



GROWTH AND ECONOMIC PERFORMANCE OF GROWING RABBITS FED TWO VARIETIES OF SORGHUM AS REPLACEMENT FOR MAIZE IN A HOT TROPICAL ENVIRONMENT

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ABSTRACT

A study was carried out to investigate the effects of dietary replacement of maize with varieties of sorghum on the growth and economic performance of growing rabbits in a 56 – day feeding trial. Twenty-five (25) growing rabbits weighing averagely 569.4 g were randomly allocated to five (5) experimental diets in which the control, T1, contained (100% maize), T2 (50% maize and 50% “Chakalere” sorghum), T3 (100% “Chakalere” sorghum), T4 (50% maize and 50% “Jigare” sorghum) and T5 (100% “Jigare” sorghum). The maize and sorghum served as the major energy sources in the diets. The sorghum varieties used were low tannin sorghum (“Chakalere”) and high tannin sorghum (“Jigare”). The design of the experiment is randomized complete block design. Each treatment consisted of 5 rabbits, replicated 5 times with one rabbit per replicate. Feed and clean drinking water were provided *ad libitum*. Routine management practices were strictly adhered to during the experiments. Data collected were the growth performance (feed intake, weight gain, feed conversion ratio) and economics of production. The results showed that there is significant difference ($p < 0.05$) in the feed intake, weight gain and feed conversion ratio in all the treatment groups. Treatment 4 (50% “Jigare” and 50% maize) consumed more feed than the rest of the treatments. The highest daily weight gain (15.54 g) was observed in treatment 4 (50% “Jigare” and 50% maize) and the lowest (8.86 g) was observed in T1 (maize – based diet). Poor feed conversion ratio (FCR) value (8.29) was observed in T2 (50% “Chakalere” sorghum and 50% maize). The best value (4.62) was obtained in T4 (50% “Jigare” and 50% maize). The results, however, indicated that the cost per kg feed and cost of feed per unit weight gain were lowest in “Jigare” followed by “Chakalere” sorghum and maize – based diets respectively. This suggests that the replacement of maize by “Chakalere” (low tannin sorghum) or “Jigare” (high tannin sorghum) in the diets of growing rabbits was economical and cost effective.

KEYWORDS: Maize, sorghum varieties, performance, economics *etc.*

INTRODUCTION

Consumption of animal protein in Africa, Nigeria inclusive, remains one of the lowest in the world, Ebuomen (1997). The daily protein requirement of an average adult is given at 65 g per capita per day (FAO, 2005) and out of this, 35 g is supposed to be of animal origin. The consumption level of animal protein in Nigeria is 4.5 g per capita which is far below the FAO minimum level of 35g (Ezike and Nwoye, 2004). The possible and most appropriate remedy for shortage of animal protein consumption lies in the production of fast maturing animals like rabbit. Rabbit is an ideal animal in meeting the protein need of developing countries, because according to IFS (1978), rabbits are prolific and have relatively low incidence of epidemic diseases compared to other farm animals. The use of their meat to meet the high protein demands of humans is increasingly becoming important in both developed and developing countries (Ahaotu *et al.*, 2008). In spite of these advantages, rabbit production has not received the desired attention in the tropics, because productivity is usually 50% or less of what is typical in the temperate countries (Cheeke, 1992). Inadequate and high cost of feed ingredients caused mainly by the stiff competition between people and monogastric animals such as the rabbit and poultry for grains, is the major constraint (Agunbiade *et al.*, 2002).

Maize grain is the major source of energy in rabbit feed in Nigeria, usually accounting for over 40% of the diets (Bamgbose *et al.*, 2004). A feasible alternative is the use of sorghum as energy source in rabbit diet. Sorghum (*Sorghum bicolor*) is one of the most abundant cereal grains throughout the world and widely found in the drier areas of Africa, Asia and Australia (Hui, 1992). Sorghum is a crop of hot and semi-arid environments with 400 to 600mm of rainfall that is too dry for maize (Doggeth, 1988). In Africa and Asia, sorghum grain is used for both human nutrition and animal feed (ICRISAT, 2005). Sorghum is a crop that can be cultivated in semi-arid regions of Africa and Asia and it is cheaper and more readily available than maize (Douglas *et al.*, 1993). A lot of research work has been done in Nigeria in an effort to replace maize with cheaper and readily available ingredient in order to reduce cost and over – dependence on maize for rabbit feeding. These include cassava peel meal (Agunbiade *et al.*, 2002), bread waste meal (Dairo and Ojewale, 2004) and rumen content (Dairo *et al.*, 2005). However, there is a dearth of information on the utilization of sorghum in rabbit diet in Nigeria. Few of the research work carried out were on replacement of maize with malted or unmalted sorghum (Abubakar *et al.*, 2006; Aderemi and Wuraola, 2010). The objective of this study was to investigate the effects of dietary replacement of

maize with two varieties of sorghum (“Chakalere” and “Jigare”) on the growth and economic performance of growing rabbits.

MATERIALS AND METHODS

The study was conducted at the University of Maiduguri Livestock Teaching and Research Farm, Department of Animal Science, University of Maiduguri, Borno State, Nigeria. Maiduguri is located on latitude 11°15' North and 30°05' East and on an altitude of 345m above sea level (Ugherughe & Ekedolum 1986). The relative humidity ranges from 30 to 50% (Encarta, 2007). It has a short period of rainfall (500 to 600mm) from June to September followed by long period of dry season (8 to 9 months) (Encarta, 2007). Twenty-five (25) growing rabbits between 5 and 7 weeks of age with average weight of 569.4 g were selected for this study. The rabbits used for the study were obtained from small-scale producers in Maiduguri. They were randomly allocated to five (5) treatments in groups of five (5) rabbits per treatment and one (1) rabbit per replicate. The rabbits were individually housed in battery cages measuring (33 x 38 x 45cm). The

experimental diets and clean drinking water were provided *ad libitum* during the study period. The study lasted for 56 days. The five (5) experimental diets are presented in Table 1. The five (5) diets were designated as Treatment 1 (control) 100% maize and 0% sorghum), Treatment 2 (50% sorghum “Chakalere” and 50% maize), Treatment 3 (100% “Chakalere” sorghum), Treatment 4 (50% sorghum “Jigare”) and Treatment 5 (100% sorghum “Jigare”). “Chakalere” and “Jigare” are low-tannin and high-tannin sorghum respectively. Data collected during this study were feed intake, daily weight gain, final weight gain, feed conversion ratio (FCR) and economic parameters (cost per kg diet, cost of feeding and cost per kg weight gain). Proximate principles such as Dry Matter (DM), Crude Protein (CP), Crude Fibre (CF), Ether Extract (EE), ash and Nitrogen-Free Extract (NFE) were analyzed using AOAC (1990) methods and Metabolizable Energy (ME) was calculated according to the formula of Pauzenga (1985). All data collected were subjected to Analysis of Variance (ANOVA) using Randomized Complete Block Design (RCBD) described by Steel and Torrie (1980) and outlined in the software package, SAS (1999).

TABLE 1: Composition of the experimental diets

Ingredients	Level of Maize Replaced by Sorghum				
	1	2	3	4	5
	0% sorghum	50% “Chakalere” sorghum	100 “Chakalere” sorghum	50% “Jigare” sorghum	100% “Jigare” sorghum
Maize	34.00	17.00	0.00	17.00	0.00
Sorghum (“Chakalere”)	0.00	17.00	34.00	0.00	0.00
Sorghum (“Jigare”)	0.00	0.00	0.00	17.00	34.00
Wheat offal	17.00	17.00	17.00	17.00	17.00
Groundnut cake	16.45	16.45	16.45	16.45	16.45
Fish meal	3.00	3.00	3.00	3.00	3.00
Groundnut haulms	27.00	27.00	27.00	27.00	27.00
Limestone	2.00	2.00	2.00	2.00	2.00
Common salt (NaCl)	0.25	0.25	0.25	0.25	0.25
Premix*	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00

Premix* (grow fast) Manufactured by Animal Care Service Consults Nigeria Ltd., Lagos, supplying the following per kg of premix: vitamin A = 32,000,000 IU, vitamin B₃ = 640,000 IU, vitamin E = 2,000 IU, vitamin K = 800 mg, thiamine (B₁) = 600 mg, riboflavin (B₂) = 1600 mg, pyridoxine (B₆) = 600 mg, vitamin B₁₂ = 4 mg, pantothenic acid = 2000 mg, folic acid = 200 mg, biotin = 8 mg, choline = 80 mg, antioxidant = 50 g, managanese = 32 g, zinc = 20 g, iron = 8 g, copper = 2 g, iodine = 0.48 mg, selenium = 80 mg and cobalt = 80 mg.

RESULTS AND DISCUSSION

The chemical composition of maize and the sorghum varieties (Table 2) revealed that energy values were similar, but slightly higher than the values (3270 kcal/kg) for sorghum (Olomu, 1995). The tannin content of “Chakalere” and “Jigare” sorghum were 1.54% and 7.44% respectively. These values agreed with the findings of Pour-Reza and Edriss (1997) who reported tannin content of 2.32% and 5.22% for low and high tannin sorghum respectively. The proximate composition of the experimental diets is presented in Table 3: The crude protein (CP) and the crude fibre (CF) of all the experimental diets were similar. These values agreed with 18 to 20% CP and 9 to 12% CF recommended requirements for growing rabbit reared in tropical countries (Omole *et al.*, 2007). The metabolizable energy (ME) were similar in all the treatment groups which were

within the 2500 to 2600 kcal ME requirements of growing rabbits (Omole *et al.*, 2007). The nitrogen-free extract (NFE), ether extract (EE) and dry matter (DM) were found to be similar among the experimental diets. The total ash was higher in the control diet than the other treatment diets. Growth performance of rabbits fed graded levels of the two varieties of sorghum is shown in Table 4. Final body weight of rabbits in the entire treatment groups showed no significant difference ($p > 0.05$). This result was supported by the work of Abubakar *et al.* (2006) who fed malted and unmalted sorghum to rabbits as energy source in place of maize. The daily weight gain of the rabbits differed significantly ($p < 0.05$) in all the treatments. The highest (15.54 g) was observed in T4 (50% “Jigare” and 50% maize) and the lowest (8.86 g) was observed in T1 (maize – based diet). However, there were similarities in T3 (100% “Chakalere” sorghum), T4 (50% “Jigare”

sorghum) and T5 (100 “Jigare” sorghum) groups which gave the highest daily weight gains compared to T1 (maize-based diet) and T2 (50% “Chakalere” sorghum) group. This result agreed with the findings of Murin *et al.* (2002) who reported that rabbits on sorghum-based diets gave better body weight gain than those on maize-based diets. Abubakar *et al.* (2006) also reported similar findings. Feed intake differed significantly ($p < 0.05$) among the experimental groups. Rabbits fed diet containing sorghum ate more feed than those fed the control diet (Maize – based). This may be attributed to the higher fibre levels of the diets containing sorghum. This result compared favourably with the result obtained by Doma *et al.* (1999) and Aderemi and Wuraola (2010) who fed similar diets to rabbits. Rabbits are known to require

more fibre in their diets than typical monogastric animals (Cheeke, 1987). Feed conversion ratio (FCR) during the whole study period differed significantly ($p < 0.05$). The highest (8.29) was observed in T2 (50% “Chakalere” sorghum and 50% maize) indicating low feed conversion ratio. The lowest value (4.62) was obtained in T4 (50% “Jigare” sorghum and 50% maize), which indicated high feed conversion ratio. Statistically, similar results were obtained for the maize and the diets containing sorghum. The superior value of 4.62 obtained in 50% “Jigare” sorghum group was only better than the 50% “Chakalere” group. The results were supported by the work of Abubakar *et al.* (2006) who reported the best feed efficiency in rabbits fed malted sorghum – based diet.

TABLE 2: Chemical composition of maize and the two sorghum varieties

Components (%)	Maize	“Chakalere” sorghum	“Jigare” sorghum
Dry matter (DM)	95.40	95.25	95.80
Crude protein (CP)	10.10	11.55	12.75
Ether extract (EE)	3.25	4.25	3.50
Crude fibre	5.50	5.75	7.75
Ash	1.00	2.25	2.00
NFE	79.35	75.95	74.00
ME (Kcal/kg)	3454	3468	3382
Tannin content	-	1.54	7.44

NFE = Nitrogen – free extract

ME = Metabolizable energy, calculated according to the formula of Pazungu (1985) ($ME = 37 \times \% CP + 81 \times \% EE + 35.5 \times \% NFE$)

Source: Medugu *et al.* (2010)

TABLE 3: Proximate composition of the experimental diets

Ingredients (%)	T1	T2	T3	T4	T5
	100% maize + 0% sorghum	50% maize + 50% Chakalere	0% Maize + 100% Chakalere	50% maize + 50% Jigare	0% Maize + 100% Jigare
Dry matter (DM)	93.30	97.90	98.30	98.10	97.50
Crude protein (CP)	19.77	19.94	20.11	19.94	20.11
Crude fibre (CF)	9.27	9.89	10.57	10.02	10.98
Ether extract (EE)	3.64	3.40	3.13	3.97	3.31
Total ash	5.00	3.00	2.00	3.00	4.00
NFE	62.32	64.39	65.31	64.00	63.31
ME (kcal/kg)	2563.97	2618.19	2643.72	2635.93	2572.73
Tannin	-	0.26	0.54	1.27	2.53

NFE = Nitrogen – free extract

ME = Metabolizable energy, calculated according to the formula of Pazungu (1985) ($ME = 37 \times \% CP + 81 \times \% EE + 35.5 \times \% NFE$)

The economic performance of the rabbits fed graded levels of sorghum as replacement for maize is presented in Table 4. The cost per kg of feed decreased progressively as the level of sorghum increased in the diets. The feed cost per kg of weight gain also declined from N393.01 in T1 (maize – based diet) to N248.84 in T5 (100% “Jigare” sorghum). The more the quantity of sorghum in the diet, the less expensive the diet becomes (T3). Thus, incorporation of sorghum into the diets of growing rabbit

lowered the feed cost and hence the cost of production. Results obtained from the study was supported by the work of Abubakar *et al.* (2006) who reported that the cost of feed per kg body weight gain was lower in the malted and unmalted sorghum diets than the maize – based diets. Thus 100% replacement of maize with malted or unmalted sorghum in the diets of growing rabbits is a cheaper and feasible option.

TABLE 4: Growth and economic performance of rabbits fed graded levels of two varieties of sorghum

Parameters	T1	T2	T3	T4	T5	SEM
	100% maize + 0% sorghum	50% maize + 50% Chakalere	0% Maize + 100% Chakalere	50% maize + 50% Jigare	% Maize + 100% Jigare	
No. of rabbits	5	5	5	5	5	
Mean initial body weight (g)	568.80	581.60	563.20	566.00	567.40	61.48 ^{NS}
Mean final body weight (g)	1166.00	1196.70	1311.30	139.00	1410.70	9.57 ^{NS}
Average daily weight gain (g)	8.86 ^b	9.89 ^b	14.52 ^a	15.54 ^a	14.81 ^a	1.84 [*]
Average daily feed intake (g)	58.95 ^b	58.67 ^b	66.25 ^a	68.30 ^a	66.01 ^a	1.98 [*]
Feed conversion ratio	7.96 ^{ab}	8.29 ^a	5.22 ^{ab}	4.62 ^b	4.93 ^{ab}	1.17 [*]
Total feed intake / rabbit (g)	3301.20	3285.50	3710.00	3824.80	3696.60	-
Total feed intake / rabbit (kg)	3.30	3.29	3.71	3.82	3.70	-
Cost / kg (₦/kg)**	59.56	57.69	55.82	57.69	55.82	-
Total feed cost (₦)	196.55	189.80	207.09	220.38	206.53	-
Total weight gain / rabbit (g)	496.16	553.84	813.12	870.24	829.36	-
Total weight gain / rabbit (kg)	0.50	0.55	0.81	0.87	0.83	-
Cost/kg gain (₦/kg)	393.01	345.09	255.67	253.31	248.84	

SEM = Standard error of means, NS = Not significantly different ($p > 0.05$) * = Significant difference ($p < 0.05$). ** Calculation was based on the prevailing cost of the ingredients at the time of study.

CONCLUSION

Results obtained from this study indicated that up to 100% level of the maize in rabbit diets could be replaced with sorghum (“Chakalere” and “Jigare”) without adverse effect on the performance of rabbits. The use of sorghum as feed ingredient also resulted in reduced feed cost and lower cost per kg weight gain. These advantages of sorghum warrant its recommendation as a feed ingredient in rabbit diet. Considering the weight gain of the rabbits and feed cost per weight gain, sorghum (“Chakalere” or “Jigare”) is recommended as a good energy source for feeding rabbits.

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