Performance, Linear Body Measurements and Carcass Characteristics of WAD Goats Fed Diets Supplemented with Slaughterhouse By-Products.

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Abstract

This study was designed to investigate the effect of slaughter house by-product – based diets on feed utilization, body measurements and quantitative carcass characteristics of West African Dwarf (WAD) goat. Rations were formulated such that 0%(A), 35%(B), 70%(C) and 100%(D) of soybean meal were replaced weight for weight with the slaughter house by-product, in a concentrate diet. Sixteen WAD goats were allocated to the various dietary treatments in a completely randomized design for 126 days and were slaughtered for carcass analysis. Result shows that animals on diet B had the least DM intake per unit metabolic size, their feed conversion ratio (i.e weight gained/dry matter intake) was the best i.e. one kg of feed produced 0.2kg of body. The data recorded for nitrogen retention in this study ranged from 6.60 to 8.83g/day. The mean apparent metabolizable energy (ME) consumed by animal on treatments A to D was 0.181, 0.171, 0.175 and 0.189 Mcal/day $W^{0.75}$ respectively. Animals on ration B recorded 48.4 cm and 39.1 cm for body length and height at withers respectively. Dressing percent was highest in goats on diet B (73.6%). Least value of cooking loss (29.73%) was observed in semitendinosus muscle of animals on diet B, while those on diet D (36.43%) had the highest result. There were significant dietary effect ($P < 0.05$) on carcass composition of goats. Ration D produced carcass with the highest weight of lean muscles (4655.0g), but the least proportion of fat (174.0g) and the highest proportion of bones (1904.0g). It could be deduced from the results that ration D supported the development of animals with tall and lean body conformation while slaughter result revealed that animals on ration B had the best dressing%.

Key words: Goats, Feed utilization, Carcass characteristics, Anthropometric measurements.

Introduction

One of the least developed aspects of the Nigerian livestock and meat industry is the utilization of animal by products which have myriads of uses that affect our every day lives more than we can realize. Wherever rapid growth of meat industry has occurred coupled with the

establishment of big abattoirs, the accumulation of large quantities of inedible offals poses not only economic but also health sanitation and disposal problems. The minimum annual potential volume of hide and skin, blood, variety meats, edible offals, bone and marrow is estimated to amount to 27,510.0, 13,128.0,

14,730.0, 66,810.0, 47,160.0 and 28,128.0 metric tonnes, respectively (Igene 1982). The inability to economically exploit these raw materials constitutes one of the major challenges facing the development of the livestock and meat industry. It has therefore become imperative that efficient and economic methods for their utilization be enhanced. Body measurement of live animals could be used as a basis for estimating age, body weight and carcass characteristics (Ngere, 1979). Carcass composition studies are an important aspect of the science of meat production from animals. Uekermann (1969) reported the positive effect of nutrition on carcass composition of goats and that goats on a higher plane of nutrition, dressed better than those on a lower plane. Exploitation of unconventional feedstuffs in goat production is advocated as a means of increasing meat production and consumption. The particular Slaughter house by-product under consideration is the scrapping from the papillae layer of the rumen of slaughtered cattle primarily used as fertilizer in some parts of the country but in view of its nutrient potential, attention is now focused on recycling it as a source of nutrient for livestock. This study therefore, was designed to investigate the effect of Slaughter house by-product based diets on quantitative carcass characteristics of West African Dwarf goats.

Materials and Methods

The Slaughter house by-product was collected at Bodija abattoir in Ibadan. It was sun-cured on a clean cemented floor until crisp and was kept in jute bags in a silo. Samples were taken and kept in air tight containers pending laboratory

analysis. Rations were formulated such that 0% (A), 35% (B), 70% (C) and 100% (D) of soybean meal was replaced weight for weight with the Slaughter house by-product in a concentrate diet containing 150g/kg soybean meal. Sixteen WAD bucks aged between 10 and 12 months and weighing between 5.87 and 6.73kg were allocated to the various dietary treatments in a completely randomized design for 126 days and all were slaughtered for carcass analysis. Weekly weight changes were taken through-out the experimental period to generate weight gain data. The linear body measurements of live animals were taken at the end of the feeding trial prior to slaughtering. The animals were fasted for 24 hours before slaughtering. All animals were slaughtered by severing both the jugular veins and the carotid artery at the atlanto occipital articulation. After skinning and evisceration, the carcasses were split into two halves along the back bone using meat saw and were chilled for 3 days. Weights were taken before and after chilling. The right side of each carcasses were separated into wholesale cuts and weighed. The left side of each carcasses was separated into trunk, pelvic and pectoral limbs and each was dissected into lean, fat and bones (Maiga, 1974) and weighed. As much as possible, the bones were scrapped clean of lean and tendon using a dissecting set and razor.

Slaughter house by-product, soybean meal, feed samples and selected muscles were analysed for proximate composition according to AOAC (2000). Neutral detergent fibre (NDF) and Acid detergent fibre (ADF) were determined using the analytical procedure of Van Soest and Robertson (1985). The gross energy (GE Mcal/g) was

Table 1 : Composition and Nutrient Contents of Slaughter house by-product-based Rations

INGREDIENT(g/100g)	Ration A	Ration B	Ration C	Ration D
Soybean Meal	15	9.75	4.50	-
Slaughter house by-product	-	5.25	10.50	15.00
Cassava Peel	34.50	35.50	36.50	38.50
Wheat offal	18.00	17.00	17.00	15.00
Corn offal	15.00	15.00	14.00	13.00
Corn cob	6.00	6.00	6.00	6.00
Sorghum gluten meal(Dussa)	6.00	6.00	6.00	6.00
Bone meal	3.00	3.00	3.00	3.00
Oyster shell meal	2.00	2.00	2.00	2.00
Vit/Min premix	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
NUTRIENT COMPOSITION				
Dry matter	85.55	85.19	84.94	85.53
Organic matter	95.00	92.50	89.00	87.00
Crude protein	16.13	16.95	17.82	17.72
ADF	20.73	19.84	21.85	21.23
NDF	37.38	36.98	38.07	38.30
EE	2.24	5.25	8.16	7.63
Ash	5.00	7.50	11.00	13.00
Ca	1.94	2.28	2.28	2.31
P	0.86	0.86	0.99	1.91
Mg	0.25	0.25	0.26	0.27
GE(Mcal/kg)	3.604	3.642	3.390	3.594

analyzed with adiabatic bomb calorimeter by Harris (1970). The general linear model (GLM) procedure of SAS(1990) was used to determine significance of group differences. When significant difference was observed in a trait, means were separated by Duncan(1955) multiple range procedure.

Calculations :

$$K_n = 0.55 + 0.24d_e$$

$$K_e = 0.656 + 0.070C$$

$$ME = 4.49X_1 + 9.05X_2 + 3.61X_3 + 3.6X_4 + 6.24X_5$$

Where

d_e = Apparent digestibility of dietary energy

C = Crude fibre content of diet on DM basis

Table 2 : Feed utilization of WAD goats fed slaughterhouse by-product-based diets.

ITEM	A	B	C	D	SEM
DM intake (g/daykg ^{-0.75})	71.02a	64.92b	69.09ab	73.19a	3.00
Feed conversion ratio	0.18b	0.20a	0.18b	0.18b	0.09
Nitrogen intake (g/daykg ^{-0.75})	1.83	1.78	2.02	2.30	0.100
Nitrogen retention (g/day)	6.60c	7.39ab	7.12ab	8.83a	0.340
ME intake (Mcal/daykg ^{-0.75})	0.181	0.171	0.174	0.189	27.11
Energy retained (Mcal/day)	1.140	1.113	1.002	1.058	38.93
Kg Weight gained (g/day)	0.110ab 75.07	0.116a 76.32	0.106b 71.43	0.113ab 74.60	0.001 3.47

a,b,c = Mean in the same row with different subscripts are significantly ($P < 0.05$) different

- K_m = Efficiency for maintenance
 K_g = Efficiency for growth/ fattening
 X_1 = Digested crude protein
 X_2 = Digested crude fat
 X_3 = Digested crude fibre
 X_4 = Digested nitrogen free extract
 X_5 = Metabolic body weight e. g. $W^{0.75}$

Results and Discussions

Feed utilization of WAD goats fed slaughterhouse by-product-based diets.

The result of the feed utilization of WAD goat fed slaughterhouse by-product-based diets is shown in Table 3. Animals on diet B had the least DM intake per unit metabolic size. Despite this,

their feed efficiency was the best i.e one kg of feed produced 0.2kg of body mass. This performance is better ($P < 0.05$) than those of the animals on control diet. Quellet *et al.*, (1997) observed an improvement of 8.4% in feed to gain ratio when fishmeal was given to growing cattle fed grass silage, however, Luginbuhl *et al.*, (2000) reported linear decreasing feed efficiency as the inclusion level of cotton seed was increasing in the diet of growing bucks. The data recorded for nitrogen retention in this study ranged from 6.60 to 8.83g/day. Positive nitrogen balance was observed for all the animals on the various dietary treatments. This observation suggests that the various rations were able to meet

Table 3 : Linear Body measurement and wholesale cuts of WAD goats fed slaughterhouse by-product-based diets.

ITEM	A	B	C	D	SEM
Body measurement(cm)					
Body length	44.8c	48.4a	46.8b	47.6ba	0.44
Height at withers	39.9b	39.1b	38.7b	41.9a	0.45
Heart girth	55.0	55.0	53.5	55.9	0.40
Scrotal circumference	16.4c	17.5b	18.2a	17.8b	0.23
Rump length	11.3a	9.4c	9.7b	11.4a	0.31
Shoulder width	13.5b	14.0a	13.8ab	14.1a	0.12
Wholesale cuts(g)					
Leg	1000.00a	880.00	925.00c	950.33b	13.15
Rack	250.00d	270.00	236.00c	325.00a	8.69
Flank	375.00b	273.00	300.33c	325.00b	11.36
Shank	325.00c	400.00	375.00b	338.00c	9.01
Shoulder	844.33a	700.00	700.00c	725.00b	18.06
Loin	213.00d	300.00	300.00a	275.00d	10.51

a,b,c – Means in the same row with different subscripts are significantly ($P < 0.05$) different

the protein need of the animals for maintenance and weight gain. This result is higher than the report of Matras *et al.* (1991) when urca, blood meal-corn gluten meal were used as protein sources in the diet of growing lambs. They reported nitrogen balance of 3.6 to 4.1 g/day but Sehgal and Makkar (1994) reported values ranging between 14.4 and 21.2 g/day for buffalo calves fed different protein sources such as groundnut cake, poultry excreta, cotton seed cake and guar meal. However, Isah *et al.* (1999) recorded nitrogen balance of 1.84 to 5.76 g/day for WAD goats weaner kids fed mango and gliricidia leaves.

The mean apparent metabolizable energy (ME) consumed by animals on treatments A to D was 0.181, 0.171, 0.175 and 0.189 Mcal/day

W^{0.75} respectively. Sutton *et al.* (1999) reported ME intake ranging from 0.232 to 0.244 MJ/day for lactating cows while values of 0.131 and 0.129 MJ/day were observed by Birnie *et al.* (1999) for non-producing dairy cows. Yan *et al.* (1999) reported ME intake of 0.363 to 0.82 MJ/W^{0.75} for growing cattle. Positive energy balance was observed for all animals on the various dietary treatments. Mean values of energy retention observed for animals on rations A to D were 1.140, 1.112, 1.003 and 1.054 Mcal/day respectively. Efficiency of utilization of metabolizable energy for growth (K_g) values was highest ($P > 0.05$) for animals on ration B (0.116), than those on rations A, C and D (0.110, 0.106 and 0.113) respectively. This indicates a remarkable efficiency of utilization of

metabolizable energy in this diet by goats for metabolic and production purposes. Rompala *et al.*, (1991) reported higher Kg values of 0.55 to 0.57kg for lambs. Average daily weight gain was highest ($P>0.05$) for animals on ration B (76.32g/day) followed by those on ration A (75.07g/day), while ration C had the least value (71.43g/day). Values of average daily gain of 67.3 to 99.2 g/day reported by Luginbulh *et al.*, (2000) for buck kids in their study were in consonance with the values obtained this study.

Linear body measurements and wholesale cuts of WAD goats fed slaughterhouse by-product-based diets.

Significant differences ($P<0.05$) were observed in the mean anthropometric measurements of

experimental animals (Table 4). Animals on ration B recorded 48.4cm and 39.1cm for body length and height at withers respectively. These values were lower than those reported by some researchers (Otuma *et al.*, 1999), except for height at withers which compared favourable with the work of Ngere (1979). Body length values were 44.8cm and 46.8cm, height at withers was 39.9cm and 38.7cm respectively for rations A and C. Heart girth values were however similar ($P>0.05$) for all the rations. The significantly high values in body measurements of animals on ration D implies that they were tall and lean in body conformation compared to those on rations A to C which were more compact and sturdy in outlook. Scrotal or testicular circumference values were not consistent with

Table 4: Slaughter yields and carcass composition of WAD goats fed slaughterhouse by-product-based diets.

ITEMS	A	B	C	D	SEM
Slaughter yields					
Dry matter(g)	71.02a	64.92b	69.09ab	73.19ab	3.00
Initial	6.33	6.73	6.00	5.87	0.33
Weight(kg)					
Liveweight at	15.25a	13.00b	12.75c	12.75c	0.32
Slaughter(kg)					
Empty body	11.7a	11.1b	9.8c	10.9b	0.21
Weight(kg)					
Warm carcass	13.49a	11.8c	11.5d	11.9b	0.22
Weight(kg)					
Dressing %	68.5c	73.6a	65.7d	68.8b	0.86
Chilled carcass	6.6a	6.1ab	5.5b	5.8b	0.15
weight (kg)					
Carcass Composition(g)					
Bone	1162.00c	1325.00b	1050.00d	1904.00a	99.2
Lean	4552.00b	3987.00c	3737.00d	4655.00a	115.56
Fat	434.20a	269.70c	348.00b	174.00d	28.95
Lean:Bone	3.96a	3.00c	3.56b	2.43d	0.18
Lean:fat	10.50d	14.80b	10.70c	26.70a	1.99

a,b,c = Means in the same row with different subscripts are significantly ($P<0.05$) different

the level of inclusion or type of protein supplement. This shows that other factors apart from protein sources were responsible for the observed result. This observation is in consonance with the report of Adedeji and Gbadamosi (1999) which stated that scrotal circumference is significantly correlated with body weight and age and could be used as a basis for estimating sexual maturity and evaluation of male for breeding soundness. The result of the wholesale cuts did not follow a particular trend and this does not allow for a meaningful interpretation of the overall result in relation to the type of or level of inclusion of protein sources in the formulated rations. However, when this results were compared with pre-slaughtered linear body measurements, certain correlations

were observed; goats on rations A and D with the highest mean values of leg and flank weights had highest rump length. Ration D with the shoulder width of 14.1cm also had the heaviest rack weight (325g) while body length and scrotal length follow the same trend with shank weight. White and Green (1952) indicated that weights of wholesale cuts could be accurately predicted from linear body measurement.

Slaughter yield and carcass composition of WAD goats fed slaughterhouse by-product-based diets. Slaughter yields and carcass composition values are shown in table 5. Animals on rations C and D had the same mean liveweights at slaughter (12.75kg) and animals on ration A had the highest value (15.25kg), while those on ration B was

Table 5 : Selected carcass traits and chemical composition of WAD goats fed slaughterhouse by-product-based diets.

ITEMS	A	B	C	D	SEM
Selected carcass traits of semi-membranosus muscle					
(%)Cooking loss	33.00b	29.73c	32.97b	36.43a	0.79
(%) Termal shortening	39.93b	32.60c	43.23a	43.30a	1.46
Warner BratzlerShear Value(kgcm ⁻²)	2.8c	3.6a	2.4d	3.4b	0.16
Lion Eye Area (cm ²)	9.0c	10.0a	9.5b	9.0c	0.17
Leg Specific gravity (g)	1.39a	0.09b	1.20ab	1.60b	0.10
Marbling Score	6.02	6.01	6.00	6.00	0.01
% Chemical composition of Longissimus dorsi muscle					
Crude Protein	23.56a	22.32b	21.28c	23.69a	0.26
Ether Extract	17.01a	11.45d	13.54b	12.91c	0.53
Ash	5.51a	3.03c	3.39b	3.72b	0.25

a,b,c = Means in the same row with different subscripts are significantly ($P < 0.05$) different

intermediate (13.00kg). Warm carcass weight was highest in animals on ration A (13.49kg) and those on ration C had the lowest value (11.5kg). Mahgoub and Lu (1998) reported lower values in Batina and Dhofari breeds of goats. Animals on ration A had the highest value of empty carcass weights (11.7kg) while those on ration C had the least value (9.8kg). Animals on rations B and D had similar but intermediate values (11.1 and 10.9kg respectively). This is an indication that animals on rations B and D possessed more of their liveweight as body tissue while those on rations A and C possessed higher weight as gut content. Dressing percent was highest in goats on ration B (73.6%). This is an indication that this ration produced goats with probably the highest quantity of consumable carcass after dressing, which is of interest to the butcher. Some researchers reported lower dressing % for goat (Sota *et al.*, 1995) and lamb (Kott *et al.*, 2003). This might be because high plane of nutrition has a positive effect on dressing %. There was significant ($P < 0.05$) dietary effect on carcass composition of goats. Ration D produced carcasses with the highest weight of lean muscles (4655.0g) but with the least proportion of fat (174.00g) and highest proportion of bones (1904.0g). This result is similar to the work of Mahgoub and Lu (1998). Goats on ration A had the highest ratio of lean to bone (3.96), while those on ration D had the least value (2.43). These values are comparable to the report of Hopkins *et al.*, (1997). The trend observed in this result followed the same pattern observed in slaughter yields such as liveweight at slaughter and empty body weight.

Chemical composition of meat, and selected carcass traits of WAD goats fed slaughterhouse by-product-based diets

Table 6 shows the results of the selected carcass traits and chemical composition of goats fed slaughterhouse by-product-based diets. Significant differences were observed in cooking loss of semitendernus muscle analyzed. Least value of cooking loss (29.73%) was observed in semitendernus muscle of animals on ration B, while those on ration D (36.43%) had the highest result. Intermediate and similar value ($P < 0.05$) was observed in animals on rations A and C (33.00 and 32.97% respectively). Similar trend was also observed in result of thermal shortening of the semitendernus muscle. However, Warner Bratzler shear value of animals on ration B was highest (3.6Kg/cm²). These values were however similar to that obtained by Babiker *et al.*, (1990) who reported values of 34.2% and 36.6% for desert goat and lamb respectively, though Schonfeldt *et al.*, (1993) in their study with Angora and Boar goats and sheep reported values higher than those obtained in this study. Jones *et al.*, (1990) reported a higher shear force value for beef muscle. However, according to Henckel *et al.*, (1997), shear force value was inversely related to the level of glycogen. Mahendrakka *et al.*, (1988) reported that the plane of nutrition affects shear values of lamb muscle while Shemeis *et al.*, (1994) observed an increase in shear force value of beef with increase in age. The animals used in this study are within the same physiological age as revealed by their dentition and of the same sex, hence the differences observed were not as a result of age or sex.

Treatment effect on loin eye area was highest in animals on ration B. Hopkins *et al.*, (1997) reported a higher loin eye area for lamb carcasses, while Fahmy *et al.*, (1992) reported similar values with the result of this study. Kamble *et al.*, (1989) noted that there was a steady increase in the rib eye muscle area with increase in liveweights and that carcass length and rib eye area had significant correlation with dressed carcass weight in male kids. Marbling scores of the carcasses were not affected by the type of protein sources in the feed. However, these values were higher than the ones reported for Angora and spanish goats and their crosses by Oman *et al.*, (2000), while Jones *et al.*, (1990) and Bennett *et al.*, (1995) reported higher values for beef muscles. Animals on rations A and D had the highest values of leg specific gravity (1.39g and 1.20g respectively). Maiga (1974) indicated that some relationship could be expected between the amount of fat in an animal and the specific gravity of its whole body. This is in view of the low density of fat as compared with bone and lean. He also noted that the specific gravity of the carcass was affected by breed alone in the young animals, while the influence of sex and level of feed intake was apparent only at heavier weights. The study showed some differences in the chemical composition of longissimus dorsi muscles as influenced by dietary treatments. When sources of protein in feed was compared, goats fed soybean meal based ration (diet A) had similar crude protein content as those fed Slaughter house by-product based ration (diet D). These values were similar to those obtained by other researches (Babiker and Yousif, 1990). Ash

content of muscle of animals on ration A was highest (5.51%) while least value was observed in ration B (3.03%). Farid (1991) reported lower ash content in sheep.

Conclusion

In conclusion, it could be deduced from the results of carcass evaluation that ration C might support bone growth and development more than ration B, while ration B might support muscle growth and favour fat accumulation more than others. Additionally, Ration D might support both muscle development and bone growth more than any other ration investigated. Ration D supported the development of animals with tall and lean body conformation while slaughter result revealed that animals on ration B had the best dressing %. No abnormality was observed in the development of muscle and skeletal tissues of all experimental animals. This therefore suggests that the abattoir waste could be used as protein source to replace the expensive soybean meal in the diet of WAD goats without any detrimental effect on the meat produced.

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