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Development and evaluation of the retail cuts, yields and sensory properties of smoked grasscutter (*Tryonomys swinderianus*)

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Abstract: The study was carried out to develop retail cuts, evaluate the effect of the method of pelage (removal/ scalding) on the yield and organoleptic quality of smoked grasscutter (*Tryonomys swinderianus*). Sixteen grass cutters were purchased from Abico bush meat market in Benin City, Nigeria. The pelages were removed by water and fire scalding. Some were brined in 15% salt solution for 3 hrs while others were not. The carcasses were cut into seven retail cuts. All samples were smoke-dried for 6 hrs. Sensory evaluation was done by a 12-man panel using a 5-point hedonic scale. The results showed that there were significant differences (P<0.05) in the yield of fresh salted and non-salted grass cutter samples. There was also significant difference (*P*<0.05) in the smoked yield of salted smoked grasscutter with WSS giving the highest yield of 1.03 kg. The method of pelage removal did not have any significant effect (P>0.05) but there was significant effects in the smoked yields. Sensory evaluation showed significant differences (*P*<0.05) in the colour, tenderness, juiciness, flavor and overall acceptability. Salted samples had the highest scores all organoleptic properties. It was recommended that further studies be carried out to evaluate the effects of salting and smoking on economic and sensory parameters of other sources of bush meat in Nigeria.

Keywords: Development, Grasscutter, Retail cuts, Salting

INTRODUCTION

The processing and smoking of game meat in Nigeria has been a long time practice. In the southern parts of Nigeria, the hunting and processing of game animals as sources of animal protein is well known (Abioye *et al.*, 2008; Ebabhamiegbebho and Ohanaka, 2012). Amongst these animals are the bush pigs, antelope, grassccutters (*Tryonomys swinderianus*), also called cane rats, deer, porcupine and the giant rats, etc. The consumption of game meat is increasing and breakthroughs have been made in the domestication of some of these game; such as grass cutter (*T. swinderianus*), (Addo, 2002; Adjanahoun, 2002; Olomu *et al*., 2003). The grasscutters also called cane rats are widely distributed and valuable game meat animals in West Africa. The value of the grasscutter as meat lies in its contribution to the nutrition of an individual in terms of animal protein supply. It is the bush meat of the consumer's first choice, as it has been reported to have higher nutritional value and meat yield than other traditional livestock species (Jori and Chardonnet, 2001; Ebabhamiegbebho and Ohanaka, 2012). The meat is the most cherished and sought after of all the game meat and has contributed in no small measure to the animal protein supply in the forest zones of Nigerian and other African countries. Grasscutter meat has a very high nutritive value; the crude protein content is about 22.7% as compared to 20.7% for rabbit, 19.2% for chicken meat, 18.2% for beef and 22.2% for turkey meat (Olomu *et al.*, 2003). It has 16.8% crude fat; 2.9% ash; 320 mg/100 gm (raw muscle) calcium; 380 mg of phosphorus; 20 mg iron (Olomu *et al*., 2003; Okpara *et al*., 2006; Okpara and Fagbemi, 2008a and 2008b). The acceptance and consumption of this meat goes beyond the shores of Nigeria. In Ghana for instance, grassccutter meat out of all the bush meat exported, still dominates the bush meat trade. It is presently exported to United States of America and Europe (Ntiamo-Baidu, 1998; Kamwi, 2002). International trade as well as regional and continental interest in the grass cutter meat provides economic basis for the development of the grass cutter processing industry in Nigeria.

The grasscutter is widely accepted and processed throughout the South, South of Nigeria. It is a common site to see them processed, pierced through with sticks and hung along major highways. In Edo State, for instance, there are major bush meat markets, the grasscutter being the most common among them followed by the antelope and others. The processors only sell the whole intact processed grasscutter (Elumelu, 2010). This is very expensive, as the prices range between N4, 000 to N12, 000 naira each. The

meat is usually sold whole after smoke-drying; without cutting into retail parts (cuts). This makes it unaffordable to low and medium income earners, who would have liked to consume the meat. The other larger bush meats such as the antelope, deer and bush pigs are however usually cut into retail parts, before they are smoked and sold. Preliminary findings showed that consumers preferred it sold in retail cuts; but that the grasscutter processors are skeptical about breaking "even", if they sell in retail cuts (Elumelu, 2010; Enuenweuche, 2010; Nwanade *et al.,* 2011). The result is a product that would be on display for many days and as such deterioration and subsequently spoilage usually set in. Therefore the need to proposed workable retail cuts of grasscutter, which would result in larger consumers, more frequent sales and higher returns.

Some works have been done on its availability and domestication (Bifarin *et al*., 2008; Olomu *et al.*, 2003). However, little or no work has been done in terms of its processing technology, product improvement, determination of retail cuts and their yields with respect to the whole carcass. The capturing, processing and marketing of this highly priced animal protein source remain in the hands of the peasant producers and marketers (Nwanade *et al*., 2011). Thus, the processing and quality control of its products are being compromised; but which remain a major challenge in the supply of quality game meats (Bifarin *et al*., 2008). The processing, distribution and marketing of grassccutter meat is at present a challenge for national food security regarding the poor expectations in terms of product quality, handling, organoleptic properties and packaging (Opara and Fagbemi, 2008a and 2008b). The need therefore for scientific transformation of the whole process becomes imperative. The objective of this study was to attempt to develop retail cuts value of smoked grasscutters. It was also, to determine the effect of the method of pelage removal (scalding) and addition of sodium chloride (salt) on the yields of the various retail cuts (parts), as related to whole, as well as the organoleptic qualities of smoked grasscutter.

MATERIALS AND METHODS

Procurement of raw materials (Grasscutters): Sixteen freshly gunshot grasscutters were purchased from Abico bush meat market in Benin City, Edo State. They were transported in picnic boxes to the laboratory for removal of the pelage/bristles (scalding) and the Entrails. Three commercially smoke-dried grasscutters on retail (GOR) which was the control were also purchased and transported in picnic box.

Processing of the grasscutters: The pelage (bristles) were removed using two methods: (i) The grasscutters were immersed in hot water (80^{o}C) for 60secs and the pelage scrapped off using a blunt knife (Water scalding, WS); (ii) The others were placed on wire mesh over a glowing fire to burn off the bristles (Fire scalding; FS). The grasscutters were neatly eviscerated and the entrails removed (Aduku and Olukosi, 2000). The carcasses were then weighed and the yield recorded. Four each of the WS and FS of the dressed carcasses were separately immersed in 15% salt solution for 3hs (WSS and FSS) at room temperature (25-28^{o}C). The changes in weights were recorded (Ebabhamiegbebho *et al*., 2011). The FS salted (FSS) and the WS salted (WSS) were cut into proposed retail cuts of seven portions. The FS not salted (FSNS) and the WS not salted (WSNS) were also cut into seven (7) retail cuts. All the parts were weighed using a laboratory scale. The percentage proportions of each part with regard to the whole carcass were also determined and recorded. The smoked samples were designated as WSS, WSNS, FSS, and FSNS for the water scalded salted smoked, water scalded not salted smoked, fire scalded salted smoked and fire scalded not salted smoked respectively. The parts were right hind limb (RHL), left hind limb (LHL), right forelimb (RFL), left forelimb (LFL), right abdomen (RA), left abdomen (LA) and head (H) (Paulsen, 2009).

Smoke drying of the samples: The grasscutter samples were smoked-dried for six hours at a temperature of 60-65^{o}C in a Model *atona* smoking kiln using Rubber (*Hevea brasillensis*) wood (Abolagba *et al.*, 2002; Abolagba and Odiko, 2005). The rate of moisture loss was determined by taking the weights of the samples every 1hour for 6hours. The drying rate graphs were plotted to determine the drying behavior of the treatment samples.

Sensory evaluation: A 12-man member panel was used for the organoleptic evaluation of colour, flavor, texture, tenderness and overall acceptability based on a 5-point Hedonic scale. The scoring of the samples ranged from 1(dislike extremely) to 3(neither like nor dislike) to 5 (like extremely) (Kilcast, 2003; Okaka, 2010).

Non-standard abbreviations: FSS: Fire scalded salted, FSNS: Fire scalded not salted, WSS: Water scalded salted, WSNS: Water scalded not salted.

RESULTS AND DISCUSSION

The results of the effect of addition of 15% salt solution by immersing freshly dressed retail cuts of grasscutter in the solution is presented in table 1. The results are presented as absolute weight of each cut and their percentage contribution to the whole carcass. The right hind limb of the FSS and FSNS showed that each of them weighed 0.98 kg representing 20.21% and 0.94 kg representing 23.15% respectively. There was no significant difference (P>0.05) in their yields. The WSS and theWSNS had weights of 1.03 kg representing 22.10% and 0.99 kg representing 22.65%. There was no significant difference (P> 0.05) in their yields. There was also no significant difference (P>0.05) in the right and left abdominal parts and the head.

Table 1. Effect of salting on the yields of fresh retail cuts of grasscutter.

Retail cuts	FSS		FSNS		SEM	WSS		WSNS		SEM
	Kg	%	Kg	%		Kg	%	Kg	%	
Right hind limb(RHL)	0.98a	20.21	0.94a	23.15	± 0.01	1.03a	22.10	0.99a	22.56	± 0.02
Left hind limb (LHL)	0.90a	18.56	0.61b	15.05	± 0.01	0.90a	19.31	0.73a	16.71	± 0.01
Right forelimb(RFL)	0.91a	18.76	0.67b	16.50	± 0.03	0.93a	19.96	0.65a	14.87	± 0.01
Left forelimb(LFL)	0.73a	15.05	0.49b	12.07	± 0.02	0.54a	11.59	0.50a	11.44	± 0.03
Right abdomen(RA)	0.48a	9.90	0.44a	10.84	± 0.04	0.40a	8.85	0.48a	10.98	± 0.01
Left abdomen(LA)	0.39a	8.04	0.43a	10.59	± 0.02	0.38a	8.15	0.42a	9.61	± 0.02
Head(H)	0.46a	9.48	0.43a	10.59	± 0.03	0.48a	10.30	0.60b	13.73	± 0.02
Total	4.85a	100.00	4.06b	100.00	± 0.02	4.66a	100.00	4.37b	100.00	± 0.01

Means with same letter within same rows are not significantly different (P> 0.05); FSS = Fire scalded salted; FSNS = Fire scalded not salted; WSS = Water scalded salted and WSNS = Water scalded not salted.

Table 2. Effect of method of scalding (pelage removal) on the yields of smoke-dried retail cuts of grasscutter.

Retail cuts	FSSS		WSSS		SEM	FSNS		WSNS		SEM
	Kg	%	Kg	%		Kg	%	Kg	%	
Right hind limb	0.40a	22.47	0.44a	20.46	± 0.02	0.43a	22.87	0.49b	21.59	± 0.01
Left hind limb	0.33	18.54	0.41b	19.07	± 0.02	0.35a	18.62	0.41b	18.06	± 0.01
Right fore hind	0.03a	16.85	0.37b	17.21	± 0.05	0.31a	16.49	0.39b	17.18	± 0.02
Left fore hind	0.21a	11.80	0.33b	15.35	± 0.03	0.23a	12.23	0.35b	15.42	± 0.03
Right abdomen	0.19a	10.67	0.19a	8.84	± 0.04	0.18a	9.59	0.20a	8.81	± 0.02
Left abdomen	0.12a	6.74	0.14a	6.51	± 0.01	0.13a	6.92	0.15a	6.61	± 0.02
Head	0.23a	12.92	0.27a	12.56	± 0.02	0.25a	13.30	0.28a	12.33	± 0.01
Total	1.78a	100.00	2.15b	100.00	± 0.02	1.88a	100.00	2.27b	100.00	± 0.01

Means with same letter within same rows are not significantly different (P> 0.05); FSS = Fire scalded salted; FSNS = Fire scalded not salted; WSS = Water scalded salted and WSNS = Water scalded not salted.

However significant differences (*P*< 0.05) were observed in the yields of the left hind limb, right and left forelimbs as well as the total yields of the FSS and FSNS grasscutter. These differences may be due to the addition of salt. It was reported in an earlier study that the addition of salt resulted in the yield of smoked beef and that there was significant difference (P< 0.05) in the salted and the not salted smoked beef (Ebabhamiegbebho *et al*., 2011). There was also no significant difference (P> 0.05) observed in the right and left abdominal portions of the FSS and FSNS. The result also showed no significant difference (*P*> 0.05) in the fresh yield of the right hind limb, left forelimbs and right and abdominal parts of the WSSS) and WSNS. There was however significant difference (P< 0.05) in the yields of the left hind limb right forelimb, the head and the total yield. These differences maybe attributable to the addition of sodium chloride (salt) to the fresh meat for 3 hrs. This is achieved by the salt chemically binding to the water molecules, thereby preventing the molecules from being released from the meat. This results in the yield, tenderness and extended shelf life of the meat. The salt also prevents microbial invasion by making the water molecules unavailable for activities of pathogenic microorganisms and subsequent spoilage of meat.

The results of the yields of the smoked-dried samples (FSS, FSNS, WSS and WSNS) are presented in table 2. The result revealed that there were significant differences (P< 0.05) in the right hind limb, right and left abdominal portions as well as the head. There was however, no significant difference in the left hind limb, right and left forelimbs and the total yields of the products of the FSS and FSNS of smoked grasscutter. Again these differences observed may be due to the effective and uniform method of addition of salt to these samples prior to smoke- drying (Paulsen, 2009; Ebabhamiegbebho *et al*., 2011). There were significant differences (P< 0.05) in the right and left hind limb, right and left forelimbs and the total yields of the smoke-dried WSS and WSNS grasscutter; whereas,

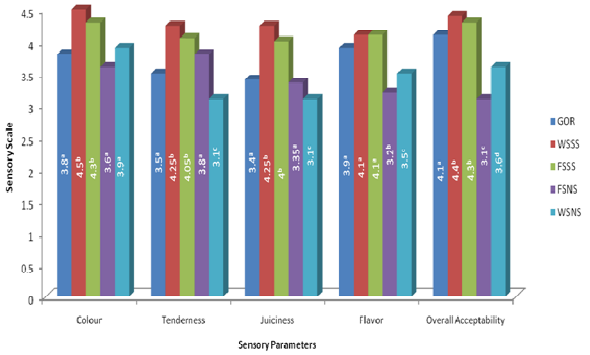

Fig. 1. *Sensory quality scores for the salted grasscutter. Means across bars with same superscripts are not significantly different (P>0.05)***;** *GOR= Grasscutter on retail, WSSS=Water scalded Salted Smoked, WSNS = Water Scalded not salted smoked dried grasscutter, FSNS = Fire Scalded not salted smoked dried grasscutter, FSSS = Fire Scalded salted smoked grasscutter.*

Table 3. Effect of the method of scalding (pelage removal) on the yield of fresh retail cuts of grasscutter.

Retail cuts	FSS		WSS		SEM	FSNS		WSNS		SEM
	Kg	%	Kg	%		Kg	%	Kg	%	
Right hind limb	0.84a	20.24	1.10b	25.35	± 0.03	0.94a	20.44	0.98a	20.42	± 0.02
Left hind limb	0.63a	15.58	0.75a	17.28	± 0.02	0.88a	19.13	0.90a	18.75	± 0.02
Right forelimb	0.86a	20.72	0.98b	22.58	± 0.01	0.85a	18.48	0.90a	18.75	± 0.02
Left forelimb	0.65a	15.66	0.53b	12.21	± 0.02	0.81a	17.38	0.83a	17.29	± 0.04
Right abdomen	0.43a	10.36	0.25b	5.76	± 0.02	0.36a	7.83	0.40a	8.33	± 0.04
Left abdomen	0.28a	6.75	0.25a	5.76	± 0.01	0.28a	6.09	0.31a	6.46	± 0.02
Head	0.46a	11.08	0.48a	11.06	± 0.01	0.49a	10.65	0.48a	10.00	± 0.01
Total	4.15a	100.00	4.34a	100.00	± 0.02	4.60a	100.00	4.80a	100.00	± 0.02

Means with same letter within same rows are not significantly different (P> 0.05); FSS = Fire scalded salted, FSNS = Fire scalded not salted, WSS = Water scalded salted and WSNS = Water scalded not salted.

Table 4. Effects of method of scalding (pelage removal) on the yields of smoke-dried retail cuts of grasscutter.

Retail cuts	FSS		WSS		SEM	FSNS		WSNS		SEM
	Kg	%	Kg	%		Kg	%	Kg	%	
Right hind limb	0.44a	19.73	0.48a	21.53	± 0.03	0.42a	23.33	0.45a	22.84	± 0.03
Left hind limb	0.42a	18.83	0.42a	18.83	± 0.01	0.27a	15.00	0.33b	16.75	± 0.02
Right forelimb	0.42a	18.83	0.44a	19.73	± 0.04	0.30a	16.67	0.31a	15.74	± 0.02
Left forelimb	0.34a	15.25	0.26b	11.66	± 0.02	0.22a	12.22	0.23a	11.68	± 0.01
Right abdomen	0.22a	9.87	0.19a	8.52	± 0.02	0.20a	11.11	0.19a	9.65	± 0.02
Left abdomen	0.18a	8.07	0.18a	8.07	± 0.03	0.19a	10.06	0.19a	9.65	± 0.03
Head	0.21a	9.42	0.26b	11.66	± 0.02	0.21a	11.67	0.27b	13.71	± 0.01
Total	2.23a	100.00	2.23a	100.00	± 0.01	1.80a	100.00	1.97b	100.00	± 0.02

Means with same letter within same rows are not significantly different (P> 0.05); FSS = Fire scalded salted, FSNS = Fire scalded not salted, WSS = Water scalded salted and WSNS = Water scalded not salted.

there were no significant differences (P< 0.05) in the right and left abdomen as well as the head portions of the WSS and WSNS smoke-dried grasscutter. These differences are attributable to the brining of samples in sodium chloride solution. The significant differences observed in the salted and not salted smoke-dried grasscutter confirmed the results obtained from the field (in previous studies) from commercial grasscutter processors. There were no significant differences in the yields of their products. This was due to the fact that, the grasscutter processors in Edo State Nigeria, do not add sodium chloride (salt) to their carcasses prior to smoke drying. The average yields recorded from the field range from 44% to 50%. This agrees with the findings of this study that the average yields are between 45 to 50%. This study further agrees with the findings of Hayta e*t al.* (2002) which reported that processing methods amongst other factors affect the functional properties and yields of food.

The result on the effect of the method of pelage removal (scalding) on the yield of fresh retail cuts of grasscutter is shown in table 3. The result showed significant differences (*P*< 0.05) in the right hind limb, right and left forelimbs as well as the right abdominal portions. There were no significant differences (P> 0.05) in the left hind limb, left abdominal portions, the head and the total yields of fresh retail cuts of FSS and WSS grasscutter. These differences may be due to the method of pelage removal. On the average, the water scalded and salted (WSS) yielded more (4.34 kg) than the fire scalded and salt (4.15 kg). This result again agrees with the preliminary field survey that showed that on the average, WS grasscutter samples yielded more than the FS; the reason why most (90%) of grasscutter processors in Edo State practice water scalding. There was also no significant difference (*P*> 0.05) in all the retail cuts of fresh grasscutter of the FSNS and WSNS samples (Table 3). There was also no significant difference (P >0.05) in the total yields. This result is however in contrast to the field report which observed significant difference (*P*< 0.05) between the WSNS and FSNS samples. Therefore, it can be inferred that the significant differences observed in the FSS and WSS based on the method of pelage removal/ scalding may be due to the combined effect of the method of pelage removal and salting.

The result on the effect of method of scalding on the smoke-dried yield of grasscutter is presented in table 4. There were significant differences (P< 0.05) in the left forelimb and the head portions of the products of the FSS and WSS samples. There were however, no significant differences observed in other retail parts and the total yields of the smoked product. This may be due to the effective method of smoke drying the final product. Abolagba and Odiko (2005) had reported that effective smoke-drying of fish using specific hard wood resulted in higher yield and better quality of smoked fish. The result of the smoked FSNS and WSNS samples showed significant differences (*P*<0.05) in the yields of the left hind limb and the

total; no significant difference (P<0.05) was observed in the other retail cuts of the carcass including the total of the smoke dried FSS and WSSS grasscutter samples. The total yields for the smoked FSNS and WSNS samples were 1.80 kg and 1.90 kg respectively. The result of the sensory evaluation of smoked grasscutter on different treatments and a control- the commercially processed grasscutter on retail (GOR) is shown in fig. 1. There was a significant difference (P<0.05) in the colour score with the water scalded salted (WSS) having the highest score of 4.5 in a scale of 5. It was not significantly different (P>0.05) from the fire scalded salted smoked (FSS) sample. These were significantly different (P<0.05) from the other treatment samples, including the control (GOR). The control had the least score of 3.8, but was not significantly different (P>0.05) from the FSNS and WSNS in the colour score. The WSS and FSS samples were scored highest in tenderness, juiciness, flavor and overall acceptability. There was no significant difference (P>0.05) between these, though the WSS was scored higher than the FSS in all parameters, except in flavor where both were scored 4.1 each. The WSS and FSS were significantly different (P<0.05) from the FSNS, WSNS and GOR in these parameters. The WSS was the most acceptable of all the treatments with a score of 4.4. The score was not significantly different (P>0.05) from the FSS; although, both were significantly different from the FSNS, WSNS and GOR. The general acceptance by consumers of the WSS and FSS grasscutter samples may be due to the addition of salt. The use of salt in enhancing the taste of food has been reported earlier (Ikene, 1990; Ebabhamiegbebho *et al*., 2011).

Conclusion

The study has shown that treating of samples with salt prior to smoking has the propensity to increase yield which is an important parameter in profit making. Salting also caused significant difference between WSNS and FSNS grasscutter samples. The method of pelaging used gave higher yields in WSS than FSS which agrees with field survey results in Edo State, Nigeria. WSS had the highest colour score and was the most acceptable of all treatments. WSS and FSS were scored highest in tenderness, juiciness, flavor and overall acceptability. It is recommended that further studies be carried out to evaluate the effects of salt and smoking on other wild animal species from which bush meat is obtained either for commercial or subsistence use.

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