ISSN 0189-0514

J. Anim. Prod. Res. (2017) 29(1):200-209

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EFFECT OF SOAKED AND FERMENTED SORGHUM AS A REPLACEMENT FOR MAIZE ON PERFORMANCE AND CARCASS CHARACTERISTICS OF JAPANESE QUAILS (*Coturnix coturnix japonica*)

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ABSTRACT

A five weeks feeding trial was carried out to investigate the effect of sorghum as a replacement for maize on growth and carcass characteristics of Japanese quail chicks using ninety one - week old Japanese quail chicks. The birds were randomly divided into five dietary groups of 18 birds per treatment and 6 birds per replicate in a completely randomized design. The formulated five maize - based diets were substituted with soaked and fermented sorghum at 0 (T1 control), 25 (T2 soaked), 25 (T3 fermented) 50 (T4, soaked).and 50 % (T5 fermented). Feed and water were offered ad libitum. Results showed that dietary treatments had significant (P<0.05) effect on all the performance parameters except age at first egg and first egg weight of quail birds. Final body weight, total weight gained and the daily weight gained followed the same trend across the treatment groups. Birds on diet T5 had significantly (P<0.05) lower values compared to those on other treatments. Total and daily feed intake were significantly (P<0.05) lower for birds fed control diet compared to those fed sorghum based diets. Feed to gain ratio was significantly (P<0.05) higher for birds fed on control diet (T1), T2 (25% soaked sorghum) and T_4 (25% fermented sorghum) than those of other treatments. Feed cost per kg gain was significantly (P<0.05) lower for birds fed diets T1 (₦304.95) and T2 (₦347.70) compared to those in other treatment groups. However, the age at first egg and first egg weight were not significantly (P>0.05) different across the treatments. No significantly different mortality was observed across the treatment groups. Carcass characteristics and organ weights were significantly (P<0.05) affected by dietary treatments except dressing percentage, thigh (%), wings (%), gizzard (%), small intestine (%) and large intestine. Live weight was significantly (P<0.05) lower in birds fed diet T_5 (50% fermented sorghum) compared to other treatments while carcass weight and dressed weight were significantly (P<0.05) lower in birds fed processed sorghum based diets compared to those in the control group. For the organ weights, the heart (%) was significantly (P<0.05) higher in birds fed T_2 compared to those of other treatments while birds on the control diet had significantly (P<0.05) higher liver (%) weight. Therefore, it was concluded that the control diet containing maize was significantly better in all the parameters measured compared to sorghum based diets. However, among the sorghum based diet birds on 25% soaked and 25% soaked and fermented sorghum were better compared to other diets.

Keywords: Processed sorghum, Japanese quails, performance, carcass characteristics.

INTRODUCTION

Livestock production in Nigeria has not been able to satisfy the animal protein need of the populace (Ekumankama, 2000) in that the average intake of animal protein have been estimated at 4.5 g/head/day as against the minimum requirement of 35 g/head/day

recommended by the Food and Agricultural Organization of the United Nations (Etsu, 2002). This problem of malnutrition characterized by low levels of animal protein is more pronounced in less developed nations (FAO, 2008). To arrest this vicious wide gap between demand and supply of animal protein, efforts are being geared towards boosting the livestock industry. Micro livestock with prolific tendency, short gestation period, short generation intervals and rapid growth is being favoured (Owen and Amakiri, 2007). Thus, the introduction of Japanese quail in Nigeria in 1992 and Bobwhite quail in 2005 by National Veterinary Research Institute, Vom. Japanese quails are mainly reared for meat and egg production.

The meat and egg of quails have less fat and cholesterol content and has been suggested as good quality meat for diabetic patients and those with high blood pressure (Agwunobi and Ekpenyong, 1990).Within the age of six weeks, female birds gain weight up to 175 - 200 g and the males weigh between 125-150 g. Female birds start laying eggs at 5 – 6 weeks of age and continue up to twenty two weeks. Usually the egg weighs about 9 - 10 g (Mishra and Shukla, 2014).

The scarcity and high cost of conventional ingredients such as groundnut cake, soybean, fishmeal and maize had led to renewed interest in the use of non-conventional, cheap and easily available ingredients in livestock feeding. Such inclusion of non-conventional feed ingredients in the diet of poultry could help to reduce the feed cost and also minimize the direct competition between humans and the livestock for the available conventional feed stuff. Sorghum [S*orghum bicolor* (L.) Moench] seems suitable in this respect (Sedghi *et al*., 2011). Sorghum is commonly found in large quantity especially in the north-eastern parts of Nigeria such as Taraba, Adamawa, Borno, Gombe and Bauchi states.

Grain sorghum (*Sorghum bicolor* L. Moench) ranks fifth in worldwide production among cereal crops, after wheat, rice, corn and barley (Wong *et al.*, 2009). Sorghum is used for human consumption and animal production as well as industrial products such as alcohol (Shawrang *et al*., 2011). Over 55% of sorghum grain produced in the world is used for human consumption and about 33% of the grain used in animal nutrition (Gangaiah, 2007).

Sorghum grain contains about 10 – 12% proteins, 3% fat and 70% carbohydrates (Gangaiah, 2007). Therefore, it is comparable to corn grain in feeding value for poultry and can reduce feed cost and dependency on maize (Nagra *et al.*, 1990). However, results are not always consistent with this assertion because of the variable amounts of tannin present in the different cultivars or varieties of sorghum. Removal of undesirable components (such as phenolic acids, flavonoids, phytic acid and tannins) is essential to improve the nutritional quality of sorghum and effectively utilize its potential as food for human or as feed for animal (Shawrang *et al*., 2011). Physical, chemical and enzymatic methods of processing have been used to overcome anti-nutritional factors in sorghum grain (Douglas, *et al*., 1991). This study was carried out to determine the effect of soaked and fermented sorghum as a replacement for maize on the performance and carcass characteristics of Japanese quails (*Coturnix coturnix japonica*).

MATERIALS AND METHODS

The research was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Taraba State University, Jalingo. A total of ninety one - week old mixed sexes of Japanese quail was obtained from National Veterinary Research Institute (NVRI) Vom, Plateau State. Sorghum was purchased from Bera market ATC Jalingo, Taraba State.

Processing of Test Ingredients

The seeds were processed by soaking 50 kg sorghum seeds in 75 litres of water for 24 hours drained for two hours, then sundried for 3 days, milled and bagged. Another 50 kg portion was soaked in 50 litres of water for 24 hours followed by fermentation for 72 hours. The water was thereafter drained, and the seeds poured inside a sack, tightened and kept in a closed room for 72 hours. It was then sun dried for 3 days, milled and bagged.

Experimental Diets

Five experimental diets were formulated using sorghum as energy source and as replacement for maize. The formulated diets contained 25 % crude protein according to standard requirement (NRC, 1994) as shown in Table 1. Maize was replaced with sorghum at dietary inclusion levels of 0 , 25 and 50 % (soaked sorghum seeds for 24 hours), 25 and 50 % (soaked for 24 hours and fermented sorghum seeds for 72 hours) designated as T1 (control), T2, T3, T4 and T5, respectively. .

Chemical Analysis

The proximate composition (dry matter, crude protein (CP), crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE)) of the samples of processed sorghum and that of experimental diets were determined using the standard methods described by AOAC (1990).

Design and Management of the Experimental Birds

Ninety one - week old Japanese quail chicks purchased from National Veterinary Research Institute (NVRI) Vom, Jos were used for the study. The birds were randomly assigned to five treatment groups of 18 birds per treatment and 6 birds per replicate using completely randomized design. Feed and water were provided *ad libitum.* Drugs were administered and other routine management practices duly observed as at when necessary. The experiment lasted for five weeks. The birds were weighed at the beginning of the experiment and their average were calculated. The chicks were subsequently weighed every week to determine the weight gained. Feed supplied and the left over were weighed daily to determine the daily feed intake. Average final weight, daily weight gain, daily feed intake, feed to gain ratio, and percentage mortality (where it occurred) were calculated. The cost/per kg of feed and feed/kg gains were computed for each dietary treatment.

Carcass Evaluation

At the end of the feeding trial (5^{th} week), two (2) birds were selected from each replicate based on the average live weight of the group, weighed and sacrificed by severing the jugular vein with a sharp knife and allowing the birds to bleed thoroughly. The birds were later scalded in hot water and subsequently de-feathered, cleaned, eviscerated and dissected. The cut parts (thigh, drumstick, breast, back, wings and neck) and organs such as liver, heart, gizzard, small intestine and large intestine were weighed using sensitive electronic scale. Organ weights were expressed relative to live weight in percentage while cut parts were expressed relative to carcass weight in percentage.

Statistical Analysis

Data were subjected to analysis of variance using the general linear model procedure of Statistical Analytic System (SAS, 2008). Means were separated using Duncan's Multiple Range Test of the same package.

Table 1: Chemical Composition of Soaked and Fermented Sorghum Based-Diets Fed to Starter Quails

Ingredients (%)	Treatments				
	T1 (Control)	**T2 25% Soaked sorghum**	**T3 50% Soaked sorghum**	**T4 25% Fermented sorghum**	**T5 50% Fermented sorghum**
Maize	47.95	35.46	23.48	35.46	23.48
Sorghum	0.00	12.49	23.47	12.49	23.47
SFF	11.00	11.00	11.00	11.00	11.00
GNC	37.00	37.00	37.00	37.00	37.00
Palm Oil	0.00	0.00	1.00	0.00	1.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	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
Determined Analysis					
Dry Matter (%)	91.12	91.12	91.05	91.01	90.95
Crude Protein (%)	15.35	16.74	17.46	18.63	19.84
Ether Extract (%)	4.69	5.21	5.48	5.84	6.00
Crude Fibre (%)	3.23	3.36	3.58	3.89	4.13
Ash (%)	3.71	3.82	3.96	4.34	4.72
Moisture (%)	8.88	8.90	8.95	8.99	9.05
Nitrogen free extract (%)	64.28	61.99	60.59	9.05	56.31
Calculated Analysis					
ME (kcal/kg)	2907.36	2884.49	2865.07	2832.20	2806.31
Crude Protein (%)	25.10	25.26	25.50	25.36	25.50
Calcium (%)	1.19	1.19	1.26	1.19	1.26
Avail. Phos (%)	0.74	0.74	0.74	0.74	0.74
Lysine (%)	1.28	1.26	1.25	1.25	1.25
Methionine (%)	0.37	0.56	0.52	0.56	0.52
Cysteine (%)	0.40	0.41	0.42	0.41	0.42
Feed cost/kg (₦)	90.58	88.85	87.80	88.85	87.80

*Vita premix provided per kg of diet: Vit A. 10,000 I.U; Vit D_3 32,000 I.U; Vit E 23,000 mg; Vit K 2,000mg; Vit. B_1 1,800mg; B_2 5,000mg; Pantothenic acid 7,500mg; Vit. B_{12} 150mg; Folic acid 750mg; Biotin 100mg; choline chloride 300,00mg; Cobalt 3,000mg, Iodine 1,000mg; Iron 20,000mg Manganese 40,000mg; Selenium 200mg; Zinc 30,000mg; Antioxidant 1250mg, ME = Metabolizable Energy, GNC = Groundnut Cake, SFF = Soya Full Fat

RESULTS AND DISCUSSION

Results of the proximate composition of soaked and fermented sorghum is presented in Table 2. The dry matter (DM) content of 90.15% and 89.72% obtained for the processed sorghum is in agreement with the report of the NVRI (2007). The crude protein (CP) of processed sorghum were 15.39% for soaked and 12.91% for fermented samples. The crude protein content of the processed sorghum was 15.39 and 12.91% for the soaked and fermented samples respectively. These values were higher than the reported 11% (NVRI, 2007) and 11.6% CP (Medugu *et al*., 2010) reported. The crude fibre (CF) of the processed sorghum of

1.84 and 1.44% are within the range of 1.7 - 2.1% reported by FAO (1993). However, 3.45% ether extract recorded for the soaked + fermented sorghum is comparable to 3.06% reported by Aduku (1993).

Ash of 2.45 and 2.20% obtained for soaked and soaked + fermented sorghum, respectively compared favourably with the range of 1.5 – 3.3% reported by FAO (1993). However, the nitrogen free extract (NFE) of 69.33 and 66.32% were lower compared with the reported 82.70% (USDA, 2009).

The result of the treatment effects on performance of quail chicks is presented in Table 2. The result shows that the final weight, total weight gain and daily weight gain across the treatments followed the same trend. They were similar for birds fed diets T_1 (control), T_2 (25% soaked sorghum), T_3 (50% soaked sorghum) and T_4 (25% soaked and fermented sorghum) and were significantly ($P<0.05$) higher compared to those on T_5 containing 50% fermented sorghum. This may be due to improved nutrient utilization by birds across the treatments. The observed daily weight gain (2.95 – 3.51 g/bird/day) in this study disagrees with the reported 8.82–9.42 g/bird as weekly weight gain by Babangida (2001) for layers. The total feed intake (TFI) and daily feed intake (DFI) were significantly ($P<0.05$) lower in birds fed control diet T1 (412.22 g and 11.78 g) compared to those fed sorghum based diets. The similarities observed in the feed intake of birds showed that the experimental diets met the energy and protein requirements of quails as recommended (NVRI, 1996).

Table 2: Proximate Composition of Processed Sorghum

	Processing Methods	
Parameters (%)	**Soaked 24 hours**	**Soaked (24 hrs.) and fermented (72 hrs.)**
Dry Matter	90.15	89.72
CrudeProtein	25.39	12.91
Crude Fibre	1.84	1.44
Ether Extract	4.60	3.45
Ash	2.45	2.20
Moisture	10.28	9.87
Nitrogen-Free Extract	69.33	66.32

The feed conversion ratio was similar among birds fed diets T_1 (control), T_2 and T4 and were significantly ($P<0.05$) higher than those on T_3 and T_5. This may be due to good nutrient utilization and better conversion of feed by birds fed the dietary treatments (Clement, 2004).The feed cost/kg gain (₦) were similar and significantly ($P<0.05$) lower in birds fed control diet (T_1) and T_2 compared to those in other treatment groups. This may be due to lower feed conversion ratio recorded in these treatments. This result agreed with the report of Bawa (2003).

There was no significant ($P>0.05$) difference in the age at first egg (days). This indicates that the birds came to lay around the same time. Similarly, weights of the first eggs were not significantly ($P>0.05$) different across all the treatments. The first egg weights obtained in this study ranges from 6.66 –7.36g. This values are lower than the reported value of 9.30 g (Yamane *et al*., 1979) and 8.92–10.13g reported by Babangida and Ubosi, (2006).

Result of carcass characteristics of quail birds fed processed sorghum grains is presented in Table 3. The results showed that there was significant ($P<0.05$) effect of dietary processed sorghum on most of the measured carcass parameters (live weight, carcass weight, dressed weight, drumstick, back, breast and neck) across all the treatment groups. Live weight (g) of birds fed T5 (50% fermented sorghum) was significantly ($P<0.05$) lower compared to those of other treatments while carcass weight and dressed weight of birds fed T1 (control) were significantly ($P<0.05$) higher compared to those fed sorghum based diets. However, there was no significant differences ($P>0.05$) in the dressing percentage, weights of thigh and wings of birds across the treatments. Similarly, relative weights of gizzard, small intestine and large intestine of birds were not significantly ($P>0.05$) different across the treatment groups. This observation suggests that the experimental treatments produced identical influence on these organ. However, the relative weights of heart was significantly ($P<0.05$) higher in birds fed T2 (25% soaked sorghum) compared to those in other treatment groups. This may be due to the residual effects of anti-nutritional factors in the diet which could not be detoxified. Also, when sorghum is soaked in water, the hydro cyanide content increases. This result agrees with the report of Abeke *et al*. (2008) that hypertrophy of the organ may occur as a result of its attempt to increase protein availability or in the process of detoxifying the anti-nutritional factors. The weight of liver was significantly ($P<0.05$) higher in birds fed T1 (control) compared to those on sorghum based diets.

CONCLUSION

Results of this study indicated that the control diet containing maize gave the best performance (but not significantly) in most of the parameters measured when compared to sorghum based diets. Thus in seasons when maize is cheaper, replacement of maize with sorghum may not be necessary. However, in seasons when prices of maize is exorbitantly high, replacement of maize with sorghum especially in locations where production is abundant can be recommended at 25% replacement level using soaking or soaking and fermentation methods of processing.

Table 3: Performance of Quails Fed Diets Containing Maize and Processed Sorghum (2–6 weeks)

Parameters	Treatments					SEM
	T1 (Control)	T2 25% soaked sorghum	T3 50% soaked sorghum	T4 25% fermented sorghum	T5 50% fermented sorghum	
Initial weight (g/bird)	20.83	20.83	20.83	20.83	20.83^{b}	0.00
Final weight (g/bird)	143.61^{a}	134.17^{a}	132.50^{a}	136.83^{a}	124.11^{b}	6.35*
Total weight gain (g/bird)	122.78^{a}	113.34^{a}	111.67^{a}	116.00^{a}	103.28^{b}	6.35*
Daily weight gain (g/bird/day)	3.51^{a}	3.23^{a}	3.19^{a}	3.31^{a}	2.95^{b}	0.18*
Total feed intake (g/bird)	412.22^{b}	443.06^{a}	485.84^{a}	458.05^{a}	469.72^{a}	31.06*
Daily feed intake (g/bird/day)	11.78^{b}	12.66^{a}	13.88^{a}	13.06^{a}	13.42^{a}	0.88*
Feed conversion ratio (g/bird)	3.36^{a}	3.91^{ab}	4.36^{b}	3.97^{ab}	4.60^{b}	0.30*
Feed cost/kg gain (₦)	304.95^{a}	347.70^{a}	383.11^{b}	352.73^{b}	404.47^{b}	27.09*
Age at first egg (days)	36.66	37.00	36.00	37.00	37.33	1.02^{NS}
First egg weight (g)	7.00	7.36	6.66	7.00	7.00	0.51^{NS}
Mortality (%)	0.00^{b}	0.00^{b}	0.00^{b}	0.33^{a}	0.33^{a}	0.15*

SEM = Standard Error of means
NS = Not significant
* = Significant

Table 4: Carcass Characteristics and Relative Internal Organs Weight of Quails Fed Diets Containing Processed Sorghum as a Replacement for Maize (2 – 6 weeks).

Parameters	Treatments					
	1 (Control)	2 25% soaked sorghum	3 50% soaked sorghum	4 25% fermented sorghum	5 50% fermented sorghum	SEM
Live weight (g/bird)	143.00[a]	134.17[a]	132.50[a]	136.80[a]	124.11[b]	6.35*
Carcass weight(g/bird)	93.69[a]	85.11[b]	88.87[b]	88.54[b]	88.12[b]	2.35*
Dressed weight (g/bird)	125.80[a]	110.20[b]	115.50[b]	118.37[b]	113.93[b]	5.77*
Dressing (%)	68.92	69.86	68.63	67.45	69.32	1.76[NS]
Drumstick (%)	6.11[a]	5.99[b]	6.17[a]	5.88[b]	6.04[b]	0.90*
Back (%)	11.76[a]	12.08[a]	10.35[b]	10.97[b]	10.28[b]	0.39*
Breast (%)	32.02[b]	31.05[b]	31.91[b]	31.67[b]	33.11[a]	0.79*
Thigh (%)	8.46	9.48	9.21	8.86	9.31	0.6[NS]
Wings (%)	5.88	6.25	5.91	5.83	6.24	0.28[NS]
Neck (%)	3.11[b]	4.14[a]	4.38[a]	3.83[b]	3.71[b]	0.24*
Internal organs (%)						
Heart	0.90[b]	1.01[a]	0.97[b]	0.92[b]	0.92[b]	0.05*
Liver	1.99[a]	1.64[b]	1.68[b]	1.68[b]	1.69[b]	0.14*
Gizzard	1.82	1.72	1.74	1.84	1.64	0.09[NS]
Small intestine	2.19	2.03	1.88	2.33	2.20	0.22[NS]
Large intestine	0.23	0.28	0.25	0.19	0.29	0.05[NS]

a, b = Means with same row bearing different superscript differ significantly (P<0.05)
* = Significant (P<0.05)
SEM = Standard Error of Means NS =Not significant

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