Sjournals
Scientific Journals
Scientific Journal of Agricultural (2012) 1(4) 92-99

Contents lists available at Sjournals

Scientific Journal of Agricultural

Journal homepage: www.Sjournals.com

Original article

Yield characteristics of goat's meat in the semi-arid zone of north-western Nigeria

M. Jibir[a], W.A. Hassan[a], S.A. Maigandi[a], S. Garba[a], A. Bello[b,*], S.A. Hena[b], M.A. Umaru[c], Y.A. Adamu[d]

[a]*Department of Animal Science, Usmanu Danfodiyo University, Sokoto.*
[b]*Department of Veterinary Anatomy, Usmanu Danfodiyo University, Sokoto.*
[c]*Department of Animal Prod. And Theriogenology, Usmanu Danfodiyo University, Sokoto.*
[d]*Department of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto.*

[*]Corresponding author; Department of Veterinary Anatomy, Usmanu Danfodiyo University, Sokoto; Tel: +2348039687589.

ARTICLE INFO

Article history:
Received 11 September 2012
Accepted 16 September 2012
Available online 19 September 2012

Keywords:
Sokoto Red goat
Sahel goat
Carcass yield
Fleshing index

ABSTRACT

A study was conducted to characterize autochthonous goats of the semi-arid zone of North-western Nigeria for their meat potential. Thirty two intact male goats representing eight replicates of two breeds (Sokoto Red and Sahel) and two ages (young and mature) were investigated for carcass and meat yield characteristics. Breed had no significant effect on carcass weight, carcass yield, fleshing index, loin eye area and total edible portion (P>0.05). Sahel goats were however heavier and had higher empty body weight (EBW) than Sokoto Red goats, which were superior in body mass index (BMI) (P<0.05). Slaughter weight, EBW, BMI, carcass weight, fleshing index and loin eye area were significantly higher in mature goats, while young goats had a higher proportion of total edible portion. Dressing percent and total saleable portion were not affected by breed or age. It was found that age had a greater influence on yield characteristics of meat goats of the Semi-arid zone of North-western Nigeria than breed. Availability of scientific information on meat characteristics of indigenous goat breeds will facilitate development efforts to improve the quality of life in developing countries.

1. Introduction

Meat production is the most important aspect of goat keeping in developing countries (Taneja, 1982; Terrill, 1986; Attah et al., 2004). The developing countries contribute about 95 % of the estimated 4.5 million metric tonne total world goat meat production. Africa produces 851.05 x 103 metric tonnes, from an annual slaughter of about 69.7 million goats, while Nigeria slaughters 11.6 million goats to produce about 147.07 x 103 metric tonnes of meat annually (FAO, 2005).

Many experts (Devendra, 1980; Raun, 1982; Wilson, 1982; Griffin et al., 1992) advocated sustainable development of goat meat production as a means of improving the quality of life in developing countries. Unfortunately however, there is a dearth of scientific information on the production potential of indigenous breeds of goats in these countries, which militates against sustainable development of that sector (Steinbach, 1987; Tshabalala et al., 2003). The present study is an attempt at evaluating carcass and meat yield characteristics of goats autochthonous to the semi-arid zone of North-western Nigeria, an area that controls a greater proportion of the Nigerian national goat herd (FDLPCS, 1992).

2. Materials and methods

2.1. Animals and their management

Experimental animals were thirty two intact bucks (16 Sahel and 16 Sokoto Red) conforming to body condition score "3" of the Australian standard for live goat evaluation (ESMGPA, 2005). The animals were procured from diverse village livestock markets in the study area. Breed identification was based on the classical phenotypic features described by Ngere et al. (1984) and Mason (1988). Prior to slaughter, the goats were rested for 24 hours during which they were maintained on an ad libitum diet of 2:1 v/v mix of cowpea husk and wheat offal. Free access to water was allowed.

2.2. Layout of experiment

The animals were divided into eight replicates of two treatment groups namely; breed (Sahel and Sokoto Red) and age (young and matured) see Table 1. Mature animals are those with one pair of permanent incisors, while young are those with only milk teeth.

Table 1
Distribution of experimental animals to treatments.

Factor	Sub-Class	No of Animals
Breed	Sokoto Red	16
	Sahel	16
Age	Young	16
	Mature	16

2.3. Slaughter operations

Animals were exsanguinated by severing the jugular vein, carotid arteries, trachea and oesophagus. After bleeding, the animals were partially skinned lying on their backs on the floor. Thereafter, the animals were suspended by their Achilles tendon on a 14cm 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).

2.4. Data collection procedures

2.4.1. Slaughter traits

Slaughter traits measured were slaughter weight, EBW and BMI. Animals were weighed by placing them in a bag suspended from a 50kg hanging spring balance just before exsanguination to obtain the slaughter weight. The

difference between slaughter weight and the weight of gut content was the EBW. BMI was determined as the ratio of body weight in kilograms to the square of the height in metres (Olopade and Onwuka, 2002).

2.4.2. Carcass characteristics

Carcass weight was determined as the weight of the headless, footless, skinned and eviscerated body of the animal with kidneys and kidney fat in place. Dressing percentage was determined on hot carcass basis. Carcass yield was the dressing percent on EBW basis, while fleshing index was the ratio of carcass length (cm) to carcass weight (kg).

2.4.3. Meat yield indicators

The loin eye area was determined by tracing the cross-section of the longissimus muscle of the hindquarter of the right halves of the carcasses cut between the 12th and 13th ribs on a tracing paper. The perimeter ($2\pi r$) of the outline was measured with an inextensible thread from which the area ($\pi r2$) was deduced. The loin eye was also examined for fat layer in order to determine its thickness.

Total edible portion of the goat was calculated as the total weight of animals less the inedible parts (skin, blood and gut contents) expressed as a percentage of slaughter weight. Percent saleable part on the other hand was estimated as the sum of the weights of commercially valuable parts, which is the slaughter weight less the weight of the blood and gut contents expressed as a percentage of the slaughter weight of the animal.

2.5. Statistical analyses

Data generated were analysed as a completely randomised design with a factorial arrangement of treatments. Using the general linear model of SPSS (SPSS, 1999), a fixed model involving the effects of breed and age was utilized. All interactions were removed from the model as they were not found to be significant so that only the main effects were considered. Significant means were separated using Duncan multiple range test (SPSS, 1999).

2.5.1. Merit analysis

A method of merit analysis was adopted to summarize the findings from this study. The measured variables were categorized along subclasses. A hypothetical score of (1) was assigned to a subclass with significantly higher mean and (0), for its counterpart with a lower mean. The scores were added up against each group of experimental animals and used to eventually rank the groups for overall merit.

3. Results and discussion

Means and standard errors for slaughter weight, EBW, and BMI of experimental animals are presented in Table 2. Breed and age had significant effects on all slaughter traits. Sahel goats were heavier and had higher EBW than Sokoto Red goats, while Sokoto Red goats excel in BMI ($P<0.05$). Age had a significant effect on all slaughter traits with mature goats having significantly higher values. Breed had no effect on any of the carcass characteristics ($P>0.05$). The carcasses of mature goats were heavier and had higher fleshing index than young goat (Table 3).

Table 2
Slaughter traits according to breed and age of goats.

Factor	Slaughter Weight (kg)	Body Mass Index	EBW (kg)
Overall Mean	16.72	43.82	14.38
Breed			
Sokoto Red	15.75[b]	46.20[a]	13.48[b]
Sahel	17.69[a]	41.45[b]	15.29[a]
Age			
Young	13.75[b]	40.81[b]	12.09[b]
Mature	19.69[a]	46.84[a]	16.68[a]
SE	0.58	1.28	0.58

[ab]Means bearing different superscripts along the same column within a subclass differ ($P<0.05$)

Table 3
Carcass characteristics according to breed and age of goats.

Factor	Carcass Weight (kg)	Dressing %	Carcass Yield (%)	Fleshing Index
Overall Mean	7.78	46.57	54.09	14.88
Breed				
Sokoto Red	7.35	46.42	54.22	15.10
Sahel	8.22	46.72	53.96	14.67
Age				
Young	6.55[b]	47.48	54.07	12.77[b]
Mature	9.02[a]	45.66	54.12	16.99[a]
SE	0.36	0.98	0.87	0.64

[ab]Means bearing different superscripts along the same column within a subclass differ (P<0.05)

Means and standard errors for loin eye area, total edible and total saleable portions of experimental animals across breed and age are shown in Table 4. Breed had no effect (P>0.05) on any of the indicators, while age significantly affected loin eye area and total edible portion. Loin eye area was higher in mature goats, but young goats had higher proportions of edible portion (P<0.05). Table 5 shows scores for significant traits against subclasses of animals evaluated. Sokoto Red and Sahel breeds were at par with one point each, while mature goats had a score of five points against one of young goats. Considering all significant traits, Mature goats of either breed ranked first followed by young (Table 6).

Table 4
Meat yield indicators according to breed and age of goats.

Factor	Loin Eye Area (cm2)	Total Edible (%)	Total Saleable (%)
Overall Mean	7.98	72.59	79.10
Breed			
Sokoto Red	7.91	72.06	78.39
Sahel	8.06	73.13	79.82
Age			
Young	6.73b	74.12a	80.46
Mature	9.23a	71.07b	77.75
SE	1.80	1.03	1.14

[ab]Means bearing different superscripts along the same column within a subclass differ (P<0.05)

Table 5
Merit analysis scoring of experimental animals.

Trait	Sokoto Red	Sahel	Young	Mature
Slaughter Weight	0	1	0	1
BMI	1	0	0	1
Carcass Weight	-	-	0	1
Dressing Percent	-	-	-	-
Carcass Yield	-	-	-	-
Fleshing Index	-	-	0	1
Loin Eye Area	-	-	0	1
Total Edible	-	-	1	0
Total Saleable	-	-	-	-
Total	1	1	1	5

Table 6
Merit ranking of experimental animals.

Combination	Score	Rank
Mature Sahel	6	1st
Mature Sokoto Red	6	1st
Young Sahel	2	2nd
Young Sokoto Red	2	2nd

4. Discussion

4.1. Slaughter weight

The significantly ($P<0.05$) heavier slaughter weight of the Sahel breed (Table 2) may be due to differences in mature size with the Sokoto Red. The Sahel is the larger breed (Ngere et al., 1984; FDLPCS, 1992) and since large breeds grow faster than smaller ones (Raghavan, 1988; Attwood, 2002), It follows that at any given age the Sahel goat will be heavier than the smaller Sokoto Red. Similar findings of significant genotypic differences in slaughter weight were reported by Nagpal et al. (1995) (on Sirohi, Kutchi and Marwari goats) and Oman et al. (1999) on Spanish goats and their crosses with the Boer.

In both Sokoto Red and Sahel breeds, mature goats were heavier than younger ones. This is in agreement with the works of Awah and Adeleye (1994), Korzeniowski et al. (1998), Abebe (2000) and Hassan and Idris (2002), where increasing slaughter weights with advancing age were reported.

Overall mean for slaughter weight (16.72kg) was higher than what obtains in France, Spain and Italy, with respective values of 6 - 12, 5 - 14 and 9 kg (Manfredini, et al. (1988). It was however lower than the 21.5 kg reported by Uko et al. (1999) and the 22.68 kg of Maigandi (2002) for goats of all ages, breed and sex at the Sokoto abattoir in the same study area. The present study owes its lower slaughter weights to the exclusive use of males, which according to (Tukur et al., 2001) are usually slaughtered at young ages because few are needed for breeding purposes and fattening is not a usual goat husbandry practice. The figure was however close to the slaughter weight average reported by Hassan and Idris (2002) for male goats having a pair of permanent incisors in the study area.

4.2. Empty body weight

Breed and age affected EBW in much the same way as they affect slaughter weight. This trend may be explained in terms of the relationship between slaughter weight of goats and their EBW. Awah and Adeleye (1994) observed significant linear increases in EBW from two through to 52 weeks of age; this justifies the heavier empty weights of matured goats compared to young ones.

Gut fill makes the only difference between EBW and slaughter weight. EBW may therefore not be expected to differ with slaughter weight in respect of breed and age since the experimental animals were more or less maintained under the same management (Hassan, 2000; Tukur et al., 2001).

4.3. Body mass index

BMI was higher in Sokoto Red than in the Sahel and higher in mature individuals than in young ($P<0.05$). According to Olopade and Onwuka (2002), differences in BMI is due to differences in mature size of breeds and height at withers in this respect, the higher withers height of the Sahel (Ngere et al., 1984; FDLPCS, 1992) might have contributed to their smaller BMI since height is inversely related to BMI. The significantly greater body mass index of mature goats was probably because of the increase in body weight as an animal matures (Awah and Adeleye, 1994; Korzeniowski et al., 1998; Abebe, 2000).

4.4. Carcass weight

That breed did not affect carcass weight despite the significantly heavier slaughter weights of Sahel goats suggests that the live weight of the Sahel was mostly contributed by non-carcass components of the goat. The absence of significant breed effect on carcass weight contradicts the findings of Johnson et al. (1995) and Kadim et al. (2004) both of which reported significant breed differences. This study however agreed with the works of Nagpal et al. (1995) and Attah et al. (2004) where no significant breed difference was established. It should however be noted that different breeds were under consideration by the aforementioned authors. While Johnson

et al. (1995) worked with American breeds and their crosses, Nagpal et al. (1995) studied the Sirohi Marwari and Kutchi breeds, and while Kadim et al. (2004) studied the Jabal Akhdar, Dhofari and Batina breeds of Oman, Attah et al. (2004) compared the Sokoto Red and West African Dwarf goats.

The heavier carcasses of mature goats may in parts be accounted for by their significantly higher slaughter weights and EBW (Table 2). Also the normal processes of tissue growth in the carcass are additively age-related (Forrest et al., 1975). Other studies (Manfredini et al., (1988); Abebe, 2000; Attwood, 2002; Hassan and Idris, 2002; Attah et al., 2004) reported significantly heavier carcasses in older goats than in younger ones. The mean carcass weight in the present study (7.78kg) compares well with the 8.30kg reported by Hassan and Idris (2002) on the same class of animals in the same study area.

4.5. Dressing percent

The absence of breed differences in dressing percent may be accounted for by the absence of significant breed differences (P>0.05) in carcass weight (Table 3).

Dressing percent did not significantly differ with age possibly because increases in carcass weight are invariably accompanied by corresponding increases in live weights.The findings of the present study on the absence of age effect on dressing percent ran contrary to the observations of Awah and Adeleye (1994) in West African Dwarf goats and of Attwood (2002), but was in agreement with those of Uko et al. (1999) and Hassan and Idris (2002) both of which were on Sokoto Red and Sahel goats from the same eco-climatic zone as the present study. Moreover, the numerical superiority of dressing percent in young goats over mature ones tallied with the findings of Uko et al. (1999), where a trend of decreasing dressing percent with age was observed. The mean dressing percent in the present study (46.57%) compares well with the 45.61% of Uko et al. (1999) and the 48.86% of Hassan and Idris (2002).

4.6. Carcass yield

Carcass yield, like dressing percent was not significantly affected by breed or age, (P>0.05). The same arguments used to support the absence significant breed effects on dressing percent, namely the absence of significant breed differences in carcass weight may be advanced for observations on carcass yield.

4.7. Fleshing index

The effect of breed on fleshing index was not significant (Table 3). Carcasses of mature goats however displayed better fleshing (P<0.05) than those of young ones. The increase in lean and fat tissues with maturity (Gaili et al, 1972; Ruvuna et al., 1992; Awah and Adeleye, 1994) might explain this difference. This is especially so as skeletal growth in animal's stops earlier than muscle and adipose (Forrest et al., 1975) a situation that will see to apparent increases in carcass weight at the expense of carcass length.

4.8. Loin eye area

Mean loin eye area for all the experimental goats was 7.98cm2, a value higher and outside the 4.50 - 6.55 cm2 range reported by Manfredini et al. (1988). This was probably because Manfredini et al. (1988) used younger goats. The value was however within the (2.11 - 9.03 cm2) reported by Gaili et al., (1972).

There was no breed difference (P>0.05) in loin eye area (Table 4). A similar observation was earlier made among Kuchi, Sirohi and Marwari breeds of goats (Nagpal et al. 1995). On the other hand mature goats had significantly larger loin eye area (P<0.05) than young goats, agreeing with the consistent and significant rise in loin eye area with increasing age as earlier reported in goats by Gaili et al. (1972) and Manfredini et al. (1988).

4.9. Total edible

Overall value for total edible portion of the experimental animals was 72.59% (Table 4). This value was close to the 72.3% reported by Owen and Norman (1977) for intact male Botswana goats and the 74.5% of Owen (1975). Breed had no significant effect on total edible portion of the experimental animals (P>0.05), but age effect was significant (P<0.05), with the young goats yielding higher than their mature counterparts.

4.10. Total saleable

The mean total commercially valuable portion or total saleable portion was 79.10% (77.75 - 80.46%). This value was close to the 80.5% reported by Owen (1975) for indigenous Malawi goats and the 79.6% of Botswana

goats (Owen and Norman (1977) Breed and age had no significant effect on total saleable portion of the experimental animals (P>0.05). The non-significance of breed effect on total saleable portion contradicted the report of Amin (2000), where Jamnapari x Black Bengal crosses yielded significantly higher than Black Bengal goats selected for growth. A possible reason for this apparent contradiction may be found in the use of empty live weight to express total saleable in the work of Amin (2000), while the present study was based on live weight.

5. Conclusion

Age plays a more important role in determining yield of meat from goats. Mature goats should be preferred to young ones on account of better fleshing. Goat carcasses are poor in fat deposition as could be seen from the absence of fat over loin eye. The Sokoto Red goat, being the most preponderant breed in Nigeria and having shown some promise for better fleshing might be investigated more closely for its genetic merit as a meat animal.

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