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PERFORMANCE AND CARCASS CHARACTERISTICS OF WEST AFRICAN DWARF (WAD) GOATS FED CASSAVA PEEL MEAL BASED DIETS SUPPLEMENTED WITH AFRICAN YAMBEAN CONCENTRATE

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Abstract: ***This study evaluated the effect of cassava peel meal (CPM) based – diets supplemented with African yambean (Sphenostylis stenocarpa) seed meal (AYBM) on the growth performance and carcass characteristics of West African Dwarf (WAD) goats. Four diets were formulated containing CPM (46 % each) and AYBM at 0, 10, 20 and 30 % levels designated as A, B, C, and D respectively. Twenty intact weaned bucks weighing between 6.5 and 10.5 kg were randomly assigned to the experimental diets after weight equalization with 5 bucks per treatment in a Completely Randomized Design (CRD) experiment which lasted for 56 days. Growth performance parameters were determined during the feeding trial while carcass and organ characteristics were evaluated at the end of the trial. Results showed that the average daily weight gain was significantly (P<0.05) different between treatments with the following values 36.07, 98.05, 124.82 and 108.04 g/buck for diets A, B, C and D, respectively. The feed gain ratio was also significantly (P<0.05) affected by treatments, bucks fed the AYBM diets had better FCR compared with the control diet. The dressing percentage (40.39, 51.90, 53.40 and 52.29 %), bone to lean meat ratio (0.31, 0.30, 0.19 and 0.20), loin (740.35, 1102.11, 1115.20 and 1105.21 g), sets (541.48, 1050.20, 1080.10 and 1061.11 g), ends (515.50, 807.45, 1388.50 and 1152.50 g) and shoulder (1158.96, 2050.81, 2156.09 and 2010.10 g) absolute weight values were significantly (P<0.05) different between dietary treatments A, B, C, and D respectively. The diets also recorded significant (P<0.05) increases in the weight of liver, heart, spleen lungs and gut as the levels of AYBM increased across the treatment groups. However, the relative weight values of all the carcass parameters did not reveal any significant effects of dietary treatments. The study therefore concludes that cassava peel meal based diets supplemented with African yambean enhanced the growth performance and carcass characteristics of goat bucks compared with the control diet. It is therefore recommended that farmers can include up to 30% AYBM in cassava peel meal based – diets meant for goats in the tropics.***

Keywords: Cassava peel meal, African yambean, goat buck, growth, carcass

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Introduction

Across the world, the landscape on which agriculture produces food and other materials (products) is a resource under pressure. By 2050 the world population will probably have grown to 10 billion people. To feed all these people adequately, productivity levels will have to increase by 60 percent (Muller, 2017). In Nigeria, increased population pressure has led to most cropped areas being extended to land hitherto considered unsuitable for this purpose. This has resulted in increased pressure on the small ruminant dynamics of the farming system because of poor feed availability. Nigeria's population of over 194.5 million is severely at risk now than ever before, given the high level of food insecurity and poverty. Without abundant, accessible, assorted, safe, wholesome and affordable supply of food, the Nigerian nation may forfeit her life of hope and dignity. Nigeria is particularly vulnerable to changing global trends, it is however predicted that in no distant time, there will be increased demand for protein foods for human needs in most developing countries. Nigeria and other developing countries may face a serious challenge since there are net importers of major food items particularly animal products. Globally, products from food animals provide over 33 percent of protein consumed in human diets and about 16 percent of food energy (Martin, 2001). In Nigeria, the gap between supply and demand for animal products in widening; this is directly the result of increase in population, rapid urbanization, growing income, changing lifestyle, food preferences and more importantly the displacement of many animal farmers in the North-East of Nigeria by terrorist activities and several land conflicts.

In sub-Saharan Africa, the livestock sector plays an important economic role and contributes to food security and livelihood of the people. Most sheep and goats in this eco – zone are held under the traditional free range system of management and these animals subsist on poor and unimproved native pastures which do not even meet their nutritional requirements, let alone production (Alalade *et al*., 2009). Within this region, the problem of seasonal variation in nutrient composition of pasture is also common; such that the productivity of animals becomes more acute especially during the dry periods of the year. This challenge results in progressive weight losses, retarded growth, late maturity/decreased reproductive performance, poor and uneven output and mortality which constitute economic losses to farmers (Shwarpshakka *et al.*, 2008; Anya, 2012). Several workers have reported that goats lose weight even in the wet season, especially when continuous rain restricts grazing time which result in under-nutrition alternating with periods of nutritional adequacy and even feed surplus, with consequences on nutrient intake and performance (Anya, 2001; Ogunjimi *et al.*, 2010; Anya, 2012; Anya *et al.*, 2013).

Cassava (*Manihot* spp.) is one of the most important annual root crops grown widely by tropical and sub-tropical farmers. It is the highest supplier of carbohydrates among staple crops and ranks fourth among food crops in developing countries after maize, rice and wheat (FAO, 1991). Cassava peels are produced in large qualities in Southern Nigeria, from the processing of cassava for human, industrial and export purposes. Unfortunately, this enormous feed resource has received very little attention and is often discarded as waste (Ozung, 2009). Cassava peel is rich in metabolizable energy (3.03 Mcal/Kg DM) but low in nitrogen (Smith *et al*., 1988).

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Generally, fibrous crop residues are poor sources of fermentable nitrogen as their crude protein is below the level required by rumen microorganisms. Also these crop residues are also low in easily degraded carbohydrates, minerals and other nutrients required to balance the products of digestion to requirements. All these result in limited intake, poor rumen function, increased methane emission and low animal productivity. The use of African yambean (*Sphenostylis stenocarpa)*, an under-exploited and often classified minor grain legume that is cheap and readily available protein source in cassava peel meal based diets is a strategy that intends to overcome the nutritional constraints of using cassava peel. It will close the feed deficit gap, reduce feed cost and sufficiently tackles seasonal fluctuations in forage quality and quantity. This would on the long run encourage increases in flock sizes, provide insurance against external shocks as well as increase the productivity of goats.

Goats provide over 1.97 million tonnes of meat annually representing 3.5% of total world meat production and 8.5% of total estimated meat production in developing countries (McGregor, 1984, Ozung *et al*., 2011). In Nigeria, goat meat contribution to total meat production as at 2006 was put at 147, 360 metric tonnes (FAOSTAT, 2008). Carcasses of goats are evaluated to give an estimation of the ratio of muscle to fat and bone or the amount of edible meat that will be obtained. The yield of dressed carcass is the major economic interest for a given liveweight. Meat (chevon) from goats is harvested over a wide range of ages, but the fact remains that meat from younger goats is generally preferred by consumers to meat from yearlings or older goats. However, edible offals contribute about 33% to the volume and quantity of edible material and also help to lower the price of meat per kilogram, thus, making goat meat affordable (Anya, 2012).

Further research information is therefore necessary on the growth performance, carcass cuts and organ weights of WAD bucks fed cassava peel based diets supplemented with African yambean concentrate, hence the main objective of this study.

Materials and Methods

Location of the study

The study was carried out in the Sheep and Goat Unit of the Teaching and Research Farm, University of Calabar, Calabar. Calabar is located on latitude $4^0 57^1$N and longitude $8^0 19^1$E of the equator. Annual temperature and rainfall ranges from 25^0 – 30^0C and from 1260 to 1280 mm, respectively. The relative humidity is between 70 and 90 % and Calabar is 98 metres above sea level (NMA, 2018).

Processing of cassava peel and African yambean seed meal

Cassava peels of TMS 30555 variety were collected fresh from the Department of Crop Science commercial "Garri" processing unit of the University of Calabar, Calabar. The peels were from 10–12 months old cassava plants. The peels were properly washed and sun-dried for a period of 7 days to constant weight during which they were regularly turned to give even drying to a moisture content of 10%. The sun-dried cassava peels were then milled with hammer mill and used in the study as dried cassava peel meal (CPM). African yambean (*Sphenostylis stenocarpa)* seeds (Nsukka brown variety) were purchased from local famers at

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Obudu and Obanliku Local Government Areas in the Northern parts of Cross River State. The undecorticated brown seeds were boiled for 30 minutes following the method of Ukachukwu and Obioha (2000) for Mucuna seeds. Water was made to boil at 100 ^{0}C in a large (mammoth) cooking pot before the seeds were poured in. The seeds were allowed to boil for 30 minutes. Water was decanted using local baskets and the seeds sun-dried on aluminium roofing sheets for 3 days before being milled and used as African yambean seed meal (AYBM) to formulate the experimental diets.

Experimental diets:

Four experimental diets designated as A, B, C and D were formulated as presented in Table 1. Diet A was the control and contained no African yambean seed meal (AYBM). Diets B, C, and D contained 10, 20, and 30 % of AYBM respectively. The diets were allotted randomly to the four animal groups. Each animal within a group was offered 1kg of an assigned concentrate diet daily for 56 days. The concentrate diets were fed at 0800 hour daily. Clean drinking water was provided *ad-libitum* for each animal within the period. Each animal was provided with salt lick block (TANLICK), a product of SKM Pharma (P) Limited JF-10, City Point, Infantry Road Bangalore – 560001 India. The salt lick had the following composition: Na, 35.96%; Zn, 0.25%; Fe, 0.30%; Mn, 0.20%; I, 0.003%; Co, 0.002%; Cu, 0.10% and Mg, 0.05%.

Animal management

Chemical analyses of experimental diets and test ingredients

All the experimental diets (A–D) including CPM and YBSM were analysed for proximate composition using AOAC (2000) methods (Table 2).

Table 1: Gross Composition of experimental diets

Ingredients (%)	A	B	C	D
Cassava peel	46.00	46.00	46.00	46.00
African Yambean Seed Meal	-	10.00	20.00	30.00
Wheat offal	33.00	23.00	13.00	3.00
Palm kernel cake	18.00	18.00	18.00	18.00
Bone meal	2.00	2.00	2.00	2.00
Salt	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

Table 2: Proximate and energy constituents of experimental diets, cassava peel meal (CPM) and African yambean seed meal (AYBM)

Parameter (%)	A	B	C	D	CPM	YBSM
Dry matter	89.44	89.35	89.42	89.62	90.10	88.50
Crude protein	10.56	10.96	11.36	11.44	3.22	22.10

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Crude fibre	12.47	11.05	10.31	10.11	14.73	5.92
Ether extract	4.50	4.61	4.80	4.94	0.91	7.53
N-free extract	51.38	53.61	54.33	54.62	65.67	47.67
Ash	10.35	9.12	8.62	8.49	5.57	5.28
Gross energy (kcal/g)	3.45	3.42	3.31	3.28	3.60	5.23

Slaughter technique and carcass evaluation

Twenty (20) goats used in the growth study and whose body weight were closed to the mean weight of each treatment were selected and slaughtered for carcass evaluation. The goats were starved for 24 hours prior to slaughter. Just before slaughter, each animal was weighed. The animals were bled by cutting the throat and then slaughtered by severing the head at its articulation with the atlas bone. Weighing was further carried out, post slaughter and dressing respectively. Dressing percentage was calculated as the weight of dressed warm carcass in relation to live weight before slaughter. A dressed warm carcass refers to the weight of the goat after removal of head, skin, contents of thoracic and pelvic cavities (including the diaphragm and Kidney) and limbs distal to the carpal and tarsal joints. The gut in each case was weighed, gut content cleansed and reweighed. The heart, liver (without gall bladder), lungs, spleen, pelvic fat and limbs (four feet) distal to the carpals and tarsals were also weighed and recorded.

Jointing the carcass (meat cuts) was done according to the procedure of Adebowale and Ademosun (1981). It involves the division of the dressed warm carcass down the spinal column by means of a meat saw. Each half was weighed accordingly. The left half was subsequently divided into various cuts. The Leg (thigh) was cut out at the attachment of the femur to the acetabulum, the Loin consist of the lumbar region plus a pair of ribs, the Ends (spare ribs plus belly) consist of six (6) abdominal ribs, the Shoulder consist of the scapula, humerus, radius, ulna and carpals, the Sets is made up of the breast and the neck. Each of the cuts was weighed and the weight doubled in each case before being expressed as percentage of the dressed carcass, the leg and loin cuts were then dissected into muscles and bone with ligaments. These components were weighed and the weights pooled to obtain the meat: bone ratio.

Experimental design and statistical analysis

The entire growth and carcass evaluation studies were designed as Completely Randomized Design- experiments. The data obtained from the experiments were subjected to one – way analysis of variance (ANOVA) procedures (Morris, 1999). Significant differences between means were separated using Duncan's Multiple Range Test (Duncan, 1955) as outlined in Obi (1991). Meat cuts were expressed as percentages of the warm carcass while organ/offal weights were expressed as percentages of the empty liveweight. Empty live weight refers to liveweight at slaughter minus gut content.

Results and Discussion

Growth performance characteristics

The growth performance characteristics of WAD goats fed CPM based - diets containing YBSM are presented in Table 3. Generally, the goats consumed the YBSM diets (B, C, and D) more than the control (A). The total feed intake (kg) observed for goats fed the control diet A (22.67g), diets B (25.98g), C (27.11) and D (27.59g) differed ($P<0.05$)

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significantly between treatments. However, total intake tended to improve with increasing levels of AYBM in the diets. Increased levels of AYBM in the diets relatively increased the crude protein content and perhaps the palatability, this may very well explain the relatively high intake observed in favour of the AYBM diets over the control. In a previous study, Ahamefule (2005) observed the same trend with cassava peel based diets containing pigeon pea seed meal.

Goats placed on the control diet averagely gained 2.02 kg which was lower than the mean body weight gain of 5.53. 6.99 and 6.05 kg recorded for goats that were fed diets containing 10, 20 and 30% AYBM respectively. Average liveweight gains (daily and total) differed significantly ($P<0.05$) among the treatment groups, but generally, AYBM diets tended to support more liveweight gain in this study compared to the control diet (A). This result is in line with that of Ahamefule (2005) and Ukpabi (2007) with pigeon pea meal and mucuna seed meal respectively. In both earlier studies, feeding growing bucks with the concentrates mentioned caused bucks to gain weight than those on the control diet, but they observed that differences in live weight gain did not differ significantly ($P>0.05$). However, among the AYBM diets, diet C (20% AYBM) supported more liveweight gain comparatively, though goats on diet C consumed less feed in relation to the other AYBM diets (B and D).

The feed conversion ratio showed feed utilization efficiency in favour of goats fed diet C (3.88) over those on B (4.69) and D (4.56) even though, the difference was not significant ($P>0.05$). Goats subsisting on diet D consumed averagely more feed than those on diet C which supported relatively higher weight gain but had comparable feed conversion ratio (4.56) which did not differ ($P>0.05$) significantly. Meanwhile, the average daily weight gain of 36.07g obtained for animals on the control diet (A) in this study, though very low was within the range of 35 – 65 g reported for WAD goats within the first 12 months of life (Nuru, 1985). The average value of 36.07g was lower than the values of 98.75, 124.82 and 108.04 g observed for animals on the AYBM diets B, C and D. The disparity in values may be due to differences in nutrient contents of diets and management systems. Results reported by Nuru (1985) were obtained from survey of animals extensively managed. The present results were obtained from WAD goat intensively managed. In this study, the differences in average daily weight gain between diet A on one hand and diets B, C and D on the other hand were significant ($P<0.05$), whereas the differences between diets B and D were not significant ($P>0.05$), while diet C was significantly different ($P<0.05$) from diets A, B and D. This however, suggests that the AYBM diets were more efficient than the control diet.

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Table 3: Feed consumption, liveweight changes and feed conversion ratio of WAD goats fed diets containing African yambean seed meal.

Parameters	A	B	C	D	SEM
Initial weight (kg)	8.33	8.38	8.31	8.35	0.02
Final weight (kg)	10.35^{c}	13.91^{ab}	15.30^{a}	14.40^{ab}	1.09
Total feed intake (kg)	22.77^{c}	25.98^{ab}	27.1 l^{ab}	27.59^{a}	1.23
Feed Intake (g/day)	395.89^{c}	463.93^{ab}	484.1 l^{ab}	492. 68^{a}	21.93
Total BW gain (kg)	2.02^{c}	5.53^{ab}	6.99^{a}	6.05^{ab}	1.09
BW gain (g/day)	36.07^{c}	98.75^{ab}	124.82^{a}	108.04^{ab}	19.38
Feed/gain ratio	10.98^{a}	4.69^{b}	3.88^{b}	4.56^{b}	1.66

^{abc} Means on the same row with different superscripts differ significantly (P<0.05)
SEM: Standard error of the mean

Carcass evaluation

Result on carcass evaluation of the experimental animals is presented in Tables 4 and 5 respectively. Liveweight at slaughter, empty liveweight and warm carcass weight were higher for goats fed the AYBM diets than the control. The corresponding values of 10.35, 7.30. 4.18; 33.91, 10.72, 7.22; 15.30, 11.88, 8.17 and 14.40, 10.94, 7.53 kg recorded respectively for diets A, B, C and D however, differed (P<0.05) significantly between treatment groups; hence there was reason to believe that the addition of AYBM to cassava peel based diets generally improved slaughter and warm carcass weights. Liveweight at slaughter, empty liveweight and warm carcass weight were highest for goats on diet C followed by diets D, B and A respectively. Diets B to D containing 10, 20 and 30% AYBM respectively produced higher live weight, empty liveweight and warm carcass weight than the control (A). The mean value of 14.36 - 0.29kg for live weight at slaughter for AYBM diets was higher than 10.35kg obtained for diet A. This showed that the inclusion of AYBM in diets for young goats enhanced their growth.

Table 4: Carcass yield of WAD goats fed cassava peel-based diets containing African yambean seed meal.

Parameter	A	B	C	D	SEM
Live wt. at slaughter (kg)	10.35^{b}	13.91^{a}	15.30^{a}	14.40^{a}	1 .09
Empty live wt. (kg)	7.30^{b}	10.72^{a}	11.88^{a}	10.94^{a}	1.00
Warm carcass (kg)	4.18^{b}	7.22^{a}	8.17^{a}	7.53^{a}	0.89

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Dressing %	40.39[b]	51.90[a]	53.40[a]	52.29[a]	3.05
Leg (g)	1224.21[b]	2209.67[a]	2430.33[a]	2201.10[a]	269.32
Loin (g)	740.35[b]	1102.11[a]	1115.20[a]	1105.21[a]	91.83
Sets (g)	541.48[b]	1050.20[a]	1080.10[a]	1061.11[a]	1 30.73
Ends (g)	515.50[b]	807.45[b]	1388.50[a]	1152.50[ab]	191.78
Shoulder (g)	1158.96[b]	2050.81[a]	2156.09[a]	2010.10[a]	230.41
Abdominal fat (g)	105.99[b]	126,55[ab]	166.67[a]	160.59[a]	14.36
Bone to lean ratio	0.31[a]	0.30[a]	0.19[b]	0.20[b]	0.03
Head (g)	1140.67	1085.33	1163.73	1140.99	16.68
Skin (g)	950.00[b]	1035.00[a]	1050.33[a]	1048.55[a]	23.90
Feet (g)	250.00[b]	273.00[b]	460.00[a]	450.00[a]	56.09
Full gut (g)	3101.00[c]	3495.45[bc]	3425.61[a]	3381.11[ab]	76.67
Empty gut (g)	998.91[b]	1270.55[a]	1251.69[a]	1275. 88[a]	66.98
Liver (g)	205.00[b]	221. 83[b]	252.15[ab]	282.63[a]	17.13
Kidney H- Pelvic fat (g)	45.92[c]	61.85[bC]	98.67[b]	198.96[a]	16.71
Heart (g)	65.51[b]	65.66[b]	66.00[a]	65.60[b]	0.11
Spleen (g)	12.73[b]	I3.49[ab]	14.53[a]	13.50[ah]	0.37
Diaphragm (g)	30.10[b]	34.95[b]	43.08[a]	35.53[ab]	2.68
Empty gall bladder (g)	1.73[b]	2.22[b]	2.29[b]	4.95[a]	0.73
Tail (g)	12.68[b]	12.22[b]	14.54[a]	12.55[b]	.0.52
Penis (g)	13.98[b]	14.76[b]	16.74[a]	15.65[ab]	0.59'
Testis (g)	124.33[b]	150.51[a]	163. 15[a]	153.31[a]	8.29
Blood (g)	350.00[c]	400. 00[bc]	520.00[a]	480.00[ab]	38.38
Lungs (g)	178.05[b]	18.0.59[b]	183.95[a]	181.60[ab]	1.22

[abc] Means on the same row with different superscripts differ significantly (P<0.05)

Dressing percentage was significantly (P<0.05) different among treatment groups. Goats on diet C had the best dressing percentage (53.40%) followed by goats on diets D (52.29%), B (51.90%) and A (40.59%) respectively. The dressing percentage of goats on diets B. C and D were not significantly different (P>0.05). The result of this study showed that the inclusion of 10

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30% AYBM in cassava peel meal based diets for growing WAD goats gave a better dressing percentage than the control diet. The values for dressing percentage obtained in this study are within .the general range of 35 - 50% (Steele, 1996) for goats and 45 - 52% reported by Nuru (1985) for WAD goats. The dressing percentage (53.40) for goats on diet C seemed to be comparatively higher than other treatments. This may probably be due to the special type of WAD breed known as 'Akpabuyo' used in this study. This type of WAD breed tends to have special attribute to fatten easily within the humid rainforest ecological zone (Anya. 2001). The meat cuts represented by leg, loin, sets, ends and shoulder (Table 4) also followed similar pattern of distribution as in liveweight at slaughter and warm carcass weight. Their values differed ($P<0.05$) significantly among treatment groups but tended to be heavier for goats on AYBM diets than the control group. AYBM therefore can be used effectively in goal fattening programmes to enhance the weight of meat cuts.

The average weight of meal cuts, organ and offal weights expressed as percentages of warm carcass or empty live weight are presented in Table 4.8 The weight of legs expressed as percentage of warm carcass were 29.287, 30.605, 29.747 and 29.231% respectively for diets A, B, C and D. The mean value of 29.86 i- 0.55% recorded for goats on AYBM diets was also similar ($P>0.05$) to 29.29% recorded for goats on the control diet (A). These values are however higher than 25.84 ± 1.86% reported for growing WAD goats by Adebowale and Ademosun (1981). The value obtained in this study however fails within the range of 29.70 - 31.80% reported by Ahamefule (2005).

The loin, sets and ends weight expressed as percentages of warm carcass weight (Table 5) agree with the findings of Akinsoyinu (1974). The range of values obtained in this study for these meat cuts were 15.33, 13.70 and 13.95 % respectively. These values fell within the range of loin (14.06 - 19.04%), sets (10.10 - 15.90%) and ends (7.03 - 16.86%) reported by Ahamefule (2005). However, the value reported for shoulder expressed as percentage of warm carcass in this study (27.30%) was lower than the range (30.31 - 38.17%) reported by Ahamefule (2005). This may probably be due to the type of WAD goats used because Hassan and Idriss (2002) reported variations in the proportion of meat cuts. These authors were of the view that proportions vary within and between breeds and are influenced by genetic/environmental interactions. The bone to lean meat ratio (Table 4) obtained for goats on the respective dietary treatments differed ($P<0.05$) significantly. Goats fed the control diet (A) had the highest bone to lean ratio (0.31) which was not different from that of goats fed 10% AYBM diet (0.30), hut showed remarkable difference ($P<0.05$) from those fed 20% (0.19) and 30% (0.24) AYBM diets.

The relatively high but comparable bone to lean ratio observed for the goats on the control diet (A) and diet B in this study was a sign of poor feed conversion into meat within the animals in these groups. This observation is further explained by the relatively high but comparable feed conversion ratios also recorded by these two treatment groups (Table 4) earlier in this study. High feed conversion ratios usually indicate poor ability of animals to maximize feed intake by failure to optimally utilize feed (nutrients) for meat production. Animals (goats) consuming the 20% AYBM diet had the least bone to lean ratio which is an evidence of high feed conversion efficiency of goats in the group.

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Table 5: Average weight of meat cuts, organs and offal weights expressed as percentages of warm carcass or empty live weights.

Meat cut		Dietary treatments A	B	C	D	Mean
	Warm carcass					
Leg		29.287	30.605	29.747	29.231	29.72
Lion		17.711	15.265	13.650	14.677	15.33
Sets		12.954	14.546	13.220	14.092	13.70
Ends		12.333	11.184	16.995	15.305	13.95
Shoulder		27,726	28.405	26.390	26.695	27.30
Tail		0.174	0.114	0.122	0.115	0.13
Offal	**Empty liveweight**					
Head		15.626	10.124	9.796	10.430	11.49
Skin		13.014	9.655	8.841	9.585	10.27
Feet		3.425	2.547	3.872	4.113	3.49
Empty gut		13.684	51.852	10.536	11.663	11.93
Organs						
Liver		2.808	2.069	2.122	2.583	2.40
Kidney		0.629	0.577	0.831	1.087	0.78
Heart		0.897	0.613	0.555	0.599	0.67
Spleen		0.174	0.126	0.122	0.123	0.14
Lungs		2.439	1.685	1.548	1.660	1.83
Testis		1.703	1.404	1.373	1.401	1.47

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The feed conversion efficiency of this group which was the lowest (3.88) (Table 4) also supported this view. The efficiency of feed utilization of goats on this treatment (diet C) was further confirmed by its comparatively high dressing percentage (53.40%) which was superior to other diets (A and B) but comparable to diets D (30% AYBM) which had a bone to-lean ratio of 0.24. Goats fed diets C and D performed comparatively well in terms of feed conversion ratio (Table 3), bone to lean ratio and dressing percentage (Table 4).

The offal weights as represented by the weights of the head, skin, feet, full gut, empty gut, diaphragm, empty bile, tail, penis, testis and blood (Table 4) differed ($P<0.05$) significantly within dietary treatments. The general trend was that the offal weights were absolutely heavier for the AYBM diets. The values for the control group however, compared favourably with those observed for animals on the AYBM based diets. The offal weights expressed as percentage of empty live weight (Table 4.9) ranged from 9.796 - 15.626% with a mean of 11.49% for the head. 8.841 -13.014% (mean 10.27%) for the skin, 2.547 - 4.113% (mean 3.49%) for the feet, 10.536 - 13.684% (mean 1.93%) for the empty gut, 0.115 - 0.174% (mean 0.13%) for the tail and 1.373 - 1.703% (mean 1.47%) for the testis. The present offal values and means are consistent with what is reported for WAD goats by Akinsoyinu (1974) and Ahamefule (2005).

All other organ weights (heart, spleen, lungs, etc.) differed ($P<0.05$) significantly between treatments. The liver weight of goats fed the control diet (A) was the least (205.00g) but compared favourably with liver weight of goats fed diet B (221.83g). The liver weight of goats on diet C (252.15g) differed significantly ($P<0.05$) from those of diets A and B while goats on diet D had the heaviest liver weight (282.63g) which however, differed ($P<0.05$) significantly from those on diets A and B. Kidney weight was also heaviest for goats fed diet D (118.96g) and this also differed significantly ($P<0.05$) from values recorded for other dietary treatments. However, kidney weight for the control group (45.92g) also differed ($P<0.05$) significantly from that of other dietary treatments. The values for liver in this study tended to increase as the level of AYBM in the diet increased from 10 - 30%. An increase in the size of the liver is usually associated with an increase in metabolic activities during detoxification (Akinmutimi 2004; 2007). This might be the case in this present study. It is common practice in feeding trials to use weight of some internal organs like liver and kidney as indicators of toxicity (Allelochemicals) in feed (Ahamefule, 2005). Bone (1979) reported that if there are toxic elements in feed samples used in feeding trials, abnormalities in the weight of organs will be observed. The abnormalities will arise because of increased metabolic rate of the organs in an attempt to reduce these element(s) or antinutrients to innocuous materials.

Cassava peel meal and African yambean meal used in this study contained some toxic or anti-nutritional properties in their raw state which may limit their use in livestock nutrition. Drying of cassava peels and boiling for African yambean seeds, are effective methods of detoxifying the anti-nutritional properties in both feedstuffs. These processing methods, according to Akinmutimi (2004), do not completely eliminate, but only reduce the concentration of these anti-nutritional properties to a tolerable level in feedstuffs. The remnant is further brought to a non- lethal level in the body by the dual actions of the liver and the kidney. Depending on the concentrations of these remnants in feedstuff and consequently in formulated rations, the size of the liver and kidney may enlarge as they increase their metabolic activities to reduce toxicity. Though, sun-drying and boiling were used as processing methods for cassava

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peels and African yambean seeds respectively in this study, these methods, no doubt, still left traces of anti-nutritional properties in the feedstuffs and consequently in the experimental diets, with the result that diet D which had the highest AYBM inclusion of 30% probably also had the highest concentrations of these anti-nutritional properties. This invariably may explain the highest liver and kidney weights recorded for goats fed diet D. Meanwhile, organ weights expressed as percentages of empty liveweight (Table 5) for the treatment groups gave 2.40 (2.069 - 2.808 %) for the liver, 0.577 - 1.087% with a mean of 0.78% for the kidney; 0.555 - 0.897% with a mean of 0.67% for the heart, 0.122 - 0.174 % with a mean of 0.14% for the spleen and 1.548 - 2.439 % with a mean value of 1.83% for the lungs. These organ values are in agreement with the reports of Akinsoyinu (1974) and Ahamefule (2005) for WAD goats.

Conclusion and recommendation

The study concludes that cassava peel meal based diets supplemented with African yambean supported a positive effect on the growth performance and carcass characteristics of goat bucks compared with the control diet. It is therefore recommended that farmers can include up to 30% AYBM in cassava peel meal based – diets meant for goats in the tropical eco - zone.

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