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Carcass characteristics and primal cuts of three Nigerian sheep as influenced by sex and breed

[1]Salihu, D.Y., [2]Zahraddeen, D., [2]Abdu, S.B., [2]Ribah, M.I., [3]Sadiq, A. A. and Zakka, T.

[1]Federal College of Animal Health and Production Technology, Vom, Plateau State
[2]Department of Animal Science, Ahmadu Bello University, Zaria
[3]FCT College of Education Zuba-Abuja
Corresponding Author: +2348060940039, yuxuf8015@gmail.com

Target audience: Breeders, Animal Product Specialists and Farmers

Abstract

The study was conducted to evaluate the carcass and primal cuts of three Nigerian sheep breed as influenced by sex and breed. A total of eighteen (18) growing (12 – 18 months) sheep comprising three rams and three ewes each of Balami, Uda and Yankasa breed purchased from National Veterinary Research Institute (NVRI) Vom. The experimental sheep were balanced for weight and allotted into six treatments based on breed (Balami, Uda and Yankasa) and sex (rams and ewes) effects with three replicates in a 2×3 factorial arrangement. The sheep were fed a total mixed ration comprised of 14.77% crude protein for 90 days. The results indicated that the rams had higher (P<0.05) fasted body weight (28.57 kg), slaughter body weight (27.43 kg), empty body weight (22.86 kg), hot and cold carcass weights (12.99 and 12.54 kg), and dressing percent (45.50 %) compared to the ewes. Like in the live body weight gain, Balami similarly recorded higher (P<0.05) fasted body weight (28.05 kg), slaughter body weight (26.93 kg), empty body weight (22.44 kg), hot and cold carcass weights (12.80 and 12.52 kg) compare to Yankasa breed while on a contrary, Uda had higher (P<0.05) dressing percent (47.50 %) than Balami and least value recorded in Yankasa. However, the percentage chilling loss for mutton was not affected (P>0.05) by both sex and breed differences. The interaction between sex and breed shows the rams and ewes of Balami sheep had higher (P<0.05) fasted body weight (29.84 kg), slaughter body weight (28.65 kg), empty body weight (23.87 kg), hot and cold carcass weights (13.75 and 13.34 kg) compare to the rams and ewes of Yankasa sheep while the rams and ewes of Uda sheep had higher (P<0.05) dressing percent (48.00 and 47.00 %) than Yankasa sheep and Balami ewes. The values for the primal cuts such as legs, chump, loin, neck, mid rib, main rib, shoulder and tail recorded in this study were higher (P<0.05) in the rams compared to the ewes while no significant difference was observed for breast. Regarding the breed effect, Balami also mirrored similar trend observed with carcass characteristics, having higher (P<0.05) values for primal cuts compared to the Yankasa breed of sheep but statistically similar to Uda. Interactively, sex did not influence the primal cuts between Balami and Uda breeds, however, the rams and ewes of Balami recorded higher (P<0.05) primal cuts than the Yankasa sheep. In conclusion, Balami sheep exhibited improved carcass characteristics and primal cuts. It can be recommended that for superior carcass and primal cuts rams of Balami should be prioritize.

Keywords: Breed, Carcass, Sex and Sheep

Description of the Problem

Carcass characteristics refer to measurable qualities of an animal's body after slaughter, including dressing percentage, muscle distribution, fat deposition, and bone-to-meat ratio. These traits are crucial in

determining meat quality and economic value (1). Balami sheep are larger and heavier than Yankasa and are generally preferred for meat in the arid and semi-arid zones of Nigeria (2). Dressing percentage ranges from 52-54% with well-developed muscle in both fore and hindquarters. Fat deposition in Balami is more than Yankasa but still within acceptable levels for meat quality. Balami has high dressing weight with relatively tender meat; suitable for commercial meat production. Balami is known for its large size, and provides higher carcass weights and dressing percentages compared to Uda and Yankasa (3).

Uda sheep are uniquely characterized by their long legs and fat tail, adapted to the hot, dry regions of northern Nigeria. These characteristics influence their carcass traits. Dressing percent is lower, about 42-48%, due to larger fat tail and lighter muscle mass. Muscle distribution is less uniform with more concentration in the hindquarters. It has high fat accumulation, especially in the tail (fat-tail deposit). Though lean in muscle, the high fat can affect consumer preference. Uda is characterized by long legs, and has lower fat deposition but longer carcass dimensions, affecting primal cut distribution (4). However, Uda meat is still valued in traditional markets. Uda sheep are generally less efficient in meat production but have potential if fat-tail traits are selectively managed (5). Despite the importance of sheep production in supplying meat and income generation, productivity of indigenous breeds such as Balami, Uda, and Yankasa remains suboptimal. In addition, most available information is based on traditional feeding systems, with little emphasis on improved nutritional strategies such as total mixed ration (TMR).

A critical gap therefore exists in the comprehensive understanding of how sex influences carcass characteristics across different Nigerian sheep breeds under a controlled feeding regime. This study is therefore oriented towards providing a holistic evaluation of carcass traits in three Nigerian sheep breeds as influenced by sex under total mixed ration feeding. The quality of carcass is influenced by various genetic and physiological factors in sheep. Among these, breeds and sex play significant roles in determining growth rate, carcass traits, meat texture, fat content, muscle fibre composition and ultimately product quality (5, 6, 7, 8). The study seeks to bridge this knowledge gap by evaluating how these factors influence the mutton carcass derived from both rams and ewes of Balami, Uda and Yankasa sheep. This finding will provide insight for sheep breeders and meat processors to improve production efficiency and product quality. The objective of the study was to evaluate the carcass characteristics and primal cuts of three Nigerian sheep as influenced by sex and breed.

Materials and Methods

Experimental site

The study was conducted at the Animal Products and Processing Laboratory of the Department of Animal Science, Ahmadu Bello University, Zaria. Zaria is located on Latitude 11º 12'N, Longitude 07º 33' E at an altitude of 660 m above sea level, along Zaria-Funtua Road in the Northern Guinea Savannah Zone of Nigeria (9). The climate is characterized by a defined wet and dry season. Wet season starts from April to early May and ends in late September to early October while dry season lasts from October to April. The total annual rainfall ranges from 748.6 – 1156.7 mm with a long-term average of 1056.7 mm. Maximum air temperature of 37ºC are recorded in May and minimum sit temperature of 11.5ºC recorded in December/January and relative humidity of

approximately 70% during the rainy season (10).

Experimental animal and experimental design

A total of eighteen (18) young (12 – 18 months) intact sheep compromising of Balami, Uda and Yankasa (three rams and three ewes) were purchased from Small Ruminant Unit of Teaching and Research Farm of the Federal College of Animal Health and Production Technology, Vom. The sheep were distributed into six (6) treatments based on breed (Balami, Uda and Yankasa) and sex (rams and ewes) each treatment was replicated three (3) times in a 2 by 3 factorial arrangement using a Completely Randomized design. The sheep were balanced for weight, tagged and kept in a pen equipped with watering and feeding facilities based on their sexes throughout the ninety days feeding trials.

Management and feeding of the experimental animal

The animals were given prophylactic treatment and quarantined for two weeks before the commencement of the experiment and were dewormed with Albendazole 10% 3ml/20kg, orally administered with Ammeter (Acaricide) 20ml/15 litre of water, injected with Oxytetracycline LA 1ml/10kg (im), Tylosine LA 1ml/10kg (im) and ivermectin 1ml/50kg (SC). The sheep were also given intra muscular application of oxytetracycline and B complex at the dosage of 1 ml/10kg body weight. A complete diet was formulated using modified Pearson square method and was done after proximate analysis was conducted to determine protein content of the protein source. For other ingredients, values from literature were used. After the formulation of complete diets, proximate analysis was carried out to determine the proximate composition of the diet. A daily allowance of complete diet at 4% per live body weight per head was offered. Fresh and clean water was given *ad-libitum*. The diet was formulated to contain 15% crude protein (CP) content (Table 1).

Table 1: Ingredient composition of the experimental diets fed to growing sheep

Ingredients	Composition (%)
Groundnut shell	40.00
Maize offal	14.00
Cotton seed cake	44.00
Bone meal	1.25
Salt	0.75
Total	100.00
Calculated Analysis	
Crude protein	15.00
Metabolizable energy (Kcal/kg)	2349.00
Laboratory Analysis	
Dry matter	97.31
Crude protein	14.77
Neutral detergent fibre	46.10
Acid detergent fibre	23.11

Daily feed intake was taken throughout the experiment by weighing the feed offered each day and left over (orts) in the following day. Daily intake of the diets was estimated for each animal by subtracting the leftover from the quantity served to the

animal. Daily water intake and ambient temperature of the environment was recorded. The experiment lasted for 90 days. Weight of the animal was measured at the onset of the trial after an overnight fasting to obtain their initial weight and subsequently at 2 weeks interval between 8:00 - 9:00 am throughout the feeding trial. Weight gain was determined by subtracting the initial weight from final weight every 2 weeks within the period of 90 days.

Slaughter and carcass characteristics evaluation

Six (6) sheep comprising of three rams and three ewes from each of the breed where randomly selected following the feeding trial. They were starved of feed and water overnight to get shrunk body weight before slaughtering. The animals were slaughtered according to the Halal standard procedure described by (11) and were later weighed after slaughtering and weighed after evisceration to determine hot carcass weight. Hot carcass weight was recorded immediately while it is still warm. The carcass was chilled at 0-4ºC to prevent spoilage. The carcass was reweighed after chilling to determine cold carcass weight (CCW).

The dressing percentage was determined using the formula below:

$$\text{Dressing \% (DP)} = \frac{\text{Hot weight}}{\text{Live weight}} \times 100$$

Primal cut yield determination: The chilled carcass from the three breeds of Nigerian sheep (Balami, Uda and Yankasa) was separated into primal cut (loin, rib chuck, flank, thigh/round, brisket leg), weight of each of the cut was recorded and expressed in kg.

Statistical Analyses and Models

All data collected were subjected to analysis of variance (ANOVA) of SAS Package (12) while significant treatment means were separated using the Duncan's Multiple Range Test (13).

Model:

$$Y_{ijk} = \mu + T_i + B_j + (A*B)_{ij} + E_{ijk}$$

Where:

Y_{ijk} = is the record of observations for dependent variables

μ= is the population mean

A_i = effect of i^{th} breed (i = Balami, Uda and Yankasa);

B_j = effect of j^{th} sex (j = Ram and Ewe);

$(A*B)_{ij}$= interaction effect between i^{th} breeds and j^{th} sex;

E_{ijk} = random error assumed to be normally and independently distributed with zero means and standard variation.

Results and Discussion

Main effects of sex on carcass characteristics of three Nigerian sheep breed fed total mixed ration

The carcass characteristics (Table 2) of three Nigerian sheep fed total mixed ration as influenced by sex indicated non-significant ($P<0.05$) effect of sex on carcass parameters measured except chilling loss. Higher ($P<0.05$) fasted body weight (28.57 kg), slaughter body weight (27.43 kg), empty body weight (22.86 kg), hot carcass weight (12.99 kg), cold carcass weight (12.54 kg) and dressing percentage (45.50 %) were observed in rams as against the lower mean noted ewes. Chilling loss ranged from 0.34 % for ewes to 0.39 % for rams.

The significantly higher fasted body weight, slaughter weight, and empty body weight in rams compared to ewes is a fundamental biological difference. This is primarily attributed to sexual dimorphism and the divergent physiological roles of the sexes. Rams, under similar nutritional regimes, typically exhibit a higher growth rate and mature at a heavier body weight than ewes. This is largely driven by

androgenic hormones, particularly testosterone, which promotes greater muscle development and overall body mass (14). This finding is consistent with the report of (15) that rams had higher slaughter and hot carcass weight compared to ewes for *Katahdin* sheep and was attributed to the later maturing pattern of males, who continue lean tissue growth for a longer period than females and tend to deposit fat earlier. Dressing percentage is a critical economic trait, representing the proportion of the live animal that translates into a saleable carcass. The values obtained in this study are within the range typically reported for indigenous tropical sheep. However, the 1.57 percentage point advantage for rams is notable. These findings are in tandem with the report of Afolayan *et al*. (2014) that rams had superior dressing percentage compared to ewes, although the values (44.5% to 47.2% for males on various diets) reported were slightly higher than the values obtained in this present study. The slight variation could be attributed to differences in breed composition, diet quality, or management practices. In another study by (16), a less pronounced sex effect on dressing percentage was reported that while rams had heavier carcasses, the dressing percentage difference was sometimes minimized by the heavier gut fill often associated with male grazing habits, a factor potentially controlled in this study through the use of a basal diet.

Chilling loss, or shrink loss, is the weight lost from a hot carcass as it cools, primarily due to moisture evaporation. The absence of a significant sex effect suggests that factors influencing evaporative moisture loss were similar between the two sexes in this study. This factor is primarily influenced by carcass composition and surface area. Fatter carcasses typically experience lower chilling losses because fat acts as an effective barrier against moisture evaporation (17). The fact that chilling loss was similar between sexes could imply that while rams were heavier and had a higher dressing percentage; their carcasses were not necessarily leaner to a degree that would significantly increase evaporative loss. The non-significant (P>0.05) effect of sex on chilling loss concurs with the findings of (18) that the cooling rate and environmental conditions of the chiller play a more dominant role than the sex of the animal.

Table 2: Main effect of sex on carcass characteristics of three Nigerian sheep breed fed total mixed ration

Parameters	Ram	Ewe	SEM
Fasted body wt (kg)	28.57^{a}	25.03^{b}	0.97*
Slaughter body wt (kg)	27.43^{a}	24.03^{b}	0.95*
Empty body wt (kg)	22.86^{a}	20.02^{b}	0.95*
Hot carcass wt (kg)	12.99^{a}	11.14^{b}	0.73*
Cold carcass wt (kg)	12.54^{a}	10.87^{b}	0.74*
Chilling loss (%)	0.39	0.34	0.03^{NS}
Dressing (%)	45.50^{a}	43.93^{b}	0.75*

^{abc}Means within rows with different superscripts differed significantly (P<0.05), SEM = Standard error of mean, NS = Non significant

Main effect of breed on carcass characteristics of three Nigerian sheep fed total mixed ration

The carcass characteristics of three Nigerian sheep fed total mixed ration as influenced by breed is shown in Table 3. There was significant (P<0.05) effect of

breed on carcass parameters measured except chilling loss. Higher (P<0.05) fasted body weight (28.05 kg), slaughter body weight (26.93 kg), empty body weight (22.44 kg), hot carcass weight (12.80 kg) and cold carcass weight (12.52 kg) were observed in Balami breed which were statistically similar to Uda breed (26.84, 25.77, 21.47, 12.25 and 11.88 kg) but higher (P<0.05) compared to Yankasa breed. On a contrary, the mean dressing percentage was higher (P<0.05) in Uda breed (47.50%) than Balami breed (44.65%) and Yanksa breed while the least (P<0.05) dressing percentage was recorded for Yankasa breed (42.00%). Chilling loss ranged from 0.34 % for Yankasa breed to 0.39 % for Balami breed.

The superiority of Balami breed over Uda breed and Yankasa corroborates with the findings of (19) and (20) who reported higher live weights, slaughter weights, and dressed carcass weights for Balami. Similarly, (2) found that Balami and Uda had superior morphometric measurements (e.g., body length, heart girth) and a higher proportion of muscle distribution compared to Yankasa. In contrast, (19) found that dressing percentage was not significantly different among the breeds in their study which could be attributed to differences in the age, weight, or nutritional status of the animals at slaughter. The non-significant effect of sex on chilling loss implies that the carcasses of all three breeds had a similar capacity to retain moisture post-slaughter, likely due to comparable levels of subcutaneous fat cover.

Table 3: Main effect of breed on carcass characteristics of three Nigerian sheep fed total mixed ration

Parameters	Balami	Uda	Yankasa	SEM
Fasted body wt (kg)	28.05^{a}	26.84^{ab}	25.52^{b}	0.97*
Slaughter body wt (kg)	26.93^{a}	25.77^{ab}	24.50^{b}	0.95*
Empty body wt (kg)	22.44^{a}	21.47^{ab}	20.42^{b}	0.95*
Hot carcass wt (kg)	12.80^{a}	12.25^{ab}	11.16^{b}	0.73*
Cold carcass wt (kg)	12.52^{a}	11.88^{ab}	10.72^{b}	0.74*
Chilling loss (%)	0.39	0.37	0.34	0.03^{NS}
Dressing (%)	44.65^{b}	47.50^{a}	42.00^{c}	1.20*

^{abc}Means within rows with different superscripts differed significantly (P<0.05), SEM = Standard error of mean, NS = Non-significant

Interaction effect between breed and sex on carcass characteristics of three Nigerian sheep feed total mixed ration

Carcass characteristics of three Nigerian sheep fed total mixed ration as influenced by breed and sex is presented in Table 4. There was significant (P<0.05) effect of sex and breed on three Nigerian sheep on fasted body weight, slaughter body weight, empty body weight, hot carcass weight, cold carcass weight and dressing percentage except chilling loss. The interaction between sex and breed shows the rams and ewes of Balami had higher (P<0.05) fasted body weight (29.84 kg and 26.25 kg), slaughter body weight (28.65 kg and 25.20 kg), empty body weight (23.87 kg and 21.00 kg), hot carcass weight (13.75 kg and 11.85 kg) and cold carcass weight (13.34 kg and 11.69 kg) compare to the rams and ewes of Yankasa while on a contrary, the rams and ewes of Uda had higher (P<0.05) dressing percentage (48.00% and 47.00%) compared to Yankasa (42.50% and 41.50%) and Balami ewes (43.30%).

The significant (P<0.05) effect of sex and breed on fasted and slaughter body weights indicated higher values for Balami breed

which were similar to Uda breed aligns directly with the final live weights reported earlier, confirming that Balami and Uda possess superior growth trajectories that translate into heavier slaughter-ready animals (21). The consistent male advantage across all breeds underscores the influence of sexual dimorphism on muscular development. A similar significant pattern was observed for metrics determining carcass yield (empty body weight and hot and cold carcass weights) revealed that the growth advantages of Balami and Uda are not merely due to gut fill but result in substantially higher edible meat yields. This is attributed to genetic differences in muscle deposition and skeletal frame, with Balami often noted for its larger body size and capacity for lean tissue growth (22).

A different and noteworthy trend emerged for dressing percentage, a critical indicator of slaughter efficiency. Here, Uda sheep outperformed others with higher percent similar to Balami breed for both rams and ewes. This finding is crucial because Balami produced the heaviest carcasses in absolute terms but Uda sheep converted their live weight into carcass weight more efficiently with higher dressing percentage. This suggests Uda may have a superior muscle-to-bone ratio or lower non-carcass component weight (e.g., internal fat, viscera), making them particularly efficient for meat production (23). The lower dressing percentage in Yankasa breed highlights a potential area for genetic or management improvement. The non-significant ($P>0.05$) effect of sex across breeds observed for chilling loss indicates that the water-holding capacity of the meat and the rate of evaporative cooling during processing were similar across all groups. This is an important practical finding, as it implies that post-slaughter yield stability is consistent regardless of the breed or sex used in this feeding system (24).

The carcass analysis reveals a multi-faceted picture that Balami sheep are the highest producers of absolute carcass mass, ideal for markets or systems prioritizing total meat volume while Uda sheep exhibit the most efficient dressing percentage, making them potentially more profitable per unit of live weight sold, especially under resource constrained conditions. Yankasa sheep, while producing lighter carcasses, remain important for adaptation traits and may be optimal in different production niches. The significant sex effect consistently favors rams for all weight-based traits, reinforcing the standard practice of using rams for meat production where possible. The lack of difference in chilling loss simplifies post-slaughter management protocols across breeds.

The superior carcass weights of Balami and Uda are widely recognized. Research by (25) on Nigerian sheep reported a similar ranking, with Balami producing the heaviest cold carcass. This consistency across studies validates the use of these breeds as foundational stock for meat-oriented production systems. The finding that Uda can achieve a higher dressing percentage than the heavier Balami is an important nuance. Yakubu *et al*. (26) also reported that dressing percentage does not always correlate perfectly with live weight in indigenous breeds, as it is influenced by gut mass, fat deposition patterns, and breed-specific morphology. A study on Ethiopian sheep by (27) similarly found that certain medium-frame breeds could outperform larger breeds in dressing percentage due to better muscling and lower gut fill. The significant advantage of males in all weight-related carcass traits is a universal observation. Webb *et al*. (28) summarized that ram lambs consistently yield 3 – 6 percentage units higher dressing percentage and heavier carcasses than ewe lambs, which is comparable to the differences observed between the rams and ewes of Balami and Uda in this study.

Table 4: Interaction effect between breed and sex on carcass characteristics of three Nigerian sheep fed total mixed ration

Parameters	Balami		Uda		Yankasa		SEM
	Ram	Ewe	Ram	Ewe	Ram	Ewe	
Fasted body wt (kg)	29.84^{a}	26.25^{cd}	28.61^{ab}	25.06^{de}	27.26^{bc}	23.77^{e}	0.97*
Slaughter body wt (kg)	28.65^{a}	25.20^{cd}	27.47^{ab}	24.06^{d}	26.17^{bc}	22.82^{e}	0.99*
Empty body wt (kg)	23.87^{a}	21.00^{bc}	22.89^{ab}	20.05^{cd}	21.81^{bc}	19.02^{d}	0.95*
Hot carcass wt (kg)	13.75^{a}	11.84^{bc}	13.19^{ab}	11.31^{cd}	12.05^{bc}	10.27^{d}	0.73*
Cold carcass wt (kg)	13.34^{a}	11.69^{bc}	12.79^{ab}	10.97^{cd}	11.48^{bc}	9.96^{d}	0.74*
Chilling loss (%)	0.41	0.36	0.40	0.34	0.36	0.31	0.06^{NS}
Dressing (%)	46.00^{a}	43.30^{b}	48.00^{a}	47.00^{a}	42.50^{b}	41.50^{b}	1.30*

^{abc}Means within rows with different superscripts differed significantly (P<0.05), SEM = Standard error of mean, NS = Non-significant

Main effect of sex on primal cuts of three Nigerian sheep breed fed total mixed ration

The primal cuts of three Nigerian sheep fed total mixed ration as influenced by sex is shown in Table 5. There was significant (P<0.05) effect of sex on primal cuts studied except breast in which higher (P<0.05) legs (3.15 kg), chump (1.26 kg), loin (1.01 kg), neck (1.26 kg), mid rib (0.88 kg), main rib (1.01 kg), shoulder (1.89 kg) and tail (0.63 kg) were recorded for rams as against the lower mean values observed in ewes. Breast ranged from 1.28 kg for ewes to 1.33 kg for rams.

Table 5: Main effect of sex on primal cuts of three Nigerian sheep breed fed total mixed ration

Parameters (kg)	Ram	Ewe	SEM
Legs	3.15^{a}	2.70^{b}	0.10*
Chump	1.26^{a}	1.08^{b}	0.05*
Loin	1.01^{a}	0.87^{b}	0.04*
Breast	1.33	1.28	0.07^{NS}
Neck	1.26^{a}	1.08^{b}	0.06*
Mid rib	0.88^{a}	0.76^{b}	0.04*
Main rib	1.01^{a}	0.87^{b}	0.04*
Shoulder	1.89^{a}	1.62^{b}	0.07*
Tail	0.63^{a}	0.54^{b}	0.04*

^{ab}Means within rows with different superscripts differed significantly (P<0.05), SEM = Standard error of mean, NS = Non-significant

The significantly higher weights of all primal cuts for rams can be primarily attributed to the anabolic effects of male sex hormones, particularly testosterone. These hormonal influences promote greater muscle development and larger frame size in males compared to females raised under similar nutrition. This finding agreed with (29) who reported that rams were heavier than the ewes at slaughter and that all the traits measured, indicated advantages in favour of rams for retail cut weights in South African Mutton Merino and Dormer sheep. Similarly, (30) confirmed that sex significantly influenced carcass characteristics and retail cut yields, with ram lambs generally producing heavier cuts in South African sheep when managed under feedlot conditions. The breast is a cut that typically contains a higher proportion of fat and connective tissue compared to other primals. Strydom *et al*. (31) reported

that the breast, along with the neck, showed no significant change in meat percentage across different fat scores, while other cuts like the loin and leg accumulated subcutaneous fat more rapidly. This suggests that the breast may be less responsive to the differential fat deposition patterns observed between sexes. The consistency of the sex effect across multiple cuts (leg, chump, loin, neck, ribs, shoulder, and tail) demonstrates that the male advantage is systemic rather than localized. This supports the conclusion of (29) that the observed advantages in retail cut weights suggested that rams were superior as far as meat production was concerned.

Main effect of breed on primal cuts of three Nigerian sheep fed total mixed ration

The primal cuts of three Nigerian sheep fed total mixed ration as influenced by breed is shown in Table 6. There was significant (P<0.05) effect of breed on primal cuts examined in this study. Balami breed recorded statistically similar mean values for legs (3.12 kg), chump (1.24 kg), loin (0.99 kg), breast (1.49 kg) neck (1.24 kg), mid rib (0.86 kg), main rib (0.99 kg), shoulder (1.86 kg) and tail (0.62 kg) to Uda breed (2.97, 1.19, 0.95, 1.43, 1.19, 0.84, 0.95, 1.76 and 0.59 kg) but higher (P<0.05) than the mean values recorded for legs (2.71 kg), chump (1.09 kg), loin (0.87 kg), (1.27 kg), neck (1.08 kg), mid rib (0.76 kg), main rib (0.87 kg), shoulder (1.63 kg) and tail (0.54 kg) of Yankasa breed.

The findings revealed that Balami sheep consistently yield the heaviest primal cuts, performing similarly to Uda in most categories, while Yankasa sheep produce significantly lighter cuts across all primal joints. The superior performance of Balami sheep across all primal cuts could be attributed to their larger body frame and genetic potential for greater muscle development. This concurs with the findings of (19, 20, 32, 33) that Balami breed of sheep was superior to Uda and Yankasa breeds in terms of carcass characteristics and prime cuts.

Table 6: Main effect of breed on primal cuts of three Nigerian sheep fed total mixed ration

Parameters	Balami	Uda	Yankasa	SEM
Legs	3.12^{a}	2.97^{ab}	2.71^{b}	0.10*
Chump	1.24^{a}	1.19^{ab}	1.09^{b}	0.05*
Loin	0.99^{a}	0.95^{ab}	0.87^{b}	0.04*
Breast	1.49^{a}	1.43^{a}	1.27^{b}	0.07*
Neck	1.24^{a}	1.19^{ab}	1.08^{b}	0.06*
Mid rib	0.86^{a}	0.84^{ab}	0.76^{b}	0.04*
Main rib	0.99^{a}	0.95^{ab}	0.87^{b}	0.04*
Shoulder	1.86^{a}	1.76^{ab}	1.63^{b}	0.07*
Tail	0.62^{a}	0.59^{ab}	0.54^{b}	0.03*

^{ab}Means within rows with different superscripts differed significantly (P<0.05), SEM = Standard error of mean

Interaction effect between breed and sex on primal cuts of three Nigerian sheep fed total mixed ration

The primal cuts of three Nigerian sheep fed total mixed ration as influenced by breeds and sex is shown in Table 7. There was significant (P<0.05) effect of sex and breed on all the parameters of primal cuts studied in which higher (P<0.05) legs, chump, loin, breast, neck, mid rib, main rib, shoulder and tail were recorded for Balami rams (3.34, 1.33, 1.07, 1.60, 1.33, 0.93, 1.07, 2.00 and 0.67 kg, respectively) as against the lower mean values observed in Yankasa rams

(2.92, 1.17, 0.94, 1.40, 1.17, 0.82, 0.94, 1.75 and 0.58 kg, respectively) but statistically similar to those of Uda rams (3.20, 1.28, 1.02, 1.54, 1.28, 0.90, 1.02, 1.92 and 0.64 kg, respectively) with similar trend observed among their ewes, except for the tail in which only numerical decrease was observed in ewes.

The significant effect of both sex and breed obtained for prime cuts mirrors the trends observed in live weight, carcass weight, and daily gain, confirming that the initial growth and size advantages of Balami and Uda directly translate into proportionally larger commercial cuts. For example, the leg (a high-value cut) weighed 3.34 kg in male Balami compared to 2.92 kg in male Yankasa—a difference of over 14%. This genetic predisposition for greater muscularity and frame size in Balami and Uda is a key determinant of their higher meat output (22).

Within each breed, rams yielded significantly heavier primal cuts than ewes. This is evident across all cuts, from high-value sections like the loin and leg to other parts like the breast and neck. For instance, in the Balami breed, the loin cut was 1.07 kg in males versus 0.92 kg in females. This sexual dimorphism is driven by the anabolic effects of testosterone, which promotes greater muscle mass and skeletal growth in rams, making them inherently more suitable for meat-focused production systems (23).

The heavier legs, loins, and shoulders from Balami and Uda mean a greater proportion of premium, tender meat suitable for grilling, roasting, and high-value retail. This can significantly increase the carcass's market value. The consistent advantage across all cuts indicates that Balami and Uda offer superior total edible meat yield per animal slaughtered. This efficiency is critical for profitability, especially in commercial meat production (22). While Yankasa yielded less, the proportional distribution of cuts is likely similar. Their smaller absolute size might be preferable for specific markets, such as small-family consumption or ceremonies where a whole, smaller carcass is desired. However, for maximizing meat tonnage, Balami and Uda are superior.

The fact that all cuts were comparably heavier in Balami and Uda suggests that the increased size is proportional and not limited to specific regions. This indicates good overall conformation in these breeds under the given feeding regime. The non-significant difference between Balami and Uda in cut weights, despite Balami's slight numerical lead, points to their comparable carcass composition and muscularity when fed the same basal diet (24).

The direct relationship between increased carcass weight and increased primal cut weights is a well-established principle. The finding of proportional cut yields aligns with studies on other indigenous African livestock. Moyo *et al*. (34) noted that within similarly adapted, nonspecialized breeds, carcass composition tends to be conserved, with variation primarily expressed in overall size. This suggests that for these Nigerian breeds; selection has not drastically altered the basic blueprint of the carcass. The results differ from findings involving intensely selected terminal sire breeds. For instance, studies on Texel or Suffolk sired lambs often show a higher proportion of weight in the hindquarter (leg and loin) relative to the forequarter, a trait known as "higher muscularity." The lack of such a proportional shift in this study indicates that Balami, Uda, and Yankasa have not been selectively bred for this specific carcass trait, remaining more generalized in their conformation (36).

Table 7: Interaction effect between breed and sex on primal cuts of three Nigerian sheep fed total mixed ration

Parameters (kg)	Balami		Uda		Yankasa		SEM
	Ram	Ewe	Ram	Ewe	Ram	Ewe	
Legs	3.34^{a}	2.87^{c}	3.20^{ab}	2.74^{cd}	2.92^{bc}	2.49^{d}	0.11*
Chump	1.33^{a}	1.15^{c}	1.28^{ab}	1.10^{cd}	1.17^{bc}	1.00^{d}	0.06*
Loin	1.07^{a}	0.92^{c}	1.02^{ab}	0.88^{cd}	0.94^{bc}	0.80^{d}	0.04*
Breast	1.60^{a}	1.38^{c}	1.54^{ab}	1.32^{c}	1.40^{bc}	1.13^{d}	0.07*
Neck	1.33^{a}	1.15^{c}	1.28^{ab}	1.10^{cd}	1.17^{bc}	1.00^{d}	0.06*
Mid rib	0.93^{a}	0.80^{c}	0.90^{ab}	0.77^{cd}	0.82^{bc}	0.70^{d}	0.04*
Main rib	1.07^{a}	0.92^{c}	1.02^{ab}	0.88^{c}	0.94^{bc}	0.80^{d}	0.04*
Shoulder	2.00^{a}	1.72^{c}	1.92^{ab}	1.65^{cd}	1.75^{bc}	1.50^{d}	0.08*
Tail	0.67^{a}	0.57^{bc}	0.64^{ab}	0.55^{c}	0.58^{bc}	0.50^{c}	0.04*

^{abcd}Means within rows with different superscripts differed significantly (P<0.05) using each sex SEM, SEM = Standard error of mean.

Conclusions and Recommendation

The significant sex effect revealed that rams were superior than ewes in terms of carcass characteristics (FBW; 28.57 kg, SW; 27.43 kg, EBW; 22.86 kg, HCW; 12.99 kg, CCW; 12.54 kg and DP; 45.50%. Balami recorded superior weights (FBW; 28.05 kg, SW; 26.93 kg, EBW; 22.44 kg, HCW; 12.80 kg, CCW; 12.52 kg), Uda had highest DP (47.50%). It can be recommended that for superior carcass and primal cuts rams of Balami should be prioritize.

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