Use of sorghum on stepwise substitution of maize in broiler feeds in Niger

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Abstract

With an objective to demonstrate the merits of diets based on locally produced non-tannin sorghums as against Maize a total of 240 1-day-old broiler chicks Early bird strain were randomly allocated to 20 pens (12 birds per pen) with four pens per treatment and five treatments, at the Maradi Government poultry farm in Niger for a period of 12weeks. Birds were allowed to consume feed and water on an ad-libitum basis. The treatments diets were: i) Maize -based, ii) 75% Maize+25% Sorghum, iii) 50% Maize+50% Sorghum, iv) 25% Maize + 75% Sorghum, and v) Sorghum. Birds consumed water and feed on an ad-libitum basis with body weights recorded on day 0, 21, and 49. At the end of the experiment, 5 birds per pen were randomly chosen and slaughtered for carcass analysis. All growth and carcass data were analyzed as a randomized complete block design using the Proc Mixed procedure of R. Live weight was used as a covariate during carcass data analysis.

Bodyweight means of 41g at d-0 and 1419 g at d-49 were similar (P = 0.17) for birds fed on all five treatments. Mean Gain/feed (G/F) ratios were similar with a mean of 540 g/kg to d-49. Birds fed Maize-based, sorghum-based or Maize-sorghum-based diets had similar growth performance and carcass characteristics. Thus, tannin free sorghum had nutritional value comparable to that of Maize, and in West Africa local sorghum is a good alternative for poultry feeds when grains price are similar.

Keywords: *diet, maize, poultry, tannin*

Introduction

Sorghum is the fifth most widely grown crop in the world. The largest area of sorghum production is in India, followed by Nigeria, Sudan and Niger. Fifty three percent of the world's production area is located in sub-Saharan Africa. In sub-Saharan Africa sorghum covers the second largest area after maize. Maize importation and it use as food, high production costs are the main constraint to poultry production in Niger and Nigeria (Maizama et al 2003, Kwari et al 2012).In experiments undertaken in India and Niger, sorghum varieties developed by the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and the National Institute for agronomic Research (INRAN) were equal to maize in nutritional value for broilers and layers (Parthasarathy et al 2005, Issa et al 2007, Issa 2009). Additionally, Hancock et al (2000) proposed that adequate processing improved the nutritive value of sorghum in poultry and swine to levels similar to that of maize. Consequently, with selection of good varieties and proper processing, sorghum could play an important part in diets fed to livestock and poultry in West Africa. However, poultry producers and extension personnel in the Sahel of West Africa have concerns

about using sorghum in feeds because of perceived low nutritional value of domestically produced sorghum grain. Thus, a broilers experiment was initiated to determine the nutritional value of broiler diets formulated with either imported maize and locally produced sorghum grains. Thus, the goal of the experiment proposed herein was to demonstrate the merits of diets based on locally produced non-tannin sorghums at 0, 25, 50, 75 and 100% level of inclusion.

Materials and methods

A total of 240 1-day-old broiler chicks Early Bird strain were randomly allocated to 20 pens (12 birds per pen) with four pens per treatment and five treatments, by June 06 2014 at the Maradi Government poultry farm in Niger for seven weeks. Birds were housed on deep litter in an open-sided building with 1.4m^2/pen. The ranges of: temperature (29 to 37°C), humidity (23.6 to 24.4%), and wind speed (1.40 to 1.5 m/s) were observed during the day. The vaccinations included were Newcastle HB1/Lasota (NVD-I2) and Gumboro (Nobilis gumboro 228E). Birds were allowed to consume feed and water on an ad-libitum basis. The control diet was maize-based with fishmeal and peanut meal used as the primary protein supplements. The diet (Table 2-3) was formulated to 1.2 and 1.1 Lys for day 0 to 21 and 21 to 49, respectively.

Table 1. Chemical composition of the ingredients fed in a broiler experiment at Maradi

Ingredient	Dry Matter %	Ash %	Cellulose %	Crude Protein %	Ether Extract %	Nitrogen Free Extract %	Tannin[a]
Maize	92	1	2	10	5	74	-
Sorghum Sepon 82	92	2	2	12	3	73	0
Groundnut meal	93	24	2	36	4	27	-
Fish meal	92	5	2	60	9	17	-
Blood meal	93	5	1	54	1	31	-

[a]*Determined using HCl-Vanillin method (Buttler and Fisher, 1978) at USD Grain Lab at Manhattan, KS-USA*

Table 2. Diet compositions used for day 0 to 21 in a broiler experiment at Maradi, Niger

Ingredient %	Diet based				
	Maize	75% Maiz + 25% sorghum	50% Maize + 50% sorghum	25% Maize + 75% sorghum	Sorghum
Maize	60	45	30	15	0
Sorghum	0	15	30	45	60
Wheat bran	10	10	10	10	10
Groundnut meal	14	14	14	14	14
Fish meal	10	10	10	10	10
Blood meal	2	2	2	2	2
Bones meal	4	4	4	4	4
Methionine	0	0	0	0	0
Lysine	0	0	0	0	0
Salt	1	1	1	1	1
Premix[a]	0	0	0	0	0
Total	100	100	100	100	100
Calculated Analysis					
MEn, kcal/kg	2,824	2,803	2,783	2,762	2,741
Total Ca, %	1	1	1	1	1
Available P, %	1	1	1	1	1
CP, %	20	20	20	20	20
Lys, %	1	1	1	1	1
Met	1	1	1	1	1

[a] *Supplied (per kg of diet): 220 mg of Mg; 220 mg of Zn; 110 mg of Fe; 248 mg of; Cu; 33 mg of I; 77,105 IU of Vit A; 27,538 IU of Vit D; 165 IU of Vit E; 0.11 mg of Vit B12; 8 mg of menadione; 66 mg of*

riboflavin; 11 mg of thiamine; 66 mg of pantothenic acid; 275 mg of niacin; 14 mg of Vit B6; 7 mg of folic acid; 3,855 of choline; and 0.33 mg of biotin

Tabla 3. Diet compositions used for d-21 to 49 in a broiler experiment at Maradi, Niger

Ingredient, %	Diet based				
	Maize	**75% Maize + 25% sorghum**	**50% Maize + 50% sorghum**	**25% Maize + 75% sorghum**	**Sorghum**
Maize	66	45	30	15	0
Sorghum	0	15	30	45	66
Wheat bran	7	7	7	7	7
Peanut meal	11	11	11	11	11
Fish meal	8	8	8	8	8
Blood meal	3	3	3	3	3
Bone meal	4	4	4	4	4
D,L-methionine	0	0	0	0	0
L-lysine HCl	0	0	0	0	0
Salt	1	1	1	1	1
Premix[a]	0	0	0	0	0
Total	100	100	100	100	100
Calculated Analysis					
MEn, kcal/kg	2,897	2,874	2,852	2,829	2,806
Total Ca, %	1	1	1	1	1
Available P, %	1	1	0	0	0
CP, %	20	20	20	21	21
Lys, %	1	1	1	1	1
Met	1	1	1	1	1

[a] *Supplied (per kg of diet): 220 mg of Mg; 220 mg of Zn; 110 mg of Fe; 248 mg of; Cu; 33 mg of I; 77,105 IU of Vit A; 27,538 IU of Vit D; 165 IU of Vit E; 0.11 mg of Vit B12; 8 mg of menadione; 66 mg of riboflavin; 11 mg of thiamin; 66 mg of pantothenic acid; 275 mg of niacin; 14 mg of Vit B6; 7 mg of folic acid; 3,855 of choline; and 0.33 mg of biotin.*

Sorghum was used to replace the Maize on a wt/wt basis so that treatments were: Maize (imported from Nigeria)-based, 75% Maize + 25% sorghum, 50% Maize +5 0% sorghum, 25% Maize + 75% sorghum, and sorghum. Maize variety was imported from Nigeria and Sepon 82 improved variety of sorghum with white seed, and no detectable tannins was used. Maize, sorghum, and diet samples were collected and analyzed for proximate components (AOAC, 1990) and particle size. Birds consumed water and feed on an ad-libitum basis with body weights recorded on d 0, 21, and 49. At the end of the experiment, 5 birds per pen were randomly chosen and killed for carcass analysis. Response criteria were live weight (at d 1, and 49), average daily gain (ADG) at 49, average daily feed intake (ADFI) at 49, gain to feed ratio (G:F) at 49, and carcass weight and carcass yield. All growth and carcass data were analyzed as a randomized complete block design using the Proc Mixed procedure of R.

Results and discussion

Body weight, average daily gain, feed intake and feed: gain (F:G) data (Table 3) indicate average daily gain (ADG) and average daily feed intake (ADFI) were greater ($P < 0.001$) for chicks fed corn vs sorghum. Growth and carcass data from 240 broilers chicks were collected in a 49 day growth assay, and all data were tested normal ($P = 0.15$). No treatment effects were observed ($P = 0.92$) for initial body weight, ($P = 0.17$) for d-49 body weight, ($P = 0.17$) for average daily gain, ($P = 0.12$) for feed intake, ($P = 0.75$) for feed: gain, ($P = 0.51$) for carcass weight, and ($P = 0.35$) for carcass yield (Table 4).

Lu et al (2007) reported live weight of 1,876 g when Arbor Acres broilers were raised at 34°C from d 0 to 60 in China, while Sarker et al (2002) reported 42-d BW of 1,260 to 1,330 g for Arbor Acres chicks

reared during winter in Bangladesh. Adeyemo et al (2007) reported BW of 1,722 to 2,097g at 60 d when Arbor Acre broiler chicks were fed Maize fish meal diets supplemented with desert locust meal in the hot weather of Nigeria. Similar body weight for birds fed all diets, reported in this in this experiment are in accordance with data reported by Issa et al (2007) and Kwari et al (2012), when Maize and tannin free sorghums where used in broilers diets in Niger and Nigeria.

Average daily gains were similar (P = 0.17) for birds fed maize, sorghum or their mixtures; those confirmed data results from a West African poultry project reported by Issa (2009). D-49 ADG were similar to those (31 to 37g) reported by Issa (2007) in a 60 day experiment. The low ADG in our experiment likely was caused by extreme heat stress in our naturally ventilated building. Ahmad et al (2006) reported ADG of 26 to 32 g when broiler chicks reared at a constant 32ºC from d 0 to 42. 49-d live weight data in this experiment were higher the 42-d l Arbor Acres live weight report by Issa (2009).

The feed intake data from d-0 to 49 (74 g/d) was lower than 125 g for birds fed sorghum-based diets and reared in environmentally-controlled house reported by Perez-Maldonado et al (2008).Feed intake can also be explained by the high temperature prevailing in the building (26 to 40°C) Henken et al (1993) reported change in ADFI from 92 to 78 g and in ADG from 35 to 30 g when broiler chicks were reared at 25°C or at temperatures 30 to 40°C. Issa (2009) reported d-60 feed intake of 77g for birds fed maize and 72g for birds fed for sorghum.

Table 4. Growth performance and carcass measurements of broilers fed maize and sorghum based diets at Maradi, Niger

Parameter	Maize	75% Maize + 25% sorghum	50% Maize + 50% sorghum	25% Maize + 75% sorghum	Sorghum	SE	*p*
Number	48	48	48	48	48		
D-1 BW, g	41	40	41	41	42	2	0.92
D-49 BW, g	1405	1418	1458	1474	1340	54	0.17
D 49 FI, g	72	73	77	77	70	3	0.12
D 49 ADG, g	28	28	29	29	27	1	0.17
D F/G, g/kg	558	550	520	544	528	32	0.75
Carcass weight, g	1001	1013	1050	1065	992	48	0.51
Carcass yield, %	71	71	72	72	71	1	0.35

Gain/feed (G/F) ratio at d-49 were similar (P = 0.75), for all diets with a mean of 540 g/kg (Table 4). D-49 F/G ratio obtained in this experiment were higher than data reported by Issa et al (2007) and Issa (2009) which ranged from 478 to 527 g/kg when broilers chicks were fed Maize or sorghum based-diets. In addition, low feed: gain ratio 255 to 450 were reported on Arbor Acres broilers reared from d-0 to 60 (Omojola and Adesehinwa 2007; Lu et al 2007).

All birds had similar carcass weight and carcass yield (Table 4). Indeed carcass measurements were similar for all treatments, which favors substitution with sorghum in place of Maize if priced more cheaply. Similarly, Perez-Maldonaldo et al (2008) and Issa et al (2009) reported that birds fed sorghum-based diets had similar body weight and meat yield at d-42 compared to bird fed wheat-based or sorghum-based diets in Burkina Faso, Mali; Niger, Nigeria and Senegal.

Conclusion

- In summary, birds fed maize-based, sorghum-based or maize-sorghum-based diets had similar growth performance and carcass characteristics. Thus, tannin free sorghum had nutritional value comparable to that of Maize and in West Africa local sorghum is a good alternative for poultry feeds when grains price are similar. It is important to make sorghum grains available for poultry producers and other processors.

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