilers fed Ash treated locust bean hull meal based diets**

|  |
| --- |
|  **Treatments**  |

**Parameters T1 T2 T3 SEM *P*-value**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Final weight gain (g) | 1669.00a | 1652.00b | 1501.00c | 0.27 | 0.001 |
| Final feed intake (g) | 2517.33 | 2492.10 | 2491.05 | 0.22 | 0.421 |
| Cost /Kg feed (#) | 742.43a  | 734.56b | 726.78c | 4.12 | 0.003 |
| Cost reduction /kg Total cost of feed Cost / kg weight gain  |  - 1870.35 2025.25  |  7.82b 1830.64 1963.48 |  15.63a 1810.44 2043.52 | 2.38 0.45 3.12 | 0.0020.232 0.164 |

*a,b,c Means with different superscripts across the row are significantly (P < 0.05), T1= 0% Ash-treated Parkia biglobosa hull inclusion, T2 = 25% Ash-treated Parkia biglobosa inclusion, T3=Ash-treated Parkia biglobosa inclusion hull inclusion, and SEM = Standard Error of Mean.*

**3.3 Physiological parameters**

The effect of feeding graded levels of ash-treated *Parkia biglobosa* hull meal to finisher broiler on physiological response is presented in Table 4. Physiological responses shows no significant (*P*>.05) difference for all the parameters examined. The rectal temperature ranged from 41.13oC - 41.83oC and the heart rate ranged from 57.33 bpm – 66.67bpm, respectively. Physiological parameters (blood profile indices, heart rate, respiratory rate, rectal temperature, pulse rate) determines imbalance in physiological responses of animals and also reflect thermoregulatory and health status of animals. Thus, the similarities in physiological responses of birds across treatments reflect balanced thermoregulation, healthy status and cellular defense of animals on ash treated based diets. Values obtained for physiological parameters in our study fall within the normal physiological range recommended for broilers in Literature [18]. The values also collaborates the findings of Okpe [19], who reported rectal temperature value range of 39.94 to 42.60oC and similar values for other physiological parameters considered for broilers raised under tropical conditions. There exists a correlation between cloaca temperature, heart rate, and breath/min and also a significant increase in the body temperature of birds could alter its physiology [19].

**Table 4:** **Physiological response of finisher broilers to varying ash treated *Parkia biglobosa* hull meal based diets.**

|  |
| --- |
|  **Treatments**  |

**Parameters T1 (0) T2 (25) T3 (50) SEM P-value**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| Rectal Temp. (°C) | 41.83 | 41.30 | 41.13 | 0.22 | 0.443 |
|  |  |  |  |  |  |
| Heart rate (bpm) | 66.67 | 65.33 | 57.33 | 2.38 | 0.245 |

*a,b,c Means with different superscripts across the row are significantly (P < 0.05), T1= 0% Ash-treated Parkia biglobosa hull inclusion, T2 = 25% Ash-treated Parkia biglobosa inclusion, T3=Ash-treated Parkia biglobosa inclusion hull inclusion, and SEM = Standard Error of Mean.*

 **3.4 Haematological Profile of Broiler Finisher Birds**

The effect of Ash treated *Parkia biglobosa* hull based diets on the haematological profile of broiler finisher birds are summarized in Table 5. The table presents the means of various hematological parameters across the three treatment groups (T1, T2, and T3). The results showed a significant increase (*P* < .05) in PCV and haemoglobin (Hb) levels as the inclusion level of ATPBH increased. Birds fed the T3 diet (50% ATPBH) had the highest Hb value (9.23 g/dl), which was significantly *(P*<.05) higher than that of T1 (0% ATPBH) and T2 (25% ATPBH). Similarly, RBC count was significantly (*P*<.05) higher in T2 (2.02 x 10⁶/l) and T3 (1.97 x 10⁶/l) compared to T1 (1.79 x 10⁶/l) and lymphocyte percentage was significantly higher (*P*<.05) in T3 (41.17%) compared to T1 (36.87%) and T2 (34.20%). The values obtained falls within the normal range of 24.66% to 25.35% established for healthy birds [16]. Moreso, the white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), platelet counts and other differentials (heterophil, Monocytes) were not significantly (*P*>.05) affected by Ash Treated *Parkia Biglobosa* Hull (ATPBH) inclusion. The positive role of Ash treated *Parkia* hull based meal that caused a significant increase (*P*<.05) in haemoglobin (Hb), red blood cells and lymphocytes levels as the inclusion level of ATPBH increased across dietary treatments indicated improved oxygen-carrying capacity, normal physiological status of birds, immune-modulatory effect and positive influence on hematopoiesis [20], possibly due to the nutritional components or bioactive compounds inherent in *Parkia biglobosa* hulls, which may enhance erythropoietin [21] indicating that ATPBH had no effect on the immune response, blood clotting factors and hemostatic functions of birds. This observation was similar to that reported by Enujiugha and Akinmoladun [22]. Thus, ash treated African locust bean hull can compete with other conventional feedstuffs as feed supplement because of its safety.

**Table 5: Haematological Profile of Broiler Finisher Birds fed ATPBH Based diets.**

|  |
| --- |
|  **Treatments**  |

**Parameters T1 (0) T2 T3 (50) SEM *P*-value**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Haemoglobin (g/dl) | 8.03c | 7.20b |  9.23a | 0.36 | 0.038 |
| Pack Cell Volume (%) | 24.33b | 25.67b | 27.33a | 1.00 | 0.033 |
| Red blood cell (x 106/l) | 1.79b | 2.02a |  1.97a | 0.07 | 0.045 |
| MCV (fl) | 136.70 | 121.03 | 137.87 | 3.93 | 0.143 |
| MCH (pg) | 59.13 | 55.63 | 57.47 | 1.80 | 0.782 |
| MCHC (%) | 43.03b | 47.77a | 41.70b | 1.24 | 0.041 |
| WBC cell (x 109/l) | 153.47 | 160.30 | 156.97 | 4.41 | 0.857 |
| Platelet (x 109/l) | 58.67 | 58.00 | 54.00 | 5.02 | 0.938 |
| Heterophil (%) | 64.13 | 52.07 | 69.63 | 4.28 | 0.254 |
| Lymphocyte (%) | 36.87b | 34.20b | 41.17a | 1.92 | 0.034 |
| Monocyte (%) | 8.07 | 7.97 | 7.27 | 0.32 | 0.594 |

*a,b,c Means with different superscripts across the row are significantly (P < 0.05), T1= 0% Ash-treated Parkia biglobosa hull inclusion, T2 = 25% Ash-treated Parkia biglobosa inclusion, T3=Ash-treated Parkia biglobosa inclusion hull inclusion, and SEM = Standard Error of Mean.*

**3.5 Morphometric traits**

The morphometric traits of finisher broiler birds fed diets containing varying levels of ash-treated *Parkia biglobosa* hull is presented in Table 6. All parameters measured were not significantly (*P*>.05) different among the treatment groups except for Back length and Thigh length (*P*<.05). The results observed for body length, back length, thigh length, shank length, Wing length, breast girth, bird length and beak length ranged from 11.02 - 11.26cm, 7.71 - 8.18cm, 4.90 - 5.18cm, 2.77 - 2.88cm, 3.88 - 4.07cm, 11.21 - 11.70cm, 12.43 - 12.83cm and 1.44-1.45cm, respectively. The similarities in treatment effects observed in morphometric parameters could have resulted from the short period of the study as the treatments may have not fully impacted the body growth of the birds. Ajayi *et al.*[1] and Yakubu *et al.*[23] also reported insignificant dietary effects for these parameters. In addition, the progressive decrease in back length as the inclusion of ATPBH increased in the diets of the birds may further suggest a possible depression in body weights of the birds that negatively affect the body morphometric profile of the birds. This observation agrees with the finding of Ajayi *et al.* [1, 4], who reported a negative effect on body weight of birds fed and also their body morphometric.

**Table 6: Morphometric traits of Finisher Birds fed Ash treated *Parkia* hull mealbased diets.**

|  |
| --- |
|  **Treatments**  |

**Parameters T1 T2 T3 SEM *P*-value**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Body length | 11.13 | 11.02 | 11.26 | 0.09 | 0.578 |
| Back length | 8.18a | 8.00a | 7.71b | 0.06 | 0.008 |
| Thigh length | 5.18a | 5.16ab | 4.90b | 0.04 | 0.006 |
| Shank length | 2.88 | 2.86 | 2.77 | 0.04 | 0.363 |
| Wing length | 3.90 | 4.07 | 3.88 | 0.05 | 0.232 |
| Breast girth | 11.70 | 11.45 | 11.21 | 0.10 | 0.164 |
| Bird height | 12.50 | 12.83 | 12.43 | 0.11 | 0.296 |
| Beak length | 1.45 | 1.44 | 1.45 | 0.01 | 0.910 |

*a,b,c Means with different superscripts across the row are significantly (P < 0.05), T1= 0% Ash-treated Parkia biglobosa hull inclusion, T2 = 25% Ash-treated Parkia biglobosa inclusion, T3=Ash-treated Parkia biglobosa inclusion hull inclusion, and SEM = Standard Error of Mean.*

**3.6 Carcass Characteristics**

The result of carcass yield of finisher broiler chicken fed Ash treated African locust bean hulls based diets is presented in Table 7. Live weight was significantly influenced (*P*<.05) by the experimental diets. The results were statistically similar for the diet containing 0% ATPBH level of inclusion (1440.0g) and the 25% inclusion diet (1402.0g) while, the lowest value (1364.26g) was recorded for birds fed 50% ATPBH level of inclusion. Similarly, dressing percentage was significantly (*P*<.05) different among the treatments. Birds on diets T2 (65.60%) and T3 (66.20%) had similar (*P*>.05) values and the best dressing percentage was obtained from birds on control diets (70.80%). Thus, dressing percentage of birds fed varying inclusion levels of ATPBH increased with quantity of weight gain. The heaviest carcass weight (1011.08g) recorded in birds fed 0% ATPH level of inclusion (T1), while the lightest weight (870.01g) recorded in birds fed 50% ATPBH level of inclusion (T3).

Carcass parameters are reflections of the final weight gain of the birds at slaughter, which decreased as the replacement level of Ash treated *Parkia* *biglobosa* fruit hull (ATPBH) increased in the diets. This result corroborates the observation of Bot *et al.* [9] who observed decreased values for live weight, carcass weight and dressing percent between treatments as the level of African locust bean pulp meals increased (0%, 25%, 50%,75% and 100%) in the dietary of broiler chickens. Tumburawa *et al* [24] opined that nutritional profile of birds influence muscular growth, as increase in protein levels of diets often lead to better muscle deposition and the production of leaner meat that transcend to improved live weight. Thus, the low Carcass weight observed in diets stuffed with Ash treated African locust beans hull may be attributed to low utilization of protein and presence of tannin in diets which depressed nutrient digestion and utilization [25]. Similarly, Sundu [26] had attributed low performance of birds fed palm kernel cake meal diets to imbalance of amino acids especially, methionine and lysine. The significant increase in carcass yield and live weight of birds on processed African locust beans hull based diets however, is in line with the report of Obun [27] who reported that processing improve energy content of feed availability and utilization of protein. Thus, leading to better performance. The observed values for carcass weight and live weight were also similar to those reported by kakagida *et al* [25] who confirmed that heavier birds produced greater eviscerated yield. In the present study, the values recorded for dressing percent across treatments however, were similar to 71% reported for tropical broiler chicken.

**3.7 Carcass primal cuts**

The weight of primal cuts of carcass were not (*P* >.05) significantly influenced by diets as they recorded similar value across the treatments (Table 7) indicating that the inclusion of 25% and 50% Ash treated Parkia biglobosa fruit hull in the diets of finishing broilers had no negative influence on the body conformations of the birds. Also, the similarity in primal cuts (*P*>.05) values across treatment groups indicates that the inclusion of 25% and 50% Ash treated *Parkia biglobosa* fruit hull in the diets of finishing broilers had no negative influence on the body conformations of the birds. This observation disagrees with that reported by Bot *et al*. [9] who noticed a significant (*P*<.05) decrease in prime cuts (breast, wings and drumstick) of birds as the level of *Parkia* pulp increased across the dietary treatments. The discrepancies in observed values could be as a result of effective processing. Ari and Ayanwale [2] and Shuaibu *et al*. [17] found a positive attribute for fermented locust bean as against the unfermented locust beans which inhibited broiler growth due to lesser protein quality and low level of essential vitamins. Our results is also in cognizance with the live weight of the birds that reduced with increased dietary supplementation levels.

**Table 7: Carcass Indices of finisher broilers fed ash treated *Parkia* hull meal based diets.**

|  |
| --- |
|  **Treatments**  |

**Parameters T1 (0.00) T2 (25.00) T3 (50.00) SEM *P*-value**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Live weight | 1440.00a | 1400.02a | 1358.30b | 2.89 | 0.032 |
| Carcass weight  | 1011.08a | 910.00ab | 870.01b | 3.26 | 0.025 |
| Dressed % | 70.61a | 65.00b | 66.19b | 1.61 | 0.036 |
| Neck weight (%) | 4.08 | 3.96 | 2.77 | 1.51 | 0.273 |
| Breast weight (%) | 29.70 | 29.30 | 27.70 | 0.56 | 0.337 |
| Drumstick (%)Thigh weight (%) | 11.7215.08  | 11.4515.15 | 11.2114.53 | 0.42 0.32 | 0.2260.571 |
| Shank weight (%) | 06.85 | 06.58 | 06.63 | 0.18 | 0.796 |
| Wings (%) **Internal organ weight** Gizzards (Empty) Heart Liver Crop Small intestine Proventriculus  | 1.4534.056.674.15 2.68 3.51 9.31  | 1.4431.507.56 5.00 2.84 4.708.97 | 1.45 32.007.00 3.20 8.33 8.91 9.01 | 0.24 1.610.981.306.781.35 0.64  | 0.260 0.7500.2900.342 0.5670.7910.349 |

*a,b,c Means with different superscripts across the row are significantly (P < 0.05), T1= 0% Ash-treated Parkia biglobosa hull inclusion, T2 = 25% Ash-treated Parkia biglobosa inclusion, T3=Ash-treated Parkia biglobosa inclusion hull inclusion, and SEM = Standard Error of Mean.*

**3.8 Internal Organ weights**

The result of the internal organ weight for broiler chicken fed ash treated African locust bean seed hull based diets are presented in Table 7. All parameters assessed as internal organ characteristics are not significantly (*P*>.05) affected by the diets thus, recorded similar values across the dietary treatments may suggest that nutrient density of Ash treated based diets need to be increased to the level that is obtained in the control diet in order to meet the demand for maximum flesh lay down [17]. The result agrees with the findings of Bot *et al.* [9] who observed no significant (*P*>.05) differences in weight of liver, heart, gizzard and spleen of birds fed dietary supplemented air dried *Parkia* based diets. Thus, the improvement in health performance, carcass yield and live weight of birds on processed African locust beans hull based diets is in line with the report of Obun [27] who reported that processing improve energy content of feed availability and utilization of protein. Thus, leading to better performance. This agrees with the report of Bot *et al*. [9] who opined that some levels of processing is necessary to reduce the anti-nutritional content of *Parkia biglobosa* pulp before being incorporated into poultry diet.

4. Conclusion

This study demonstrated that ash treated *Parkia biglobosa hull* (ATPBH) could replace palm kernel cake meal at 50% inclusion level in the diets of finisher broiler chicken without any adverse effect on performance characteristics. Ash treatment also enhanced the utilization of diets in broilers. Owing to high proportion of ash in test ingredient, there is need for further application of test ingredient in diets of layers birds to examine its effect on egg quality traits.

**COMPETING INTERESTS**

All Authors declared that no competing interests exist.

Authors’ Contributions

 Yisah JL conceptualized and designed the study, Agbana JA wrote the original draft of the manuscript; Michael AJ and Adebayo MO performed the Data Curation & statistical analysis; Eboh S wrote the protocol; Onuche J, Emmanuel OS and Aliyu AK handled Project formal Analysis and Resources; Abisoye FO and Muhammed AO review and edited the draft of the manuscript; Fanwo RR, Ete OA, and Ahmed ST Supervised the Project; Inda N, Madamori J, and Iduh-Momoh L collected the Data/investigations while, Abdullahi AA, Aina ET and Kayode V validated the methodology. Muhammad BY, Ameh G and Oricha IM managed the literature searches. All authors read and approved the final manuscript.

Ethical approval

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable as the animals used in research were cared for and experimental protocols were followed as approved by the ethical committee of the Institutional animal care and use (KSPACUC-2022)

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

References

1. Ajayi BA, Olubamiwa O, Afolayan JL and Adesola MM. Morphometric Traits in Arbor-Acres Broiler Chicken (*Gallus gallus)* fed Graded Levels of Cocoa Bean Shell Meal. *Nigerian Journal of Animal Science. 2016;* 1:1-10.
2. Ari, MM and Ayanwale BA. Replacement value of *Parkia filicoidea* in broilers. *Journal of Agricultural Technology*. 2021; 1: 42 - 52.
3. Agbana JA, Mepaiyeda S and Oyewole BO Cost benefit of Inclusion of Parboiled mango seed kernel meal in Weaned Rabbits diets. *International Journal of Agricultural Research and Biotech.* 2022; Vol. 8 (1):152-160.
4. Ajegena YS, Atara JG, and Emgba KS. Proximate Analysis of Fermented and Unfermented African locust Beans (*Parkia biglobosa*) found in Lafia, Nasarawa State, Nigeria. *International Journal of Research and Scientific Innovation (IJRSI)*. 2020; Volume VII, Issue, 2321–2705 www.rsisinternational.org P. 235
5. Dada AS & Akinmoladun FO Nutritional evaluation of *Parkia biglobosa* seed meal in poultry diets. *Animal Feed Science and Technology*. 2020; 268, 114-125.
6. Adewusi SRA, & Oyeleke OM. The potential of *Parkia biglobosa* seed meal as an alternative feed source: A review. *Journal of Animal Science and Technology. 2022;* 64 (1): 35 - 47.
7. Ekpa AS. Changes in amino acid composition of African locus beans (*Parkia biglobosa*) on cooking. *Pakistan Journal Nutrition. 2006;* 5: 245-256.
8. Akonia O, Onuoha SA, Akoma AO and Ozigis AA. Physio-chemical attributes of wine produced from yellow pulp of *Parkia biglobosa* using traditional juice extract. *Poultry Science*, 2001; 18
9. Bot MA, Bawa GS and Abeke FO. Replacement value of maize with African locust beans (*Parkia biglobosa*) pulp mal on performance, Haematological and Carcass characteristics of broiler chicken. *Nig. J Animal Sci.* Vol. 2013; 15: 59 -70.
10. Yisah LJ, Joseph MA, Adebayo OM, Fanwo RR, Aliu KA, Abisoye FO and Aina ET Proximate Composition of Africa Locust Bean Hull (*Parkia biglobosa*) subjected to Different Treatment Methods. Proceeding of 49th Conference of Nigeria Society for Animal Production. 24 – 27 March, 2024, Univ. of Ibadan, Nigeria. Pp. 1371-1373.
11. Akintobi OO, Adejuwon AO, and Olawale AK. Antimicrobial evaluation of the stem bark extract of *Parkia biglobosa* (Jacq) Berth. *Report & Opinion. 2013;* 5(10):41-45.
12. Osuntokun OT, Jemisaiye TA and Araa AR. Comparative study between the effect of *Parkia biglobosa* (Jacq) Berth and conventional antibiotic resistant pathogenic bacteria. *MOJ Bioequivalence & Bioavailability* 2018; 5 (4). Doi.10.15406/mojbb.2018.05.00103.
13. Alabi DA, Akinsulire OR and Sanyaolu MA. Quantitative determination of Chemical and Nutritional Composition of *Parkia biglobosa (*Jacq.) Benth. *African Journal of Biotechnology*. 2005; 4: 812-818.
14. NIMET (Nigeria Meteorological Agency, Nigeria) Climate weather and water Information for Sustainable Development and Safety, Annual Climate Reports. 2019;
15. U.S.D.A. The science of meat and meat products. United State Department of Agriculture marketing Service. *Marketing Bulletin. 1999;* 6.
16. LSUMC-S Louisiana State University Medical Centre. Clinical Laboratory Sciences Haematology procedures. C/s. 2009; ume.edu/courses/CL5312/indices.doc.
17. Shuaibu US, Abubakar A, Abdullahi U, Mijinyawa A and Egbo MI Growth performance of broiler chicken fed various levels of African locust beans (*Parkia biglobosa*) based diet. Proceedings of the Nig. Soc. For Animal prod. (NSAP), 46th Annual conf. Dutsinma, 2021, pp. 221 – 225.
18. Lamb GN Manual of Veterinary Laboratory Technique CIBA-GEIGY, Kenya. 1999; Pp. 92 – 100.
19. Okpe AA Physiological response and performance of broiler chickens rear under restricted feeding conditions in the humid tropical environment. Unpublished PhD Theses, Department of Animal production, Kogi State University, 2017; Nigeria.
20. Crawford R & Park H K. Hemoglobinopathies and anemia in poultry. *Poultry Science*, 2021, 10 (8), 2221.
21. Ikeukwumere FC and Herbert U. Physiological response of broiler chickens to quantitative water restriction. Hematological and serum biochemistry. *International Journal of Poultry Science. 2006;* 100(4), 1158-1166.
22. Enujiugha VN, & Akinmoladun FO. The effect of *Parkia biglobosa* seed meal on growth and hematological indices of broiler chickens. *Journal of Animal Science and Biotechnology, 2019;* 10 (1):14.
23. Yakubu AA, Salako AE and Imumorin IG Morphometric traits of Fulani and Yoruba ecotype indigenous chickens in the derived savanna zone of Nigeria. *Tropical Animal Health and Production*, 2010; 42(3), 715-722.
24. Tamburawa MS, Ogundipe SO, Tegbe TSB, Olugbemi TS, Ibrahim U, Saidu S and Abdullahi AY Effect of graded levels of toasted African locust beans seed meal on performance and carcass characteristics of broiler chickens at finishing stage. N*igerian J Animal Sci. 2019;* 21 (3): 315 - 324.
25. Kakagida AY, Isa MM, Anka AB, Mohammed AA and Sol MS. Carcass evaluation in broiler feed diets containing graded levels of locust beans (*Parkia* biglobosa) seed meal in North Western zone of Sokoto, Nigeria. *Asian J Biochem. Genetics and Molecular biology. 2021;* 7(1):1-10.
26. Sundu B, Kumar A, and Dingle J Response of birds fed increasing levels of palm kernel meal supplemented with enzymes.  *Australian Poultry Sci. Symposium*, 2015; 12: 63-75.
27. Obun CO Performance, digestibility and Carcass and organ weights of finisher broiler chicks fed graded levels of fermented locust bean (*Parkia biglobosa*) seed meal. *Asian J Poultry Science. 2018;* 2 (1): 17 - 23.