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EFFECT OF DIFFERENT PROCESSING METHODS ON THE PROXIMATE COMPOSITION, MINERAL, AND ORGANOLEPTIC PROPERTIES OF DOMESTICATED GRASSCUTTER (*Thryonomys swinderianus)*

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ABSTRACT

Wildlife plays a crucial role in supplying energy, protein, and various components essential for human diets in tropical regions. In urban areas, there is still substantial consumption of bush meat, such as grasscutter, which serves as a significant source of nutrition. The study examined the proximate composition, mineral content, and sensory properties of processed grasscutter (Thryonomys swinderianus) meat using three distinct preparation methods. The grasscutter samples were acquired from the Department of Forestry and Wildlife Management at the Federal University of Agriculture, Abeokuta, Nigeria. The meat underwent smoking, boiling, and oven drying after slaughtering and washing. A portion of each processed grasscutter meat was collected, placed in sterile containers, and transported to the laboratory for proximate and mineral analysis. A questionnaire was employed for organoleptic evaluation and twelve taste panelists comprising randomly selected students, non-academic staff members, and lecturers from the department participated in the assessment. The proximate analysis followed the standard procedure outlined in the AOAC method (2005). Results indicated that the crude protein content was 20.06% for smoked and 16.40% for oven-dried grasscutter meat. The oven-dried meat exhibited lower fat content. Sensory evaluation suggested that oven-dried meat was perceived as the most favorable, with the highest mean values for aroma (8.42±0.26), taste (7.67±0.36), flavor (8.42±0.99), texture (7.67±0.36), acceptability (7.67±0.36), and the lowest for odor (2.08±0.31) compared to boiled and smoked samples. Moreover, oven-dried grasscutter meat demonstrated elevated levels of magnesium (7.45%) and potassium (27.43%). It is therefore recommended that the oven drying method of meat processing should be encouraged among various households and bush meat sellers as a useful technique of meat preservation.

Keywords: Consumption, Mineral, Processing, Proximate, Utilization, Wildlife

INTRODUCTION

Generally, the cane rat (Thryonomys swinderianus) or also known as the grasscutter is mainly harvested from the wild. It is highly nutritious and an important source of animal protein for people in West African countries such as Nigeria, Togo, Ghana, Côte d'Ivoire, and Benin (Hoffman, 2012; Ogunsanmi *et al*., 2002). In the human diet, rodents contribute an average of 80% of meat consumed (Fayenuwo *et al.,* 2003). Grass-fed meat is valued for its flavor, tenderness, and lower fat content than beef, lamb, and goat (Hoffman and Cawthorn, 2013). Boateng (2005) reported that grass meat is highly prized and considered a delicacy. Grasscutter meat is very low in cholesterol and rich in protein and minerals (e.g. phosphorus, calcium, and iron) compared to other meats such as rabbit, beef, and lamb. Studies have shown that grasscutter meat is accepted by all walks of life among ethnic groups in both urban and rural areas of Nigeria (Fayenuwo and Akande, 2002). It is sold in various forms (fresh, marinated, and smoked). The acceptability of cane rats as food is a result of the nutritional quality of the meat (Adu *et al.,* 2017). In Nigeria, grasscutter meat is regarded as the king of bush meat because of its exceptional taste (Ibitoye, 2019).

Owen and Dike (2012) reported that the grasscutter market's contribution to capital animal protein consumption is unlimited. Grilling, boiling, grilling, sautéing and roasting are different preparatory methods used by people to increase the tenderness, taste, flavor, and, palatability of food (Joyce *et al.,* 2016). The sun-drying method is commonly used by butchers and sellers in most rural areas to preserve meat, while the freezing method is mainly popular among urban housewives (Akhter *et al.,* 2009). Insect and fly larvae infestation is a major problem associated with exposing the meat to the sun to spoil the product before consumption. Unfortunately, bushmeat sellers do not know suitable meat preservation techniques and have no logical knowledge of its quality (Okoye and Oni, 2017). Their products are not up to quality standards. Therefore, this study was conducted to determine and compare the effects of boiling, smoking, and drying methods on the nutritional quality of thyme.

MATERIALS AND METHODS

Study Area

The study was carried out at the Department of Forestry and Wildlife Management, Federal Agricultural University, Abeokuta (FUNAAB), Nigeria. FUNAAB is located along Alabata Road, on 10,000 hectares of land, in the northeast of Abeokuta, Ogun State. It lies between Latitude 7º 30`N and Longitude 3º 54'E. The area has an average annual rainfall of 1113.1 mm, the average monthly temperature ranges between 22.9ºC and 36.32ºC,and the relative humidity range between 75.52ºC and 88.15ºC (Aiboni, 2001).

Sample

Three (3) live adult grasscutters were purchased from the Department of Forestry and Wildlife Management, Federal University of Agriculture, Abeokuta Domestication Unit for this study. The grasscutters (Thryonomys swindarianus) were slaughtered, washed, and then subjected to three preparatory methods which are; Smoking, boiling, and oven drying. The study was carried out in two (2) phases.

Phase 1: Proximate and mineral analysis was carried out on the boiled, smoked, and oven-dried samples. A small piece of each processed cane rat meat is removed and placed in a sterile plastic container and transported to the laboratory for Proximate and mineral analysis.

Phase 2: A structured questionnaire was provided to the panelists to assess the organoleptic properties of the boiled, smoked, and dried samples.

Sensory Evaluation
Twelve (12) taste panelists consisting of randomly selected members of the academic staff, non-academic staff, and students from the Department of Forestry and Wildlife Management were used for the evaluation. The panelists were served the processed meat samples to rate the aroma, taste, flavour, odour, texture, and acceptability using a nine-point descriptive scale (of which, 9: extremely satisfied 8: very satisfied 7: moderately satisfied 6: slightly satisfied 5: neither satisfied nor dissatisfied 4: Slightly dissatisfied 3: moderately dissatisfied 2: very dissatisfied 1: extremely dissatisfied).

Proximate Composition
The standard procedure of the AOAC method (2005) was used for the analysis of moisture, crude protein, carbohydrate, ash, fat, and f. extract

Moisture Content (MC)
Two grams (2 g) of each sample were heated at 105°c in a crucible until a constant mass was achieved. The moisture content is calculated as the loss of mass of the original sample and expressed as a percentage of moisture.

$$\text{Moisture Content \%} = \frac{W2 - W3}{W2 - W1} \times 100$$

Where; W_1 = Initial weight the of empty crucible
W_2 = Weight of crucible + sample before drying
W_3 = Final weight of crucible + sample after drying

Ash
Two grams (2 g) of each sample were placed in a crucible and ignited in a muffle furnace at 550°C for 6 hours. It was then cooled in a desiccator and weighed at room temperature to get the weight of the ash, using the formula:

$$\text{Ash Content \%} = \frac{\text{Weight of Ash}}{\text{Weight of original sample}} \times 100$$

Crude Fibre
Five grams (5 g) of each sample were heated with 1.25% H2SO4 for 30min and then filtered. The residue was washed with distilled water until it the acid was gone. A 1.25% solution of NaOH was used to boil the residue for 30min and filtered it until was no longer alkaline. The residue was placed in a crucible and dried at 105°C in an oven overnight. After cooling in a desiccator and weighed (W1), the ash was heated in a furnace at 550°C for 90 minutes to obtain the weight of the ash (W2).

$$\text{Crude Fibre \%} = \frac{W1 - W2}{\text{Weight of sample}} \times 100$$

Fat
Using a Soxhlet extractor, 10g of the sample each was weighed and wrapped with filter paper, and placed in a thimble. The thimble was covered with cotton wool and placed in the extraction column connected to a condenser using n–hexane to extract the liquid.

$$\text{Fat \%} = \frac{W2 - W3}{\text{Weight of sample}} \times 100$$

W_2 = Weight of filter paper and sample before extraction
W_3 = Weight of filter paper and sample after extraction

Crude Protein
Two grams (2g) of each of the samples were weighed, and placed in the Kjeldahl digestion flask, and 20ml of Concentrated H_2SO_4 and 16g of digestion mixture in a ratio 8:1 (K_2SO_4, $CuSO_4$). The sample was digested and distilled.

Nitrogen Content
The nitrogen content in the distillate was determined by titrating with 0.01m of H_2SO_4 and the endpoint was obtained when the color of the distillate changed from green to pink. The percentage of nitrogen was calculated and multiplied by 6.25 to obtain the value of the crude protein.

$$\text{Nitrogen \%} = \text{Vs} - \text{Va} \times \frac{\text{Normality of acid} \times 0.01401}{W} \times 100$$

W
Vs = Titre value of the sample
Va = Volume of acid required to titrate
W = Weight of sample in grams

Carbohydrate Content
The carbohydrate content was determined by subtracting the sum percentage composition of moisture, protein, fat, fibre and ash content from 100.
Carbohydrate %
= [100 - % (Protein, Moisture, Fat, Fibre, Ash)]

Mineral Content Determination
The mineral contents were determined using perchloric acid wet digestion. 1g of the sample was weighed into a 125ml Erlenmeyer flask which has been previously washed with acid and distilled water. 4ml perchloric acid, 25ml of Conc. HNO_3 and 2ml of Conc. H_2SO_4 was added under a fume hood. The contents were mixed and heated gently at low to medium heat on a hot plate under a perchloric acid fume hood and combined until dense white fume appeared. Finally, the contents were heated strongly for a minute and, allowed to cool before 40 – 50ml distilled water was added and boiled for 30 seconds. The solution was finally cooled and filtered with filter paper. This was made up to mark with distilled water in a 100ml pyrex volumetric flask. Minerals were determined using Atomic Absorption spectrometric.

Data Analysis
The data obtained were analyzed using descriptive statistics, and the separation of means was performed using the least significant difference.

Proximate Analysis of Samples
The proximate composition of the meat samples is presented in Table 1. The results showed that the oven-dried meat samples had the highest ash value (6.74%) while boiled was lower in ash (1.68%). Nitrogen-free extract (NFE) was higher (27.82%) in the smoked sample while oven-dried had the lowest value (10.48%). Also, the crude protein was higher (20.06%) in the smoked sample. The moisture and crude fat were found to be higher in boiled (58.21%) and smoked (13.62%) respectively. Furthermore, oven dried had the highest carbohydrate (5.95%) than the other processing methods.

Table 1: Proximate analysis of grasscutter on different processing methods

Processing method	Nutrient %					
	Ash	NFE	C. protein	Moisture	C. fat	Carbohydrate
Boiled	1.68	13.08	15.39	58.21	6.21	4.49
Smoked	2.10	27.82	20.06	32.16	13.62	3.37
Oven-dried	6.74	10.48	16.40	61.55	4.62	5.95
LSD	0.117*	0.114*	0.219*	0.114*	0.132*	0.114*

Sensory Evaluation

Table 2 presents the outcomes of the sensory evaluation conducted on boiled, smoked, and oven-dried grasscutter meat. The results reveal that oven-dried meat had the highest mean value for aroma (8.42±0.26), with the boiled sample exhibiting the lowest mean value (6.85±0.66). Similarly, the highest mean value for taste (7.67±0.36) was observed in the oven-dried meat sample, while the boiled sample displayed the lowest mean value (6.92±0.62). Likewise, the results indicate that the oven-dried meat samples recorded the highest mean values for flavor (8.42±0.99) and texture (7.67±0.36). Regarding general acceptability, the oven-dried meat sample attained the highest mean value (7.67±0.36), while the boiled sample obtained the lowest mean value (6.50±0.73). Furthermore, the lowest mean value (2.08±0.31) for odor was recorded in the oven-dried meat samples.

Table 2: Sensory Evaluation of grasscutter on different processing methods

Processing method	Parameters					
	Aroma	Taste	Flavour	Odour	Texture	Acceptability
Boiled	6.85±0.66	6.92±0.62	6.67±0.61	8.25±0.25	6.83±0.42	6.50±0.73
Smoked	7.58±0.42	7.42±0.42	7.58±0.40	2.42±0.65	2.42±0.65	6.75±0.64
Oven-dried	8.42±0.26	7.67±0.36	8.42±0.99	2.08±0.31	7.67±0.36	7.67±0.36

Mineral Composition

The findings presented in Table 3 indicate that calcium content was higher (6.16) in the smoked sample, while the boiled and oven-dried samples exhibited a slight difference with values of (7.52) and (7.28) respectively. Additionally, iron content was higher (1.34) in the boiled sample and lower (1.02) in the oven-dried sample. Moreover, the oven-dried samples recorded the highest values for magnesium (10.6) and potassium (59.84).

Table 3: Mineral composition of grasscutter on different processing methods

Processing method	Parameters			
	Ca	Mg	K	Fe
Boiled	7.52	8.98	29.30	1.34
Oven-dried	7.28	10.64	59.84	1.02
Smoked	6.16	7.45	27.43	1.07
LSD	0.185*	0.115**	0.113**	0.116*

RESULTS AND DISCUSSION

Table 1 presents the proximate analysis of the boiled, smoked, and oven-dried meat samples. The results indicated that the smoked meat sample exhibited the lowest moisture content compared to both the oven-dried and boiled meat samples. This reduction in moisture content in smoked samples can be attributed to the effective moisture-reducing properties of wood smoking, which lowers water activity and diminishes the risk of microbial spoilage. This observation aligns with the findings of Emelue and Ikoyo (2017), who asserted that low-moisture bushmeat is less prone to spoilage, resulting in an extended shelf life.

Furthermore, the oven-dried meat samples displayed a lower percentage of fat content, consistent with Oduntan's (2016) conclusion that game meat is characterized by generally low-fat content. The crude protein content in smoked and oven-dried grasscutter meats was measured at 20.06% and 16.40%, respectively. This result parallels the findings of Abernethy *et al.* (2013), who reported crude protein levels of 20% and 17.90% in smoked and oven-dried grasscutters, respectively. Additionally, the ash content in the oven-dried sample was 6.74%, surpassing the values observed in both the boiled and smoked grasscutter meats. This aligns with the findings of Adebowale *et al.* (2022), who reported elevated ash content in oven-dried grasscutters.

The sensory evaluation results indicated that oven-dried grasscutter meat scored the highest mean values in aroma, taste, flavor, texture, and overall acceptability compared to the boiled and smoked samples. This aligns with the findings of *Joyce et al.* (2016), who concluded that various cooking methods, such as barbecuing, grilling, and broiling, are employed to enhance aroma, taste, tenderness, and overall palatability. Additionally, the study revealed that oven-dried grasscutter meat exhibited the least odor among the three processing methods. On the other hand, the mineral composition analysis indicated that the oven-dried meat sample had the lowest iron content (1.02%), slightly lower calcium content (6.16%) compared to boiled meat, while recording higher levels of magnesium (7.45%) and potassium (27.43%).

CONCLUSION

In this study, it is deduced that grasscutter meat exhibits superior nutritional value, characterized by high carbohydrate, low fat, and NFE content, along with a moderately high protein content when compared to smoked cane rat meat. Nevertheless, among the three processing methods, oven-dried grasscutter meat demonstrated the highest moisture content. Additionally, the drying method yielded better organoleptic properties and mineral composition in comparison to the smoked and boiled samples.

The overall evaluation suggests a slight advantage of the drying method over smoking. To promote sustainable game meat consumption in both urban and rural areas, the processing of meat through oven-drying emerges as a valuable preservation technique and should be advocated among households and bushmeat vendors.

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