African Journal of Biotechnology Vol. 5 (17), pp. 1579-1583, 4 September 2006
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2006 Academic Journals

Full Length Research Paper

Performance and digestibility of weaner rabbits fed graded levels of soybean cheese waste/maize offal diet and brachiaria grass hay

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Accepted 24 July, 2006

Weaner crossbred rabbits were allocated to five treatment groups in a completely randomized design. The treatments consisted of 100, 75, 50 and 25% levels of soybean cheese waste/maize offal diet (SBW). 100% rabbit meal served as control. Each rabbit received chopped *Bracharia decumbens* hay *ad libitum*. Water was offered *ad libitum*. Concentrate and hay were offered in separate feeders. Rabbits on the control diet had significantly higher feed intake compared with SBW treatments. Hay intake was significantly lower in 100 and 75% level treatments than 50 and 25% SBW treatments. Weight gain was significantly lower for 25% level with daily gains ranging between -2.08 g for 25% and 6.70 g for the control. Feed conversion efficiency was significantly lower for 25% level compared with other treatments. Survival rate of rabbits ranged between 40 and 60% for the experimental treatments. Dry matter, ash, ether extract, crude protein and nitrogen free extractives intake decreased with decrease in the level of concentrate. Crude fibre intake was similar for the control, 100, 75 and 50% SBW treatments but significantly lower for 25% SBW treatment. Dry matter, ether extract and nitrogen free extractives digestibility were similar for the control, 75 and 25% SBW treatments, and significantly higher than 100 and 50% SBW treatments. Crude protein digestibility and retention were similar for all the groups. Soybean cheese waste/maize offal diet offered at 50% along with bracharia hay compared favorably with the standard rabbit meal in terms of growth and digestibility of nutrients by weaner rabbits. Level of SBW concentrate offered to rabbits should however, not be below 50% when fed with bracharia hay.

Key words: Performance, digestibility, rabbits, soybean cheese waste, maize offal, bracharia grass.

INTRODUCTION

Increased rabbit production is one sure way of meeting the animal protein requirements of the Nigerian populace (Iyeghe-Erakpotobor et al., 2002). Increased production of fryers and breeders can be ensured through proper nutrition and feeding of weaner rabbits.

Over the years, there has been a great increase in the production of soybean in Nigeria, which has resulted in a concomitant increase in the consumption of soybean. Soybean is used in making various products such as soups, milk and cheese. Soybean cheese waste, a by-product of milk and cheese from soybean, is used for feeding animals such as cattle, sheep and goats. It is readily available and cheap in towns and villages where the cheese is widely produced and eaten.

Full fat soybean contains 38% crude protein (CP) and 3300 kcal ME/kg while soybean cake contains 44% CP and 2420 kcal ME/kg (Aduku, 1992). From this, it is very likely that soybean cheese waste meal might contain adequate amounts of protein and energy that can meet the requirements of weaner rabbits. Maize offal is the by-product of maize milling into flour. Ogundipe et al. (1992) reported maize offal to contain similar protein (10% CP) and energy (2800 kcal ME/kg) as whole maize and a good source of energy for poultry and livestock. Bracharia hay (6% CP, 2000 kcal ME/kg DM) has been

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Table 1. Concentrate diets fed to weaner rabbits.

Ingredient	Proportion in diet (%)	
	Rabbit meal (Control)	Soybean cheese waste meal
Maize	39.24	-
Maize offal	15.00	48.50
Groundnut cake	42.26	-
Soybean cheese waste	-	48.00
Bone meal	3.00	3.00
Salt	0.25	0.25
Vitamin/mineral premix*	0.25	0.25
	100.00	100.00
Energy (Kcal ME/kg)**	2600	2300

*Vitamin/mineral premix content per kilogram ration: Vitamin A 1251 IU; vitamin D3 2750 IU; vitamin E 151 IU; vitamin K 0.002 g, vitamin B_2 0.006 g; nicotinic acid 0.035; calcium D-pantothenate 0.01 mg; vitamin B_6 0.0035 g; vitamin B_{12} 0.02 g; folic acid 0.001 g; biotin 0.0005 g; vitamin C 0.025 g; cholin chloride 0.39 g, zinc bacitracin 0.02 g; Methionine 0.2g, Avatec (Lasolocid) 0.09g, Manganese 0.1g, Iron 0.05g, Zinc 0.04g, copper 0.002 g; iodine 0.00153 g; cobalt 0.000225 g; and selenium 0.0001 g.
**Energy was calculated.

proven to be well accepted and utilized by rabbits (Partridge, 1989). Studies have shown that rabbits can utilize 50 g of concentrate with forage grass or legume without adverse effect on growth (Bamikole and Ezenwa, 1999; Iyeghe-Erakpotobor et al., 2002, 2003; Iyeghe-Erakpotobor, 2006). There is very little information on digestibility of concentrates and forages by rabbits in literature. This study was therefore designed to investigate growth performance and digestibility of weaner rabbits fed levels of soybean cheese waste/maize offal diet and Bracharia hay.

MATERIALS AND METHODS

Study site

The study was conducted in the rabbitry of the National Animal Production Research Institute (NAPRI), Shika, Nigeria, located in the northern Guinea Savanna ecological zone. The area lies between Latitude 10°11' N and Longitude 7°8' E, and 650 meters above sea level. The area receives an annual rainfall of 1100 mm, spread between April and October. The mean minimum and maximum temperatures range from 12 –28°C during the cold (harmattan) season and 20 - 36° in the hot season. Relative humidity during the rainy season is about 75% and 21% during the dry season.

Animals and housing

Crossbred weaner rabbits were used for this study. The rabbits were progenies obtained from mating between New Zealand White X California and California X Chinchilla breeds. The rabbits were individually housed in metal cages located in a well-ventilated house. The house is completely walled with wide, open windows covered with wire mesh and mosquito netting. The experimental animals were kept, maintained and treated in adherence to accepted standards for the humane treatment of animals.

Experimental procedure

Forty-nine eight weeks old weaner rabbits were randomly allocated to five treatments in a completely randomized design. The treatments consisted of the following levels of soybean cheese waste/maize offal diet: 100, 75, 50 and 25%, while 100% (100 g) rabbit meal comprised the control. Table 1 shows the composition of the diets. Bracharia (*Bracharia decumbens*) grass hay was fed *ad libitum* (60 g) to all the groups. Bracharia was harvested from the pasture fields of the Forage and Crop Residue Research Programme (NAPRI), dried on the field and chopped into smaller sizes before feeding to rabbits. The concentrate diet and grass hay were weighed and offered in separate earthen feeders at 08.00 h daily. Water was supplied *ad libitum* in earthen drinkers. Concentrate and hay left over and/or wastage was weighed daily before feeding. The rabbits were weighed at the start and at weekly intervals during the study. Feed intake was determined by subtracting feed wastage and leftover from the total feed offered. The earthen feeders had curved tips which drastically reduced feed wastage. Parameters monitored were weight change, feed intake, feed conversion efficiency (FCE) and survival rate. The study lasted five weeks.

Digestibility study

Digestibility study was conducted using six rabbits per treatment during the fourth week of feeding. Fecal and urine samples were collected daily for four days and stored at –20°C in a deep freezer immediately after collection. At the end of each collection period, the fecal samples were bulked for each animal for proximate analysis according to AOAC (1980) procedures while the urine samples were bulked for nitrogen analysis. Nutrient composition of the concentrate and bracharia were determined according to AOAC (1980). Feed and nutrient intake, digestibility coefficients and nitrogen retention were determined.

Statistical analysis

Data were subjected to analysis of variance using the General Linear Model procedure. Pair-wise difference method (pdiff) was

Table 2. Chemical composition of diets and bracharia hay fed to weaner rabbits.

Diet	Nutrient (%DM)				
	Dry matter	Ash	Ether extract	Crude fibre	Crude protein
Rabbit meal diet	95.71	24.64	12.48	11.19	17.88
Soybean cheese Waste diet	97.88	16.51	15.22	19.11	15.18
Brachiaria decumbens	97.39	10.36	13.42	35.60	12.94

Table 3. Performance of weaner rabbits fed levels of soybean cheese waste/maize offal meal and bracharia hay.

Parameter	Treatment					Contrast*	Trend *	
	Control (100% RBM)	100% SBW	75% SBW	50% SBW	25% SBW	a	b	c
Initial weight (kg)	0.92±0.05	0.99±0.06	0.99±0.06	1.00±0.06	0.92±0.07			
Final weight (kg)	1.20± 0.08^{a}	1.22± 0.10^{a}	1.03±0.10^{ab}	1.07±0.09^{ab}	0.84±0.11^{b}			
Total weight gain (g)	281.2±76.80^{a}	230.0±97.15^{a}	40.0±97.15^{ab}	75.0±88.68^{ab}	-87.5±108.61^{b}	*	*	
Daily weight gain (g)	6.70±1.83^{a}	5.47±2.31^{a}	0.95±2.31^{ab}	1.78±2.11^{ab}	-2.08±2.59^{b}		*	
Concentrate intake (g)	76.5±2.12^{a}	52.8±2.29^{b}	41.1±2.35^{c}	41.0±2.21^{c}	22.4±2.44^{d}	*	*	
Grass intake (g)	33.3±1.06^{ab}	31.7±1.14^{bc}	31.2±1.17^{c}	35.4±1.10^{a}	34.9±1.22^{ab}		*	
Total feed intake (g)	109.9±2.77^{a}	84.6±2.99^{b}	72.3±3.07^{c}	76.4±2.89^{c}	57.3±3.20^{d}	*	*	
FCE (gain/intake)	0.044±0.023^{a}	0.040±0.024^{a}	0.013±0.025^{ab}	0.054±0.024^{a}	-0.048±0.026^{b}		*	
Survival rate (%)	80±15.9	56±16.8	50±15.9	60±15.9	40±15.9			

Means with different superscript along rows are significantly different at (P<0.05). RBM –rabbit meal, SBW – soybean cheese waste meal.
a – control vs other treatments, b- linear, c- quadratic.
**Level of significance (P<0.05)

used to separate significant means, contrast procedure was used to compare the control and the experimental treatments while trend analysis was carried out to determine the trend between the treatments and the parameters monitored (SAS, 1987).

RESULTS AND DISCUSSION

Table 2 shows the chemical composition of the diets and hay fed. The control diet (rabbit meal) had higher crude protein and ash than the soybean cheese waste diet. However, the difference in the crude protein content of the two diets was not very high. Crude protein of bracharia hay used in this study was higher than that reported in literature. Final weight and total weight gain (Table 3) were similar for the control and 100% SBW groups though significantly lowest for the 25% SBW treatment. The 25% SBW group lost weight and therefore had a negative weight change compared with the other groups. Contrast analysis however, showed a signify-cantly higher total weight for the control than the experimental treatments. Daily weight gain followed a similar pattern as total weight gain. Weight gain showed a linear decrease with decrease in concentrate levels. Weight gains of –2.08 to 6.70 g obtained in this study are lower than those (8.53 to 17.22 g) reported by Onyimonyi and Ene (2003) with *Panicum maximum* and concentrate. This could probably be attributed to the coarseness of bracharia hay or because they used wilted forage as opposed to hay used in this study. Daily weight gain of 6.70 g obtained for the control is also lower than 8.86 g obtained by Iyeghe-Erakpotobor et al. (2003) for grower rabbits fed rabbit meal and chloris hay. This indicates that type and quality of forage fed to rabbits has an effect on their growth rate.

Concentrate intake (Table 3) was significantly higher for weaners fed the control than the 100% SBW diet. Similar intake of concentrate was observed for 75 and 50% SBW treatments. There was a significantly (P<0.05) higher intake of concentrate by rabbits on the control than the experimental treatments. Concentrate intake decree-sed linearly with decrease in concentrate levels. Intake of concentrate was significantly (P<0.05) higher for the control than the 100% SBW diet. This indicates that the control diet was likely more palatable than the soybean cheese waste diet. Grass intake was significantly lower (P<0.05) for weaners on 75% SBW and higher for those on 50, 25% SBW and the control. Grass intake increased linearly with decrease in concentrate levels. There was generally low intake of the grass hay by all the groups. This might probably be due to the high dry matter content or the coarse nature of brachiaria hay. Total feed intake was significantly higher for the control than the 100% SBW group. Total intake was also lowest for the 25% SBW group while being similar for 75 and 50% SBW groups. Onyimonyi and Ene (2003) reported similar significantly lower average daily feed intake of grower rabbits fed 25% concentrate and *Panicum maximum*. However, total feed intake of 57.28 g obtained on the 25% SBW and brachiaria treatment in this study is higher than the 27.46 g reported by Onyimonyi and Ene (2003).

Table 4. Nutrient intake and digestibility of weaner rabbits fed levels of soybean cheese waste/maize offal meal and bracharia hay.

Parameter	Treatment					
	Control (100% RBM)	100% SBW	75% SBW	50% SBW	25% SBW	SE
Nutrient intake (gDM/d):						
Dry matter	119.8^{a}	82.4^{b}	81.8^{b}	74.8^{b}	54.6^{c}	6.07
Ash	29.9^{a}	12.1^{b}	11.8^{b}	10.1^{b}	7.1^{c}	0.94
Ether extract	15.3^{a}	12.1^{b}	11.9^{b}	10.7^{b}	7.8^{c}	0.89
Crude fibre	21.2^{a}	19.9^{a}	20.2^{a}	20.4^{a}	15.4^{b}	1.43
Crude protein	19.8^{a}	12.0^{b}	11.8^{b}	10.5^{b}	7.6^{c}	0.89
Nitrogen free extractives	38.5^{a}	26.4^{b}	26.0^{b}	23.1^{b}	16.6^{c}	1.96
Digestibility coefficient:						
Dry matter	0.76^{a}	0.63^{b}	0.74^{a}	0.63^{b}	0.76^{a}	0.03
Ether extract	0.75^{a}	0.67^{b}	0.75^{a}	0.65^{b}	0.77^{a}	0.02
Crude fibre	0.58^{ab}	0.45^{b}	0.64^{a}	0.52^{b}	0.71^{a}	0.05
Crude protein	0.78	0.74	0.79	0.69	0.75	0.04
Nitrogen free extractives	0.81^{a}	0.74^{b}	0.85^{a}	0.72^{b}	0.84^{a}	0.03
Crude protein retention	0.72^{a}	0.73^{a}	0.73^{a}	0.57^{b}	0.71^{a}	0.05

Means with different superscript along rows are significantly different at (P<0.05).
SE – Standard error, RBM –rabbit meal, and SBW – soybean cheese waste meal.

The control rabbits consumed significantly (P<0.05) more total feed than the experimental group. The trend of total feed intake showed a linear decrease with decrease in concentrate level and increase in brachiaria level. This indicates an inability of the rabbits to adequately adjust their intake with increase in brachiaria hay level. The reason for this could probably be as a result of the high fibre content, coarseness and high dry matter content of the brachiaria hay. Feed conversion efficiency (Table 3) was significantly (P<0.05) lower for the 25% SBW group than the other treatments, which had similar conversion efficiency. There was a linear decrease in feed conversion efficiency with decrease in concentrate level. It is obvious that the 25% SBW group were not taking in enough nutrients for body maintenance probably because they were not able to make up for the low concentrate intake by increasing their grass intake. Survival rate was lower in the SBW treatment groups than the control.

Table 4 shows nutrient intake and digestibility of rabbits. Dry matter, ash, ether extract, crude protein and nitrogen free extractives intake decreased with decrease in the level of concentrate. Crude fibre intake was however, similar for the control, 100, 75 and 50% SBW treatments but significantly (P<0.05) lower for 25% SBW treatment. Crude protein intake and other nutrients, except crude fibre were significantly (P<0.05) lower for the 100% SBW treatment compared with the control though quantity of concentrate offered both groups was the same. It was expected that rabbits from both groups would have similar feed and nutrient intake. Apparently, the soybean cheese waste meal diet was not as palatable as the control hence the lower concentrate intake observed. This, coupled with the inability of rabbits to adjust their hay intake, to make up for inadequate nutrient intake from concentrate, as a result of the restriction in concentrate offered, could be the reason for the lower weight gain of rabbits, especially for those offered the lower levels of concentrate.

Dry matter, ether extract and nitrogen free extractives digestibility were similar for the control, 75 and 25% SBW treatments, and significantly (P<0.05) higher than 100 and 50% SBW treatments. Crude protein digestibility and retention were similar for the control and all the experimental groups. This could indicate a high efficiency in crude protein utilization even when the nutrient supply and/or intake were inadequate for optimum growth performance.

Results from this study show that though rabbits are good forage eaters, their capacity for intake and utilization of grass hays, especially when offered with low concentrate level, is poor. Low survival rate of rabbits observed for the soybean cheese waste treatments could be a result of inadequate intake of nutrients by the rabbits resulting from their inability to adequately adjust their intake to meet their nutrient requirements. It is concluded from this study that soybean cheese waste/maize offal diet compared favorably with the standard rabbit meal fed to rabbits in growth and nutrient digestibility. However, because of weight loss observed for the 25% SBW, level of SBW concentrate offered to rabbits should not be below 50% (50g) when fed with bracharia hay.

ACKNOWLEGDEMENTS

The authors wish to express their gratitude to the Director, National Animal Production Research Institute

(NAPRI) for permission to publish this study. The contributions of staff in the Rabbit Research Unit for data collection and the Central Laboratory for laboratory analysis are acknowledged. The Federal Ministry of Agriculture and Rural Development, Nigeria funded the work.

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