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GROWTH AND CARCASS CHARACTERISTICS OF BROILER CHICKENS FED MAIZE, SORGHUM, MILLET AND THEIR COMBINATIONS IN THE SEMI ARID ZONE OF NIGERIA

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ABSTRACT
A study was carried out to investigate the effect of dietary replacement of maize with soghum and millet on the growth performance and carcass measurements of broilers chickens in a forty two (42) day feeding trial. Two hundred and seventy (270) unsexed broiler chicks weighing averagely 366.13 g were randomly allotted to six (6) experimental diets. The design of the experiment was Randomized Complete Block Design consisting of 45 birds replicated three (3) times with 15 birds per replicate. The control (T1) contained 100% maize, T2 (100% Sorghum), T3 (100% millet), T4 (50% maize and 50% sorghum), T5 (50% maize and 50% millet) and T6 (50% sorghum and 50% millet). The maize sorghum and millet served as the major energy source for the broilers. The result shows that there were significant differences in the final weight and overall weight gain. Treatment 4 (50% maize and 50% sorghum) recorded the highest final liveweight (2472.10 g) and the lowest (2251.80 g) was observed in treatment 3 (100% millet). The same trend was observed for overall weight gain. There were no significant (P>0.05) differences in daily feed intake, daily weight gain and feed conversion ratio among all the treatment groups. For carcass measurements, dressing percentage was highest (81.25%) in treatment 2 (100% sorghum) although they were not different from treatment 1 (100% maize) and 6 (50% sorghum and 50% millet). There were no significant (P>0.05) differences among treatments for breast and thigh weights. These results suggest that maize could be replaced by low tannin sorghum and millet in the diets of broilers without adverse effect on their performance.

KEY WORDS: Growth, Carcass Characteristics, Broiler, Chickens, Maize, Sorghum, Millet.

INTRODUCTION

The use of maize as the sole energy source in poultry diet formulation is becoming unrealistic on account of the decline in the land cultivated for maize as a result of climatic changes, the use of maize grain as a staple food for humans and other industrial uses. This situation has called for investigation into the potentials of other readily available cereals for poultry feeding. The alternative energy sources that meet most of the qualities of maize are low tannin sorghum and millet. Sorghum can be grown in low rainfall areas and isa popular crop in hot draught – prone regions. The high tannin content of some sorghum varieties limit their uses in poultry diets but low tannin varieties are now available and can be used in poultry diets without any limitation. The energy value of low tannin sorghum is about 90-95% that of maize. Olomu (2011) gave the metabolizable energy and crude protein values of sorghum as 3270 kcal/kg and 9.5% respectively. Millet is another feed ingredient that has potential for incorporation into poultry diets. The protein content of millet, though variable is higher than maize (Burton *et al*., 1972; Sullivian *et al*., 1990; Adeola *et al.*, 1994; Amato and Forrester,1995) and the essential amino acid profile is more balanced than maize (Adeola*et al*., 1994; Amato and Forrester,1995). According to Olomu (2011), millet has a lower metabolizable energy (2555kcal/kg) but higher crude fibre (4.30%), ash (3.00%) and crude protein (12.0%) than maize and sorghum. Cromwell and Coffey (1993) exonerated millet from antinutritional properties (phytate and tannins) and NRC (1996) has reported millet contains 5-7% oil and has higher minerals than maize. Medugu*et al*. (2010) reported that maize can be completely replaced with millet and low tannin sorghum in broiler diets without adverse effects on their carcass and blood biochemical indices. The objective of this study was to compare the growth and carcass characteristics of broiler chickens fed maize, sorghum, millet and their 50:50% combinations in the semi arid zone of Nigeria.

MATERIALS & METHODS

Study site

The study was conducted at the Poultry unit of the University of Maiduguri Livestock Teaching and Research Farm Maiduguri, Nigeria during the months of March-April, 2013. Maiduguri is situated on Latitude 11^0 05' North and Longitude 30^0 05' East and an altitude of 334 m above sea level. Maiduguri falls within the Sahelian (semi-arid)region which is noted for its great climatic and seasonal variation. It has short period of rainfall of 3-4months giving about 500-700 mmper annum with a long dry season of about 8-9 months. The ambient temperature could be as low as 20 ^{0}C during the dry cold season (October-January) and as high as 44^0C during the dry hot (February-May) Relative humidity is about 5% in April and May and day length varies from 11-12 hours (Raji *et al*., 2009).

Source of test materials

White maize, low tannin sorghumand millet grains which were the test materials were purchased from a grain

market in Maiduguri metropolis, ground to the same particle size (2.0 mm) and used for the diets formulation.

Experimental diets

Six experimental diets were formulated using three different cereal grains (white maize, low tannin sorghum and millet) as the main energy source at the inclusion levels of 100% maize (T1), 100% sorghum (T2), 100% millet (T3), 50% maize and 50% sorghum (T4), 50% maize and 50% millet (T5) and 50% sorghum and 50% millet (T6). The protein sources were fish meal and full fat soybean meal. The ingredient and calculated chemical composition of the diets (starter and finisher) are presented in Tables 1 and 2.

TABLE 1. Ingredients and Chemical Composition of Broiler Starter Diets

	Treatment/Diets					
	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum	T5 (50% maize & 50% millet	T6 (50% sorghum & 50% millet
Maize	45.80	-	-	22.90	22.90	-
Sorghum	-	45.80	-	22.90	-	22.90
Millet	-	-	45.80	-	22.90	22.90
Wheat offal	12	12	12	12	12	12
Soybeans	32.0	32.0	32.0	32.0	32.0	32.0
Fish meal	7	7	7	7	7	7
Bone meal	2.5	2.5	2.5	2.5	2.5	2.5
Premix*	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Total (kg)	100	100	100	100	100	100
Proximate Analysis						
Crude protein (%)	23.3004	23.621	24.766	23.4149	24.0332	24.1935
Crude fibre (%)	4.09	4.09	5.83	4.29	4.28	5.56
EE (%)	4.50	4.50	5.10	4.61	4.72	4.81
NFE (%)	58.30	58.21	56.51	59.11	57.83	57.81
Calcium (%)	0.925	1.46232	1.4669	1.45545	1.45774	1.46461
Phosphorus (%)	0.85422	0.956	0.956	0.90689	0.9068	0.85422
ME (kcal/kg)	2791	2731.52	2390.31	2761.17	2591.14	2560.90

Metabolizable energy calculated according to the formula of Pauzenga (1985) as ME= 37x%CP+81x%EE+35.5x%NFE

*Premix :- Vitamin A 12,000mg, Vitamin E 15,000mg, Folic acid 1000mg, Panthotenic acid 15,000 mg, Vitamin B_{12} 15,000 mg, manganese 100 mg, Vitamin D3 2500, 000 iU, Nicotinic acid 40, 000 mg, Vitamin B1 2000 mg, Biotin 60, 000 mg, Vitamin C 30,000 mg, Copper 1500 mg, Cobalt 250 mg and Selenium 100 mg.

Experimental birds and management

A total of two hundred and seventy (270) day-old broiler chicks were purchased from a reputable hatchery and used for the study. The chicks were brooded together for two weeks(14 days) during which they were fed a commercial starter diet. At the end of the 14th day, the birds were weighed individually and allocated to the six treatments randomly in groups of 45 birds per treatment and each treatment was replicated thrice with15 birds per replicate in a Completely Randomized Design (CRD) housed in deep litter management system.The birds were vaccinated against Gumboro (2 and 4 weeks of age) and Newcastle (3 and 5 weeks of age) diseases. Each of the diets in Tables 1 and 2 andclean cool drinking water were given *ad libitum*throughout the experimental period of 42 days.

Data collection

During the experimental period, the following data were collected:

Feed intake: known quantities of feed were offered in the morning and the left over measured the next morning. The difference was considered as feed intake. This was done daily.

Body weight gain: this was measured weekly per bird. The current body weight was subtracted from the weight of the previous week to obtain the weekly gain.

Feed Conversion Ratio (FCR): this is calculated as the ratio of feed intake to weight gain.

Carcass and organ measurements

At the end of the experiment, two birds each were randomly selected from each of the replicate pens, six (6) birds from each treatment and used for the carcass and organ measurements. Thebirds were starved overnight before weighing and slaughtering the next morning. Defeathering was done after immersing the birds in hot water for 2-3 minutes. The birds were then dressed and the dressed weight and dressing percentage (carcass yield) were computed. Cut-up parts were all weighed and expressed as percentage of liveweight. The visceral organs for each bird which include full gizzard, liver, full intestine, heart, spleen, abdominal fats and caeca were also weighed and expressed as percentage of live weight.

Statistical analysis

All data collected were subjected to Analysis of Variance (ANOVA) in a completely Randomized Design (Steel and Torrie, 1980) and where necessary, means were separated using the Duncan's Multiple Range Test (Duncan, 1955).

TABLE 2. Ingredients and Chemical Composition of Broiler Finisher Diets

	Treatment/Diets					
	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum	T5 (50% maize & 50% millet	T6 (50% sorghum & 50% millet
Maize	51.60	-	-	25.80	25.80	-
Sorghum	-	52.60	-	25.80	-	25.80
Millet	-	-	51.60	-	25.80	25.80
Wheat offal	16.00	16.00	16.00	16.00	16.00	16.00
Soybeans	23.20	23.20	23.20	23.20	23.20	23.20
Fish meal	6.00	6.00	6.00	6.00	6.00	6.00
Bone meal	2.5	2.5	2.5	2.5	2.5	2.5
Premix*	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Total (kg)	100	100	100	100	100	100
Proximate Analysis						
Crude protein (%)	20.31	20.67	21.90	20.49	21.14	
Crude fibre (%)	4.36	4.48	5.90	4.50	4.80	5.61
EE (%)	4.60	4.70	4.90	4.65	4.76	4.80
NFE (%)	60.13	61.01	59.11	60.62	60.00	59.61
Calcium (%)	1.37	1.39	1.39	1.38	1.38	1.39
Phosphorus (%)	0.79	0.91	0.91	1.06	0.84	0.91
ME (kcal/kg)	2817.52	2759.838	2749.838	2783.53	2591.669	2557.70

Metabolizable energy calculated according to the formula of Pauzenga (1985) as ME= 37x%CP+81x%EE+35.5x%NFE
*Premix :- Vitamin A 12,000mg, Vitamin E 15,000mg, Folic acid 1000mg, Panthotenic acid 15,000 mg, Vitamin B_{12} 15,000 mg, manganese 100 mg, Vitamin D3 2500, 000 iU, Nicotinic acid 40, 000 mg, Vitamin B1 2000 mg, Biotin 60, 000 mg, Vitamin C 30,000 mg, Copper 1500 mg, Cobalt 250 mg and Selenium 100 mg.

RESULTS & DISCUSSION

The proximate composition of the experimental diets is shown in Tables 1 and 2. The diets have adequate nutrients to meet the requirements of broilers in the Tropics (Olomu, 2011). They also exhibited similarities between the nutrient composition of the maize, sorghum and millet which support the reports of Smith (2001), Travis *et al*. (2006) and Torki and Farahmand (2007). The results of the performance indices are presented in Table 3. Feed intake, daily weight gan and feed conversion ratio showed no significant (P<0.05) differences among all the treatment groups.

TABLE 3. Effects of replacing maize with sorghum and millet on the performance of broiler chickens

	Treatment/Diets						
	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum	T5 (50% maize & 50% millet	T6 (50% sorghum & 50% millet	SEM
Initial weight (g)	369.60	369.60	370.40	364.20	362.70	360.30	NA
Final live weight (g)	2381.70	2365.30	2251.80	2472.10	2432.80	2417.00	62.933
Feed intake (g)	119.02	124.52	119.60	130.87	127.40	125.67	9.0694
Daily weight gain (g)	43.80	48.27	46.92	53.48	49.35	50.18	3.1898
Feed conversion ratio	2.80	2.63	2.59	2.52	2.66	2.46	0.1110
Overall weight gain (g)	2012.10	1995.70	1881.40	2107.90	2070.10	2056.70	58.019
Mortality (Number)	10.00	1.00	6.00	4.00	8.00	1.00	NA

a,b, c: = means within the same row bearing different superscripts differ significantly (P<0.05)
ns =not significant (P<0.05), * = Significant (P<0.05), SEM = Standard Error of Mean.

TABLE 4. Carcass and organ measurement of broiler chickens fed maize, sorghum, millet and their 50:50 combinations

	Treatments/Diets						
Parameters	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum)	T5 (50% maize & 50% millet)	T6 (50% sorghum & 50% millet)	SEM
Live weight (g)	1900.00 [a]	2216.70 [ab]	2216.70 [ab]	2033.33 [ab]	2260.00 [a]	2350.00 [a]	0.1034*
Slaughter weight (g)	1466.70 [b]	2116.70 [a]	2116.70 [a]	1933.30 [ab]	2241.70 [a]	2250.00 [a]	0.1603*
Plucked weight (g)	1750.00 [b]	2033.30 [ab]	1866.70 [ab]	1833.33 [ab]	2000.00 [ab]	2100.00 [a]	0.1041*
Dressed weight (g)	1383.30 [c]	1800.00 [a]	1525.00 [abc]	1400.00 [c]	1516.70 [bc]	1716.70 [ab]	0.0917*
Dressing (%)	72.763 [ab]	81.247 [a]	68.723 [b]	68.853 [b]	67.187 [b]	73.113 [ab]	2.7773*
Cut-up parts as percentage of live weight							
Head	2.00 [b]	3.76 [a]	2.48 [b]	2.22 [b]	2.28 [b]	2.10 [b]	0.2465*
Legs	3.93	3.76	3.68	3.69	3.54	3.45	0.2145 [ns]
Thigh	11.28	10.77	10.89	10.86	11.24	10.68	0.6469 [ns]
Wings	9.01 [a]	7.63 [b]	8.31 [ab]	8.37 [ab]	8.22 [ab]	7.91 [b]	0.3498*
Back	15.08 [a]	14.12 [a]	11.14 [b]	13.88 [a]	14.28 [a]	14.45 [a]	0.6663*
Neck	4.93 [abc]	5.51 [a]	4.51 [c]	4.80 [bc]	5.23 [ab]	5.40 [ab]	0.2189*
Breast	20.29	17.64	18.97	19.90	18.22	19.93	1.3467 [ns]
Drumstick	8.91 [ab]	8.07 [b]	8.66 [ab]	9.23 [a]	9.24 [a]	8.53 [ab]	0.3296*
Organs weight as percentage of live weight							
Full crop	0.83 [b]	2.77 [a]	1.19 [ab]	1.09 [ab]	1.59 [ab]	1.44 [ab]	0.5487*
Gizzard	3.17 [a]	2.62 [ab]	2.41 [b]	3.09 [ab]	2.72 [ab]	2.73 [ab]	0.2393*
Liver	1.87	1.77	1.93	1.87	2.00	2.73	0.1623 [ns]
Spleen	0.12 [ab]	0.05 [b]	0.13 [ab]	0.15 [a]	0.13 [ab]	0.10 [ab]	0.0436*
Abdominal fat	2.24	1.96	2.36	2.37	2.53	0.52	0.3742 [ns]
Caeca	0.58	0.45	0.46	0.48	0.53	0.52	0.0702 [ns]
Heart	0.49	0.42	0.47	0.46	0.40	0.44	0.0828 [ns]
Intestine	6.10 [a]	6.08 [a]	4.50 [b]	5.46 [ab]	5.86 [a]	5.45 [ab]	0.5719*

a,b,c: = means within the same row bearing different superscripts differ significantly (P<0.05)
ns =not significant (P<0.05)
* = Significant (P<0.05)
SEM = Standard Error of Mean

Final live weight and overall weight gain indicates that the diet with 50% maize and 50% sorghum (T4) showed superiority over the diet with 100% millet (T3) although there were no differences between 100% maize, 100% sorghum, 50% maize and 50% sorghum, 50% maize and 50% millet and, 50% sorghum and 50% millet diets. There were also no differences in final live weight and overall weight gain between 100% maize, 100% sorghum, 100% millet, 50% maize and 50% millet and, 50% sorghum and 50% millet diets. This indicates that the inferiority exhibited by 100% millet has been counteracted by the mixing of 50% maize and 50% sorghum into the millet diet. The feed intake values (119.02-130 g/bird/day) obtained in this study were lower than the values (164-183 g/bird/day) reported by Kwari *et al*. (2012) who fed diets containing graded levels of low tannin sorghum. However, these values are close to the values (94-100.9 g/bird/day) reported by Medugu *et al*. (2010) who fed millet, low tannin sorghum and high tannin sorghum as replacement for maize in broiler diets. The values for daily weight gain (43-53 g/bird) and feed conversion ratio (2.46 – 2.80) obtained in this study are higher than the values (34-43 g/bird/day) and (3.56) reported by Medugu *et al*. (2010) and Kwari *et al*. (2012) respectively. They are however similar to the values reported by Adamu *et al*. (2001). Table 4 summarizes data on carcass measurements and organ weights. Dressing percentage of broilers was superior ($P<0.05$) in the 100% sorghum (T2) compared to 100% millet (T3), 50% maize and 50% sorghum and, 50% maize and 50% millet but there were no significant ($P<0.05$) differences between the 100% millet (T3), 100% maize (T1), 50% maize and 50% sorghum (T4), 50% maize and 50% millet (T5) and 50% sorghum and 50% millet (T6). The dressing percentage values ranged between 67.19% and 81.29%. The values obtained from this study were close to that of Ravindran and Savakanessan (1996) and Salami *et al*. (2004) who reported 70.77% and 65-70% respectively as the ideal dressing percentages for well finished broilers. Weight of breast and thighs did not differ($P>0.05$) among all the treatment groups. Low protein intake has been reported (Salami and Boorman, 1999) to have adverse effect on yield of carcass and cut-up parts of broilers.The results of this study indicate that the diets used were adequate for the birds.

CONCLUSION

It can therefore be concluded that maize, sorghum and millet or their combinations can be used as major energy sources in broiler diets without compromising performance and carcass yield of broiler chickens.

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