CARCASS AND GUT CHARACTERISTICS OF BROILER BIRDS FED SORGHUM AS A REPLACEMENT FOR MAIZE

ZAGI, S. P., *BELLO A. MUSA and AJIGHJIGH, D. T.*
Department of Agricultural Science Education, School of Vocational and Technical Education, Aminu Saleh College of Education Azare, P. M. B. 044, Bauchi State, Nigeria.
Corresponding Author's E-mail: *spzagi@gmail.com Tel: +234-7064291541*

ABSTRACT
A feeding trial was conducted at the Aminu Saleh College of Education Azare Teaching and Research Farm, Bauchi State to evaluate the dietary response of broiler birds fed sorghum in place of maize at various inclusion levels. A total of one hundred and five day old chicks were used for the study. Five experimental diets were formulated and designated as T_1 (control), T_2, T_3, T_4 and T_5. The birds were randomly allotted to five experimental treatments of twenty one birds per treatment while each treatment was replicated three times (seven birds per replicate) in a completely randomized design (CRD). The result of growth performance revealed that average daily weight gain were significantly ($p<0.05$) influenced by the dietary treatments. Birds fed 25% sorghum had superior weight gain compared with other treatments. Daily fed intake was however not influenced ($p>0.05$) by the dietary treatments. There were significant ($p<0.05$) difference in the cut parts measured except the weight of chest and wings. Birds fed 75% sorghum had lowest values in wing weight while birds fed 100% sorghum had lowest values in chest weight. Carcass weight were significantly ($p<0.05$) different across dietary treatments. Organs weight and length were not significantly ($p>0.05$) different across dietary groups except in small intestine length. It was concluded that 25% sorghum can be included in the diet of broilers without adverse effect on growth performance of broilers. However, T2 with 25% sorghum is recommended, since birds on this diet had the best performance and carcass characteristics.
Keywords: Broiler, Day-old chicks, Sorghum, Diet, Treatment

INTRODUCTION
Due to increasing meat consumption and a growing population, animal production is increasing in the world (Food and Agriculture Organization of the United Nations FAO, 2016). This increase is realized through fewer, but larger farms (large animal units and high stocking densities and with large numbers of animals per farm) in upper middle-income countries and high income countries (Lowder *et al.,* 2016). Commercialization in the poultry industry and generally in the agriculture sector has increasingly become popular in East Africa, mainly as an entrepreneurial response to income growth in the region (Katongole *et al.,* 2013). According to FAO (2013), chicken meat production in Africa between 2006 and 2013 increased steadily by almost 5% per year. With regard to number of animals, poultry production (with broilers being the most commonly reared poultry species) is one of the largest livestock sectors in the world (Silvera, 2017). Broiler production is one of the livestock industries that offers the highest turnover rate and quicker returns on investment either in small, medium or large scale production (Afolayan *et al.,* 2014). Poultry birds especially broilers play a significant role in the provision of animal protein required by man to meet his daily protein intake (Maidala and Istifanus, 2012). The increased demand of poultry meat has directed breeding focus towards a fast growing broiler with increased feed efficiency and greater final weights (Petracci and Cavani, 2012). Within the age of six weeks, female birds gain weight up to 175-200g and the males weigh between 125-150g (Akintunde *et al.,* 2017). Female births start laying eggs at 5-6 weeks of age and continue up to twenty two weeks of which the egg weighs about 9-10g (Akintunde *et al.,* 2017). There are also essential in poultry production being fundamental attributes for assessing growth and feed efficiency as well as important yardstick in management and economic decision making (Assan, 2015). This study was carried out to determine the effect of sorghum replacement for maize on the performance and carcass characteristics of broilers.

MATERIALS AND METHODS
Experimental site
The study was conducted at the poultry unit of the Department of Agricultural Science Education Teaching and Research Farm, Aminu Saleh College of Education Azare, Bauchi state.

Experimental birds and management

One hundred and five day-old broilers chicks purchased from Amo farm, Kano state were used for the seven weeks experiment. The chicks were brooded conventionally in a deep litter system using electric bulb (200wattt) as a source of heat and light. The chicks were brooded for fourteen days. Medications, vaccinations and other routine management practices as described by Abdo *et al.* (2015) were strictly followed. The birds were weighed on commencement of the experiment to obtain the initial weight and 21 birds were randomly selected and allotted to each of the five treatments of 3 replicates each (7 birds per replicate) making a total of 105 birds. The birds were fed diets containing 0, 25, 50, 75 and 100% graded levels of red sorghum, both at starter and finisher phases.

Experimental diets

The sorghum and maize used for the experiment was bought from a local market in Azare, Katagum L.G.A of Bauchi state. The dried feed ingredients were grounded using hammer mill and mixed together to homogenized, packed in a sack and stored at room temperature (Wafar and Tarimbuka, 2016). Diets were formulated by using Pearson square method. Two basic diets comprising of the starter and finisher diets were formulated. The diets were formulated in order to meet the broilers nutritional requirements, based at nutritional program recommendation by Rostagno *et al.* (2011). The nutritional and energy levels, as well as the feed composition of the diets involved in all treatments were based on the four nutritional stages (pre-starter, starter, grower and finisher). Five experimental diets were formulated using sorghum as energy source and as replacement for maize. Maize was replaced with sorghum at dietary inclusion levels of 0, 25, 50, 75 and 100% designated as T_1 (control), T_2, T_3, T_4 and T_5 respectively.

Chemical analysis

Samples of each diet fed to the birds (starter and finisher) were analyzed to determine the dry matter, crude protein, crude fibre and ether extract according to the method of AOAC (2006). The analysis was conducted at Central Laboratory Services Unit, National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria.

Data Collection

Data were collected on weekly weight changes was determined by weighing the birds on weekly basis and weight gain was calculated by subtracting the weight of the previous week from that of the current week. The feed intake was determined by subtracting the left-over feed from the feed offered, while feed conversion ratio was calculated as average feed intake divided by average /weight gain. The mortality was recorded daily and the weights of all the dead birds were taken in order to minimize an error in feed conversion ratio. It was expressed as percentage mortality at the end of the experiment for corresponding treatment group.

Statistical Analysis

The experimental design was completely randomized design. The data obtained from the study were subjected to analysis of variance (ANOVA) procedure (Steel and Torrie, 1980). Significant means were separated using Duncan's Multiple Range Tests (Duncan, 1955). All statistical analyses were carried out using SPSS (2012) package (statistical package for social sciences) procedure.

RESULTS AND DISCUSSION

The percentage composition of broiler starter and finisher's diet are shown in table 1 and 2. The result of cut parts of broilers chicken fed with sorghum as replacement for maize (1-7 weeks) is presented in table 3. The cut parts revealed significant difference ($p<0.05$) in pectoral muscle (8.94-12.01%), back (3.62-6.44%) and thigh (11.45-14.95%). Table 4 revealed the result of carcass and offal characteristics of broiler chickens fed with sorghum to replace maize (1-7 weeks). The result unveiled that the live weight gain ranged from 1600- 2150g which was significant ($p<0.05$) and the result is comparable (1925-2200.0g) reported by Adamu *et al.* (2012). The values recorded for dressed weight ranged from 50.04-58.38% which was significant ($p<0.05$) across dietary treatment. The dressed weight is lower than (66.20-71.11%) recorded by Bakoshi *et al.* (2014). This could be attributed to the source of the chicks used for the experiment. The plucked weight ranged between 1466-1900g and were found to be statistically significant ($p<0.05$) this result is comparable (1750.0-2025.0g) reported (Adamu *et al.* (2012). The result agreed with the work of Bakoshi *et al.* (2014) but contradicts that of Medugu *et al.* (2010a) who observed no significance ($p<0.05$) in carcass yield of broilers fed sorghum

compared with maize. Similarly, the organs weight (%) has no significant difference (p>0.05) on the two energy sources in the heart and legs (3.82-6.75%), gizzard (1.19-1.40%), heart (0.17-0.29%), lungs (0.29-0.35%), pancrease (0.8-0.12%), liver (1.33-1.79%), small intestine (0.65-1.01%), large intestine (1.47-2.38%), caecum (0.31-0.46%) and proventriculus (0.24-0.33%). This result agreed with the work of other authors (Medugu *et al.*, 2010b; Mohammed *et al.*, 2013). The values recorded for the organs weight in the proventriculus, lungs, small intestine, large intestine and liver are higher than the values recorded by Ibitoye *et al.* (2012) in a similar experiment elsewhere.

CONCLUSION

The complementary nature of maize for sorghum as energy sources in feeding broilers in Nigeria can be encouraged as it does not affect most of the growth and carcass characteristics, this will reduce the cost and diversify the feed ingredients used as energy feedstuff.

Table 1: Composition of broiler starter diets

Graded level of sorghum and maize (%)					
Ingredients	**0%**	**25%**	**50%**	**75%**	**100%**
Maize	45.99	34.49	22.99	11.49	-
Sorghum	-	11.49	22.99	34.49	45.99
Soybean	34.51	34.51	34.51	34.51	34.51
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100
Calculated analysis					
ME (Kcal/kg)	2986	2970	2856	2936	2920
Crude protein	23	23	23	23	23
Crude fibre	3.14	3.07	3.00	2.90	2.82
Calcium	1.55	1.56	1.52	1.54	1.57
Phosphorus	0.90	0.89	0.89	0.89	0.89
Methionine	0.40	0.40	0.40	0.40	0.40
Lysine	1.20	1.23	1.23	1.23	1.23

Table 2: Composition of broiler finisher diets

Graded level of sorghum and maize (%)					
Ingredients	**0%**	**25%**	**50%**	**75%**	**100%**
Maize	54.67	41.00	27.34	13.67	--
Sorghum	-	13.67	27.34	41.00	54.67
Soybean	27.83	27.83	27.83	27.83	27.83
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30	0.30
Total					
Calculated analysis					
ME (Kcal/kg)	3007	2985	2963	2840	2918
Crude protein	20.00	20.00	20.00	20.00	20.00
Crude fibre	4.26	4.16	4.07	3.97	3.88
Calcium	1.47	1.47	1.47	1.47	1.47
Phosphorus	0.71	0.71	0.71	0.71	0.71
Methionine	0.35	0.35	0.35	0.35	0.35
Lysine	0.52	0.50	0.50	0.50	0.50

Table 3: Cuts part of broiler fed with sorghum as replacement for maize (1-7wks)

Parameter	**Diets**					**SEM**
	TRT1	**TRT2**	**TRT3**	**TRT4**	**TRT5**	
Pectoral muscle (%)	12.01	10.46	10.91	8.94	11.38	*4.21
Wings (%)	4.72	5.25	5.29	5.16	6.21	NS
Back (%)	5.84a	6.33a	5.99a	3.62b	6.44a	*3.21
Chest (%)	3.65	4.27	3.55	3.96	3.39	NS
Thigh (%)	11.45	13.22	13.22	12..97	14.95	*3.12

SEM = Standard Error of mean; * = ($p<0.05$); ab = means being symbolic as statistically significant and NS = Not significant

Table 4: Carcass and Offal characteristics of broiler chickens fed with sorghum to replace maize (1-7 wks)

Parameter	Diet					SEM
	TRT1	TRT2	TRT3	TRT4	TRT5	
Live weight (g)	2000a	2150a	1800b	1600b	1883b	*
Slaughter weight (g)	1866a	2016a	1700b	1533b	1800b	*
Plucked weight (g)	1833a	1900a	1650b	1466b	1750b	*
Dressed weight (%)	50.04b	58.38a	55.30b	50.66c	56.04a	*
Head and Legs (%)	4.29	4.66	4.01	3.82	6.75	NS
Abdominal fat (%)	0.72	0.58	0.79	0.82	0.59	NS
Gizzard (%)	1.40	1.19	1.30	1.25	1.36	NS
Heart (%)	0.17	0.29	0.27	0.26	0.26	NS
Lungs (%)	0.35	0.35	0.29	0.25	0.31	NS
Pancrease (%)	0.12	0.11	0.11	0.10	0.08	NS
Liver (%)	1.38	1.33	1.34	1.47	1.79	NS
Small intestine (%)	0.74	1.01	0.79	0.65	0.68	NS
Large intestine (%)	2.38	1.47	2.14	1.86	1.79	NS
Caecum	0.34	0.31	0.34	0.41	0.46	NS
Small intestine (cm)	72.67b	110.00a	81.00b	78.60b	76.33b	*
Large intestine (cm)	153.33	112.00	137.33	97.67	146.33	NS
Prevenculus (%)	0.33	0.24	0.28	0.31	0.31	NS

SEM= Standard error of mean; * = ($p<0.05$); ab = mean being significant; a = statistical significant; NS = Not significant

REFERENCES:

Abdo, M., Mengistu, U. and Kefyalewa, G. (2015). Effects of replacing maize with sorghum on growth performance and feed efficiency of commercial broiler chicken. *Journal of Verterinary Science and Technology,* **6** (3): 1-5

Adamu, M. S., Kubkomawa, H. I., Doma, U. D. and Duduwa, A. T. (2012). Carcass and gut characteristics of broilers fed diets containing yellow sorghum *(Sorghum bicolor)* variety in place of maize. *International Journal of Sustainable Agriculture,* **4** (1): 8-11.

Akintunde, A. R., Taphee, D. G., Inuwa, I. and Danladi, Y. (2017). Effect of soaked and fermented sorghum as a replacement for maize on performance and carcass characteristics of Japanese quail (*Coturnix coturnix japonica*). *Journal of Animal Production Research*, **29** (1): 200-209.

Afolayan, M., Bawa, G. S., Sekoni, A. A., Abeke, F. O. and Daramola, S. T. (2014)**.** Effect of inclusion level of African Locust Bean (*Parkia biglobosa*) pulp on growth parameters of egg type chicken (0- 20 weeks). *Nigerian Journal of Animal Science,* **16** (1): 51-60.

AOAC (2006). **Association of Official Analytical Chemists.** Official methods of analysis of the AOAC (Horwitz, W. Editor). 20th Edition. (3) Arlington Va. U.S.A.

Assan, N. (2015). Methodology and factors influencing the association of body weight, performance parameters with linear body measurements assessment in poultry. *Scientific Journal of Pure and Applied Sciences,* **4:** 200 – 210.

Bakoshi, A. M., Maidala, A. and Gumai, S. A. (2014). Evaluation of carcass yield and gut characteristics of broiler chickens fed three partially sprouted sorghum varieties as a replacement for maize. *Journal of Environment Technology and Sustainable Agriculture,* **2** (1): 33-41.

Duncan, D. B. (1955). Multiple ranges and multiple F-test. *Biometrics.* **11**: 1-42.

Food and Agricultural Organization FAO (2013). *FAO Statistics: Food and Agricultural Organisation of the United Nations.*http://faostat.fao.org/site/573/default.aspx#ancor.

Food and Agricultural Organization of United Nations FAO, 2016.

Ibitoye, E. B., Olerede, B. R., Jimoh, A. A. and Abubakar, H. (2012). Comparative performance and organ relative weight of broiler chickens fed three sources of energy diet. *Journal Animal Production Advances,* (5): 233-238.

Katongole, C. B., Nambi-Kasozi, J., Lumu, R., Bareeba, F., Presto, M., Ivarsson, E. and Lindberg, J. E. (2013). Strategies for coping with feed scarcity among urban and periurban livestock farmers in Kampala, Uganda. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS),* **113** (2): 165-174.

Lowder, S. K., Skoet, J. and Raney, T. (2016). The Number, Size and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide. *World Development,* **87:** 16-29.

Maidala, A. and Istifanus, J. A. (2012). The role of micro livestock in alleviating protein deficiency and poverty reduction in Nigeria. **In:** Dantata, I. J., Maidala, A. and Garba, A. R. (Eds). Proceedings of 2nd National conference of school of vocational and technical education, College of Education Azare. Bauchi state

Medugu, C. I., Kwari, I. D., Igwebuike, J., Nkama, I., Mohammed, I. D. and Hamaker, B. (2010a). Carcass and blood components of broiler chickens fed sorghum or millet as replacement for maize. *Agriculture and Biology Journal for North America,* **1** (3): 326-329.

Medugu, C. I., Kwari, I. D., Igwebuike, J., Nkama, I., Mohammed, I. D. and Hamaker, B. (2010b). Performance and economics of production of broiler chickens fed sorghum or millet as replacement for maize. *Agriculture and Biology Journal for North America,* **1** (3): 321-325.

Mohammed A. Ahmed, Bakheit M. Dousa and Khadiga A. Abdel Atti (2013). Effect of substituting yellow maize for sorghum on broiler performance. *Journal of World's Poultry Research,* **3** (1): 13-17.

Petracci, M. and Cavani, C. (2012). Muscle growth and poultry meat quality issues. *Nutrition,* **4:**1-2.

Rostagno, H. S., Albino, L. F. T., Donzele, J. L. (2011). Tabelas brasileiras para aves e suinos: compoosicao de alimentos e exigencias nutricionais. Vicosa: UFV, 251. P

Silvera Anna (2017). Automatic Welfare Assessment in Broilers with focus on Human-Animal Relationship and Lameness. Doctoral Thesis. Faculty of Veterinary Medicine and Animal Science, Department of Animal Environment and Health, Uppsala Swedish University of Agricultural Sciences, Uppsala. Pp. 61.

SPSS (2012). Statistical package for the social sciences. Ver. 16.0 SPSS Inc.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and procedures of statistics 2nd Edition. A biometrical approach. McGraw Hill Book Company. Inc. New York.

Wafar, R. J., Tarimbuka, L. I. (2016). Effects of quantitative substitution of maize with sun-dried Irish potatoes peel meal on growth and economic performance of weaner rabbit. Proceedings 21 Annual Conference of Animal Science Association of Nigeria 18 – 22, 2016, Port Harcourt Pp. 845-849.