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## **Carcass and Lean Quality Characterization of the Autochthonous Goats in the Semi-arid Zone of North-western Nigeria**

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### **ABSTRACT**

The experiment was conducted with the aim of investigating effects of breed and age on carcass and lean quality characteristics of goats in the study area. To achieve the aim, a total of 32 intact bucks, matching condition score “3” of the Australian Standard for Live Goat Evaluation were balanced for weight across 8 replicates of 2 breeds (Sokoto Red and Sahel) and 2 age treatments (Young and Mature). Animals were bled by slashing their throats to sever the jugular, the carotid, the trachea and the oesophagus. After bleeding, the animals were partially skinned lying on their backs on the floor. Thereafter, the animals were suspended by the hind legs on a 14 cm wide gambrel for further skinning. The head was removed at the atlanto-occipital joint and the fore and hind feet removed at the carpal and tarsal joints respectively. Breed had no effect ( $p>0.05$ ) on any of the traits investigated. Also, feathering, flank streaking and marbling were not affected by age ( $p>0.05$ ). However, mature goats recorded significantly higher values (1.438, 1.625, 1.750, 1.812 and 1.625) for flank firmness, kidney fat score, subcutaneous fat score, lean texture and lean firmness respectively. Corresponding figures for young animals were 1.062, 1.125, 1.062, 1.000 and 1.188. It was observed that goats in the study area have poor carcass fat deposition.

**Key words:** Carcass, lean, quality, characteristics, goats

### **INTRODUCTION**

The potential of meat from indigenous goats in promoting the socio-economic development of developing countries has been acknowledged (Devendra, 1980; Von Maydel and Spatz, 1981; Wilson, 1982). This, according to Griffin *et al.* (1992) is especially in the area of nutrition and internal trade. The growing popularity of goat meat worldwide will add value to this potential. A full realization of this potential will require a system of quality assurance, or at least, some form of grading of the commodity. Unfortunately, however, quality standards have not been established in developing countries despite their share of over 95% of the global goat population, according to FAO (2005).

Pieces of information on quality traits of indigenous goats in developing countries are limited (Tshabalala *et al.*, 2003). The situation might even be worse in the Semi-arid zone of North-western Nigeria, the region that, according to the Nigerian Federal Department of Livestock and Pest Control Services (1992), holds the greatest proportion of the Nigerian national goat herd. Here,

there is a virtual absence of information on goat meat quality. The few researches on goat meat were on aspects of yield. The present study will attempt to fill this research gap by characterizing the Sokoto Red and Sahel goats for carcass and lean quality traits. The objective of the study was to determine and compare quality traits on the carcass and lean of Sokoto Red and Sahel goats as affected by age at slaughter.

## **MATERIALS AND METHODS**

**Experimental animals and design:** A total of 32 intact bucks, matching condition score “3” of the Australian Standard for Live Goat Evaluation (ESMGPA, 2005) were balanced for weight across 8 replicates of 2 breeds (Sokoto Red and Sahel) and 2 age treatments (Young and Mature). Young goats were those with only milk teeth, 7-8 months of age and weighed 11-15 kg; while mature ones had one pair of permanent incisors, were about 13-15 months old and weighed 17.5-25.5 kg. The animals were rested for 24 h during which they were maintained on an *ad libitum* diet of 2:1 w/w mix of cowpea husk and wheat offal prior to slaughter. Free access to water and mineral lick was allowed.

**Slaughter operations:** Animals were bled by slashing their throats to sever the jugular, the carotid, the trachea and the oesophagus. After bleeding, the animals were partially skinned lying on their backs on the floor. Thereafter, the animals were suspended by the hind legs on a 14 cm wide gambrel for further skinning. The head was removed at the atlanto-occipital joint and the fore and hind feet removed at the carpal and tarsal joints respectively. Quartering, jointing and tissue separation were carried out according to the standard methods and procedures for goat carcass evaluation outlined by Colomer-Rocher *et al.* (1987).

**Data collection:** Flank streaking, marbling, feathering, fat over eye, kidney fat and subcutaneous fat were scored on a three-point heuristic scale of increasing intensity, recommended by Colomer-Rocher *et al.* (1987) for rating kidney fat (1 = little, 2 = medium, 3 = excessive). Ratings of subcutaneous fat colour, (1 = white, 2 = cream, 3 = yellow) and colour of Rectus abdominis (1 = pale, 2 = pink 3 = red) were also utilized from Colomer-Rocher *et al.* (1987). Kidney fat was also excised and weighed. Flank firmness, lean texture and lean firmness were scored on a three point scale of 1 = fine, 2 = medium, 3 = coarse for texture and 1 = soft, 2 = firm, 3 = very firm for firmness. A nine banded colour chart using the HSL colour model of Microsoft PowerPoint® (Microsoft Inc., 2007), was developed to quantitatively assess lean colour. Hue and saturation were set on the red band (255). The bands were labelled by sequential reduction of 20 luminosity units, starting at 220. Samples were scored for the luminosity of the colour band that best match their colours and rated numerically.

The surface of the loin eye of the right halves of the carcass was used for the evaluation of all lean quality characteristics.

**Data analyses:** Data generated were analyzed as a Completely Randomized Design with a factorial arrangement of treatments (breed, age) using the general linear model programme of SPSS (IBM Corporation, 2007). A fixed model involving the main effects of breed and age was utilized. Interactions were excluded from the model as they were not found to be significant.

**RESULTS AND DISCUSSION**

**Carcass quality indices:** Carcass quality indices are presented in Table 1. Breed had no effect on any of the indices. On the other hand, age had significant effects but only on flank firmness, kidney fat score and subcutaneous fat score; with mature goats having higher values in all cases.

**Feathering, marbling and flank streaking:** Feathering, marbling and flank streaking showed similar trends across breed and age. This was probably because of the strong correlation among them (Forrest *et al.*, 1975).

Part of the explanation for this poor carcass fat development may be found in the nature of goat management in the study area and the other part in the nature of goats themselves. The goat management system in the study area is predominately free ranging. This system is characterized by poor feed supplementation and a higher degree of energy expenditure on the part of the animal, occasioned by roaming about in search for food, conditions that will not allow for deposition of carcass fat. Secondly, goats by nature deposit very little fat in the carcass (Gaili *et al.*, 1972; Naude and Hofmeyr, 1981; Devendra, 1988a; Attwood, 2002). This or the combined effect of the two factors (management and species peculiarity) might be responsible for the trends shown by these parameters.

**Flank firmness:** Differences in flank firmness rating due to breed were not significant, but significant differences were observed between mature and young goats (1.438 and 1.062, respectively). The absence of breed effect on flank firmness has earlier been reported (Johnson *et al.*, 1995).

Carcasses of mature goats had firmer flanks than those of young ( $p < 0.05$ ). This may appear unexpected owing to the assertion of Forrest *et al.* (1975) that fat is a major contributor to carcasses firmness, considering that the amounts of dissectible fat in both the flank and carcass were not significantly different between young and mature goats. It is the opinion in the present study that; while solidified fat in chilled carcasses may contribute a lot to flank firmness (Forrest *et al.*, 1975), carcass fat may not play such an important role if carcasses were evaluated hot as was the case in this experiment. Therefore, another factor will have to be considered and this other factor may

Table 1: Means and standard errors for fat-related carcass quality indices ratings

Trait	Overall	Breed		SE	Age		SE
		Sokoto red	Sahel		Young	Mature	
Flank streaking	0.125	0.062	0.188	0.084	0.062	0.188	0.084
Marbling	0.00	0.00	0.00	0.000	0.00	0.00	0.000
Feathering	0.094	0.062	0.125	0.076	0.062	0.125	0.076
Kidney fat (g)	15.63	16.56	14.69	1.26	15.06	16.19	1.26
Fat over eye	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Flank firmness	1.250	1.312	1.188	0.101	1.062 <sup>b</sup>	1.438 <sup>a</sup>	0.101
Subcutaneous fat colour	1.125	1.062	1.188	0.084	1.062	1.188	0.084
Kidney fat score	1.375	1.375	1.375	0.109	1.125 <sup>b</sup>	1.625 <sup>a</sup>	0.109
Subcutaneous fat score	1.406	1.438	1.375	0.131	1.062 <sup>b</sup>	1.750 <sup>a</sup>	0.131
<i>Rectus abdominis</i> colour	3.000	3.000	3.000	0.000	3.000	3.000	0.000

Means bearing different superscripts along the same row within a subclass differ ( $p < 0.05$ )

likely be the size of the muscle fibre. A possible explanation for the firmer flanks of mature goats may therefore be their thicker muscle fibres. It is well documented that older goats have thicker muscle fibres than young ones (Gaili *et al.*, 1972; Forrest *et al.*, 1975). This view is lent credence to, by the significantly coarser lean texture of mature goats, as would be seen subsequently in this study. Lean texture itself is a measure of muscle fibre size.

**Kidney-and subcutaneous fats scores:** Sokoto Red and Sahel goats had similar ratings of subcutaneous and kidney fats, both of which were low. Low subcutaneous fat cover appears to be a species characteristic of goats (Morand-Fehr, 1981; Devendra, 1988b) and because of that, any difference between individuals of different breeds evaluated at similar age should not be expected to be significant. Similarity in management system may be another factor responsible for the similarity. This is because feeding exerts a significant role in the accretion of adipose tissue (Morand-Fehr, 1981; Attwood, 2002) and both breeds happened to be autochthonous to the study area and maintained under similar management conditions of poor nutrition.

Mature goats rated higher in both kidney (1.625 against 1.125) and subcutaneous (1.750 against 1.062) fat scores ( $p < 0.05$ ). This perhaps may be due to the accumulation of fat in all depots occasioned by advancing age, as reported by Gaili *et al.* (1972) and Morand-Fehr (1981).

**Colours of subcutaneous fat and Rectus abdominis muscle:** Across all the sub-classes, mean rating for subcutaneous fat colour was 1.41, a figure less than 2 indicting that the colour of subcutaneous fat was white. This finding is in line with Ibarra (1988), who made a general observation that fat colour in goat meat is chalk white. This generalization justifies the absence of significant differences in subcutaneous fat colour rating between and within the subclasses of the experimental animals.

There was also no variation in the colour rating of Rectus abdominis muscles of the experimental animals for the simple reason that they all had the same score (3) on the Colomer-Rocher *et al.* (1987) scale. The score 3 signified the darkest red which tallies with the observation of Ibarra (1988), that the colour of goat meat is brick red.

**Lean quality indices:** Table 2 represents the effects of breed and age on the lean quality indices of texture, firmness and colour. The effects of age on lean texture and lean firmness were significant. These apart, all other subclass-quality index combinations remain non-significant.

**Lean texture:** Lean texture, being a measure of muscle fibre size (Forrest *et al.*, 1975), expectedly rated higher ( $p < 0.05$ ) in mature than in young goats (1.812 against 1.000), for the simple reason

Table 2: Means and standard errors for lean quality indices ratings

Trait	Overall	Breed		SE	Age		SE
		Sokoto red	Sahel		Young	Mature	
Lean texture	1.406	1.375	1.438	0.097	1.000 <sup>b</sup>	1.812 <sup>a</sup>	0.097
Lean firmness	1.406	1.438	1.375	0.115	1.188 <sup>b</sup>	1.625 <sup>a</sup>	0.115
Lean colour	124.375	125.000	123.750	9.116	135.000	113.750	9.116

Means bearing different superscripts along the same row within a subclass differ ( $p < 0.05$ )

that growth in goats and indeed in all animals, entails increases in thickness of muscle fibres (Gaili *et al.*, 1972; Forrest *et al.*, 1975). This phenomenon allows for the muscles of mature animals to be coarser and hence have a higher rating for lean texture than young animals.

**Lean firmness:** The absence of breed effect on lean firmness has been reported by Johnson *et al.* (1995). The superiority of mature goats in lean firmness (1.625 against 1.188) may be ascribed to their possession of larger muscle fibres than young goats.

**Lean colour:** Mean lean colour did not differ within any of the subclasses of breed and age ( $p>0.05$ ). This phenomenon appears to be related to the apparent species specificity of lean colour (Forrest *et al.*, 1975; Ibarra, 1988; Aduku and Olukosi, 1991) which makes within species differences in colour hard to detect, especially when appraisal is done visually as was the case in the present study.

The grand mean (124.38) obtained for the colour rating of lean represents HSL 255-255-124.38 which approximates the colour usually attributed to goat meat. Variations in mean colour rating within the age subclass are greater than that within breed. This shows that mature goats had (at least numerically) darker lean colour than young which is in line with the generally accepted trend of increasing darkening of lean with advancing age.

## CONCLUSION

Carcasses of mature goats had firmer flanks and ranked higher for kidney and subcutaneous fat scores than carcasses of young goats. Meat from mature goats was also found to be firmer and of coarser texture than that from young animals.

The major findings of the study are as follows:

- Age is a more important factor determining quality of meat from goats than breed. This was suggested by the greater number of variables that were influenced by age
- Goat carcasses are poor in fat deposition as could be seen from the very low rating and in some instances complete absence of some fat-related traits
- Fat needs not to feature as major consideration in goat carcass quality evaluation
- Goat meat could be of significant value as a source of healthy meat for fat conscious individuals and communities
- The new meat colour evaluation technique developed in the course of this study was found to be more sensitive and more responsive than the standard method developed for the European Union by Colomer-Rocher *et al.* (1987). The innovation could be improved by better scaling

**Recommendation:** Breed evaluation of goats for quality traits needs to be extended to cover the West African Dwarf goat which is not common in the study area, but together with the Sokoto Red and Sahel represent the dominant breeds of goats in Nigeria. Older animals which are not commonly slaughtered in the study area, need be investigated as well.

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