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Carcass and Meat Characteristics of Grass cutter (*Thryonomys swinderianus*)

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Target audience:

Abstract

A total of twelve adult male grass cutter (cane rats) with an average age of 38 months were used for the evaluation of meat quality attributes and carcass characteristics. The animals were starved of feed for 16 hours, weighed, stunned, slaughtered and properly bled. The thoroughly bled carcasses were scalded and eviscerated. The dressed carcass was cut into two half carcasses, one half was dissected to determine meat yield while the other half was cut into five primal cuts of leg, shoulder, rib, loin and breast, shank and flank (B. S. F.). These cuts were cooked, their percent cook yields and cooking losses were determined. Shear force value and water holding capacity (WHC) were determined. Also determined was the length to live weight ratio. Mean live weight and dressing percentage of cane rat were 4462.50g and 66.43%, respectively. Leg and the shoulder had the highest lean yield while BSF had the least ($P<0.05$). The larger cuts had greater cooking losses and vice-versa. An average shear force value of 2.71kg/cm^3 was obtained while a range value of 69.15-82.10% WHC was obtained. The meat to bone ratio was highest ($P<0.05$) in BSF and least in the loin. The value obtained for loin cut did not differ ($P>0.05$) from the values obtained for the shoulder, rib and leg. The percent cooked yield was highest in the rib cut (79.62%) and least in the leg cut (73.90%). The length to live weight ratio was 60.4, while the average carcass length was 271.50mm.

Key words: Carcass; Primal cut; lean meat; Water holding capacity.

Introduction

The exploitation of wildlife for the supply of bushmeat appears enormous from one section of the country to the other (1). Akiri (2) clearly showed that bush meat contributes about 16% of total animal protein consumed in Nigeria, while 20% was earlier reported for the rural communities (3). It has long been suggested that the shortage of animal protein in Nigeria can be ameliorated by improving the existing conservation programme of wildlife, particularly the domestication of rodents that are tractable, prolific and widely acceptable to the public for consumption (4, 3, 5, 6 and 7). Captive rearing of rodents and other species of manageable sizes in cages and enclosures (intensive management) might augment the bushmeat supply from the wild. Among the small mammals, the grass cutter (*Thryonomys swinderianus*) is popular with consumers of wild animals. The meat of grass cutter is acceptable to all social classes of people both in the urban and rural areas (8) and the acceptability cuts across both religion and cultural beliefs.

The nutritional value of cane rat compares favorably with that of domestic livestock species. It has less fat, more calcium and phosphorus than beef and pork (9). Several studies had been carried out on the behavioural pattern (8), reproductive behaviours in captivity (10, 11) and on various aspects of the biology of the animal (12, 13 and14). Not much has been done on the carcass characteristics, meat yield and meat quality characteristics of cane rat. The present study therefore focused on these attributes.

Materials and Methods

Twelve adult male grass cutter (cane rats) with an average age of 38 months were used for the study. The animals were purchased from the stock in Forest Research Institute of Nigeria, Ibadan, Nigeria.

Prior to slaughtering, the animals were starved of feed for 16 hours, weighed and stunned. They were bled immediately after stunning and their carcasses hung on a rail upside down for proper bleeding. The thoroughly bled carcasses were scalded in hot water (80°C) for 5 seconds to loosen the base of the fur. The fur was scraped off with a hand scraper.

Evisceration; The scalded carcass was eviscerated. The head was cut by cutting between the zygomatic arches and the atlas. Evisceration was carried out by cutting down the breastplate and continuing through the abdomen to the pelvis. The anus was cut round and retracted, trachea and oesophagus were retracted together. A cut was made round the oesophagus at the distal end to separate it from the diaphragm. The lung and the trachea were removed intact and weighed while the gastrointestinal tract (GIT) was removed intact and weighed. The remaining carcass was weighed as warm carcass weight. The dressing percentage was determined as:

$$\frac{\text{Warm carcass weight} \times 100}{\text{Live weight}}$$

The dressed carcass was separated into two halves down the vertebral axis by cutting from the cranial to the caudal end. Each half carcass was hung by the archilles tendon and allowed to set after which the weight was taken, and chilled overnight, thereafter the chilled half carcass was then allowed to stabilize at room temperature and the surface water mopped off. The carcass was weighed to determine the chilled weight and chilling loss. Thus,

$$\text{Chilling loss} = \frac{\text{Warm weight} - \text{chilled weight} \times 100}{\text{Warm weight}}$$

Carcass dissection: Dissection of the primal cuts (shoulder, rib, loin, leg, breast and flank) from the right half carcass was carried out. The breast, shank and flank (BSF) were removed by cutting from the face of the leg parallel to the vetebral axis, cutting through the fore shank, breast and flank. The shoulder was removed by cutting across between the 5th and 6th thoracic vertebrae while the leg was separated by cutting between the last lumbar and the first sacral bone or at the tip of the illium. The rib and the loin were separated by cutting after the 13th rib through the lumbar vertebrae.

Each primal cut was weighed and its proportion relative to the chilled half carcass was determined.

Meat quality attributes.

Cooking loss and percent cooked yield.

Each primal cut was separated, weighed and cooked for 20 minutes at a pressure of 102, 000 N/ms² using a pressure cooker. Each cooked sample was cooled to room temperature, blotted dry and weighed. Cooking loss was calculated as

$$\frac{W_1 - W_2}{W1} \times 100$$

Where W1 = Weight of fresh meat sample (weight before cooking)

W2 = Weight of cooked meat sample

Cooked yield of each primal cut was calculated as

$$\frac{\text{Cooked weight}}{\text{Chilled weight}} \times 100$$

Shear force determination: Warner Bratzler shear force (WBSF) determination was performed on the cooked meat samples using the modified procedure of (15). Three cores were removed using an electrical coring machine. Each core was sheared at three locations parallel to the orientation of muscle fibre.

Water holding capacity: This was carried out following a slightly modified method of (16). Approximately 0.5g of sample was weighed ,layered between two diameter 9cm Whatman No. 1 filter paper and pressed between two 10.2 x 10.2 cm plexi glass for 1 minute using a G-clamp vice. The samples were oven-dried in order to determine the moisture content. The amount of water released from the sample was measured indirectly by measuring the area of the filter paper wetted relative to the area of pressed sample. Thus,

$$WHC = 100 - \frac{[(Ar - Am) \times 9.47]}{Wm \times Mo} \times 100$$

Where Ar = Area of water released from meat (cm^2)
Am = Area of meat sample (cm^2)
Wm = Weight of meat (g)
Mo = Moisture content of meat(%)
9.47 is a constant

Separation of primal cuts into skin, lean and bone: Each primal cut was cooked to an internal temperature of 72^{0}C, cooled and separated into skin, lean meat and bone. Each of these was recorded individually. The weight of the skin, lean meat or bone was expressed as percentage of each cut. For example,

$$\text{Weight of skin} = \frac{\text{Weight of skin} \times 100}{\text{Weight of cut}}$$

The same was done for lean meat and bone for all cooked primal cuts. The weight of all skin, all lean meat and all bones of all cuts were added together and each expressed as percentage of chilled half carcass. This was calculated as

$$\text{\% of all skin} = \frac{\text{Weight of all skin} \times 100}{\text{Weight of half carcass}}$$

$$\text{Meat to bone ratio} = \frac{\text{Skin + lean of each cut}}{\text{Bone of each cut}}$$

Statistical Analysis

Meat quality characteristics, weight of primal cuts and their proportions relative to the chilled half carcass weight, percent cooked yield, cooking loss and meat to bone ratio as well as the proportions of skin, lean and bone from each cooked primal cuts were subjected to analysis of variance (ANOVA) in a completely randomized design. Where statistical significance was observed, the means were compared using the Duncan's Multiple Range (DMR) test. The SAS computer software package (17) was used for all statistical analyses.

Results and Discussion

Carcass quality characteristics

The mean live weight obtained in this study was 4462.50g (Table 1) as against 5872.10g reported by (8). The value however exceeded those reported for giant rat and domestic rabbits which were 1033g and 1567g respectively (5). The dressing percentage of 66.43% recorded in this study (Table 1) was higher than 63.8% reported by (8) for cane rat. It compared well with the value of 66.56 –67.63% obtained for 2.0kg broiler chicken (18). However, it was higher than 56.88 and 53.55 reported for West African Dwarf goats and Red Sokoto goats, respectively (19). Scalded cane rats in this study gave a higher dressing percentage than scalded matured New Zealand White rabbits with a dressing percentage of 55.32% (20). Cane rat also has superior dressing percentage than the West African Dwarf sheep with a dressing percentage of 45.78% (21). The grass cutter can thus be said to have higher carcass yield than other conventional livestock.

Carcass length: live weight ratio: Although, there was no previous record of length to live weight ratio of grass cutter, (22) reported carcass length to live weight ratio of 8.9mm/kg for barrows and 9.01 mm/kg for gilts in their study. Awosanya (23) reported a carcass length to live weight ratio of 116.73mm/kg for rabbits as against 60.41mm/kg reported for grasscutter in this present study. The results showed that cane rat is more muscular than rabbit.

The weight of primal cuts

The weight of primal cuts and their proportions to the chilled half carcass weight are shown in Table 3. The leg portion gave the highest percentage (36.64%) followed by the shoulder (19.36%), while the rib gave the least ($P<0.05$) value (10.26%). Other values were 14.66 and 11.84 for lóin and B S F, respectively. The absolute weights followed a similar trend with the leg having the highest value (525g) followed by the shoulder, loin, B S F and rib with 282.50, 215.00, 173.75 and 148.75g, respectively (Table 3). Ironically, the least percent cook yield of 73.90 was recorded by the leg as against the values of 76.27, 79.62, 75.05 and 76.26 percent for shoulder, rib, loin and B S F, respectively(Table 4)

Table 1: Carcass characteristics of grass cutter (cane rat).

Parameter	Mean	SD	CV (%)	Min. Max.
Live weight (g)	4462.50	425.00	9.52	4050 – 4900
Bled weight (g)	4337.50	430.84	9.93	3900 – 4800
Blood loss (%)	2.83	0.75	26.50	2.04 – 3.70
Warm carcass weight (g)	2955.00	292.18	9.89	2700 – 3260
Chilled carcass weight (g)	2895.00	282.19	9.75	2650 – 3200
Dressing percentage (%)	66.43	2.82	4.25	62.65 – 69.47
Carcass length (mm)	271.50	5.66	2.09	220 – 305
Length /live weight ratio	60.41	4.55	7.53	54.32 – 65.06

Table 2: Meat quality characteristics of grass cutter (cane rat).

Parameter	Mean	SD	CV (%)	Min. Max.
Chilling loss (%)	2.31	0.62	26.84	1.54 – 3.05
Percent cook yield (%)	76.26	1.65	2.16	73.18 – 79.52
Cooking loss (%)	23.84	1.76	7.38	20.88 – 26.10
Water holding capacity (%)	75.26	3.72	4.94	69.15 – 82.10
Shear force (kg/cm^3)	2.79	0.81	29.03	2.07 – 2.81
Meat /Bone ratio	8.58	1.71	19.93	8.25 – 8.79
*All skin (%)	21.50	1.71	7.95	19.80 – 24.12
*All flesh (%)	61.83	3.29	5.32	56.55 – 69.85
*All bone (%)	11.80	1.25	10.59	8.52 – 14.15

* Percentage relative to total cooked cuts.

Table 3: Weights of primal cuts and their proportions (%) to the chilled half carcass weight (g)

	Weight of cuts (g)			% Relative to carcass		
Primal Cut	Mean	SD	CV(%)	X	SD	CV(%)
Shoulder	282.50^b	59.10	20.92^b	19.36^b	2.82	14.56
Rib	148.75^e	18.43	12.39	10.26^d	0.86	8.38
Loin	215.00^c	63.51	29.54	14.63^c	2.96	20.23
Leg	525.00^a	23.80	4.71	36.64^a	5.63	15.37
BSF	173.75^d	57.93	33.34	11.84^d	3.07	25.93

a,b,c: Means along the same column with different superscripts differ significantly ($P<0.05$).

Table 4: Percent cook yield, cooking loss and meat /bone ratio of primal cuts of grass cutter (cane rat).

	% Cook yield			% Cooking loss			Meat: Bone ratio		
Primal Cut	X	SD	CV (%)	X	SD	CV (%)	X	SD	CV (%)
Shoulder	76.27^{b}	3.25	4.26	23.73^{b}	3.25	1.37	6.86^{b}	1.40	20.41
Rib	79.62^{a}	6.62	8.32	20.88^{c}	7.00	33.52	7.33^{b}	1.67	22.78
Loin	75.05^{b}	6.26	8.34	24.96^{b}	6.27	25.12	6.24^{b}	1.29	20.67
Leg	73.90^{c}	3.95	5.35	26.10^{a}	3.95	15.13	6.74^{b}	0.99	14.67
B.SF	76.26^{b}	4.25	5.57	23.53^{b}	4.25	18.06	15.58^{a}	3.11	19.96

a,b, c: Means along the same column with different superscripts differ significantly (P<0.05)

Table 5: Proportions of skin, lean and bone from each cooked primal cut (% relative to each cut)

Primal Cut	Skin			Lean			Bone		
	X	SD	CV	X	SD	CV	X	SD	CV
Shoulder	17.76^{c}	4.79	26.94	69.11^{a}	4.88	6.48	13.10^{a}	2.81	21.45
Rib	24.62^{b}	7.19	29.20	61.66^{b}	3.29	5.34	13.72^{a}	2.31	16.84
Loin	21.79^{b}	3.98	18.27	64.06^{b}	8.38	13.08	14.15^{a}	2.55	18.02
Leg	17.88^{c}	2.28	12.75	69.04^{a}	3.40	4.93	13.09^{a}	1.67	12.76
B.SF	43.96^{a}	6.10	13.88	49.71^{c}	5.05	10.16	6.33^{b}	1.62	25.59

a, b, c: Means along the same column with different superscripts differ significantly (P<0.05)

Meat quality characteristics

Chilling loss: A mean chilling loss of 2.31% (Table 2) was observed in this study. Lower chilling loss values were reported by (22) for barrows and gilts (2.19 and 2.23) while (23) reported percent chilling loss of 4.38 for eight-month-old rabbits. Taiwo (24) reported percent chilling loss of 3.46 for the Nigerian Dwarf sheep.

Percent cook yield was highest in the rib with a value of 79.62 while the leg gave the least value (P<0.05) of 73.90% (P<0.05) (Table 4). Similar results were obtained by (23), who recorded higher percent cook yield in loin than thigh cuts, which suggested that larger cuts have lower yield and vice-versa.

Cooking loss as measured in the various primal cuts of grass cutter showed that the highest percent cooking loss (P<0.05) occurred in the leg cut (26.10%). The shoulder, rib, loin and BSF recorded 23.73, 20.88, 24.96 and 23.53%, respectively. The least cooking loss percent was obtained from the rib, which incidentally was the smallest cut. This showed an inverse relationship between the two quality characteristics. The average cooking loss of all cuts was 23.84%. This value was lower than 29.35% reported for scalded rabbits (20). However, the value was similar to the 24% reported for Bunaji cattle (25). Fisher *et al.* (22) gave cooking losses of 26.8 and 26.7% for barrows and gilts, respectively.

An average shear force value of 2.79kg/cm^{3} was obtained for the thigh muscle of the grass cutter used in this study (Table 2). Although no previous records were found for grass cutter, (23) obtained a value of 2.98kg/cm^{3} for eight-month-old rabbits, peak shear force value obtained by (26) for fresh veal muscles cooked at 50^{0}C and 60^{0}C were 5.99 and 2.91 kg/cm^{3}, respectively. Shear force values of 4.60, 4.13

and 4.04 were however reported by (25) for Bunaji, Gudali and Keteku cattle, respectively. Comparatively therefore, grass cutter meat could be adjudged to be more tender.

Water holding capacity is the ability of meat to retain its water during the application of external forces such as cutting, grinding or pressing (27). Berge *et al.* (28) reported that water holding capacity is one of the most important qualitative characteristics of meat, since it affects the appearance of the product, its behaviour on cooking and its juicy sensation on chewing. Many of the physical properties of meat such as colour, texture and firmness of raw meat, juiciness and tenderness of cooked meat are partially dependent on WHC (29). An average value of 75.26% WHC was obtained for all cuts in this study. This value was higher than the 66.97% obtained for scalded rabbit (20).

Proportion of skin, lean and bone yield from each cooked primal cut:

As shown in Table 5, the greatest amount of lean meat was obtained from the shoulder with a value of 69.11% followed by the leg (69.04%). The lean meat yields were not statistically different in the two primal cuts. However, the least % lean yield was obtained from the BSF, (breast, shank and flank) with a value of 49.71% ($P<0.05$). Fisher *et al.* (22) reported percent lean yield of 66.9 and 67.9% for shoulder cut in barrows and gilts, while 66.5 and 70.5% were obtained for the leg cut of barrows and gilts, respectively.

Percent skin yield was highest ($P<0.00$) in BSF while the shoulder and leg had the least value. This was probably due to the fact that BSF cut encompasses the whole length of the thorax and abdomen and has little bone.

The highest percentage of bone was found in the loin cut while the least was found in BSF ($P<0.05$). Percent bone yield in the shoulder (13.10%) and leg cut (13.09%) were not significantly different (Table 5). Fisher *et al.* (22) however reported greater a difference in shoulder and leg bone yield in barrows (16.8% and 8.44%). The grass cutter has higher yield of edible meat (skin and lean) in comparison to some conventional livestock. A contributory factor to high leanness in the grass cutter is the relative low bone content of the carcass. Bone percentage relative to half carcass obtained in this study was 11.80%, while lean percentage (all flesh) was 61.83% (Table 2). Percent lean yield obtained in this study was higher than the value reported by (30). The greatest meat to bone ratio was obtained in BSF cut (15.58), basically because BSF had been reported to have the least percentage of bone. The lowest meat to bone ratio was found in loin cut with 6.24 :1, the rib had 7.33 :1 while shoulder and leg cuts had 6.86:1 and 6.74:1, respectively. Meat to bone ratio for all cuts was 8.58:1 (Table 2). Djoukam (31) obtained a lean /bone ratio of 4.87: 1 in 52-week old Large White pig, while (23) reported a lean/bone ratio of 5.93: 1 in rabbit carcasses. The meat to bone ratio of grass cutter goes further to prove that it has a better yield of edible meat than swine and rabbit carcasses.

Conclusion

The study revealed a mean dressing percentage of 66.43% for grass cutter. A low chilling loss was observed while the greatest cooking loss was obtained in cuts with the largest weight. Shear force values obtained in this study were low, while the WHC was higher than for rabbits. It was also observed that the primal cuts with the lowest weight had the highest meat to bone ratio and vice versa. The percent cook yield was highest in the rib and lowest in the leg cut. The higher the cook yields the lower the cooking loss percentage. Grass cutter was found to be more muscular than rabbits and the meat more tender.

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