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Effects Agro-Industrial by Products on the Growth of Rabbits in Northern Ghana

Terry Ansah, Kamara Francis, Ninkarb Seth Joejoe, Takinam Rockson Kwaku and Gabriel Ayum Teye,
Department of Animal Science, Faculty of Agriculture, University for Development Studies, Tamale, Ghana

Abstract: The use of agro-industrial by products as a source of protein could minimize the challenge of obtaining locally available concentrate for rabbit production especially in the dry season. The study was carried out to investigate the effects of four agro-industrial by products and maize as a control on growing rabbits. The agro by-products included Milled Mango Seed Kernel (MMSK), Maize Bran (MB), Brewers Spent Grain (BSG) and Corn Mill Residue (CMR). A total of 20 rabbits were randomly assigned to the five experimental diets for a period of 49 days after one week adaptation period. The OM was in the range of 609-857g/kg and that of carbohydrate was in the range of 563-768.5g/kg. The crude protein from the experimental diet was in the range of 168 and 330g/kg. The highest ADF fraction was obtained in BSG and the least from maize. There was no significant ($p>0.05$) difference in final live weight gain and average daily weight gain among the treatments diets. Significant difference was observed in PCV, RBC and Hb with the highest recorded in MB. The total WBC was also significantly different with the highest obtained in CMR and the least in MMSK. There was no significant difference ($p>0.05$) in dressing percentage, hot carcass and cold carcass weight. Maize bran could be incorporated in the diet of rabbits at 70% without any detrimental effect on grower rabbits.

Key words: Agro-industrial by products, maize bran, rabbits, carcass, blood profile

INTRODUCTION

The search for a cheap but growth enhancing feed material for livestock is a continual process in view of the high demand for livestock products. The answer to this quest relies heavily on the exploitation of locally available feed materials within a particular region. Rabbits are a group of livestock with the potential of supplying the protein needs of families particularly in the developing nations. When compared with other domestic livestock, rabbit meat is reported to contain lesser amounts of cholesterol, fat and calories with a higher amount of protein (Lebas and Matheron, 1982 and Fielding, 1991). Cost of feeding remains the single most expensive component of intensive livestock production. There is therefore the need to search for locally available feed materials so as to encourage the poor and malnourished people to go into rabbit production.

It is against this background that four locally available agro-industrial by product were selected for investigation as feed for growing rabbits.

Objective: The objective of this study was to determine the effects of four agro-industrial by products on the growth, blood profile and carcass characteristics of growing rabbits.

MATERIALS AND METHODS

Study area: The study was carried out at the Nyankpala Campus of the University for Development Studies, Tamale, Ghana. Nyankpala is about 18 km west of Tamale in the Tolon District. It is located on latitude 9°25' 41"N and longitude 0°58'42" W at an altitude of 183 m above sea level (SARI, 2001). The area is in the Guinea Savannah Zone characterized by a unimodal rainfall pattern. Rains begin in April, rising to a peak in August-September and ending in October or November. Rainfall averages 1060 mm per annum. Temperatures range from as low as 15°C in January when the weather is under the influence of the North Easterly (Harmattan) winds and as high as 42°C around the end of the dry season in March (SARI, 2001).

Source and preparation of test diet

Milled Mango Seed Kernel (MMSK): Mango seeds were gathered between April and June 2011.These seeds were dried in the sun for two weeks and cracked manually to remove the kernel. The kernels were further dried in the sun for another two weeks before milled into desirable texture at a commercial corn mill.

Maize bran (MB): Maize bran was obtained from the local porridge producers within Nyankpala and dried thoroughly in the sun to prevent it from getting mouldy. It was then bagged into a jute sack for the feed preparation.

Brewer's spent grains (BSG): BSG was obtained from the local wine (Pito) producers. The wine is usually

Corresponding Author: Terry Ansah, Department of Animal Science, Faculty of Agriculture, University for Development Studies, Tamale, Ghana

prepared from millet through the process of fermentation. These products were collected and dried to get rid of the moisture. It was then bagged in jute sacks for storage.

Corn mill residue (CMR): CMR was obtained from the corn millers in Nyankpala and dried under shade to prevent it from getting mouldy. The residue from the corn mill is composed of debris from several ingredient milled at the corn mill. These include maize, sorghum, pepper, groundnut, dried cassava (konkonte), millet and cow pea (personal communication). The composition of the CMR depends on the type of food milled at the corn mill and may vary from locality to locality.

Experimental design and animals: Twenty weaned rabbits of mixed breed with an average weight of 785.5±1.03g were sourced at 8 weeks from Ejisu near Kumasi. The Completely Randomized Design (CRD) was used in grouping the animals and placed on 5 different diets. The feeding trial lasted for 49 days. Each dietary group had 4 replicates. The dietary treatments were (70% maize) (70% MMSK) (70% BSG) (70% CMR) and (70% MB).

Management of the experimental animals: The rabbits were housed in wire mesh cages each raised 1m above the ground. The dimension of the hutch is 50cm length x 60 cm width x 60 cm high. Each cage was provided with two bowls made of clay for water and feed.
Each animal was given 100g of feed a day for the 49 days. Water was given *ad libitum.* Medication was given as and when the need arose.
The following data were collected during the experiment Feed intake: A 100g of each treatment diet was weighed and fed to each animal at about 8:00am. The following day the left over was weighed and subtracted from what was offered. The result is recorded as feed intake for each animal. The animals were allowed 7 days adjustment to the feed.

Weight gain: Each animal was weighed before the introduction of the feed. This gives the initial Weights (w_0) g. After each week of feeding, the weight of the animals is taken again. Weight gain is computed from the difference between the initial and final weight.

Blood profile: Blood samples from each of the rabbit in the treatment groups were obtained using a 5ml plastic syringe through the marginal ear vein into well labeled sample bottles that contained Ethylene Diamine Tetra-acetic Acid (EDTA) as anticoagulant (Radostits *et al*., 1994).
The Packed Cell Volume (PCV), Red Blood Cell (RBC), White Blood Cell (WBC) and the Haemoglobin (Hb) concentrations were measured using the Wintrobes Microhaematocrit, improved Neubauer haemocytometer and Cyanomethaemoglobin methods respectively (Baker and Silverton, 1990).
A sample of blood (0.1ml) was taken and diluted with 2ml of the WBC diluting fluid using the WBC diluting pipette and mixed. The mixture was left to stand at room temperature for 5-10 minutes after which it was counted under a microscope.
A sample of the blood was smeared on a slide and air dried. It was then stained using leishman's stain. The plates were examined under a X10 objective lens and the differential counted. The results were expressed in percentage.

Dressing Percentage (DP): This was determined by taking the dressed carcass weight and dividing it by the final live-weight of the animal multiplied by 100.

Hot Carcass Weight (HCW): The weight of carcass was taken within 15-30 minutes after slaughtering. The carcass did not include blood, skin, distal parts of the tail, fore and hind legs, gastrointestinal and urogenital tracts.

Cold carcass weight (CCW): Cold carcass weight was determined, when carcass was chilled for 24 h in a ventilated cold room (4°C).

Chemical analysis: The experimental diets were analyzed for the crude protein, ether extract, ash and Dry Matter (DM) content according to the procedure of AOAC (2001). The meat products were also analyzed for ether content and moisture. The NDF and ADF were analyzed using the detergent method described by Van Soest *et al*. (1991). The gross energy content (GE) of the feed was determined using a bomb calorimeter. The carbohydrate (CHO) fraction was calculated using the formulae proposed by Sniffen *et al*. (1992) (100-CP-Fat-Ash), organic matter (DM-Ash).

Table 1: Inclusion levels of the various ingredients

	Treatment				
Ingredients (%)	Maize	MMSK	BSG	CMR	MB
Maize	70	-	-	-	-
MMSK	-	70	-	-	-
BSG	-	-	70	-	-
CMR	-	-	-	70	-
MB	-	-	-	-	70
Soya bean meal	29	29	29	29	29
Salt	0.25	0.25	0.25	0.25	0.25
Di-calcium phosphate	0.5	0.50	0.5	0.5	0.5
Vitamin Premix	0.25	0.25	0.25	0.25	0.25
Total (%)	100	100	100	100	100

*premix composition (g/kg): -itamin, 12, 500 IU; vitamin D3, 2500 IU; -itamin, 50.00 mg; vitamin K3, 2.50 mg; vitamin B1, 3.00 mg; vitamin B2, 6.00 mg; vitamin B6, 6.00 mg; niacin, 400 mg; calcium pantothenate, 10 mg; biotin, 0.8 mg; vitamin B12, 0.25 mg; folic acid, 1.00 mg; chlorinechloride, 300 mg; manganese, 100 mg; iron, 50 mg; zinc, 45 mg; copper, 2.00 mg; iodine, 1.55 mg; cobalt, 0.25 mg; selenium, 0.10 mg; antioxidant, 200 mg

Data analysis: Data collected was analyzed using analysis of variance from Genstat 13th Edn.

Means was separated using Duncan's multiple range test at 5%.

RESULTS AND DISCUSSION

Table 2 shows the analyzed nutrient composition of the treatment diets used in this study. The CP was in the range of 168-330g/kg with the highest recorded in BSG and the least in MMSK. The CP content of the treatment diets was all above the 16% recommended levels for optimum growth (NRC, 1977 and Obinne and Okorie, 2008). The lowest NDF was recorded in CMR with BSG having the highest. The high NDF recorded in BSG could be due to the industrial process used to extract the local wine (pito) from the grains. The process involves fermentation which makes use of most of the soluble carbohydrates leaving behind the structural carbohydrates (NDF). The NDF in CMR was lower than the 34% recommended to minimize the accumulation of digesta in the caecum (De Blas and Mateos, 1998). The highest gross energy was obtained in BSG. Ether extract was in the range of 7.5-72g/kg. Total carbohydrate was in the range of 768-563g/kg with maize having the highest.

There was no difference ($p>0.05$) in live weight, final weight gain, average daily weight gain and daily dry matter intake (Table 3). The daily dry matter intake was highest for BSG but this did not correspond to a significant increase weight gain. The high intake may be due to the high CP content of the BSG. There was a significant difference ($p<0.05$) in gain per feed intake with the highest gain per feed recorded in the maize diet and the least recorded in MMSK. The lower gain/feed recorded in the MMSK diet could be due to the presence of Anti-Nutritional Factors (ANFs) such as tannins that have been reported in MMSK (Ravindran and Sivakanesanb, 1996). ANFs bind to CP and make it unavailable for digestion in the GIT. With the exception of MMSK, all the other agro-industrial byproducts compared favorably with the maize in terms of final live weight and weight gain providing a readily available source of ingredients for rabbit diet.

The results on the effect of the treatment diets on blood profile are presented in Table 4. Significant differences ($p<0.05$) were observed in all the parameters except

Table 2: Analyzed and calculated nutrient composition of the experimental diets ± standard deviation

Analyzed nutrient composition (g/kgDM)	Treatment				
	Maize	MMSK	BSG	CMR	MB
Dry matter	838±7.5	914±6.5	880±9.3	770±9.8	877±7.0
Crude protein	191±6.5	168±1.6	330±9.7	184±5.6	232±6.4
Ether extract	7.5±1.0	72±0.7	33±0.1	20±0.2	15±0.1
Ash	33±0.2	57±4.6	74±0.9	161±3.8	77±3.8
Acid detergent fibre	56±6.9	107±9.6	184±3.3	59±5.0	88±1.9
Neutral detergent fibre	354±1.9	385±4.3	455±3.1	182±8.9	327±8.4
Gross energy (kcal/Kg)	4328±0.9	4330±0.5	4629±2.1	3233±0.3	4570±0.3
Calculated nutrient composition					
Carbohydrate (g/kg)	768.5	703	563	635	676
Organic matter (g/kg)	805	857	806	609	800

Table 3: Effect of the treatment diet on intake, growth, blood profile and carcass characteristics of rabbits

Parameters	Treatment						
	Maize	MMSK	BSG	CMR	MB	SED	p-value
Live-weight (g)	1189	1039	1173	1275	1404	271.6	0.740
Final weight gain (g)	524	234	490	345	540	158.6	0.064
Average daily weight gain (g)	10.70	4.77	9.99	7.04	11.02	3.236	0.640
Daily dry matter intake (g)	52.6	61.0	82.1	60.8	70.1	14.58	0.100
Gain/Feed	0.197^{b}	0.083^{a}	0.120^{ab}	0.124^{ab}	0.160^{ab}	0.047	0.040
PCV (g/l)	26.33^{a}	31.00^{ab}	39.50^{cd}	35.00^{ab}	41.50^{d}	2.392	0.001
HB (%)	8.81^{a}	10.30^{ab}	13.15^{cd}	11.65^{bc}	13.80^{d}	0.800	0.001
RBC (µL)	3.423^{a}	4.030^{ab}	5.135^{cd}	4.550^{bc}	5.394^{d}	0.311	0.001
WBC (%)	6.97^{ab}	5.77^{a}	10.15^{b}	10.30^{b}	8.550^{ab}	1.528	0.038
Neutrophils (%)	48.00	44.00	49.50	48.50	51.00	2.513	0.124
Lymphocytes (%)	48.00	53.33	49.50	50.75	47.00	3.109	0.326
Eosinophils (%)	3.00^{a}	2.00^{ab}	1.00^{bc}	0.75^{c}	1.50^{bc}	0.555	0.008
Monocytes (%)	1.00^{b}	0.67^{ab}	0.00^{a}	0.00^{a}	0.50^{ab}	0.325	0.036
Dressing (%)	52.0	49.1	48.9	49.6	55.3	6.22	0.817
Hot carcass weight (g)	788	632	729	617	1028	324.2	0.724
Cold carcass weight (g)	739	606	685	583	959	303.6	0.746

Mean values in row with uncommon superscripts are significantly different at ($p<0.05$); SED: Standard error of difference

Neutrophils and lymphocytes. The highest PCV, HB, RBC were recorded in MB. The PCV and Hb were all within the normal range reported for rabbits except for maize which was lower. A PCV and Hb of 33-50 and 9.4-17.4, respectively have been recommended by Mitruka and Rawnsley (1997) and Ross *et al*. (1979). The high Hb and RBC recorded in BSG and MB could reflect the efficient digestion and absorption of dietary protein in these treatments.

There was no significant difference ($p>0.05$) recorded in the carcass characteristics. The dressing percentage was in the range of 48.9 and 55.3 with MB having the highest. The dressing percentage for MB was in the recommended range of 55-61% reported by Dalle Zotte and Ouhayoun (1998).

Conclusion: Maize bran (MB) could be used in the diet of rabbits at 70% without any detrimental effect.

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There are three tables in the article, but you discussed Table No. 4 also in the Results and Discussion section, is it a spelling mistake or Table No. 4 is missing. Please clear this point.