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SERUM METABOLITES AND MEAT CHARACTERISTICS OF BROILER CHICKENS FED DIETS CONTAINING MANGO SEED KERNEL

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ABSTRACT

A study was conducted to evaluate serum metabolites, haematology and meat quality traits of breast muscle of broiler chickens that were fed diets containing different varieties of mango seed kernel that was either soaked or boiled. At the eight week of the experiment, six birds per treatment were used for analysis of serum metabolites and haematological parameters while three birds per treatment were used to asssess meat quality traits. Mango seed kernel had significant effect on serum chemistry and haematological parameters of the birds. ALT and ALP were significantly ($p<0.05$) higher in birds fed control, Kanbiri boiled, mixed varieties soaked and mixed varieties boiled than in birds fed Kanbiri soaked. AST was significantly ($p<0.05$) higher in birds fed Kanbiri soaked, Kanbiri boiled and mixed varieties soaked than in birds fed control and mixed varieties boiled. Mixed varieties boiled had the lowest AST values. White blood cell count was significantly ($p<0.05$) higher in birds fed control, Kanbiri boiled, mixed varieties soaked and mixed varieties boiled than in birds fed Kanbiri soaked but there was no significant difference in white blood cell count of birds fed control diet and Kanbiri soaked The sensory assessment was in favour of the meat of birds fed the control diet and mixed varieties of mango kernel boiled. Meat of birds fed control diet and diet containing mixed varieties of mangoes boiled had better taste, colour and acceptability than other diets. Water holding capacity, cooking loss and pH was similar in breast muscle of all birds. Birds fed the control diet and mixed varieties of mango kernel boiled had better taste, colour and overall acceptability hence the mixed varieties of mango kernel boiled is recommended amongst all the differently processed kernels.

INTRODUCTION

Cost constitutes about 80% of the total cost of intensive production in the livestock industry (Esonu 2000, Tewe *et al* 2002) because of the high cost of conventional feedstuffs such as maize. Hence today, the focus in the livestock industry (involving intensive production) is on alternative feedstuff; mostly those which can either substitute directly for maize or can be included at certain level to attain a comparable quality with the conventional maize, but must not be deleterious to the animal's health (Muller *et al*., 1974). In Nigeria, tonnes of mango seed kernel are generated from the fruits annually as waste and thereby constituting environmental nuisance (Kayode and Sani, 2008). Diarra *et al*. (2011) reported that 50% and 75% of maize can be replaced by mango seed kernel in broiler chicken starter and finisher diets respectively without adverse effect on blood parameters. Most of the non conventional feeds contain anti-nutrients and toxic components such as saponins, lectins, tannins, trypsin inhibitors and cyanogenic glycosides which make them unsafe as protein and carbohydrate sources in

livestock production (Aregheore, 1992). Boiling has been reported to be an effective method of tannin reduction (Mbajunwa, 1995). Other methods of processing include soaking and sun drying. In living systems, the liver is considered to be highly sensitive to toxic agents. The study of different enzyme activities such as AST, ALT and ALP have been found to be of great value in the assessment of clinical and experimental liver damage. Necrosis or membrane damage releases the enzyme into circulation; therefore, it can be measured in serum (Hoffbrand and Pettit, 1997; Dash *et al*., 2007). Nutrition is one of the parameters that affect meat quality of which appearance may be regarded as the most important since it is very often the first impression which determines whether or not the produce will be selected for purchase. Appearance will be influenced by colour and the absence of any abnormal physical imperfections

Little information is available on the effect of feeding differently processed mango kernel on serum metabolites and meat quality of broiler chickens hence this study was carried out to determine the effect of boiled or soaked mango seed kernel on liver function enzymes, some haematological parameters and meat quality of broiler chickens.

MATERIALS AND METHODS

Experimental Design and Management of Birds

A total number of 225 day old broiler chickens were randomly allotted to five dietary treatments in a completely randomized design. The birdss were kept in a deep litter system. Feed and water was provided *ad libitum* and other routine management practices such as vaccination and maintenance of clean environment were adequately observed.

Sources and Processing of Mango Seed Kernel (MSK)

A local variety of mango seed kernel (kanbiri) and sample of different varieties (SDV) of mango seed kernel were collected within Kaduna State. The kernels were obtained by cutting the seed coat open using a knife and the kernels were subjected to either boiling or soaking. The chemical composition and antinutritional factors of the differently processed kernels is shown on Tables 1 and 2. Table 3 shows the composition of broiler finisher diets fed to the chickens in accordance to requirements (NRC, 1994).

Table 1: Chemical Composition of Differently Processed Mango Seed Kernel

Composition	KS	KB	MVS	MVB
Crude Protein (%)	6.5	7.38	7.94	7.23
Ether Extract (%)	4	4.01	3.77	3.98
Crude Fibre (%)	3.39	3.08	4.9	4.93
Ash (%)	6.26	6.15	7.02	6.23
Nitrogen Free Extract (%)	79.85	79.38	76.02	77.63
Metabolizable Energy (Kcal/kg)	3,362	3,379	3,275	3,310

KS- Kanbiri soaked; KB- kanbiri boiled; MVS- mixed varieties soaked; MVB- mixed varieties boiled

Table 2: Anti-Nutritional Factors of Differently Processed Mango Seed Kernel (MSK)

	Anti-nutritional factor %			
Processing method	**Phytate**	**Tannins**	**Cyanide**	**Oxalate**
Raw SDV Mango Seed Kernel	0.93	0.34	0.25	0.71
SDV Mango Seed Kernel boiled for 30 minutes	0.24	0.18	0.06	0.68
% Reductions of ANF of the boiled SDV Mango Seed Kernel	74.2	47.1	76	42.2
SDV Mango Seed Kernel soaked for 72hours with changing of water every 8 hours	0.28	0.24	0.04	0.64
% Reduction of ANF of the soaked SDV Mango Seed Kernel	67.9	29.4	84	9.9
Raw local variety (Kanbiri)	0.9	0.14	0.18	0.5
Local variety (Kanbiri) boiled for 30minutes	0.14	0.04	0.04	0.38
% Reduction of ANF of the boiled Kanbiri	84.4	71.4	77.8	24
Local variety (Kanbiri) soaked for72 hours with changing of water every 8hours	0.16	0.08	0.04	0.4
% reductions of ANF in soaked Kanbiri	82.2	42.9	77.8	20

ANF: Anti-nutritional factor; SDV-Sample of Different Varieties

Table 3: Composition of Broiler Finisher Diets (5-8 weeks)

	Variety and Method of Processing of Mango Seed Kernel				
Ingredients (Kg)	**Control**	**KS**	**KB**	**MVS**	**MVB**
Maize	50.00	19.40	19.40	19.40	19.40
Soya beans (full fat)	25.12	25.92	25.92	25.92	25.92
MSKM	0.00	30.30	30.30	30.30	30.30
GNC	10.00	10.00	10.00	10.00	10.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.15	0.15	0.15	0.15	0.15
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30
TOTAL	**100**	**100**	**100**	**100**	**100**
CALCULATED ANALYSES					
Crude protein (%)	20.00	20.00	20.00	20.00	20.00
ME Kcals/Kg	2923.56	2918.13	2923.72	2892.13	2902.74
Crude fibre (%)	4.10	4.20	4.00	4.60	4.70
Ether Extract (%)	8.10	7.90	7.90	7.90	7.90
Calcium (%)	1.2	1.4	1.4	1.4	1.4
Phosphorus (%)	0.96	0.89	0.89	0.89	0.89
Lysine (%)	1.0	0.93	0.93	0.93	0.93
Methionine (%)	0.30	0.24	0.24	0.24	0.24

*Biomix premix supplied per Kg of diet: Vit. A, 10,000iu;Vit D3, 2000iu; Vit E, 23mg; Vit. K, 2mg; Vit, B1, 1.8mg; Vit B2, 5.5mg; pantothenic acid, 7.5mg; Vit. B12, 0.015mg; Folic acid, 0.75mg; Biotin, 0.06mg; Choline chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1mg; Iron, 20mg; Manganese, 40mg; Selenium, 0.2mg; Zinc, 30mg; Antioxidant, 1.25mg.

Experimental Site

The study was carried out at the poultry unit of the Animal Science Department, Ahmadu Bello University, Samaru Zaria located within the northern Guinea Savannah zone.

Haematological and Serum Analysis

At the end of the growth study, 2 birds were randomly selected from each replicate fasted for 13 hours and 2 mls of blood was collected from the wing vein by inserting a sterile needle, 0.5 ml of blood was extracted into a sterile test tube containing ethylene diamine tetra acetic acid (EDTA) and analyzed for complete white blood cell count and differential count. (eosinophil, monocyte, lymphocyte, neutrophil). EDTA free bottles were used to collect 1.5 mls of blood for ALT, AST, ALP analysis. The analysis was carried out at the Ahmadu Bello University, Teaching Hospital (ABUTH).

Cooking Loss and pH

A cube of meat weighing 30 g was taken from the breast muscle of three dressed birds per treatment and cooked in moist heat in a water bath to an internal temperature of 72^{o}C, cooled to room temperature and weighed again to obtain the cooking loss. P^{H} was directly determined by inserting the digital pH meter into the breast muscle of three dressed birds per treatment.

Water Holding Capacity Meat cube of 30 g taken from the breast muscle of three dressed birds per treatment was placed between two Whattman filter papers of 90mm θ x 100 circles and placed between two glass plates and a weight of 10 kg was placed on it for 30 minutes (Hamm, 1959). The difference in weight before and after the procedure represented the water loss.

Sensory Evaluation

A total number of 30 semi-trained panelists were used, 12 males and 18 females with age ranging from 22 to 28 years. The panelists were made to rate coded samples of meat using score sheet for hedonic-scale rating test. Samples were taken from three cooked birds per treatment served in odourless plastic plates. The panelists rated the samples on a four point hedonic scale for colour, taste, smell and overall acceptability.

Statistical and Laboratory Analysis

All data obtained from the study were subjected to Analysis of variance (ANOVA) using SAS (2002) in a Completely Randomized Design. Duncan Multiple range test (DMRT) was used to seperate the means. The chemical composition and anti-nutritional factors analysis was carried out in the biochemical laboratory of the Department of Animal Science, A.B.U, Zaria.

RESULTS AND DISCUSSION

Table 1 shows the result of chemical analysis of differently processed mango seed kernels. The gross energy is within the range of 2,999 kcal/kg and 3,404 kcal/kg reported by Awoniyi *et al.*, (2000) which is comparable to the gross energy of maize and thus can be utilized as a source of energy. The high NFE values (76 – 79.35%) also indicate its high energy content.

Table 2 shows the anti nutritional factor composition of mango seed kernel which are phytate, cyanide, tannin, oxalate. The result obtained shows decrease in the anti-nutritional factor with processing method. Boiling reduced most of the anti-nutrients of both boiled mixed variety and Kanbiri variety than soaking but cyanide content of mixed variety MSK was reduced more by soaking.

Table 4 shows the result of the serum chemistry. ALT and ALP for birds fed control diet, KB, MVS and MVB was significantly ($p<0.05$) greater than that of birds fed KS. Birds fed soaked Kanbiri mango kernel diets had lower ALT and ALP values, an indication that soaking decreased the anti-nutrients in the kernel more effectively than boiling thus maintaining the integrity of the liver. Birds fed KS, KB and MVS diets had significantly ($p<0.05$) higher AST than birds fed control and MVB diets. Birds fed MVB diets had the lowest AST which could mean that this processing method was the most effective in reducing the anti-nutritional factors in this variety.

Table 4: Serum Chemistry Parameters of Broiler Chickens Fed Differently Processed Mango Seed Kernel Diets

	Variety and methods of processing of mango seed kernel					
Parameters	**Control**	**KS**	**KB**	**MVS**	**MVB**	**SEM**
ALT (IU/L)	5.08[a]	3.35[b]	4.95[a]	4.51[a]	4.22[a]	0.50
AST (IU/L)	4.80[b]	5.39[a]	5.78[a]	5.68[a]	4.13[c]	0.31
ALP (IU/L)	35.00[a]	31.83[b]	33.17[a]	32.00[a]	32.67[a]	1.47

[abc] Means within rows with different superscript are significantly differently ($p<0.05$); ALT- alanine aminotransferase; AST- aspartate aminotransferase; ALP- alkaline phosphatase KS- Kanbiri soaked; KB- kanbiri boiled; MVS- mixed varieties soaked; MVB- mixed varieties boiled

Table 5 shows the white blood cell count and differential of broilers fed mango seed kernel diets. There were significant ($P<0.05$) differences in the white blood cell, neutrophil, lymphocyte, eosinophil and monocyte counts. The white blood cell count of birds fed control, KB, MVS and MVB were similar ($p<0.05$) but significantly ($p<0.05$) greater than that of birds fed KS. Birds fed control diet and KS had similar WBC. The result shows that boiling and soaking of the mango kernels reduced the anti-nutrients to a level that had no detrimental effect on the health of the birds to necessitate an increase in the WBC count. The WBC count obtained in this study (26.33 - 31.67 (10^9/L) was higher than the average value of 25 (10^9/L) reported by Diarra and Usman (2008). This could be due to individual differences in the birds.

Lymphocyte count for birds fed control, MVS and MVB (27.5 - 33.33%) was significantly ($p<0.05$) greater than KS and KB (23.5-26.83%). There was also no significant ($p>0.05$) difference in the lymphocyte count of birds fed KS, MVS and MVB. The value for the birds fed KB was significantly ($p<0.05$) lower than the other treatments. All the values obtained were lower than range reported by Clinical Diagnostic Division (1990). The difference observed may be due to breed, environment or individual differences in the birds.

Table 5: White Blood Cell Count and Differential White Blood Cell Count of Broilers Chicken fed Diets containing Mango Seed Kernel Diets

Parameter	Control	KS	KB	MVS	MVB	SEM
WBC ($\times 10^9$/L)	28.17^{ab}	26.33^{b}	31.67^{a}	28.17^{a}	31.50^{a}	2.19
Lymphocyte (%)	33.33^{a}	26.83^{b}	23.50^{b}	29.50^{ab}	27.50^{b}	2.23
Neutrophils (%)	60.50^{b}	70.17^{a}	70.50^{a}	61.33^{b}	60.83^{b}	1.80
Eosinophils (%)	1.67^{a}	1.00^{c}	1.67^{a}	1.40^{b}	1.00^{c}	0.05
Monocytes (%)	2.00^{c}	4.33^{a}	2.50^{bc}	2.33^{bc}	2.75^{b}	0.32

^{abc} Means within rows with different superscript are significantly differently ($p<0.05$); KS- Kanbiri soaked; KB- kanbiri boiled; MVS- mixed varieties soaked; MVB- mixed varieties boiled

Table 6: Meat Quality Trait Values of Broiler Chickens Fed Differently Processed Mango Seed Kernel

Parameter	Variety and Method of processing					
	Control	KS	KB	MVS	MVB	SEM
Water holding capacity	27.00	27.00	27.00	27.00	27.00	0.19
P^H	6.35	6.30	6.30	6.44	6.44	0.03
Cooking loss	28.00	28.00	28.00	28.00	28.00	0.18

KS- Kanbiri soaked; KB- kanbiri boiled; MVS- mixed varieties soaked; MVB- mixed varieties boiled

The neutrophil count for birds fed KS and KB (70.17 - 70.0%) are similar ($P>0.05$) but significantly ($P<0.05$) lower than control, MVS and MVB (60.5-61.33%). The values obtained are higher than that reported by (Clinical Diagnostic Division, 1990). Eosinophil count for birds fed control diet and KB was significantly ($p<0.05$) greater than the other treatments but similar to MS. The value of 1% obtained for birds fed KS, MVS and MVB were a bit lower than value of 1.5 – 6% reported (Clinical Diagnostic Division, 1990) but similar to values (1 – 1.67%) reported by (Daudu, 2012). Monocyte count for birds fed KS and MVB was significantly ($p<0.05$) greater than that of birds fed control, KB and MVS. The lowest value was obtained for birds fed control. There is no consistent trend in the result obtained and therefore could be attributed to chance.

Table 6 shows the result of water holding capacity, cooking loss and pH of broilers fed mango seed kernel diets. From the results obtained there was no significant difference in ($P>0.05$) water holding capacity, cooking loss and pH. The cooking loss (28.0) is similar to values (29.69 – 30.18) reported by (Souza *et al*., 2011). Average breast pH values (6.3 - 6.35) were not affected by MSK variety or processing method. The breast is composed of glycolytic muscles, which are not often used in movements performed by the bird during the pre-slaughter period. In addition, the experimental birds did not suffer transportation stress and were submitted to the same pre-slaughter management conditions (Souza *et al*., 2011). These conditions possibly influenced the uniformity of the pH values found among the treatments in the present study. The pH values obtained in this study is higher than the values (5 – 5.78) reported by Souza *et al*., (2011) but similar to values (6.39 – 6.66) reported by (Warris *et al*., 1988). The high pH observed could be attributed to fasting of the birds as reported by Pauls *et al*. (2014).

Table 7: Sensory Evaluation of Broiler Chickens fed Differently Processed Mango Seed Kernel Diets

Attributes	Control	KS	KB	MVS	MVB	SEM
Taste	3.90[a]	3.67[b]	3.67[b]	3.30[c]	3.87[ab]	0.1
Smell	4.13[a]	3.77[b]	3.70[bc]	3.00[c]	3.63[bc]	0.09
Colour	3.97[ab]	3.47[c]	3.63[b]	3.60[b]	4.17[a]	0.09
Overall Acceptability	4.07[a]	3.43[b]	3.43[b]	3.33[c]	3.80[ab]	0.10

[abc] Means within rows with different superscript are significantly differently ($p<0.05$); KS- Kanbiri soaked; KB- kanbiri boiled; MVS- mixed varieties soaked; MVB- mixed varieties boiled

Table 7 shows the result of sensory evaluation of broilers fed differently processed mango seed kernel. The results of sensory evaluation showed a significant difference in the ($P<0.05$) parameters evaluated. The sensory assessment of the cooked meat of birds fed the control and MVB diets was significantly ($p<0.05$) better than other treatments in terms of taste, colour and overall acceptabiliy. The taste of the cooked meat of birds fed MVS was significantly poorer than the other treatments; this could be attributed to low reduction (29.4%) of tannin with soaking. The smell of the cooked meat of birds fed control was significantly ($p<0.05$) better than the other treatments; meat smell of birds fed KS, KB and MVB were similar ($p>0.05$). The lowest value was obtained in MVS. The colour of the meat of birds fed control and MVB was significantly ($p<0.05$) brighter than other treatments. The level of myoglobin in the meat will influence the "redness" colouration and specifically the balance between the various myoglobin complexes, ie oxymyoglobin will produce a characteristic bright red colour whereas metmyglobin will impart a browner colour. Low pH generally produces a pale meat colour and high pH results in a much darker colouration. It is thought that pH has its effect through its influencing the various haem reactions in the muscle which are pH dependant. With the clear involvement of pH in muscle colouration it is apparent that any of the feeding practices previously described, i.e. feed withdrawal prior to slaughter, that are designed to prevent rapid pH fall post mortem, will also affect meat colour. General acceptability of cooked meat of birds fed control diet and MVB was significantly ($p<0.05$) higher than the other treatments. The lowest value was obtained for cooked meat of birds fed MVS diets.

CONCLUSION AND RECOMMENDATION

The ALT, ALP and white blood cell count of the birds fed control, Kanbiri boiled, mixed varieties of mango soaked and boiled were similar suggesting that the differently processed mango kernels did not have a detrimental effect on the birds. Birds fed the control diet and mixed varieties of mango kernel boiled had better taste, colour and overall acceptability hence the mixed varieties of mango kernel boiled is recommended amongst all the differently processed kernels. Water holding capacity, cooking loss and pH was similar in breast muscle of all birds.

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