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Growth, carcass and blood profile of rabbits fed agro-industrial by-products in Northern Ghana

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Abstract

The use of agro-industrial by-products (AIBP) 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 AIBP's and maize as a control on growing rabbits. The AIBP 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 609g/kg to 857g.kg and that of carbohydrate was in the range of 563g/kg to 768.5g/kg. The crude protein in the experimental diet was in the range of 168g/kg and 330g/kg. The highest ADF fraction was obtained in BSG and the least from maize. There was no significant difference in final live weight gain and average daily weight gain among the treatments diets. The gain per feed intake differed ($P=0.04$) among the treatments with the least recorded in MMSK. Significant difference ($P<0.05$) was observed in, PCV, RBC and Hb with the highest recorded in MB. The total WBC was also significantly different ($P<0.05$) with the highest obtained in CMR and the least in MMSK. There was no difference ($P>0.05$) in dressing percentage, hot carcass and cold carcass weight. Maize bran at 70% inclusion yielded the best results in terms of final weight gain, and average daily weight gain. Maize at 70% had the best gain per feed intake but due the cost and its role as a primary food source for humans, it will not be recommended. Other AIBP's like BSG and CMR could also be used at 70% without any detrimental effect. A further treatment to reduce the possible effect of the ANF's present in MMSK is recommended to enhance its utilization..

Keywords: -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 in Ghana (SRID, 2011). One way of solving this problem relies 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 due the relatively cheaper cost of production, meat handling and storage. 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; Fielding, 1991). Feeding remains the single most expensive component of intensive livestock production (Abate *et al*., 1992). There is therefore the need to search for locally available feed materials to produce cheap feeds so as to encourage the rural farmers to go into rabbit production.

It is against this background that four locally available AIBP's were selected for investigation as feed for growing rabbits.

Objective

The objective of this study was to determine the effects of four AIBP's 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 Savanna 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 diets

Milled mango seed kernel (MMSK)

Mango seeds were gathered between April and June 2011.These seeds were dried sundried for two weeks and cracked manually to remove the kernel. The kernels were further sundried for another two weeks before it was milled into desirable texture (approx.0.2 mm) at a commercial corn mill.

Maize bran (MB)

Maize bran was obtained from local porridge producers within Nyankpala and thoroughly sundried 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 beer (Pito) producers. The beer is usually 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 corn millers in Nyankpala and shade dried to prevent it from getting mouldy. The residue from the corn mill is composed of debris from several ingredients milled at the corn mill. These include maize, sorghum, pepper, groundnut, dried cassava (konkonte), millet, and cowpea. The composition of the CMR depends on the type of food crop milled at the corn mill and may vary from locality to locality

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Table 1 Inclusion levels of the various ingredients

INGREDIENTS (%)	TREATMENT				
	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 (per kg of diet): vitamin A, 12,500 IU; vitamin D3, 2500 IU; vitamin E, 50.00mg; vitamin K3, 2.50mg; vitamin B1, 3.00mg; vitamin B2, 6.00mg; vitamin B6, 6.00mg; niacin, 40mg; calcium pantothenate, 10mg; biotin, 0.08mg; vitamin B12, 0.25mg; folic acid, 1.00mg; chlorine chloride,300mg; manganese, 100mg; iron, 50mg; zinc, 45mg; copper, 2.00mg; iodine, 1.55mg; cobalt, 0.25mg; selenium, 0.10mg; antioxidant, 200mg

Experimental design and animals

Twenty (20) 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 contained 70% of maize, MMSK, BSG, CMR and 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 50 cm length × 60 cm width × 60 cm high. Each cage was provided with two bowls made of clay for water and feed.

Each animal was given 100 g of feed a day for the 49 days. Water was given *ad libitum.* Medication was given as and when an animal was diagnosed with a disease.

The following data were collected during the experiment:

Dry matter feed intake: Approximately 100 g 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 consumed for each animal. Daily feed samples were taken from each treatment and stored at 4^0C until experiment was over. At end of the experiment, the stored feed was bulked together for each treatment and sub sampled for dry matter determination. The dry matter percentage was computed and multiplied by the total feed consumed by each animal to get the dry matter feed intake.

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).

Packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC) and 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 hours in a ventilated cold room (4^0C).

Chemical analysis

The experimental diets were analyzed for crude protein, ether extract, ash and dry matter (DM) content according to the procedure of AOAC (2001). The meat products were also analysed for ether extract content and moisture. The Neutral detergent fiber (NDF) and Acid detergent fiber (ADF) were analysed 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).

CHO=100-CP-Fat-Ash where CP=crude protein

Organic matter =DM-Ash where DM=Dry matter

Data analysis

Data collected on growth, haematology and carcass of rabbits were analysed by analysis of variance using Genstat 13th edition. Means were separated using Duncan's multiple range test at 5%.

RESULTS AND DISCUSSION

Table 2 shows the analysed nutrient composition as well as the calculated nutrient composition of the treatment diets used in this study. The CP was in the range of 168 to 330g/kg with the highest recorded in BSG and the least in MMSK. The CP contents of the treatment diets were all above the 16% recommended levels for optimum growth (NRC, 1977 and Obinne and Okorie, 2008). The high CP content reported in MB compared with maize might be due to the processing the maize goes through when porridge (a local breakfast) is prepared. The process involves fermentation which introduces some lactic acid bacteria that are high in protein. 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 beer (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). Ether extract was in the range of 7.5 to 72g/kg. Higher ether extract has the tendency to reduce dry matter feed intake and may decrease effective ether digestibility, probably because of its effect on digestive efficiency and microflora activity in the caecum (Maertens *et al*., 1986). Falcaoe Cunha *et al*. (2004) observed reduced cellulolytic and pectinolytic activity in the caecum and caecotrophes of rabbits fed high-fat diets.

Table 2 Nutrient composition of the experimental diets ± standard deviation

Analysed 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	768.5	703	563	635	676
Organic matter	805	857	806	609	800

MMSK; Milled mango seed kernel, BSG; Brewers' spent grain, CMR; Corn mill residue, MB; Maize bran

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. The high intake may be due to the high CP content of the BSG which is supported by the finding of Willimason and payne (1975) and Konlan *et al*. (2012). The high dry matter feed intake recorded for diets with high CP did not correspond to a significant increase in weight gain. This may be an indication of poor digestibility of the CP in these diets. Even though different levels of CP have been recommended for growth of rabbits, it appears the source of the CP play an important role and not just the levels (NRC, 1977; Omole, 1982; Abdella, 1988). 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 Sivakanesan, 1996). ANFs form complexes with CP and make it unavailable for digestion. With the exception of MMSK, all the other agro-industrial by products compared favorably with the maize in terms of final live weight and weight gain providing a readily available source of ingredients for rabbit diet.

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

Parameters	TREATMENT						
	Maize	MMSK	BSG	CMR	MB	s.e.d	P-Value
Final live-weight (g)	1189	1039	1173	1275	1404	271.6	0.740
Total 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 ($\times 10^{9}$/l)	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
Carcass 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; s.e.d-standard error of difference; MMSK; Milled mango seed kernel, BSG; Brewers' spent grain, CMR; Corn mill residue, MB; Maize bran

The results on the effect of the treatment diets on blood profile are presented in Table 3. Significant differences (P<0.05) were observed in all the parameters except 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. The WBC and differentials were within the ranges reported for growing rabbits and suggests that the treatments had no negative effect on the health of the rabbits (Archetti *et al*., 2008)

There was no significant difference (P>0.05) 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% to 61% reported by Ouhayoun (1998) and Dalle Zotte and Ouhayoun, (1998).

CONCLUSION

Maize bran at 70% inclusion yielded the best results in terms of final weight gain, and average daily weight gain. Maize at 70% had the best gain per feed intake but due the cost and its role as a primary food source for humans, it will not be recommended as feed for rabbits. Other agro-byproducts like BSG and CMR could also be used at 70% without any detrimental effect. A further treatment to reduce the possible effect of the ANF's

present in MMSK is recommended to enhance its utilization.

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