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The effects of sex on carcass yield in indigenous goat

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ABSTRACT

The slaughter data from 90 local Matebele goats (30=does, 30 intact males, 30 castrated males) managed on the range were analyzed to determine the influence of sex on edible and saleable components. The edible proportion of live weight was obtained as all body components minus skin, lungs, heart, head, feet and gut fill, while the saleable proportion of live weight was defined as all body components except feet and gut fill. According to local criteria the total edible percentage were 45.99 ±1.36, 48.04 ± 0.74 and 53.79 ± 1.04 for does, castrated males and intact males, respectively. There were significantly higher saleable proportions of live weight in intact males than does and castrated males which were 48.60 ± 1.27, 50.36 ± 0.72 and 56.42 ± 1.07, for does, castrated males and intact males, respectively. Castration did not have any influence on the yield of the external non carcass component as a percentage of empty body weight (EBW) as compared to intact males, however does have lower external non carcass components as a percentage of EBW than both castrated and intact males. The significantly lower ($p<0.05$) internal non carcass component as a proportion of EBW for does compare to castrated males and intact males may have influenced a higher dressing percentage.

1. Introduction

Due to a deficit of meat supply in both urban and rural areas of Zimbabwe created by reduction of large scale commercial beef production (Hargreaves et. al., 2004) male and female goats have become equally potential candidates for sell or slaughter in the goat informal market (Homann et. al., 2007). The country has 4.4 million goats mostly kept by small scale farmers (van Rooyen et. al., 2007) compared to 5.3 million cattle and 0.3 million sheep (both declining)(according to CSO, 2000). Recent reports highlighted the need to consider the total yield of consumable and saleable products rather than only carcass weight and dressing percentage in evaluating the suitability of breeds for meat production (Ermias et al 2000; Shrestha and Fahmy, 2005). Goat meat evaluation have received little attention and as a result knowledge of yield and quality is limited when compared to sheep and cattle (Anous and Mourand, 1993). Contrary to the western world where an increased interest in the production of goat meat is experienced due to high demand by consumers who are in search of low-fat, low-calorie, healthy meat sources and are willing to try new types of meats in an effort to control fat/calorie consumption (Curlucci et al., 1998; Potchoiba et al., 1990).

The proportion of edible and /or saleable components may vary according to breeds (Devendra, 1966; Owen and Norman, 1977) and weight for age at slaughter (Pratiwi et al., 2006; Mahgoub et al., 2004; Mc Millin and Brock, 2005), however feeding regime which is not common in Zimbabwe has proved to influence the proportion of edible and /or saleable components more in goats (Legesse and Abebe, 2008). Compared to sheep and cattle, knowledge of the yield of goat meat is limited (Warmington and Kirton, 1990).

2. Materials and methods

2.1. Study location

Matopos Research Station (20 0 23’ S, 310 30’ E.) situated 30 km South West of Bulawayo in Zimbabwe at an altitude of 800m above sea level which experiences low erratic rainfall of less than 450 per annum (Homann et al., 2007). High summer temperatures, maximum and minimum mean temperatures of hottest months are 31.6 0 C and 21.4 0 C, respectively with a possibility of severe droughts (Hagreveas et al., 2004). The most common type of vegetation is sweet veld with a comparatively high nutritional value of browse and annual grass species (Ward et al., 1979). Detailed description of the climate and vegetation type were given by Day et al (2003) and Gambiza and Nyama (2000), respectively.

2.2. Flock management

The does and their progeny were grazed on an extensively managed dry land veld during the day from 0800 hours to 1500 hours and were penned at night. The major grass species in these pastures are Hyparrhenia spp., Andropogon spp., Pennisetum purpur and Brachiaria mutica. Depending on availability of food and severity of the dry season. varying quantities of energy (maize stover) and protein (cotton seed cake) supplements were given when does grazed standing hay or cut and stacked hay. The does were fed 0.3 kg and kids 0.2 kg of cottonseed cake meal each per day from the end of May each year until the onset of the rainy season. The nutrient composition of cotton seed cake was 930g/kg Dry Matter, 730g/kg Total Digestible Nutrient, 390-450g/kg Crude Protein, 300-360g/kg Digestible Protein and Metabolizable Energy value 10.9 Megajoules/kg. Water was constantly available. Mineral licks were often ad libitum in the dry season. Prophylaxis deworming and de-ticking in a plunge dip were regularly carried out using organophosphates. All animals were vaccinated against Pulpy Kidney and Rift Valley Fever.

Does were assigned into mating flocks each year but mating of close relatives was avoided. Does of all age categories were represented in each single buck-mating group. The breeding season was between May and June. Single sire flocks comprised of one buck to 30 does. Females were introduced to the breeding flock for mating when they attained one and half years of age and bucks were not used for service until they were over one and half years old. Initial buck selection was based on birth weights with male singles of over 3 kg and twins over 2.5 kg weight being retained , while the entire rest of the males were castrated using rubber rings. The selection criteria used for subsequent retention in the flock were: firstly does giving birth to twins and rearing them to weaning; does giving birth to singles and rearing them to weaning; does giving birth to twins and rearing one to weaning; dry (i.e. non-pregnant) does, and lastly does which gave birth but did not wean a kid depending on the number of

replacements does requiring. Once the doe lock stabilized at about 300-400 does from 1993 then all dry does and those does not rearing kids were usually culled. Older does were culled mainly on their reproductive performance, with does not having kids or weaned a kid in two consecutive seasons being culled. Culling was also on age and dentition status from 6 years of age and older. Most kids were born between late October and early November, which is the start of the rainy season. Kids were weighed using an electronic scale and ear tagged soon after birth and left to suckle their dams during grazing until weaning at approximately 3 months of age. Kids were separated by sex at weaning into different weaned flocks. The records taken on kids included birth weights and weaning weights.

2.3. Slaughter method

All animals were humanely slaughtered at a commercial slaughtering facility. The entire gastro-intestinal tract was removed from the slaughtered goat individually and weighed with and without contents. Head, feet, skin, thoracic cavity content, abdominal cavity contents, pleural cavity contents and cannons were removed to obtain hot carcasses from slaughtered animals. The hot carcass was weighed within one hour of slaughter. Liver, lungs, heart, kidneys, kidney fat was removed from the body cavity and weighed separately. The dressed carcasses were chilled at –200c for 24 hours. Chilled carcass weight was obtained before cutting the carcass into different prime cuts. The weight of chilled prime cuts (front barrel and hind barrel) was also recorded. Last rib was left attached to the hind barrel. The chilled carcass was split between the 6th and 7th ribs to obtain the rib barrel. Fat score on back fat was done by visual assessment of 1 to 3.5.

Edible proportion of live weight was obtained as all body components minus skin, lungs, heart, head, feet and gut fill, while the saleable proportion of live weight was defined as all body components except feet and gut fill. Carcass and non-carcass components were weighed immediately after slaughter. Weights of internal non carcass (blood, visceral fat, empty gut, liver, heart and trachea and lungs) and external non carcass components (skin, head, feet,) were weighed and expressed as a percentage of empty body weight (EBW). The weight of the four unskinned feet was recorded as feet weight. Carcasses were split along the vertebral column into left and right halves. Weight of gut fill was computed as the difference between a full gut and an empty alimentary tract. An empty body weight (EBW) was computed as the difference between slaughter weight and weight of gut fill.

Data on 90 local Matebele goats (30= does, 30=castrated males, 30= intact males) of approximately an average slaughter weight of 23 kg for an average of weight for age at slaughter of 2 years from Matopos Research Station, Bulawayo, Zimbabwe were analyzed for edible and saleable proportion as percentage of live weight and internal and external non carcass components as a percentage of EBW analyzed utilizing General Linear Models (GLM) procedures of Statistical Analysis System (SAS 1999- 2000).

The general statistical model used:

$Yijk = u + Ai + b(Pij) + eijk$

Yij=components analyzed (edible, saleable, internal, external components)

u=general mean;

Ai=fixed effect of sex; ith=does, castrated males, intact males;

b =linear regression coefficient of pre-slaughter weight of sex at slaughter on edible, saleable, internal and external components;

Eijk = is the error term, assumed to be random and independently distributed with a mean equal to 0 and variance equal to 0.

3. Results and discussion

The efficiency of goat to produce meat as influenced by sex on range may be measured by their carcass yield and the weight of non carcass components in relation to edible portions (Legesse and Abebe, 2008). In Zimbabwe, it has not been fully established whether this low carcass productivity is due to genetic make up or effects of the inefficient production system (Hatendi et al., 1992). The study revealed that the influence of sex exists on the proportion of edible and saleable components in local Matebele goats of Zimbabwe. The total edible components according to local criteria was 45.99 ±1.36, 48.04 ±0.74 and 53.79 ±1.04 for does, castrated males and intact males, respectively and the total saleable percentage of live weight were 48.60 ±1.27, 50.36 ±0.72 and 56.42±1.07 for does, castrated males and intact males, respectively (Table 1). Intact males had higher ($p< 0.05$) edible and saleable live weights than both does and castrated males. Whoever does have the least edible and saleable live

weights. Edible and saleable weight increased curvillinearly with age of slaughter but not affected by sex (Chowdhury and Faruque, 2004). In our study goats studied were approximately 23 kg slaughter weight at an average weight for age at slaughter of 2 years and in a related study for Malaysian goats slaughtered at about 25 kg live weight, Devendra (1966) reported a higher (61%) total edible material which is on average higher than the edible material percentage observed in the present study. Elsewhere in indigenous East African goats slaughtered at approximately lower body weights (14 kg) than the breed considered here, Wilson (1958) estimated that the total edible proportion of the live weight according to local criteria was 48% which is comparable to the percentage reported here for higher live weight, while the total saleable percentage of different age groups fell between the range of 55% to 61% in their study . Higher edible and saleable percentages according to local criteria than observed in the present study were reported in Malawi on local goats of 19.4 kg live weight was as much as 76 % (Owen, 1975). On the other hand, Owen and Norman (1977) reported 78 % to 81 % of saleable and 70 % and 74 % of edible percentages for indigenous Malawi goats and Boer goats which were higher than those reported in the present study.

Table 1
The effect of sex on yields of non carcass (NCC), edible and saleable components of indigenous Matebele goats of Zimbabwe.

Component	Does	Castrated	Intact
External NCC, as % of EBW	17.04± 1.33^{a}	21.97±0.97^{b}	23.33±0.45^{b}
Internal NCC, as % of EBW	16.03± 1.17^{ab}	21.00±1.18^{b}	18.74±0.67^{b}
Gut fill as % of live weight	16.72±1.46^{a}	19.65±2.29^{b}	21.23±0.83b
Edible proportion of live weight	45.99±1.36^{a}	48.04±0.74^{b}	53.79±1.04^{c}
Saleable proportion of live weight	48.60±1.27^{a}	50.36±0.72^{b}	56.42±1.07^{c}
DP	52.93±5.50^{a}	44.94±6.56^{b}	38.95±2.31^{c}

Means with different superscripts in the same row differ significantly ($p<0.05$).

Studying the effect of sex on yield of edible and saleable components of Mahgoub and Lodge, (1996) reported 62 to 63 % of total edible and 69 to 70 % total saleable percentages for different sex groups of Omani Batina goats slaughtered at 28 kg. Feeding of local goats seems necessary in order to achieve desired total edible and saleable proportion of live weight for different sex groups (Mahgoub and Lodge, 1996). Legesse and Abebe, (2008) observed greater total edible and saleable proportion of live weight of different feeding systems were extensively managed goats had lower total edible and a saleable proportion of live weight as compared with their browsing or grazing contemporaries. Mature size of goats can vary tenfold between breeds, with consequent variation in growth rates hence comparison for total edible and saleable proportion of live weight with previous reports may be difficult because most of these studies were generally being made at substantially different weight for age (Wilson, 1958; Owen, 1975;) or differences in genotypes studied which could be larger size (Owen and Norman (1977) (Boer) or smaller size breeds than considered here (Wilson, 1958) (indigenous East African goats). There are a huge number of goat breeds in the world but few objective comparative data exist (Warmington and Kirton, 1990) and comparisons are confounded by the range of environmental conditions in which goats are kept. Most total edible and saleable proportion of live weight reported in other parts of the tropics are not far from those computed in the present study however computational procedure or methodology may definitely influence the magnitude of the total edible and saleable proportions of live weight reported in different studies and the definition of total edible and saleable proportion of live weight varies according to locality which may be based on cultural values.

There were no differences ($p<0.05$) for external non carcass components in castrated males and intact males, however castrated males had a higher proportion of internal non carcass components than does and intact males. In contrast female goats had lower percentages of pelt and feet compared to other sex classes which are in agreement with the findings of Johnson et al (1995). In line with our findings castration influenced internal and external non carcass components (Kebede et al., 2008; Moron-Fuenmayor, and Clavero, 1999). Elsewhere Legesse and Abebe, (2008) reported higher non carcass components as a proportion of EBW in goats which are browsing or grazing than intensively managed goats. Conversely goats managed intensively had higher edible and saleable proportions of live weight than those on range. Speculated that the lower edible and saleable proportions of live weight of goats managed on range was primarily due to their higher proportion of external non carcass

components. Feeding improved edible and saleable proportions of live weight as it resulted in a low proportion of external non carcass components (Legesse and Abebe, 2008) increasing the edible portion influencing the profit margin (Legesse et al, 2005).

The gut fill in does, castrated males and intact males comprised of 16.72%, 19.23% and 21.02 %, respectively. There were no differences in the proportion of gut fill as a percentage of live weight in castrated males and intact males which were significantly higher ($p<0.05$) than in does. The gut fill in does, castrated males and intact males comprised of 16.72%, 19.23% and 21.02 %, respectively, were greater than the six to eight percent recorded for finished Sudan Desert goats (Gaili et al., 1972) but fall within the range of ten to twenty three reported in Zimbabwe for a similar breed (Hatendi et al., 1992) and compared with fifteen reported in indigenous Malawi and Boer (Owen and Norman, 1977). Mahgoub. (1997) reported an increase in offals with increase in age in goats, which resulted in a reduction in overall edible portions mainly on extensively managed goats.

Discussing the concept of DP it is important to note that gastrointestinal contents can have a dramatic effect on DP of meat animals, therefore all comparisons involving this parameter should be made on the basis of EBW (i.e. live weight minus the weight of gastrointestinal gut content (Gall, 1982). Battacharyya and Khan, (1988) stated that EBW or the amount of rumen and intestine content indicated that DP might be affected by organs to be included in dressed carcasses as inclusion or removal of any visceral organs in a hot carcass measurement might be resulted in different DP. In the present study the weight of gut fill contribution may be regarded as relatively high (Aduku et al., 1991) the fact that DP was higher in does may not mean that a higher carcass yield may be expected, possibly because of low slaughter weights in females. In line with our observation Solomon et al (1991) observed significant differences in DP in which castrates (41.6%) where superior that intact males (39.50%) however Hopkins- Shoemaker (2004) in contrary DP was non significant in intact males with castrated males studying Boer x Spanish goat crosses. Although the present study was carried out under range management in semi arid tropics, the DP range obtained (38.95 to 52.93) was almost comparable to those reported by Dadi et. al., (2005)(41.0 to 45.90) working with Borana and Arsi-Bale goats under different durations of feedlot management. Elsewhere estimated DP for local Matebele goats correspond with the reports of Nsoso et al., (2004) and Warmington and Kirton (1990). This coincidence may not be expected because expect differences in genotype could influence differences in dressing percent in goats (Dhanda et. al., 1999; Mahgoub and Lodge, 1996); Amin et. al., 2000). In our case goats on range tend to have low DP than those with intensive management (Ryan et. al., 2007) possibly due to low slaughter weights and high proportion of non carcass components (Mahgoub, 1997). Owen, (1983) reported that as slaughter age increases the proportion of internal body organs minus gut content increased relative to external components which may have reduced the DP. Comparable DP to the range obtained in the present study were reported for Borana and Arsi-Bale by Dadi et al., 2005 (41.0 to 45.9 %) and Boer crossbred goats on range by Ryan et al., (2007) (41.8 %), however in the same study concentrate fed goats had higher DP (48.2 to 51.3 %) (Ryan et al (2007). Elsewhere higher DP than in the present study based on EBW were reported for Capretto and Chevon goat carcasses of 50 to 55% by Dhanda et. al., (1999).

Least squares means of yields of non carcass fat depots expressed as a percentage of EBW are presented in Table 2. There were no differences ($p<0.05$) of kidney fat expressed as a percentage of EBW in does, castrated males and intact males, however intact males had the lowest proportion of both omental and mesenteric fat than does and castrated males. Contrast Wildeus et al (2007) observed that back fat and percentage kidney/pelvic fat were lower in bucks than in does. In support of our observation sex class influenced carcass composition, with fat tissue being the most affected (Mahgoub et al., 2004). Fat score distribution was more such that castration scored higher (fatter) than rams (Lee, 1986). In related studies sex had an influence in intramuscular fat, the values being higher among female goats (Toro et 2000) and females had a greater proportion of fat than males (Santos et al, 2008). Castration had an effect on fat deposition (Kebede et al., 2008). Bayraktaroylu et al., (1988) reported that castrated males had more mesenteric and kidney fat than intact males and carcasses from intact males had lower content of fat than carcasses from female goats (Colomer-Rocher et al., 1992), whereas carcasses of castrated male kid goats had lower amounts of omental fat than carcasses from female kid goats (Hogg et al., 1992). These findings were contradicted by Wilson (1960) who reported that female East African dwarf kids goats had higher fat than male goats, with greater differences with increased age. The role of nutrition and stage of maturity in determining level and distribution of fat are poorly understood in Matebele goat on range in Zimbabwe. Due to a tendency to deposit fat females contain less muscle than males at most weights (Warmington and Kirton, 1990) which may conform to the observation in the present study.

Table 2
The effect of sex on yields of non carcass fat depots expressed as a percentage of EBW in indigenous Matebele goats of Zimbabwe.

Component	Does	Castrated males	Intact males
Omental fat	1.06±0.05[a]	1.22±0.12[a]	0.99±0.10[b]
Mesenteric fat	1.15±0.02[a]	1.07±0.02[a]	0.95±0.02[b]
Kidney fat	0.32±0.09[a]	0.33±0.12[a]	0.29±0.11[a]

Means with different superscripts in the same row differ significantly ($p<0.05$).

5. Conclusion

This study indicated marked influence of sex on total edible and the saleable proportion of carcass components and the proportion of non carcass components in goats kept on the range. Optimum total edible and saleable proportion of carcass components are attainable utilizing intact males. Future work needs to ascertain sex differences on total edible and the saleable proportion of carcass components and the proportion of non carcass components in indigenous Matebele goats under feedlot condition.

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