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Carcass and Gut Characteristics of Broiler Chicken Fed Different Energy Sources

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Abstract: The effect of feeding broiler chicken with different dietary energy sources on the carcass yield and gut characteristics was investigated. Five diets containing maize, red sorghum, white sorghum, *Gero* millet and *Dauro* millet were formulated and designated as 1, 2, 3, 4 and 5, respectively. Two hundred and ten day old marshal breed of broiler chicks were randomly allotted to five dietary treatments in a completely randomized design and each of the treatment was replicated three times. Feed and water were provided *ad libitum* and the feeding trial lasted for eight weeks. Most of the carcass and gut parameters did not differ significantly except live weight, kidney weight, plucked weight, eviscerated weight, carcass weight, kidney weight, gizzard weight ($p < 0.01$) and spleen weight ($p < 0.05$) that were affected. This study therefore reveals that using sorghum or millet in place of maize has no adverse effect on the carcass and gut characteristics of broiler chickens.

Key words: Poultry production, poultry feed, dietary energy sources, carcass yield

INTRODUCTION

The most important component of poultry production is the feed which constitute about 60-80% of the whole cost of poultry production (Daghir, 1995; Orusebio and Smile, 2001; Talha and Yaqoub, 2008), maize which form the major source of energy in poultry diet is very expensive due to low production and intense competition for its usage by man and other livestock species (Agbede *et al.*, 2002; Hamzat *et al.*, 2003), maize remain the cheap source of energy in compounded feed and constitute about 50-55% of poultry diet (Ajaja *et al.*, 2002; Afolayan *et al.*, 2002). The nutritive value of maize is comparable to that of sorghum grain (Nagra *et al.*, 1990; Hancock, 2000; Reyes *et al.*, 2000; Rama Rao *et al.*, 2002; Sannamani *et al.*, 2002; Tyagi *et al.*, 2003) and wheat (Mikkelsen *et al.*, 2008). Sorghum had slightly lower fat and energy than maize but higher values of protein, (Etuk *et al.*, 2012). The amino acid profile of sorghum compared favourably to that of maize, though the average lysine content of sorghum was tested to be 0.2% against maize which is 0.3%. Olomu (2011) gave the metabolizable energy and percent crude protein as 3270 kcal/kg and 9.5%, respectively.

Pearl millet is accepted to be the most widely grown specie of millet around the globe since pre-historic times, it is generally accepted that the crop is originated from Africa (Tornekari *et al.*, 2009). Pearl millet is well adapted to production system characterized by low

rainfall, low soil fertility and high temperature; therefore, it can be grown where other cereals cannot survive. The grain has about 11.50% crude protein and 2900 kcal/kg metabolizable energy which is close to maize (9% crude protein and 3330 kcal metabolizable energy). Therefore, pearl millet provides a very good replacement for maize in poultry feed as there is a striking resemblance in their nutrient composition, (Prasad and Panwar, 1997). Millet has been reported to contain 5-7% oil, higher protein and minerals than maize and also free from anti-nutritional factors (phytate and tannins (Cromwell and Coffey, 1998; NRC, 1996). The ultimate objective of this study was to evaluate the carcass and gut component of broiler chickens fed different energy sources.

MATERIALS AND METHODS

Experimental site: This experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Abubakar Tafawa Balewa University Bauchi, Nigeria. The State shares boundary with Yobe to the North, Jigawa to the East, to the North-West Kano to the West, Plateau, Taraba to the South and Gombe to the East. The State has a total land mass of about 49119 square metres, which represents about 5.3% out of Nigeria's total land mass 909,890 square metres (NBS, 2010). The State lies between longitude 8°50' to 11° East of the Greenwich meridian and latitude 9°3' to 12°3' North at an altitude of 600 m above sea level.

Management of the experimental birds and design:

Two hundred and Ten day old Marshall Breed of broiler chicks were obtained from Zartech limited Jos, the chicks were brooded for the period of one week on deep litter. They were fed *ad libitum* on commercial diet throughout the brooding period. Two weeks before the arrival of the chicks the experimental pen was thoroughly washed, cleaned, disinfected and dried. A week prior to the arrival of the bird's wood shaving was spread to the required length on the floor, electrical appliances, feeders; drinkers were all put in place and the electrical appliances. Upon the arrival of the chicks brooding commenced at once, heat was provided by the use of 200 W electric bulb, kerosene stove and charcoal were made available in case of power failure to provide heat intermittently. Water and feed were supplied *ad libitum* during the whole period of the trial. Routine management, vaccines and medications were administered according to the methods of Oluyemi and Roberts (2007). After the brooding period of about one week the birds were randomly allotted to five dietary treatment with 42 birds per treatment and each treatment was replicated three times with 14 birds per replicate, in a completely randomized design (CRD). The birds were fed the experimental diets for four weeks during the starter phase and four weeks during the finisher phase.

Experimental diets: Five diets containing different energy sources with maize as control were formulated; other diets consist of two varieties of Sorghum (Red and White), Millet (Gero and Dauro). The diets were designated as 1, 2, 3, 4 and 5, respectively. Maize, Sorghum and Millets were the principal sources of energy while major sources of protein in the diet were roasted full fat soya beans and fish meal. The diet were formulated to supply approximately 3000 kcal/kg ME, 23 and 20% crude protein for both starter and finisher diets respectively, methionine and lysine were used as supplement in the diet. The ingredient, chemical composition and calculated analysis of the experimental diet for both starter and finisher phases are shown in Table 1 and 2, respectively.

Statistical analysis: All the data generated during the experiment for all the parameters studied were subjected analysis of variance technique as outline by Steel and Torrie (1980). The differences between the treatment means were further separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS

The result of the carcass and gut characteristics of birds fed diets containing different energy sources are presented in Table 3. Significant difference ($p < 0.01$) was observed among the treatments for live weight (1.67 to

Table 1: Ingredients and proximate composition (%) of diets containing different energy sources fed to broiler chickens at the starter phase (1-4 weeks)

Ingredients	Diets				
	1	2	3	4	5
Maize	43.33	-	-	-	-
Red sorghum	-	46.88	-	-	-
White sorghum	-	-	46.88	-	-
Gero millet	-	-	-	45.15	-
Dauro millet	-	-	-	-	45.15
Soyabeans	35.47	32.12	32.12	33.85	33.85
Wheat offal	12.00	12.00	12.00	12.00	12.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated analysis					
ME (kcal/kg)	3087	3029	3029	2849	2849
Crude protein (%)	23.00	23.00	23.00	23.00	23.00
Crude fibre (%)	4.10	3.96	3.96	6.01	6.01
Calcium (%)	1.35	1.36	1.36	1.35	1.35
Phosphorous (%)	0.85	0.94	0.94	0.84	0.84
Ether extract (%)	8.96	8.04	8.04	8.80	8.80

Table 2: Ingredients and proximate composition (%) of diets containing different energy sources fed to broiler chickens at the finisher phase (5-8 weeks)

Ingredients	Diets				
	1	2	3	4	5
Maize	54.26	-	-	-	-
Red sorghum	-	58.43	-	-	-
White sorghum	-	-	58.43	-	-
Gero millet	-	-	-	56.27	-
Dauro millet	-	-	-	-	56.27
Soyabeans	24.74	20.57	20.57	22.73	22.73
Wheat offal	12.00	12.00	12.00	12.00	12.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated analysis					
ME (kcal/kg)	3101	3029	3029	2804	2804
Crude protein (%)	20.00	20.00	20.00	20.00	20.00
Crude fibre (%)	3.70	3.60	3.60	4.80	4.80
Calcium (%)	1.47	1.73	1.73	1.48	1.48
Phosphorous (%)	0.79	0.90	0.90	0.79	0.79
Ether extract (%)	7.50	6.30	6.30	7.20	7.20

2.35 kg). The highest live weight was recorded in birds fed diet 5 (*Dauro* millet diet), while the lowest was recorded in birds fed diet 2 (red sorghum diet). The plucked weight ranged from 1.32 to 1.93 kg however, there was a significant difference ($p < 0.01$) across the diets. The highest value was recorded in birds fed diet 5 (*Dauro* millet diet), while the lowest was recorded in birds fed diet 2 (red sorghum diet).

Significant difference ($p < 0.01$) was observed among the treatments for eviscerated weight (1.09 to 1.65 kg). The highest value was recorded in birds fed diet 5

Table 3: Carcass yield of broiler chickens fed diets containing different energy sources

Parameters	Diets					SEM
	1	2	3	4	5	
Live weight (kg)	1.79 ^{bc}	1.67 ^c	1.78 ^{bc}	1.93 ^b	2.35 ^a	0.05 ^{**}
Plucked weight (kg)	1.51 ^b	1.32 ^c	1.42 ^{bc}	1.59 ^b	1.93 ^a	0.05 ^{**}
Eviscerated weight	1.23 ^{bc}	1.09 ^c	1.17 ^{bc}	1.32 ^b	1.65 ^a	0.04 ^{**}
Carcass weight	1.12 ^b	0.97 ^c	1.05 ^{bc}	1.19 ^b	1.51 ^a	0.04 ^{**}
Dressing (%)	62.63	58.24	58.78	61.50	63.85	0.66 ^{NS}

abc, Means in the same row with different superscripts are significantly different (**: $p < 0.01$). NS: Not significant, SEM: Standard Error of the mean

Table 4: Gut characteristics (% body weight) of broiler chickens fed diets containing different energy sources

Parameters	Diets					SEM
	1	2	3	4	5	
Lungs weight (%)	0.52	0.49	0.48	0.52	0.43	0.02 ^{NS}
Kidney weight (%)	0.25 ^a	0.24 ^a	0.14 ^c	0.21 ^{ab}	0.16 ^c	0.01 ^{**}
Liver weight (%)	1.88	1.77	1.62	1.79	1.79	0.05 ^{NS}
Spleen weight (%)	0.06 ^b	0.09 ^a	0.09 ^a	0.09 ^a	0.01 ^c	0.01 [*]
Heart weight (%)	0.41	0.38	0.44	0.44	0.37	0.01 ^{NS}
Gizzard weight (%)	2.38 ^a	1.94 ^b	1.69 ^b	1.88 ^b	1.33 ^c	0.07 ^{**}
Small intestine (%)	15.57	4.97	5.39	3.58	3.64	1.49 ^{NS}
Large intestine (%)	0.23	1.18	0.19	0.18	0.21	0.18 ^{NS}
Abdominal fat (%)	1.36	0.99	1.15	1.80	1.18	0.12 ^{NS}
Caecal weight (%)	0.75	0.64	0.71	0.68	0.63	0.03 ^{NS}
Pancreas weight (%)	0.35	0.29	0.33	0.32	0.27	0.01 ^{NS}

abc, Means in the same row with different superscripts are significantly different (*: $p < 0.05$, **: $p < 0.01$). NS: Not significant, SEM: Standard Error of the mean

(*Dauro* millet diet), while the lowest value was observed in birds on diet 2 (red sorghum diet). Carcass weight varied from 0.97 to 1.51 kg however, there was a significant difference ($p < 0.01$) across the diets. The highest value was observed in birds fed diet 5 (*Dauro* millet diet), while the lowest value was observed in birds fed diet 2 (Red sorghum diet). The dressing percentage ranged from 58.24 to 63.85, however; there was no significant difference across the dietary treatment. The highest value was observed in birds fed diet 5 (*Dauro* millet diet), while the lowest value was observed in birds fed diet 2 (Red sorghum based diet). The value of the leg and head ranged from 5.78 to 6.88%. The highest value was recorded in birds on diet 2 (red sorghum diet), while the lowest value was observed in birds fed diet 5 (*Dauro* millet diet). However, no significant difference was observed across the dietary treatment. The lungs weight ranged from 0.43 to 0.52%. Birds fed diets 1 and 4 had the same lungs weights which were higher than those fed diets 2, 3 and 5. However, no significant difference was observed across the dietary treatments. Significant difference ($p < 0.01$) was observed for kidney weight (0.14 to 0.25%). The highest kidney weight was recorded in birds fed diet 1 (Control), while the lowest value was recorded in birds fed diet 3 (white sorghum diet). The liver weight ranged from 1.62 to 1.88%. The highest value was observed in birds fed diet 1 (Control), while the lowest value was observed in birds fed diet 3 (white sorghum diet). However, there was no significant

difference across the dietary treatment. Significant difference ($p < 0.05$) was observed among the treatments for spleen weight (0.01 to 0.09%). Birds fed diet 2, 3 and 4 had the same spleen weights which were higher than those fed diets 1 and 5.

The values of the heart weight varied from 0.37 to 0.44%. Birds fed diets 3 and 4 had the same heart weight which was higher than those fed diets 1, 2 and 5. However, there was no significant difference across the dietary treatments. Significant difference ($p < 0.01$) was observed for gizzard weight (1.33 to 2.38%). The highest gizzard weight was recorded in birds fed diet 1 (control), while the lowest value was recorded in birds fed diet 5 (*Dauro* millet diet). The values of small intestine varied from 3.55 to 15.57%. The highest value was observed in birds fed diet 1 (Control), while the lowest value was observed in birds on diet 4 (*Gero* millet diet). However, no significant difference was observed across the dietary treatments.

The large intestine ranged from 0.18 to 1.18%. The highest value was observed in birds on diet 2 (red sorghum diet), while the lowest value was observed in birds on diet 4 (*gero* millet diet). The abdominal fat weight varied from 0.99 to 1.80%. The highest value was recorded in birds fed diet 4 (*gero* millet diet), while the lowest value was observed in birds fed diet 2 (red sorghum diet). However, no significant difference was observed across the dietary treatments.

Caecal weight varied from 0.63 to 0.75%. The highest value was observed in birds on diet 1 (Control), while the lowest value was recorded in birds fed diet 5 (*Dauro* millet diet). However, no significant difference was observed across the dietary treatment. The pancreases weight ranged from 0.27 to 0.35%. The highest value was observed in birds fed diet 1 (Control), while the lowest value was observed in birds fed diet 5 (*Dauro* millet diet). However, no significant difference was observed across the dietary treatment for pancreas.

DISCUSSION

The result of the carcass and gut characteristics showed a very significant difference for live weight, plucked weight, eviscerated weight, carcass weight, kidney weight, spleen weight ($p < 0.05$) and gizzard weight. While other parameters observed showed no significant difference across the diets. The result of the live weight, eviscerated weight and carcass weight is in agreement with the findings of Hazim *et al.* (2011) who observed effect of different fat on carcass trait of Japanese quails. The result of the plucked weight is not in agreement with the findings of Medugu *et al.* (2010) who evaluated the effect of feeding broilers with millet, low and high tannin sorghum based diet compared with maize. The result of the kidney weight, gizzard weight and spleen weight, were also found to be significant ($p < 0.01$) and ($p < 0.05$),

this is in agreement with the findings of Rama Rao *et al.* (2005) who study performance, serum lipid profile and immune competence of broiler fed graded levels of finger millets and found significant difference for kidney, gizzard and spleen weight, this also agreed with the findings of Rama Rao *et al.* (2004) who reported significant difference in relative weight of spleen weight as influenced by variation in different energy sources. The low carcass weight observed in diet 2 (0.97 kg) and 3 (1.17 kg) may be attributed to low protein and presence of tannin in sorghum based diet which depress nutrient digestion and utilization as reported by Widodo *et al.* (1996).

Other parameters observed, Dressing percentage, Head and leg weight, lungs weight, liver weight, heart weight, small intestine weight, large intestine weight, abdominal fat weight, caecal weight and pancreases weight were not significantly influenced by the dietary treatment, this is in conformity with the result of Bai (2002) who reported no significant difference in carcass yield and abdominal fat percentage of broiler when normal maize was replaced by quality protein maize, is also in conformity with the finding of the Rama Rao *et al.* (2004) who reported that the relative weight and length of intestine were not significantly affected by variation in dietary energy sources, it also agrees with the findings of Zand and Froudi (2011) who uses corn snacks waste on the performance of broilers.

The result equally, agrees with the findings of Iliya (2008) who observed no significant difference across the dietary treatment for dressing percentage, Head and legs weight, Lungs weight, Liver weight, Heart weight, Small intestine weight, large intestine weight, Abdominal fat weight, Caecal weight and pancreases weight of broiler chicken fed graded levels of germinated red *jigari* sorghum as replacement for maize, this contradict the findings of Mohammed *et al.* (2013), high value of abdominal fat in millet based diet might be due high oil content as reported by NRC (1996). The lower values of dressing percentage was observed in the sorghum based diets which disagree with the findings of Kwari *et al.* (2014) who reported 67.19-81.29% in broilers, this may be due to low protein intake which is reported to adversely affect carcass yield and gut characteristics of broilers. The higher Dressing percentage obtained in millet based diet is close to the values reported by Salami *et al.* (2004) for well finished broilers, 65-70%, this indicates that the diets used were adequate to support good performance of broiler chickens.

Conclusion: Based on the carcass and gut parameters observed in this study, it can be concluded that millet and sorghum can be use as an alternative energy sources for maize in broiler diets without any adverse effect on the carcass and gut component of broiler chickens.

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