Trop J Phytochem Pharm Sci, September 2024; 3(4): 356 - 363
ISSN 2955-1226 (Print)
ISSN 2955-1234 (Electronic)

Tropical Journal of Phytochemistry & Pharmaceutical Sciences

Available online at https://www.tjpps.org

Original Research Article

Nutritional Properties of *Kigelia africana* Fruit Meal: Additive Effects on Growth Response, Blood Characteristics, Carcass Properties and Organoleptic Attributes of Japanese Quails

Taiwo K. Ojediran[1,2]*, Victor O. Durojaye[2], Mathew S. Ajayi[2], Ifedayo A. Agbede[2], Funmilayo L. Oni[1], Lateef O. Alamu[3], Isiaka A. Emiola[2]

[1]*Department of Wildlife and Ecotourism Management, Ladoke Akintola University of Technology, Ogbomoso, 210210, Nigeria.*
[2]*Department of Animal Nutrition and Biotechnology, Ladoke Akintola University of Technology, Ogbomoso, 210210, Nigeria.*
[3]*Department of Forest Resources Management, Ladoke Akintola University of Technology, Ogbomoso, 210210, Nigeria.*

ABSRTACT

This trial was drawn to investigate the growth response, blood constituents, carcass, and sensory properties of Japanese quails to the dietary inclusion of Suasage (*Kigelia africana*) fruit meal as a feed additive. Four feeding groups were drawn at random from among 240 unsexed Japanese quails, aged two weeks. They were fed *Kigelia africana* Fruit Meal (KaFM) as a feed additive at 0.00% (A), 0.10% (B), 0.20% (C), and 0.30% (D) inclusion rate respectively. During the eight-week trial, three replicates of twenty quails each were used in each feed group. The three-week-long growing phase ended when the quails were further divided according to sex at first lay. Throughout the trial, weekly data on growth performance were gathered, and at 10 weeks of age, the birds were slaughtered for blood, carcass, and organoleptic analyses. All data were analyzed using one-way Analysis of Variance. These findings revealed that KaFM influenced ($p<0.05$) intake, feed-to-gain, age at first lay, haematological parameters, transaminase activity, carcass and organoleptic indices. Conclusively, group (A) reached laying age earlier (39d), thus KaFM could delay female sexual maturity. According to the study's findings, 0.1% KaFM inclusion dose was sufficient for boosting the growth performance of Japanese quails (Feed conversion ratio=4.53), 0.20% KaFM for blood metabolites which were within the established range for healthy quails, higher carcass weight, meat color, tenderness, and overall acceptability.

Keywords: *Coturnix japonica, Kigelia africana, Performance, Blood metabolites, Sensory*

Received 07 September 2024
Revised 26 September 2024
Accepted 26 September 2024
Published online 01 October 2024

Introduction

Poultry species occupy an important niche in the livestock industry. This is due to their nutritional functions in family diets, especially in developing nations, in addition to their economic and sociocultural benefits.[1] For years, the production of widely known poultry species such as domestic fowls, turkeys, ducks, and geese, has been adversely affected by the high and constantly increasing feed cost. The affordability of the majority of chicken products has been adversely affected, especially by residents of developing nations like Nigeria, by the ongoing rise in the price of the ingredients used in poultry diets. Therefore, this warrants a paradigm shift towards the massive production of lesser-known poultry species such as quail, which consumes lesser feed quantity, yet, gives products that are nutritionally better than other poultry birds.[2]

Japanese quail, are a significant mini-livestock poultry species that can be utilized to supplement diets deficient in animal-derived proteins.[3] Short generational periods, early sexual development, laying onset, and laying more than 200 eggs in the first year of laying are among their known characteristics.[4,5]

The birds are majorly reared for their products (eggs and or meats) which are renowned for their superior biological value.[6] However, to sufficiently bridge the inadequacies in animal protein intake resulting from the ever-increasing human population, much effort should be geared toward optimizing quail and other livestock. A practically possible way is the application of affordable managerial techniques such as the use of feed phyto-additives and non-conventional drugs.

Kigelia africana is a plant of interest, used as a phyto-remedy because of its numerous potentials including therapeutic and several other beneficial effects.[7,8,9,10,11] Because of its enormous fruit that resembles sausages or cucumbers, this plant, which is native to Africa in particular, is also known as the "sausage" or "cucumber" tree. *K. africana* plant is also identified by various Nigerian tribes with different indigenous names such as *Pandoro, Iyan* (Yoruba); *Rawuya* (Hausa), and *Uturubein* by the Igbos.[12,13]

There is a paucity of knowledge on the potential of this plant on the performance of any poultry species fed with its fruit meals or other plant parts. However, the aqueous extract of *Kigelia africana* bark reverses early testicular damage induced by the methanol extract of *Carica papaya*.[7] Anti-inflammatory activities of the ethanolic stem bark extract and fruit have been traced to the antioxidant, vitamin, phytochemical, and pharmacological properties. [8,9,10,11] This research is timely, as it will help to strengthen the use of natural additives and food safety. This study therefore explored the possible impacts of *Kigelia africana* fruit meal (KaFM) additive on the growth, blood and carcass, and sensory characteristics of Japanese quails.

*Corresponding author. E mail: tkojediran@lautech.edu.ng

Tel: +234-8034104295

Citation: Ojediran TK, Durojaye VO, Ajayi MS, Agbede IA, Oni FL, Alamu LO, Emiola IA Nutritional Properties of *Kigelia africana* Fruit Meal: Additive Effects on Growth Response, Blood Characteristics, Carcass Properties and Organoleptic Attributes of Japanese Quails. Trop J Phytochem Pharm. Sci. 2024; 3(6): 356 - 363 http://www.doi.org/10.26538/tjpps/v3i6.6

Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria.

ISSN 2955-1226 (Print)
ISSN 2955-1234 (Electronic)

Materials and methods

Location of the investigation and Ethics approval

The study was conducted in Ogbomoso, Nigeria, in the Poultry unit of the Teaching and Research Farm at Ladoke Akintola University of Technology. This investigation met the guiding rules and received the approval of the Animal and Research Ethic Committee of the Department of Animal Nutrition and Biotechnology, (number ANB/22/U/151031).

Management of experimental birds

Two weeks old mixed-sex Japanese quail chicks totaling 240 were obtained from a research center located in Ikire. As soon as they arrived, an anti-stress solution (Super-vit plus® at 0.5g/l) was given to the chicks which were gently moved into a pre-warmed pen. The birds had unrestrained to feed and water before the commencement of the feeding trial with a four-day acclimatization. The chicks were then split into four feed groups at random, each consisting of three replicates with twenty birds. Throughout the trial period, they were housed in an enclosed housing with a thorough litter management system and weekly litter changes. The experiment's growth response was measured throughout the first 21 days, and on the 60th day, the carcass and organoleptic assessments were completed. Throughout the trial, the birds had unlimited amounts of fresh feed and water.

Procurement and preparation of Test ingredients

Kigelia africana fruits were sourced within Ogbomoso. It was authenticated by the botany and herbarium unit of the Department of Pure and Applied Biology. They were processed by slicing to enhance air drying, pounded with mortar and pestle and ground to powdery form with an Electric grinder. The powdered ingredient was thereafter stored at room temperature (25°C) before usage.

Experimental diets

There were four diet groups under observation. Group A received the control (basal) diet, which contained 0% *Kigelia africana* fruit meal. Groups B, C, and D, on the other hand, received diets that included 0.1%, 0.2%, and 0.3% of KaFM, respectively (Table 1).

Data Collection

Growth parameters

Assessment of growth indices was carried out weekly. This was measured in grams using a digital sensitive scale. Throughout the investigation, the following information was gathered:

Feed intake (FI): This was calculated each day by taking the entire amount of feed delivered to the birds less the total amount left over. i.e. Feed intake = (Feed offered –Total feed left over).

Intake per bird in each treatment group was estimated by dividing the total feed taken by the group by the number of quails in the replicates.

Weight gain: This was computed by determining the difference between the body weight at that particular growth stage and the bird's starting weight before the feeding trial.

Total weight gain (WG) = Subsequent weekly weight - Original body weight at day one

$$\text{Average weight gain} = \frac{\text{total weight gain of the birds}}{\text{number of birds}}$$

$$\text{Average Daily Weight Gain: } \frac{\text{Total Weight Gain}}{\text{Total number of days of feeding trial}}$$

$$\text{Average Daily Feed Intake: } \frac{\text{Total feed intake per day}}{\text{Total number of days of feeding trial}}$$

Feed Conversion Ratio (FCR): This was determined as the ratio between feed intake and weight gain.

$$\text{FCR} = \frac{\text{Total feed intake}}{\text{Total weight gain}}$$

Blood Sample Collection and Analysis.

Three birds were randomly chosen and slaughtered from each replication on the sixtieth day of the feeding study. Bottles containing ethylene diamine tetra-acetate (EDTA) and those without EDTA were used to collect blood samples. Using the method outlined by [14], the samples were subjected to laboratory analysis for the determination of hematological parameters such as Red Blood Cell (RBC) and White Blood Cell (WBC) counts, haematocrit/packed cell volume (PCV), haemoglobin (Hb) content, and absolute differential leucocyte count namely neutrophil, eosinophil, lymphocyte, monocytes, and basophil value. Utilizing conventional formulas the mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) values were determined.[15]

Blood serum was collected from the coagulated sample within the EDTA-free bottles for analysis of hormones and biochemicals. Parameters of interest include blood glucose, total protein, albumin, globulin, alanine aminotransferase, aspartate aminotransferase, and alkaline phosphatase amongst others. The total protein and serum glucose were determined spectrophotometrically using a commercial kit and adhering to the manufacturer's instructions.[16,17] Cholesterol level was also assayed through the spectrophotometric methods.[18] Alanine Transaminase (ALT), Aspartate aminotransferase (AST) and Alanine phosphatase (ALP) were determined.[19] Urea was determined by urease method and creatinine, through Folin-Wu filtrate methods. Albumin was determined using the BCG (Bromocresol green) method[20] while the globulin was calculated from the difference between the serum albumin and total protein values.

Table 1: Gross Composition of the Basal Diet

Ingredients	Quantity (%)
Maize	50.00
Soya bean meal	25.00
Groundnut Cake	12.45
Bone meal	2.00
Palm Kernel Cake	6.00
Corn bran	2.00
Limestone	1.50
Methionine	0.25
Lysine	0.30
Premix	0.25
Salt	0.25
KaFM	±
Total	100.00
Calculated Nutrients	
ME (Kcal /kg)	2914.23
Crude Protein	22.34
Ether Extract	3.91
Crude Fibre	3.77
Available Phosphorus	0.41
Calcium	1.14

ME = Metabolizable Energy KaFM = *Kigelia africana* Fruit Meal

Carcass Characteristics

Twelve birds with each group's representative weight were chosen at random to assess the carcass. These birds were weighed before bleeding and the bled weights were noted. Evisceration was done and the eviscerated weights were equally recorded. Measurements of the following parts were then made: head, carcass weight, thigh, shank, breast, drum-stick, wings, neck, gizzard and proventriculus. The carcass weights were expressed relative to the live weights.

 ISSN 2955-1226 (Print)
ISSN 2955-1234 (Electronic)

Organoleptic Properties of Meat

The final day of the investigation saw the performance of sensory analysis employing a double-blind approach. Meat samples from the breast were coded with random digits, boiled for fifteen minutes in coded nylons, and then cooled before being given to panelists for testing. Samples from the four treatments were presented simultaneously to ten invited nonallergic panelists The variables of the organoleptic test taken were colour, flavour, texture, juiciness, tenderness and overall acceptability. These qualities were rated from 1 to 9 on a hedonic intensity scale.

Each panelist received a single serving of the meat samples randomly on paper plates. Water, crackers and mineral water at room temperature were also provided to remove residual flavor between the samples. Each panelist tasted one meat per treatment and was altogether guided by grading one sample at a time while determining the sensory characteristics of the meat.

Data analysis

The SAS software package's one-way ANOVA was used to analyze the data. Using the same software program, Duncan's Multiple Range (DMR) test was used to differentiate statistical means.[21, 22] The laboratory analyzed the proximate content of a sample of the experimental diets using the methods specified by the AOAC.[23] The calculated metabolic energy (ME) matched the prediction of Pauzenga's equation.[24]

Result and discussion

Nutritional composition of sausage (Kigelia africana) fruit meal

The proximate composition of processed Sausage fruit meal is presented in Table 2. The values obtained for the sample collected showed 5.69 % crude protein, 5.02 % crude fat, 7.02 % fibre content and 5.0 %) ash content. Moisture content and the calculated metabolizable energy were 7.02 % and 2934.59 Kcal/Kg respectively. The proximate composition of KaFM is similar to the observation of Ojediran et al. [10]. It is low in moisture, protein, ether extract and ash content. The fibre content in this study is higher than that reported by Ojediran et al.,[10]. The discrepancies in results could be attributed to the age of the plant, species, method of processing or geographical location. The moisture content demonstrates a good shelf life needed for storage.[25] The protein content is lower than *Jatropha curcas* kernel meal[26], and *Cajanus cajan*.[27]

Growth Performance

Table 3 displays the growth results of Japanese quails given different concentrations of KaFM supplement. Significant differences (P>0.05) were noted in the age at first lay, feed conversion ratio, final weight, total weight growth, and average daily weight gain, as well as in the feed intake (total feed intake, average feed intake, and average daily feed intake) between the groups. Birds fed dietary treatment B had the best final weight gain value of 160 ±0.31 which was significantly similar to that of the control (157.30 ±1.47). The lowest final weight gain was observed in dietary treatment C (150.35 ±0.77) while dietary treatment D had 150.35 ±1.76.

The control A, consumed more feed (8.63 ±92.08) when compared to others fed KaFM-containing diets. Dietary group B had the lowest intake (7.97 ±142.60) and the best feed conversion ratio (FCR) value of 4.53 ±0.10 as against A, C and D which had 5.15 ±4.60, 5.12 ±0.34 and 5.00 ±0.08 respectively. Birds fed the control diet A reached laying age earlier (39.00 ±0.00) than others in dietary groups B, C and D which recorded 40.50 ±0.28, 39.50 ±0.28 and 40.00 ±0.57 respectively. No significant influence (p>0.05) was observed in the birds' initial weights, egg's weights at first lay and in the growth values of birds after the period of active growth.

Although quails require less feed than chicken,[2] Feed intake parameters, observed for the control (A) in this study were higher in comparison to those on B, C, and D. This might be brought on by the amount of fiber in sausage fruit meal. According to Akinfala et al. [28], group A's greater feed consumption may also be explained by their need to meet their energy needs. The weight gain of each bird throughout time, including TWG ADWG, and FWG was more favorable for nutritional treatment (B), which had a 0.1% inclusion level. This observation possibly suggests that KaFM contained certain nutrients that are required in minute quantities in diets. Furthermore, the age at first lay was observed to be influenced in all the groups. The differences observed in the values across the four groups showed significant differences based on the computation of Analysis of variance, however, seeing that the control group reached laying age at a much earlier date could mean that the test ingredient can delay laying age of birds. This can be attributed to the active ingredients or phytogenic material and the level of inclusion used. It therefore suggests that KaFM may delay the sexual maturity of females.

Although the feed intake was prominent in quails of groups A, C and D, results on feed conversion ratio showed a better feed utilization for birds in group B, than others. It is however likely that the weight-lowering effects of high doses of KaFM in the treated group C and D were because of the anti-nutrients present or excessive availability of certain micro-nutrients which resulted in poor feed utilization as expressed in weight loss. This is contrary to the observation of Alagbe et al., (2024)[29] on the use of *Uvaria chamae* leaf meal. The rate of feed conversion results were in line with the research of Edache et al. [30], which involved feeding quails varying amounts of yam peel. These results, however, conflicted with those of Guluwa et al.[31], who found no discernible difference in Japanese quails fed varying amounts of water-soaked sweet orange peel meal.

In general, based on our current findings as presented in the results, weekly weight gains of Japanese quail only showed differences in the first three weeks of the feeding trial. This therefore suggests that body weight gain or development in quails is achieved within the first five weeks post-hatching.

Table 2: Proximate Composition of Sausage (*Kigelia africana*) Fruit Meal

Parameter (%)	Crude protein	Fat	Moisture	Fibre	Ash	ME (kcal/kg)
KaFM	5.69	5.02	7.02	19.01	5.00	2934.59

ME = Metabolizable Energy KaFM = *Kigelia africana* Fruit Meal

Table 3: Growth parameters of Japanese quail fed varying level of *Kigelia africana* fruit meal additive within 1–21days

Parameters	A	B	C	D	SEM	P-value
Initial weight (g/b)	73.25	72.25	73.00	72.25	0.46	0.85
Final weight (g/b)	157.30^{a}	160.35^{a}	150.35^{b}	150.35^{b}	1.13	0.00
Total weight gain (g/b)	84.05^{b}	88.10^{a}	77.35^{c}	80.60^{bc}	1.16	0.00
ADWG (g/b/d)	4.00^{b}	4.19^{a}	3.68^{c}	3.84^{bc}	0.05	0.00
Total feed intake (kg)	8.63^{a}	7.97^{b}	7.91^{b}	8.06^{b}	89.31	0.00
ADFI (b/g/d)	20.55^{a}	18.99^{b}	18.85^{b}	19.19^{b}	0.21	0.00

ISSN 2955-1226 (Print)
ISSN 2955-1234 (Electronic)

Feed conversion ration	5.14^{a}	4.53^{b}	5.12^{a}	5.00^{a}	0.32	0.01
AGEFL (days)	39.00^{b}	40.50^{a}	39.50^{ab}	40.00^{ab}	0.85	0.03
EGWFL (g/b)	8.50	8.00	8.00	8.00	0.61	0.63

^{a,b,c} – means with distinct superscripts on the same row indicate a substantial difference (p< 0.05).
No significant influence was observed in the growth values of birds (p>0.05) after the first 21days of the experiment. SEM: Standard error of mean, ADWG: average daily weight gain, ADFI: average daily feed intake, g/ b: gram per bird per day, AGEFL: Age at first lay, EGWFL: Egg weight at first lay, g/b: gram per bird per day.

Blood profile

Table 4 shows the haematological characteristics of quails given different amounts of processed sausage fruit meal inclusion. All hematological measures, including white blood cells (WBC), red blood cells (RBC), hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and neutrophils, showed significant differences (p <0.05).

Values obtained for PVC showed a linear reduction from quail-fed diet A to D as A had the highest value of 54 ±0.86 % and D, 41.00 ±1.73 %. However, values obtained for quails offered diets A to C were significantly similar (p <0.05). A similar trend was observed in the values for mean corpuscular volume (A, 108 ±0.00 fL and D, 95.50 ±0.28 fL), mean corpuscular haemoglobin (A, 35.50 ±0.28 pg and D, 31.00 ±0.00 pg), and mean corpuscular haemoglobin concentration (A, 33.25 ±0.43 pg and D, 32.65 ±0.02 pg).

Quadratic effect was seen in red blood cells' (RBC) values, as birds fed dietary treatment C had the highest value of 5.15 ±0.02 ($\times 10^{12}$/L) which was significantly similar to that of A (5.05 ±0.85 $\times 10^{12}$/L). Dietary treatment D had the lowest value (4.30 ±0.17 $\times 10^{12}$/L) and was significantly not dissimilar to the values obtained for group B (4.85 ±0.31 $\times 10^{12}$/L).

WBC values were significantly influenced (P < 0.05) such that birds fed diets A, had the highest count (67.25 ±2.91 $\times 10^{9}$/L) and B had the least (42.00 ±3.75 $\times 10^{9}$/L). However, B value (42.00 ±3.75 $\times 10^{9}$/L) was similar significantly to C (51.80 ±0.17 $\times 10^{9}$/L). Neutrophils values were also significantly influenced with C having the highest (41.50 ±11.25 %) and A having the lowest (5.50 ±0.28 %). Conversely, highest value was observed for lymphocyte counts in dietary treatment A (94.50 ±0.28 %) while the least value was seen in C (57.00 ±10.96 %). Dietary treatments B and D recorded 91.00 ±1.73 % and 80.50 ±0.86 % respectively. The haemoglobin value shows that quails fed 200g SFM had the highest value (18.10 ±0.23 g/dl) but were not significantly similar to A (18.00 ±0.46 g/dl) and B (17.10 ±1.21 g/dl). D had the lowest value (13.40 ±0.57 g/dl) and differed significantly from other treated groups.

Except for Aspartate aminotransferase (AST), Tri-glyceride (TRG), and Albumin (ALB), none of the serum metabolites (Table 5) were substantially impacted (P>0.05). The AST values demonstrate that the quails fed diets B through D had higher (P<0.05) values than quails on the control diet. Diet C had triglyceride readings ranging from 93.00 to 148.00 mg/dl. ALB showed a significant difference (P<0.05) for birds fed diets B and C, but the other diets were equivalent. The serum findings also demonstrate a linear rise in urea and creatinine levels, with control remaining at the lowest value.

According to Akinrotimi et al. [32], hematological tests are a useful method for assessing health status and identifying physiological changes brought on by stressful situations such as being exposed to toxins and pollutants. In line with the results of Idowu et al. [33], who assessed the toxicity effect of *Kigelia africana* aqueous extract on the haematology and histopathology of juvenile Nile tilapia (*Oreochromis niloticus*), the PCV values obtained showed a linear decrease as the inclusion level of sausage fruit meals increased but within normal range. It was proposed that this resulted from the harmful potentials of *K. africana*'s aqueous extract on *O. niloticus* blood as the extract's concentration rose. This was also consistent with the findings of Adakole [34], who noted a similar pattern in fish exposed to toxins. Additionally, according to Eriegha et al. (2017)[35], the PCV values of all fish exposed to the toxicants were lower than those of healthy fish receiving the control treatment.

It has been suggested that haemoglobin, which is closely linked to the blood's ability to bind oxygen, is a key indicator of survivability. The results of this investigation showed that the dissolved oxygen and hemoglobin values varied, with the group with the highest SFM inclusion level having the lowest hemoglobin value—13.40 g/dL. This negated the findings by Mnisi *et al.* (2018)[36] which gave the normal Haemoglobin value for quails to be within 7.57-15.00 g/dL, as the control group in this report had 18.00 g/dL value. A drop in dissolved oxygen levels is correlated with a drop in hemoglobin levels. According to Ali et al. (2008)[37], toxicants' effects on blood are the reason of this.

Interestingly, there was a substantial difference in the WBC counts, with observed values rising as the KaFM inclusion level increased. Changes in defense mechanisms against *Kigelia africana*'s hazardous potentials may be the cause of this.[38] The study's hematological results did not match those of Atawodi and Olowoniyi (2015)[39], who found no change in hematological variables in male Wistar albino rats given water-soluble anti-diabetic polyherbal extract ADD-199, which contained three other plants in addition to *Kigelia africana*, at daily doses of 100 or 500 mg/kg body weight for 30 days. This negation however may result from the antagonistic effects of the various plants in the polyherbal preparation.

According to Mitruka and Rawnsley (1977)[40], MCV is a crucial characteristic that controls erythrocyte cell size and, as a result, plays a significant role in determining a bird's capacity to endure extended oxygen famine. This study observed significant but decreasing MCV values with an increase in SFM inclusion level across the groups as the control had the highest value of 108.00 and group D (with 300g/100kg feed inclusion level) had 95.50.

In this study, SFM additive had a positive relationship with the inclusion levels on WBCs and RBCs. This study therefore agreed with Alagawany *et al.* (2020)[41] who observed improved WBCs and RBCs in quail supplemented with Chia oil and also Pravda *et al.,* (1996)[42] who reported normal MCV and MCH ranges for quail, to be 88.24-433.96 μm^3 and 25.27-104.62pg MCH respectively. This study, however, disagreed with the RBC ranges of 1.06-4.34 x 10^6 RBC/µL (Pravda *et al.,* 1996)[42] as the observed value for the control group was 5.05x10^6 RBC/µL. Additionally, the values for neutrophils and lymphocytes differed significantly (p<0.05).

The serum metabolite values observed are consistent with the findings of Humayun et al. [43]. Although fluctuations in metabolism during the experiment cannot account for all of the important data acquired in this investigation, similar findings are presented. Aspartate aminotransferase, or AST, is found in red blood cells, cardiac and skeletal muscle, and is frequently linked to liver parenchymal cells. Glucogenic amino acids are transaminated by AST enzymes to generate glucose. The cytoplasmic enzyme known as alanine aminotransferase is responsible for catalyzing the conversion of L-alanine and α-ketoglutarate into glutamate and pyruvate.[44] Hepatocellular illness might be suggested by noticeably elevated AST concentrations in birds.[45] According to the pathological findings in this study, which show increased numbers of Kuppfer cells in the liver and fibrosis in the portal area, the apparent rise (P<0.05) in the AST and ALT levels may be the outcome of liver damage.[46] Comparing all *Kigelia africana* fruit meal diet treatment groups to the control, a dose-dependent significant rise in blood creatinine and urea values was also noted. The diet was found to have a major impact on either the AST or ALT activity. As observed in the treated groups, increased levels of AST can indicate organ damage, hepatic illness, muscular dystrophy, and myocardial infarction. Hepatitis is one of the many hepatic disease conditions that cause elevated ALT levels. Bacterial infections in the abdomen, liver or bone disease, and congestive heart failure can all be causes of elevated alkaline phosphatase (ALP). Lesions to liver and heart may be the cause

 ISSN 2955-1226 (Print)
ISSN 2955-1234 (Electronic)

of the increased mean AST and ALT values found in this study.[47] Ashour et al. [48] and Taib et al. [49] both report similar changes. According to microscopic analysis of the kidneys, the increase in creatinine and urea values may be the result of severe renal parenchyma injury, which may have impeded glomerular infiltration. According to Patra et al. [46], proteinuria brought on by renal injury and decreased liver function may be the causes of the drop in blood albumin levels from B to D.

Table 4: Haematological indices of Japanese quails fed diets containing *Kigelia africana* fruit meal additive

Parameters	A (control)	B (0.1%)	C (0.2%)	D (0.3%)	SEM	P-Value
Packed cell volume (%)	54.50^{a}	53.50^{a}	52.00^{a}	41.00^{b}	1.89	0.01
Red blood cell ($\times 10^{12}$/L)	5.05^{a}	4.85^{ab}	5.15^{a}	4.30^{b}	0.12	0.02
Mean corpuscular volume (fL)	108.00^{a}	107.00^{a}	104.00^{b}	95.50^{c}	1.52	0.00
Mean corpuscular hemoglobin (pg)	35.50^{a}	35.50^{a}	35.50^{a}	31.00^{b}	0.58	0.00
MCHC (%)	33.25^{ab}	32.90^{b}	33.85^{a}	32.65^{b}	0.18	0.04
White blood cell ($\times 10^{9}$/L)	67.25^{a}	42.00^{c}	51.80^{bc}	61.20^{ab}	3.35	0.01
Neutrophils (%)	5.50^{b}	8.50^{b}	41.50^{a}	19.50^{b}	4.91	0.01
Lymphocytes (%)	94.50^{a}	91.00^{a}	57.00^{b}	80.50^{a}	5.01	0.01
Haemoglobin (g/dl)	18.00^{a}	17.10^{a}	18.10^{a}	13.40^{b}	0.65	0.01

[a,b,c] – means with distinct superscripts on the same row indicate a substantial difference (p< 0.05). SEM = Standard Error of Mean. MCHC: Mean corpuscular hemoglobin concentration. A = Diet 1 (No test ingredient (KAFM) added), B = Diet 2 (Basal diet + 100g KAFM), C= Diet 3- (Basal diet + 200g KAFM), D= Diet 4 (Basal diet + 300g KAFM).

Table 5: Serum Biochemistry of Japanese Quails fed *Kigelia africana* fruit meal additive

Parameters	A	B	C	D	SEM	P-value
ALT (U/L)	23.00	23.50	26.00	25.50	0.61	0.24
AST (U/L)	85.50^{b}	107.00^{a}	115.00^{a}	123.50^{a}	4.87	0.00
ALP (U/L)	29.50	38.00	37.50	32.50	2.27	0.55
Urea (mg/dl)	11.00	12.00	12.50	15.00	0.68	0.20
Creatinine (mg/dl)	0.55	0.60	0.70	0.65	0. 04	0.70
Total protein (g/L)	26.00	26.00	23.50	25.50	0.54	0.35
Cholesterol (mg/dl)	201. 00	207.50	187. 00	238. 00	15.11	0.73
Triglyceride (mg/dl)	133.50^{ab}	112.50^{bc}	93.00^{c}	148.50^{a}	7. 04	0.00
Albumin (g/dl)	13.50^{ab}	16.00^{a}	11.00^{b}	12.50^{ab}	0.75	0.09
LDL(mg/dl)	138.00	151.50	134.00	159.50	12.24	0.90
HDL(mg/dl)	37.00	37.50	38.00	41.00	1.06	0.60

[a,b,c,] – means with distinct superscripts on the same row indicate a substantial difference (p< 0.05).
SEM - Standard Error of Mean, AST – Aspartate aminotransferase, ALT - Alanine aminotransferase, ALP-Alkaline phosphate, HDL- High-Density Lipoprotein, LDL- Low-Density Lipoprotein.

Carcass weight

The carcass parameters of Japanese quail offered processed *Kigelia africana* fruit meal are displayed in Table 6. A statistically significant lack of influence (P>0.05) was noted for indices including drum stick, thigh weight, wing weight, live weight, dressed weight, shank weight, neck weight, breast weight, back weight, and abdominal fat. The addition of KaFM to the diet did, however, significantly (P<0.05) affect the bled weight and carcass weight. The progressive increase observed in the live weights of groups B, C and D could not be blamed on anything, as the analyzed energy contents in these diets were lower than the control (A). Additionally, the results regarding the features of the carcass matched those of Abang et al. [50]. Our results, however, are at odds with those of Sabow et al. [51], who observed that there was no discernible variation in the percentage of eviscerated weights in Japanese quails that were fed powdered *Lactuca serriola*. On the other hand, the incredibly high fiber content in KaFM may be the reason for the lower fat amounts in groups B–D as opposed to control (A). This could imply that the component promotes the deposition of lean muscle.

Sensory properties of meat

The analyzed panelists' response on the sensory properties of quail's fed KaFM additive is shown in Table 7. While color, tenderness, and overall acceptability varied considerably (P<0.05) amongst the treatment groups, flavour, juiciness, and texture did not differ significantly (p>0.05).

The observed colour for dietary group B (6.14 ± 0.27), C (7.16 ±0.32) and D (6.33 ±0.51) were comparable (P<0.05) with C having a higher value; whereas A had the lowest value (3.66 ±0.44) which also differs significantly from other groups. Birds fed diets A, B and D showed significantly similar values on meat tenderness (P<0.05), with D obtaining the lowest grading (5.66 ± 0.48) and C, recording the highest but significantly (P<0.05) dissimilar value of 7.66 ±0.22. Similarly, the best overall acceptability value (8.16 ±0.20) was observed at group C, whereas acceptability observations for birds in dietary groups A to C did not differ (P<0.05) from each other.

Food's color can either improve or decrease the acceptance of the dish among panelists, as shown by Goldberg et al.[52]. Customers can directly observe these sensory attributes for the first time. This is because consumers like healthful products with good eating quality.[53] Food color can be determined by factors such as pigments, [54] how heat affects sugar (caramel), and whether or not additional ingredients are

 ISSN 2955-1226 (Print)
ISSN 2955-1234 (Electronic)

blended.[55] Panelists may be visually drawn to it and be prompted to rate or like/dislike any food item based on their impression.

In present studies, meat colour observation across the groups showed the influence of KaFM additives. The notably elevated values seen in groups B, C, and D relative to the control indicate the component's potential to enhance the visual attractiveness of meat-based items. This shows that

Food and taste receptors interact chemically in a convoluted and sophisticated process to produce food's taste sensations on the tongue. This guarantees that a favored dish that was previously ingested is recognized via perception.[56] The test ingredient had no discernible effect on the study's findings regarding flavor, juiceness, or texture. This was consistent with findings published by Ayanwale et al. [57] in broiler chickens fed rice bran treated with sodium chloride in place of corn offal and Ojediran et al., [58] on the suitability of cassava root meal in quail diet. Lawrie [59] notes that while the animal's age may have an impact on flavor, the amount of fat in the carcass may determine juiciness. Meat's ability to hold water and its amount of intramuscular fat are closely correlated with its juiciness. Among other poultry birds, quail meat has the least amount of water lost when cooking, according to Akinwunmi et al. [60]. It is therefore more succulent and soft than others. KaFM inclusion probably accounts for the statistical decrease in juiciness values as observed in the current study, particularly, as the inclusion level increases.

According to Ashie et al. [61], tenderness is a crucial quality factor that customers consider when evaluating meat quality. The findings of Agu et al. [62], who observed a substantial difference when comparing the tenderness of broilers supplied dietary levels of ginger root meal, were consistent with the observations made here regarding tenderness. Although, the overall acceptability observed in the current findings was enhanced by KaFMA, there was no statistical dissimilarity in the observed values up to 0.2% inclusion level. This therefore suggests that the dosage of dietary KaFM had little influence on the decisions of panelists to either accept or reject the samples. However, natural products like KaFM have therapeutic values.[63]

Conclusion

Seeing that Japanese quails fed 0.1% achieved the best feed-to-gain ratio (FCR), final weight and the best results on organoleptic characteristics on appearance, tenderness and acceptability when compared with the control; it is safe to conclude that at low dosage, KaFM could enhance growth performance and meat acceptability. The study similarly submits that dietary inclusion of KaFM up to 0.3% could delay female sexual maturity. We therefore recommend KaFM as a feed additive for poultry consumption at 0.1% for best performance on growth and sensory properties. Further studies should however be carried out to determine the optimum level for other class of livestock.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

References

1. Delgado C, Rosegrant M, Steinfeld H, Ehui S, Courbois C. Livestock to 2020: the next food revolution. Food, Agriculture, and the Environment Discussion Paper 28. International Food Policy Research Institute, Washington DC. 1999.
2. Ijaiya AT, Aremu A, Egena SSA, Jiya EZ, Akinwale MO, Malik AA. Mamman H. Growth response and egg production of japanese quails (*Coturnix coturnix japonica*) fed diets containing varying levels of fermented cassava (*Manihot esculenta*) Peel Meal. 19th European Symposium on Poultry Nutrition held between 26th –29th August, 2013 at Potsdam, Germany. 2013.
3. Ani AO, Okeke GC, Emeh MB. (2009). Response of growing Japanese quail (*Coturnix coturnix japonica*) chicks to diets containing different energy and protein levels. Proceedings 34th Annual Conference Nigeria Society for Animal Production 15th – 18th March, Uyo, 2009; 328 – 331p.
4. NRC. Quail. In: Micro-livestock's – Little known small animals with a promising economic future. *National Research Council, Academy Press*, Washington D.C. 1991; 147-155p.
5. Hemid AFA, Abd El-Gaward AH, El-Wardany I, El-Daly EF, Abd El-Azeem NA. Alleviating effects of some environmental stress factors on productive performance in Japanese quail laying performance. *World J. Agric Sci.*, 2010; 6:517–524.
6. Ijaiya AT, Aremu A, Alabi JO, Tiya EZ, Malik AA., Chakwen SJ, Onyemerekwe, CDA. Replacement value of millet for maize in practical diet fed to Japanese quail chicks. *Nig. J. Poult Sci.*, 2009; 6:1–16.
7. Abioye AIR, Duru FIO, Noronha CC, Okanlawon AO. Aqueous extract of the bark of *Kigelia africana* reverses early Testicular damage induced by methanol extract of *Carica papaya*. *Niger. J. Health Biomed Sci,* 2003; 2(2):87-89.
8. Owolabi OJ, Omagbai EKI. Analgesiac and anti-inflammatory activities of the ethanolic stem bark extract of *Kigelia africana* (Bignoivaceae). *Afr. J. Biotechnol.*, 2007; 6: 582-589.
9. Atawodi SE, Olowoniyi OD. Pharmacological and Therapeutic Activities of *Kigelia africana* (Lam.) Benth. *Annu Res. Rev.Biol.,* 2015; 5(1):1-17.
10. Ojediran TK, Emiola IA, Durojaye V, Alagbe OJ. Proximate, vitamin and GC-MS profiling of *Kigelia africana* fruit powder. *Cerrado: Agr. and Biol. Res.,* 2024; 1(1): 13-9.
11. Ojediran TK, Alagbe OJ, Durojaye V, Emiola IA. Analysis of *Kigelia africana* (Lam.) Benth. fruit powder's antioxidant and phytochemical properties. *Braz. J. Sci.*, 2024; 3(7): 38-49.
12. Mann A, Gbate M, Umar AN. Medicinal and economic plants of nupeland, *JubeEvans Books and Publications*, Bida. 1st Edition; 2003; 277.
13. Otimenyin SO, Uzochukwu DC. (2012). Spasmolytic and Anti-diarrhea effects of the bark of *Erythrina senegalensis* and root of *Kigelia africana*. *Asian J. Pharm Clin. Res.*, 2012; 3(4):11-14.
14. Ojediran TK, Emiola IA. Effect of processing and level of inclusion of processed-fermented *Jatropha curcas* (L.) kernel meals on the performance of starter broiler chicks *Trop. Agric.* (Trinidad), 2018; 95(1):55-66.
15. Ojediran TK, Olayeni TB, Shittu MD, Ogunwemimo OT, Emiola IA. (2015). Residual antinutrients in differently processed *Jatropha curcas* kernel meals: Effect on Blood Parameters and gut Microbes of Broilers Chicks. *Int. J. Appl. Res. Technol.*, 4(1):29-38.
16. Tietz, NW. Clinical guide to laboratory test, 3 edition. W.B. Sanders company, Philadephia. 1995; 518-519.
17. Barham D, Trinder P. An improved colour reagent for the determination of blood glucose by the oxidase system. *Analyst,* 1972; 97: 142-145.
18. Donmas BT, Watson BT, Biggs HC. Albumin standard and the measurement of serum with Bromo Cresol Green. *Clin. Chim Acta,* 1971; 31: 87-96.
19. Schmidt E., Schmidt F. W. (1963). Determine of serum glutamic oxaloacetic and glutamic pyruvic transaminase. *Biol. Clin*. 1963; 3: 1.
20. Peters T, Biomont CT, Doumas B1. Frotein (total protein) in serum, urine and cerebrospinal tluid, albumin in sernum: in selected methods of clinical chermistry, 1996.

21. SAS. SAS/STAT Guide for personal computers version and Edition. *Cary, North Carolina, SAS Institute*; 2000.
22. Duncan DB. Multiple range test and F-tests. *In Biometrics,* 1955; 11:1-42.
23. AOAC. Official methods of analysis (19th Ed). Association of Official Analytical Chemists, Arlington, VA. 2002.
24. Pauzenga U. Feeding Parent Stock. *Zootech Int*. 1985; 22-25.
25. Alagbe JO. Characterization of bioactive compounds in *Luffa aegyptiaca* leaf ethanolic extracts using gas chromatography and mass spectrometry (GC-MS). *Food Sci. Appl. Microbiol. Reports,* 2022; 1(2), 21-28.
26. Ojediran TK, Emiola IA. Consequences of defattening and cooking on the proximate and mineral composition of *Jatropha curcas* Kernel Meal. *Int. J. Phytofuels Allied Sci.*, 2012; 1(1):27-34
27. Abioye AA, Ojediran TK, Emiola IA. Fermented African yam bean (*Sphenostylis stenocarpa*) and pigeon pea (*Cajanus cajan*) seed meals: Effect of residual anti-nutrients on the blood profile, organ weight and carcass characteristics of broiler chickens. *IOSR J. Agric. Vet. Sci. (IOSR-JAVS)*, 2007; 10(12), 1-7.
28. Akinfala EO, Aderibigbe AO, Matanmi O. Evaluation of the nutritive value of whole cassava plant as replacement for maize in the starter diets for broiler chicken. *Livest Res. Rural Dev*., 2002; 14(6):44-49.
29. Alagbe OJ, Jubril EA, Matthew B, Effiong E, Ojediran TK. Supplementing broiler chicken diet with *Uvaria chamae* leaf meal: effects on immune response, gut microbial population and growth performance. *Sci. Lett.,* 2024; 12(1):10-19.
30. Edache JA, Usman M, Haruna ES, Esilonu JO, JIbrin I, Okpala EJ, Dogo IG. Replacement value of guinea corn for maize in practical diet fed to quails chicks. *Anim. Res. Int.,* 2005; 2(2):29–31.
31. Guluwa LY, Madaki YA, Machido H, Dantayi RJ, Kulokom S. Performance and carcass evaluation of quails fed graded levels of water soaked sweet orange peel meal. *Adv. Life Sci. Technol.,* 2014; 20:1-6.
32. Akinrotimi OA, Agokei EO, Aranyo AA. Changes in haematological parameters of *Tilapia guineensis* exposed to different salinity levels. *J. Environ Eng. Technol.,* 2012; 1:4-12.
33. Idowu AA, Popoola OC, Alani JO, Ipadeola A, Nwekoyo VE. (2020). Toxicity effect of *Kigelia africana* aqueous extract on the haematology and histopathology of juvenile nile tilapia (*Oreochromis niloticus*) *Agro-Sci. J. Trop. Agric. Food Environ. Ext.*, 2020; 19(1):37-42.
34. Adakole JA. Changes in some haematological parameters of the African catfish (*Clarias gariepinus*) exposed to a metal finishing company effluent. *Indian J. Sci. Technol.,* 2012; 5(4):2510-2514.
35. Eriegha OJ, Omitoyin BO, Ajani EK.. Evaluation of haematological and biochemical parameters of juvenile *Oreochromis niloticus* after exposure to water soluble fractions of crude oil. *J. Appl. Sci. Environ. Manage,* 2017; 21(6):1041-1045.
36. Mnisi CM, Mlambo V. Growth performance, haematology, serum biochemistry and meat quality characteristics of Japanese quail (*Coturnix coturnix japonica*) fed canola meal-based diets. *Anim. Nutr.,* 2018; 4(1):37–43
37. Ali MY, Abdur RK, Shakoori AR. Haematological and biochemical responses of blood of an endangered South Asian fresh water fish Tor putitora against aquatic pollution. *Pak. J. Zool.,* 2008; 40(2):123-134
38. Zaghloul KH, Omar WA. Abo-Hegab S. Environmental hazard risk assessment on *Oreochromis niloticus* and *Tilapia zillii* fish. *J. Egypt. Ger. Soc. Zool.*, 2005; 46:105-139.
39. Atawodi, S. Olowoniyi OD. Pharmacological and therapeutic activities of *Kigelia africana* fruitpowder. *Annu. Res. Rev. Biol*, 2015; 5(1), 1-7.
40. Mitruka BM, Rawnsley HM. Chemical, biochemical and haematological, reference value in normal experimental animals. Mason, N.Y. 1977; 287-380.
41. Alagawany M, Nasir M, Al-Abdullatif A, Alhotan RA, Azzam MM, Reda FM. Impact of dietary cold-pressed chia oil on growth, blood chemistry, haematology, immunity and antioxidant status of growing Japanese quail. *Ital J, Anim. Sci.,* 2020; 19(1):896-904.
42. Pravda D, Boda K, Baumgartner J, Jelinek P, Ku~insky P, Okruhlica M, Petrovska E. Haematological parameters of japanese quail (*Cotumix cotumix japonica*) kept in cages under normal conditions and exposed to long-term hypodynamy. *Acta Vet. Brno,* 1996; 65:93-97.
43. Humayun Y, Aslam A, Azeem T, Abid AS, Shah MAA, Munir MT, Umar S. (2015). Toxic effects of lead on biochemical and histological features and their amelioration by vitamin E in Japanese quails (*Coturnix coturnix japonica*). *J. Avian Res.*, 2015; 1(1): 4-9.
44. Kraft W, Dürr UM. Serum-Protein. In: Klinische Labordiagnostik in der Tiermedizin, (Ed.) Schattauer, Stuggart, Germany, 1999; 169- 200.
45. Harr KE. Clinical chemistry of companion avian species: A review. *Vet. Clin. Pathol*, 2002; 31: 140-151.
46. Patra RC, Amiya RK, Swarup D. Oxidative Stress in Lead and Cadmium Toxicity and its Amelioration. *Vet. Med. Int.*, 2011; 3: 18-27.
47. Barde IJ, Bale JO, Oladele SB, Fatihu MY, Kumbish PR, Rimfa AG, Ahmed JS, Okelowo PA. Serum biochemical changes in Japanese quail (*Coturnix coturnix japonica*) Experimentally Infected with Salmonella Enterica Servorar Gallinarium. *Afr. J.Cell. Pathol.*, 2015; 4: 42-47.
48. Ashour AERA, Yassin MM, Abuaasis NM. Ali RM. (2007). Blood Serum glucose and renal parameters in lead-loaded albino rats and treatment with some chelating agents and natural oil. *Turk. J. Biol.*, 2007; 31: 25-34.
49. Taib NT, Jarrar BM, Mubarak M. (2004). Ultrastructural alterations in hepatic tissues of white rats (*Rattus norvegicus*) induced by lead experimental toxicity. *Saudi J. Biol. Sci.*, 2004; 11: 11-20.
50. Abang FBP, Ikyume T, Ina-Ibor BO. (2016). Carcass and organ characteristics of growing Japanese quails (*Coturnix coturnix japonica*) fed diets containing boiled *Prosopis africana* seed coat meal (BPASCM). *Glob. J. Agric. Res.,* 2016; 4(6):1-6.
51. Sabow A, Abdulla N, Ahmad B. The carcass and meat quality characteristics of Japanese quail fed a diet supplemented with powdered *Lactuca seriola* leaves. *Potravinarstvo Slovak J. Food Sci.,* 2021; 15:521–527.
52. Goldberg EM, Ryland D, Gibson RA, Aliani M. House JD. Designer laying hens diets to improve egg fatty acid profile and maintain sensory quality. *Food Sci. Nutr.*, 2013; 1:324-335.
53. Nwokocha KE, Oboh G, Ademosun AO, Adefegha SA, Akindahunsi AA. Sensory qualities, nutritional properties and glycaemic indices of biscuits produced from processed Fonio Millet flour.*Trop J Phytochem Pharm. Sci.* 2024; 3(1):124-130.
54. Makinde, FM, Udo, EF, Olugbile, DD, Abiola OO. HPLC and FT-IR Analyses of Nigerian Alligator Pepper (*Aframomum melegueta*) Methanol Seed Extract. *Trop J Phytochem Pharm. Sci.* 2024; 3(3):230-233.
55. Winarno FG. Food Chemistry and Nutrition. Gramedia, Jakarta. 1997.
56. Nagodawithana T, Reed G. Enzymes in Food Processing, 3rd ed. Edited. 1994.
57. Ayanwale BA, Adama TZ, Jiya EZ. Meat yield and meat composition of broiler chickens fed sodium chloride treated rice bran as a replacement for corn offal. *Trop. J. Anim. Sci.,* 2003; 6(1):27-32.

ISSN 2955-1226 (Print)
ISSN 2955-1234 (Electronic)

58. Ojediran TK, Busari O, Olagoke OC, Emiola IA. Multi-processed cassava root meal: A suitable replacement for maize in Japanese quail diet. *Emerging Anim. Species*, 2023; 9:1-7
59. Lawrie RA. Lawrie's Meat Science. 6th Edition, Woodhead Publishing Ltd., Cambridge, England, 1998; 336.
60. Akinwumi AO, Odunsi AA, Omojola AB, Akanda TO, Rafiu TA. Evaluation of carcass, organ and organoleptic properties of spent layers of different poultry types. *Bots. J. Agric. Appl. Sci.*, 2013; 9(1):3-7.
61. Ashie INA, Sorensen TL, Nielsen PM. (2002). Effects of papain and a microbial enzyme on meat proteins and beef tenderness. *J. Food Sci.,* 2002; 67(6):2138-2142.
62. Agu EC, Okeudo NJ, Aladi NO, Okoro VMO. Effect of dietary inclusion of ginger meal (*Zingiber officinale Roscoe*) on performance, serum cholesterol profile and carcass quality of broilers. *Niger. J. Anim. Prod.,* 2017; 44(1):254-266.
63. Falodun A, Igbinosa EO. Prospects of microbial natural products and their biological entities in drug discovery. *Trop J Phytochem Pharm. Sci.* 2022; 1(1):1.