SHORT COMMUNICATION

Growth performance and carcass characteristics of West African Dwarf bucks fed *Panicum Maximum* and Bambara nut (*Vigna subterranea*) seed meal supplemented dietsOdoemelam^{1*}, V.U. , Ahamefule², F.O. , Ibeawuchi², J.A. and Ezeokeke¹, C.T.¹Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria. ²College of Animal Science and Animal Production, Micheal Okpara University of Agriculture, Umudike - Umuahia, Abia State, Nigeria.

*Corresponding Author's Tel: +2348035477065 and E-mail: Odoemelamvu@yahoo.com

Abstract

Twelve individually housed West African Dwarf (WAD) Bucks averaging 7.3 ± 0.91 kg were used to study the effect of varying levels of Bambara nut seed meal on the performance and carcass characteristics of West African Dwarf (WAD) Bucks. Four experimental diets designated A, B, C and D were formulated to contain 0, 10, 20 and 30% Bambara nut meal (BNM) respectively. The twelve WAD bucks were divided into four (4) groups of three animals each. Each group was assigned to one of the four experimental diets in a completely randomized experiment. Each animal in a group represented a replicate. The experiment lasted 56 days. Data on Feed and dry matter intake, Weight gain, concentrate/gain ratio, dressing percentage and carcass quality was collected. Investigations revealed that incorporating BNM in concentrate diets did not significantly ($P > 0.05$) enhance dry matter intake (405, 416, 395 and 407g/day for diets A, B, C and D respectively), daily weight gain (27, 60, 23, and 42g/day for diets A, B, C and D respectively) concentrate /gain ratio (9.36, 5.62, 10.60 and 8.37 for diets A, B, C and D respectively). Dressing percentage differed significantly ($P < 0.05$) among treatment groups and was higher for goats fed the BNM- based diets compared to the control and the values were 40.56, 43.28, 41.85 and 41.34% for diets A, B, C and D respectively. Meat cut values showed that leg, loin and shoulder of all the Jointed parts (Shoulder, leg, loin, sets and ends) were significantly different ($P < 0.05$) among treatment groups. The values were 13.20, 13.56, 12.12 and 11.44 %; 12.38, 11.30, 13.19, 11.97 %; 13.60, 12.37, 10.91 and 11.31 % for goats on diets A, B, C and D for leg, loin and shoulder respectively. There was significant differences ($P < 0.05$) among treatment means for all parts that constitute the offal (head, skin, feet, full gut and empty gut) except for empty gut. On the average Diet B comparatively, yielded lower offal weight. It can be concluded that goats fed Diet B (10% BNM) performed better comparatively in terms of feed conversion ratio, dressing percentage and bone to lean ratio.

Keywords: West African Dwarf Goats, Bambara nut, Growth, Carcass quality

Introduction

Animal protein consumption in Nigeria and other developing countries has been reported to be comparatively low (Ayorinde and Aromolaran, 1998). The average Nigerian consumes about 54 grams of protein per day, with 6.5 grams coming from animal sources. This is a far cry from

the recommended daily protein intake of 80 grams with 28 grams derivable from animal protein (FAO, 1985). This problem has generally been attributed to shortage of animal protein products which is responsible for the existing high price of animal products making them out of reach to an average Nigerian (Akinmutimi *et al.*,

2006; Etuk *et al.*, 2011). One of the ways of solving this problem is by directing efforts at promoting and encouraging production of prolific, indigenous animal species (Ahamefule and Ibeawuchi, 2005). The West African dwarf goat is most prevalent in the hot humid forest zone of southern Nigeria. Its relative tolerance to excessive humidity and trypanosomiasis, both of which are important factors in animal production in a forest zone has singled it out as a breed of choice in southern Nigeria (Odoemelam, 2012). The West African dwarf goat is early maturing, prolific and a non-seasonal breeder (Osuagwu and Akpokodje, 1981; Akusu and Ajala, 2000). Nutrition has been identified as one of the major factors responsible for poor performance of this indigenous breed (Adamu *et al.*, 2010; Garba *et al.*, 2010). The animals are exposed to severe nutritional stress especially during the dry season when forage is scarce and of low quality (Agishi, 1985; Lamidi *et al.*, 2010) this leads to weight loss, mortality, decreased reproductive performance and kid mortality (Ahamefule, 2005). To improve on the productivity of this breed and hence the animal protein intake of the average Nigerian, it becomes therefore necessary to supplement the seasonal fodder fluctuations of natural pasture with concentrates. However, the escalating price of conventional feedstuffs as a result of competition between man, industries and livestock (Ukachukwu, 2000; Esonu *et al.*, 2002) makes this difficult. Efforts by earlier researchers to test non-conventional, unexploited novel legumes (Udedibe and Carlini, 1998; Ukachukwu, 2000; Amaefule, 2002; Akinnitimi, 2004), crop residues and agro-industrial by-products (Alhassan, 1985) on livestock in Nigeria is a welcome approach to the development of the subsector. One of such non-

conventional feedstuff is Bambara nut. Bambara nut has been identified as an under-utilized feed resource of livestock and it is indigenous to Africa (Ani and Okafor, 2004). Its nutritional quality (Olomu, 1995) has necessitated its utilization as livestock feedstuff. Literature reports reveal that extensive research has been conducted on feeding Bambara nuts to monogastrics especially poultry and rabbits (Uzegbu, 2003; Ani and Okafor, 2004). However, there is a dearth of information on its utilization in ruminant animal nutrition and particularly goats. This study therefore evaluates the growth performance and carcass characteristics of WAD bucks fed varying levels of Bambara nut supplemented diets.

Materials and Methods

Experimental Site

The experiment was conducted in the sheep and goat unit of the Teaching and Research farm, Michael Okpara University of Agriculture, Umudike. Each animal was allocated to an individual pen with a floor space measuring 1.85m X 1.65m. Concentrate diets were placed in feeding troughs while water was placed in plastic containers.

Management of Experimental Animals

Twelve West African Dwarf (WAD) bucks averaging 7.3 ± 0.91 kg in weight were purchased from a local market close to Michael Okpara University of Agriculture, Umudike. The animals were dewormed immediately on the following day using ivermectin (ivermectin) injection and quarantined for 21 days. At the end, three (3) goats were assigned to each of the four (4) experimental diets (Tables 1) in a Completely Randomized Design (CRD).

Experimental Diets

Four experimental diets designated A, B, C and D were formulated as presented in

Table 1. Diet A was the control and contained no Bambara nut seed meal (BNM). Diets B, C, and D contained 10, 20 and 30% BNM meal, respectively. Guinea grass (*Panicum maximum*) was served as the basal diet. Each animal was offered 2.0 kg of guinea grass and 300g of concentrate see Table 1 daily. The concentrate diets were fed at 08.00 hour while the forage was fed at 11.00 hour. Clean drinking water was made available to each animal.

Chemical Analyses of Experimental Diets

The experimental diets, Bambara nut seed meal and guinea grass (*Panicum maximum*) were analysed for proximate composition according to AOAC (1990), employing Kjeldahl Nitrogen method for Crude Protein estimated as (NX6.25), Nitrogen Free extract was determined by difference, Gross energy was determined by calculation using the Atwater method as outlined by FAO (2003).

Data Collection

Data on voluntary feed intake was recorded every morning for each animal by subtracting feed refusals from the amount offered on the previous day. Each animal was weighed weekly and recorded. These data were used to compute average daily feed intake, average daily weight gain and feed to gain ratio for each animal. The data

were collected over a period of 8 weeks (56 days).

Carcass Evaluation

At the end of the 56 day study the goats were starved 24 hours prior to slaughter. Slaughtering was done by severing the jugular vein of the goats. Pre-slaughter weight, weight at slaughter and dressing weight was carried out. Calculation of dressing percentage was based on the weight of dressed warm carcass in relation to liveweight before slaughter. Warm dressed carcass was made up of what remained of the carcass after the removal of the head, skin, contents of the thoracic and pelvic cavities (including the diaphragm and kidney) and the limbs distal to the carpal and tarsal joints.

The gut in each case was weighed, cleaned and reweighed. The heart, liver (without gall bladder), lungs, spleen, pelvic fat and limbs (four feet) distal to the carpals and tarsal were also weighed and recorded.

The procedure employed by Akinsoyinu (1974) was adopted for the meat cuts of the carcass. The leg plus loin cuts were then dissected into muscles and bones with ligaments to obtain the meat to bone ratio.

Statistical Analyses

The data collected were subjected to analysis of variance procedures. Significant

Table 1 Composition of Experimental Diets.

Ingredients (%)	Diets			
	A	B	C	D
Maize offal	52.00	52.00	52.00	52.00
Brewers dried grain	18.00	14.00	11.00	7.00
Palm kernel cake	22.00	16.00	09.00	03.05
BNM seed meal	0.00	10.00	20.00	30.00
Molasses	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00
Sodium chloride	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

BNM= Bambara nut meal

means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

Results and Discussion

The proximate composition of the experimental diets, Bambara nut meal (BNM) and *Panicum maximum* fed to growing WAD bucks are presented in Table 2. The proximate values for Bambara nut were comparable to those reported by James (2009) and Omoikhoje (2008). The proximate constituents of the forage *Panicum maximum* also fell within the range of values reported by Ukpabi (2007) and Odedire and Babayemi (2008).

The dry matter percent of the BNM containing diets (B, C, D) was comparable to the control diet (diet A). It increased with increasing dietary inclusion of BNM. The crude protein and crude fibre contents of the diets were slightly lower compared to the control diet. Crude fibre decreased with increasing inclusion of BNM. Ether extract and ash values did not show any consistent trend among the diets.

Results for Feed intake, live weight changes and feed conversion ratio of WAD bucks fed *Panicum maximum* supplemented with Bambara nut meal (BNM) based concentrate diets are presented in Table 3. Total forage intake was 23.95, 24.54, 25.92

and 27.32 kg for goats fed diets A, B, C and D respectively. The result showed that forage intake increased as the level of BNM in the concentrate diets increased. Forage intake for animals fed diet D was the highest and significantly ($P < 0.05$) differed from the value obtained for diet A. However, it did not differ ($P > 0.05$) from the other BNM-based treatment groups (C and D). On the other hand, concentrate intake of the test diets (B, C and D) was a bit lower compared to the control diet. However, the differences were not significant ($P > 0.05$). This result corroborates the findings of Whyte and Wadak (2002) that attributes similarity in concentrate dry matter intake to isonitrogenous nature of diets. This is true concerning the diets formulated for this study as they were isonitrogenous. Increase in BNM levels of the diets from 0% to 30% thus, had no significant ($P > 0.05$) effect on the dry matter intake.

The mean values for body weight gain (Kg) were 1.53, 3.38, 1.25 and 2.36 Kg for diets A, B, C and D respectively. The observed difference in body weight gain of the goats were not significant ($P > 0.05$). However, goats in all treatment groups gained weight, indicating that the diets were well above maintenance requirement (Inweh *et al.*, 2011). Mean daily body weight gain values

Table 2 Proximate composition of experimental diets, Bambara nut seed meal (BNM) and *Panicum maximum* fed to growing WAD goats (%).

Parameters	Diets				BNM	<i>P. maximum</i>
	A	B	C	D		
Dry matter	94.2	94.3	94.44	94.78	95.28	35.00
Crude protein	19.08	16.28	15.93	15.91	20.48	9.28
Ether extract	5.01	6.00	5.03	4.10	3.02	3.01
Crude fibre	4.33	4.14	3.33	2.00	4.33	22.31
N-free extract	58.79	58.54	62.53	66.53	64.17	6.74
Ash	7.00	9.34	7.65	6.34	3.30	2.67
Gross energy (Kcal/g)*	356.52	353.28	358.84	365.76	365.60	91.08

*Calculated

Table 3 Live weight changes, feed intake and feed conversion ratio of WAD bucks fed *Panicum maximum* supplemented with Bambara nut meal (BNM) based concentrate diets

Parameters	Diets				SEM
	A	B	C	D	
Initial weight (Kg)	7.95	7.37	6.87	7.08	0.34
Final weight (Kg)	9.48 ^{ab}	10.75 ^a	8.12 ^b	9.44 ^{ab}	0.33
Total forage intake (Kg)	23.95 ^b	24.54 ^{ab}	25.92 ^{ab}	27.32 ^a	0.55
Total Conc. Intake (Kg)	15.17	15.59	13.84	13.95	0.39
Forage intake (g/d)	428.00 ^a	438.00 ^{ab}	463.00 ^{ab}	488.00 ^a	9.88
Conc. Intake (g/d)	271.00	278.00	247.00	249.00	7.14
Total FDMI (Kg)	8.38 ^b	8.59 ^{ab}	9.07 ^{ab}	9.56 ^a	0.19
FDMI (g/d)	149.00	153.00	162.00	170.00	3.51
Total CDMI (Kg)	14.29	14.70	13.07	13.23	0.37
CDMI (g/d)	255.00	263.00	233.00	236.00	6.62
Total DMI	22.67	23.29	22.14	22.79	0.28
DMI (g/d)	405.00	416.00	395.00	407.00	4.97
Total BW gain(Kg)	1.53	3.38	1.25	2.36	0.39
BW gain (g/d)	27.00	60.00	23.00	42.00	6.90
DMI/gain ratio	14.85	8.65	17.95	14.22	5.00
feed/ gain ratio	9.36	5.62	10.60	8.37	1.81

SEM= Standard error of mean; ^{a, b} means in the same row with different superscripts differ significantly ($P < 0.05$); FDMI= forage dry matter intake; CDMI= Concentrate dry matter intake.

(g) were 27, 60, 23 and 42g for goats fed diets A, B, C and D respectively. The means were similar ($P > 0.05$). These values fall within the range of 25g – 44g reported by Velez-Nauer *et al.*, (1982); Ukpabi (2007) and others within the range of 35-65g reported for WAD goats within first 12 months of life (Nuru, 1985). The ratio of dry matter intake to body weight gain was highest for diet C (17.95), followed by diets A (14.85), C (14.22) and B (8.65). However, the differences were not significant ($P > 0.05$). In absolute terms diet B had the most favourable dry matter/gain ratio. A similar trend was observed in feed intake to gain ratio. The results showed that goats on diet C consumed the highest amount of feed per Kg gained (10.60) followed by those on diets A (9.36) and D (8.37). WAD Bucks fed diet B were most efficient in utilizing feed for conversion to meat. Diet B supported more live weight gain than others.

Carcass evaluation

Table 4 summarizes the carcass yield of

WAD goats in this study. The liveweight at slaughter (Kg) were 9.48, 10.75, 8.12 and 9.44 for diets A, B, C and D respectively. Diet B produced the highest liveweight and significantly differed ($P < 0.05$) from Diet C, but was similar to other treatment groups which did not differ significantly ($P > 0.05$) from each other. For empty body weight (Kg), diet B gave a significantly higher ($P < 0.05$) weight (8.52) compared to 6.91, 6.23 and 7.17 kg of treatment groups A, C and D. Warm carcass (kg) followed the same pattern observed in liveweight at slaughter with Diet B (10% BNM) yielding a higher value. Ukpabi (2007); Ahamefule and Udo (2010) observed a similar pattern. Dressing percentage differed significantly ($P < 0.05$) among treatment groups and was higher for goats fed the BNM- based diets compared to the control. Diet B had the highest value followed by diet C and D. The values obtained for all the treatment groups falls within the range of 35 - 40% reported for goats (World Bank, 1983; Steele, 1996; Prinkerton, 2003; Attah *et al.*, 2004).

Table 4 Carcass yield of WAD goats fed *Panicum maximum* supplemented with BNM- based concentrate diets.

Parameters	Diets				SEM
	A	B	C	D	
Live weight at slaughter (Kg)	9.48 ^{ab}	10.75 ^a	8.12 ^b	9.44 ^{ab}	0.33
Empty body weight (Kg)	6.91 ^b	8.52 ^a	6.23 ^b	7.17 ^b	0.30
Warm carcass (Kg)	3.86 ^{ab}	4.65 ^a	3.40 ^b	3.91 ^{ab}	0.17
Dressing (%)	40.56 ^b	43.28 ^a	41.85 ^{ab}	41.34 ^b	0.48
Weight of parts as percentage of empty	Body	Weight			
Leg	13.20 ^a	13.56 ^a	12.12 ^b	11.44 ^c	0.32
Loin	12.38 ^{ab}	11.30 ^b	13.19 ^a	11.97 ^{ab}	0.26
Sets	5.34	5.61	5.86	5.98	0.09
Ends	12.63	11.93	12.87	11.53	0.68
Shoulder	13.60 ^a	12.37 ^b	10.91 ^c	11.31 ^c	0.33
Abdominal fat	1.67 ^a	1.62 ^a	0.94 ^b	1.14 ^b	0.11
Bone to lean ratio	0.30 ^{ab}	0.28 ^b	0.35 ^a	0.30 ^{ab}	0.01
Head	10.63 ^{bc}	10.05 ^c	11.82 ^a	11.06 ^{ab}	0.22
Skin	10.34 ^c	9.73 ^c	13.14 ^a	11.53 ^b	0.41
Feet	4.14 ^a	3.68 ^{bc}	3.97 ^{ab}	3.58 ^c	0.08
Full gut*	27.21 ^a	18.94 ^b	23.31 ^{ab}	23.66 ^{ab}	2.28
Empty gut	9.65	9.72	9.54	9.66	0.21
Liver	2.32	2.15	2.25	2.22	0.03
Kidney † pelvic fat	1.22 ^a	0.77 ^b	1.20 ^a	0.97 ^{ab}	0.07
Heart	0.61 ^b	0.57 ^b	0.76 ^a	0.62 ^b	0.02
Spleen	0.17	0.20	0.20	0.19	0.01
Lungs	1.70	1.58	1.73	1.81	0.06

* As percentage of live weight

^{a,b,c} Means in the same with different superscript are significantly different ($P < 0.05$)

SEM = Standard

Warm carcass = [Carcass – (head+Skin+contents of thoracic and pelvic cavity+ limbs distal to the carpal and tarsal joints)]

The weight of meat cuts, offals and organs were expressed as percentage of empty body weight (EBW) and are presented in Table 4. Meat cut values for WAD goats showed that leg, loin and shoulder of all the Jointed parts (Shoulder, leg, loin, sets and ends) were significantly different ($P < 0.05$) among treatment groups. The legs of animals fed diet B gave the highest value (13.56%) but was similar ($P > 0.05$) to that of goats on diet A (13.20%). Goats fed diet A and B yielded significantly superior values ($P < 0.05$) compared to those fed diet C and D. This result indicates that inclusion of Bambara nut meal at 10% level in diets of growing WAD goats most favourably improved the weight of their legs in relation

to empty body weight. These values are also comparable to the values reported by Ukpabi (2007) but lower than the values reported by Akinsoyinu (1974) for WAD bucks. The weight of legs expressed as percentage of warm carcass (Table 5) were also significantly different ($P < 0.05$) among treatment groups and followed the same pattern observed in weight of leg as percentage of empty body weight. The values were 23.69, 24.75, 22.32 and 20.98% for treatment groups A, B, C and D respectively. These values are lower but comparable to the values obtained by Adebowale and Ademosun (1981) but higher than the values reported by Ukpabi (2007) for goats fed Brewers dried grain

and Mucuna seed meal respectively.

Except for WAD bucks fed diets B and C, there was no significant difference among treatment groups for the weight of loins. WAD bucks on diet C yielded a superior loin weight followed by those on diet A, D and B respectively. The average value of $12.15 \pm 0.26\%$ for loins of goats fed BNM-based diets is comparable to 12.38% obtained for goats on the control diets. The weight of loins expressed as percentage of warm carcass (Table 5) showed no significant difference ($P > 0.05$) among treatment groups. However, the absolute values followed the same pattern observed for loin weight expressed as percentage of empty body weight. These values are higher than the values reported by Ahamefule (2005); Ahamefule and Udo (2010) but are comparable to the values reported by Ukpabi (2007).

Values for shoulder as a percentage of EBW revealed that shoulder development declined with increasing inclusion of the BNM in the concentrate diets. Values for goats fed diet A (13.60%) was highest and significantly ($P < 0.05$) differed from other treatment groups, followed by those fed diet B (12.37%) which also significantly ($P < 0.05$) differed from other treatment groups. However, goats fed diet C and D did not differ ($P > 0.05$) from each other. Shoulder weight expressed as a percentage of warm carcass (Table 5) followed a similar pattern. This suggests that the control diet influenced the development of shoulder better than the BNM containing diets. The values obtained for shoulder as a percentage of warm carcass (Table 5) in this study are comparable to 25.40% reported by Adebawale and Ademosun (1981) but higher than 18.76% and 20.8% reported by McGregor (2007) and Ahamefule and Udo (2010). The variations may be attributed to factors like age, weight and body condition

of the animals at the time of slaughter (Prinkerton, 2003). Set and ends of WAD goats were similar ($p > 0.05$) across treatment groups when expressed as percentage of EBW (Table 4) and warm carcass (Table 5). However, in absolute terms it could be seen that goats on the BNM diets had higher values for sets compared to the control diet. Thus, suggesting that the BNM diets supported higher sets development. The weights of abdominal fat expressed as percentage of EBW were 1.67 , 1.62 , 0.94 and 1.14% for diets A, B, C and D respectively. There was a significant influence ($P < 0.05$) of diets on fat deposition in the abdominal region. WAD bucks fed diets A and B were similar ($P > 0.05$) but had significantly higher abdominal fat compared to diet C and D. The values obtained for goats fed diets A and B falls within the range of $1.2 - 2.6\%$ reported for WAD goats (Ahamefule *et al.*, 2005a), while diets C and D falls within the range of $0.72 - 2.6\%$ reported by Ukpabi (2007) for WAD goats fed Mucuna seed meals. The values for bone to lean ratio were 0.30 , 0.28 , 0.35 and 0.30 for diets A, B, C and D respectively. Goats fed diet B had the most favourable value for bone to lean ratio which did not differ significantly ($P > 0.05$) from treatment groups A and D but significantly differed ($P < 0.05$) from treatment group C. The comparatively low bone to lean ratio observed for goats fed diet B indicates the efficiency of feed utilization of the goats on this diet. This is further confirmed by the higher dressing percentage (43.28%) when compared to other treatment groups. In this study goats fed diet B (10% BNM) performed better comparatively in terms of feed conversion ratio (Table 3), dressing percentage and bone to lean ratio (Table 4). Thus distinguishing it as a diet of choice for fattening WAD goats.

The head, skin, feet, full gut and empty gut represent the offal. Their weights expressed as a percentage of empty body weight is presented in Table 4. There was significant differences ($P < 0.05$) among treatment means for all except empty gut which didn't differ significantly ($P > 0.05$) among treatment groups. The values obtained for head were 10.63, 10.05, 11.82 and 11.06% respectively. Goats fed diet B yielded the lowest value for head followed by goats fed diet A, D and C respectively. These values are comparable to the values of 9.21-11.69%, 10.21-11.14% reported by Ahamefule *et al.*, (2005a) and Ukpabi (2007) respectively for WAD goats, but slightly lower than 12.64% reported by Ahamefule and Udo (2010) for WAD goats in another study. The values for skin were 10.34, 9.73, 13.14 and 11.53% for diets A, B, C and D respectively. Diets A and B were similar ($P > 0.05$) and had the lowest skin weight but significantly differed from diet C and D. These values fall within the range of values reported by Akinsoyinu (1974) for WAD goats, while Corti and Sangiorgio (2000) reported $9.85 \pm 0.43\%$ for Frisa - valtellinese kids.

The feet constituted 4.14, 3.68, 3.97, and 3.58% of the EBW of WAD goats fed diet A, B, C and D respectively (Table 4). Significant differences ($P < 0.05$) existed within the treatment groups. The mean value of $3.74 \pm 0.08\%$ obtained for goats on

the BNM- based diets reveals that goats on diet A had larger feet weights as percentage of empty body weight. The values are consistent with the range of values reported by Akinsoyinu (1974); Ahamefule (2005) and Ukpabi (2007) for WAD goats.

Values for full gut expressed as a percentage of live weight (Table 4) were 27.21, 18.94, 23.31 and 23.66% for WAD goats fed diets A, B, C and D respectively. Goats fed diet A had significantly ($P < 0.05$) heavier full guts than those on diet B, however, this did not differ significantly ($P > 0.05$) from that of goats fed diet C and D. Diet B had the lowest full gut value (18.94%). The values obtained in this study are comparable to the values reported by Ahamefule *et al.*, (2005a). It has been reported (McGregor, 2007) that gut content may constitute up to 20% of the live weight of goat, depending on how long the goat was fasted before slaughter.

Empty gut expressed as a percentage of empty body weight yielded 9.65, 9.72, 9.54, and 9.66% for diets A, B, C and D respectively. The treatment means did not differ significantly ($P > 0.05$). These values are lower but comparable to 10.63% reported by Ahamefule *et al.*, (2005).

The values obtained for the various parts that constitute the offal reveals that diet B comparatively, yielded lower offal weight. This also implies that the diet supported less development of offals and possibly is the

Table 5 Average weight of meat cuts expressed as percentage of warm carcass.

Parameters	Diets				SEM
	A	B	C	D	
Leg	23.69 ^a	24.75 ^a	22.22 ^b	20.98 ^c	0.39
Loin	22.26	20.68	24.18	21.97	0.33
Sets	9.58	10.24	10.74	10.97	0.31
Ends	21.96	21.67	23.59	21.15	0.85
Shoulder	24.46 ^a	22.42 ^b	20.01 ^c	20.75 ^c	0.30

^{a b c} Means in the same row with different superscripts differ significantly ($P < 0.05$).

reason for the higher dressing percentage. Mean organ weights expressed as a percentage of EBW are also shown in Table 4. Except for the weight of the heart and kidney + pelvic fat, all other organs (the liver, spleen and lungs) did not differ significantly ($P>0.05$) in weight among treatment groups. The liver constitutes 2.32, 2.15, 2.25 and 2.22 % of the EBW of WAD bucks that were fed diets A, B, C and D respectively. In absolute terms diet B had the lowest liver size and on the average the value of 2.21% obtained for the BNM-based diets is lower than the liver weight of WAD goats fed the control diet. These values are higher than 1.96 – 2.0% reported by Akinsoyinu (1974); Ahamefule *et al.*, (2005), but lower than 3.32% reported by Almeida *et al.*, (2000). An increase in the size of the liver is usually associated with an increase in metabolic activities related to detoxification (Akinmutimi, 2004). The results reveal that the liver of the goats on the test diets were not challenged adversely and suggests BNM seeds posed no toxic or antinutritional challenge to the goats. The values for kidney + pelvic fat were 1.22, 0.77, 1.20, and 0.97% for WAD bucks fed diets A, B, C and D in that order. Goats fed diet A had a significantly ($P<0.05$) higher kidney + pelvic fat value compared to those fed diet B however, the kidney + pelvic fat value of the goats on diet A was similar ($P>0.05$) to those of diets C and D. These values falls within the range of values (0.51 – 1.82%) reported by Ahamefule, (2005) but higher than (0.47 – 0.65%) reported by Ukpabi (2007) for WAD goats fed *Mucuna* seeds. It is a common practice in feeding trials to use weight of some internal organs like kidney and liver as indicators of antinutritional factors in the test ingredient (Akinmutimi, 2004; Ahamefule, 2005). Bone, (1979) reported that if there is any toxic element in feed samples used in

feeding trial, abnormalities will arise because of increased metabolic activities of the organ in an attempt to reduce these toxic elements or anti-nutritional factors to non-toxic materials. This might not be the case in the present study, because diet A produced the highest values for liver and kidney + pelvic fat and it did not contain BNM.

The values for heart were 0.61, 0.57, 0.76 and 0.62% for WAD goats on diets A, B, C and D respectively. Goats on diet C had a significantly ($P<0.05$) heavier value for heart compared to treatment groups A, B and D which however did not differ ($P>0.05$) from each other. Diet B had the lowest value for heart. Szabo and Tebbett (2002) reported that the presence of other antinutritional factors (such as Serotonin) other than L- DOPA in the feed affects the functioning of the heart. The observed differences in this study however may not be ascribed to the diets since the value for diet A was the highest even though it did not contain BNM. The values obtained in this study are comparable to 0.56 – 0.72% and 0.47 – 0.72% reported by Ahamefule (2005) and Ukpabi, (2007) respectively, but lower than 0.86% reported by Almeida *et al.*, (2002) for Boer bucks.

Conclusion

Incorporation of Bambara nut seed meal in concentrate diets fed as supplements to WAD bucks on *Panicum maximum* forage significantly influence ($P>0.05$) dressing percentage in WAD bucks. Diet B which contained 10% BNM could be recommended because it promoted high dressing percentage, better bone to lean ratio and feed to gain ratio. Results from organ characteristics also showed that the WAD bucks were not challenged adversely in terms of increased metabolic activities associated with detoxification. Suggesting

that the BNM seeds posed no toxic or antinutritional challenge to the goats. Year round provision of feed is possible and practicable through effective utilization of forages during the rains while in periods of scarcity like the dry season goat farmers can harness crop residues, farm wastes, agro-industrial by-products and some unconventional legume seeds like Bambara nuts, especially, in areas where they are abundant and cheap.

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