**Original Research Article**

**Proximate Composition and Organoleptic Properties of Wild Grasscutter (*Thryonomys swinderianus*) Smoked-Dried with Selected Wood Species, Obubra, Cross River State, Nigeria**

**ABSTRACT**

**Aims:**The proximate composition and organoleptic properties of wild Grasscutter smoked and dried with selected wood species was studied out to determine the proximate composition and organoleptic properties of wild grass cutter using different wood species and local drying kiln. An adult grass cutter was obtained and smoke-dried for six hours daily for three days using four different wood species and traditional drying kiln.

**Study design**: The design for the experiment was a Completely Randomized Design (CRD).

**Place and duration of study**: The study was carried out for four months, in the Department of Forestry and wildlife management, University of Cross River State, Nigeria, between September 2024 to December 2024.

**Methodology**: An adult grasscutter was purchased, processed, cut in parts, and smoked-dried using four drying kiln, using different wood species for 48 hours. The organoleptic properties were determined using structured questionnaire and a team of assessors, while proximate composition of the wild grasscutter was determined through laboratory analysis.

**Results**: The study revealed that Mangifera indica (Mango wood) was rated higher for taste and appearance but rated lower for aroma. Also, *Petrocarpus mildbraidii* was rated higher for texture as against Mangifera indica, Tectona grandis and Gmelina arborea. The laboratory analysis indicates that wild grass cutter smoked-dried with Mangifera indica had the highest (10.13%) moisture content, while that from Tectona grandis dished the least (8.62%) moisture content. The meat smoke-dried with Mangifera indica also recorded the highest (2.68%) ash content, while Tectona grandis recorded the last (1.67%) ash content. The level of fat was higher (6.09%) in the meat smoked-dried with *Pterocarpus mildraidii* and lower (5.01%) in that smoke-dried with Mangifera indica. The highest (24.01%) protein content was recorded in the meat smoked-dried with Mangifera indica, with Tectona grandis recording the lowest (22.33%). Dry matter content was highest (61.35%) in the meat smoke-dried with Tectona grandis and lowest in *Mangifera indica.*

**Conclusion**: The study therefore recommends Mangifera indica and *Pterocarpus mildbraidii* as the best wood species for smoke-drying wild grass cutter if good aroma, test, appearance and texture must be achieved.

***Key Words:*** Organoleptic, proximate, grasscutter, wood, composition

## **1. INTRODUCTION**

Bush meat is a major delicacy in Nigeria and remains one of the major non wood forest products consumed for its high protein content. Majority of bushmeat species are vastly acceptable, with only a few species considered as taboo in some tribes in Nigeria. Comparatively, pork and beef except fish are no match to bushmeat [3]. The global demand for bushmeat is alarming but supply is inadequate supposedly due to human population increase and the need to meet basic protein needs.

Decay and spoilage can result to undesirability and unacceptability of meat for human consumption due to alterations in physical and nutritional qualities. Bushmeat processing and preservation is essential to prevent economic losses, as it is highly susceptible to deterioration soon after kill [9]. Prevention methods should be applied to bushmeat to prolong its shelf-life, especially if it is not consumed or sold fresh. Drying, smoking, freezing, sterilization and pasteurization are some of the effective methods for the processing and preservation of bushmeat. To achieve maximum quality, yield and profit, efficient processing and preparation of bush meat is paramount. Smoking and drying methods of bushmeat varies among and within countries, and desirability depends on the species and type of product [8]. The long distance of distribution necessitates some processing and storage is necessitated by the challenges of bushmeat distribution through difficult terrains and long distances, since refrigeration is not readily available due to fluctuations in power supply. Major losses in quality and quantity of stored and dried meat in Nigeria is due to insect infestation. In Nigeria at the moment, the mechanization level of bushmeat processing is low, which is a result of the overall limited production, seasonal availability, poor information dissemination of the available improved technology to processors and lack of simple equipment adaptable for bushmeat processing [7].

Fuel wood is the major energy source for bushmeat smoking, with many wood types being used as fuel for fish smoking. The factors affecting the choice of wood used depend on local availability, with fuel wood preferences for bush meat relating to the physical characteristics of the wood and how they affect the smoked product [2]. Different fuel woods may affect the quality of the smoked meat differently, with the organic constituents of the wood comprising cellulose, hemicellulose and lignin. When wood is burnt, the chemical compounds are broken down into many smaller compounds as a result of incomplete combustion, as the characteristics of traditionally smoked products dependent greatly on the source of the smoke. A study on smoked fish with Eucalyptus wood in Zambia showed a golden-brown desirable texture, as well as an appealing smoky aroma. Different types of wood impact variety of flavours on meat [10]. The need for the development of bushmeat preservation and processing mechanism and techniques for effective handling, processing and storage cannot be over emphasized especially, as there is need to improve the dietary requirements of Nigerians. Therefore, this study aims at assessing the carcass quality and organoleptic properties of grass cutter smoked with different wood species with the intent of determining which wood species is most suitable for smoking of bushmeat.

## **2. METHODOLOGY**

This study was carried out in Ovonum, Obubra local government area of Cross River State, Nigeria. The State is located at longitude 80 - 90E and latitude of 60 - 70 N of the equator, with an annual rainfall of about 500 – 1070mm with a warm weather and annual temperature of about 210 C - 300 C.

## **2.1. Materials**

An adult Grass Cutter(*Thryonomys swinderianus*) was obtained from local hunters in Ovonum, Obubra Local Government Area of Cross River State Nigeria. Four traditional Drum kiln**,** consisting of a round wall of about 1m in height and 1.5m in diameter was sourced from a local vendor within the community. Most of them used for smoke drying are very simple in design and construction [4]. They range from the simple type which is an open fire above and the meat was laid on the grill, hut in which the meat was placed on racks above a fire. The wood species to be used was sourced from local vendors.

**2.2.** **Experimental Treatments and Procedure**

A Completely Randomized Design (CRD) was used for the experiment. Treatment one (T1) was made up of grass cutter meat smoked dried with *Pterocarpus mildbradii*, Treatment two (T2), grass cutter meat smoked dried with *Gmelina arborea*, Treatment three (T3), grass cutter meat smoked dried with *Mangifera indica,* while treatment four (T4) comprised grass cutter meat smoked dried with *Tectona grandis*. The parts of the carcass of the grass cutter were placed on each of the four drying kiln and smoked dried at regulated temperature for six hours daily for three days, after which the fresh and smoked meat was taken to the laboratory for proximate analysis and the smoked meat for assessment of quality and organoleptic properties [14].

## **2.3.** **Grasscutter Processing**

An adult full grown grass cutter was obtained from local hunters in Obubra Local Government Area at Cross River State. The meat smoking kiln was operated by first loading the specific wood species for each treatment into the heat chamber, setting fire to it, pre heating for ten minutes and then loading the unsalted pieces of meat into the rack trays on top of the smoking kiln, covered to allow the smoking to take place, with the capacity being 5 kg per rack [12]. The smoking time, temperature and ambient conditions was monitored during each smoking operation. The smoking was terminated when the meat is properly dried after six hours. The fresh and smoked samples were analyzed for lipids, protein, moisture content, ash, crude fibre and nitrogen free extract (NFE). The sensory/organoleptic evaluation was conducted using seven-unit hodonic scales conducted by ten semi-trained panelists, according to [6].

## **2.4. Data Collection**

The meat was smoked for a duration of six hours per treatment under close supervision after which the proximate composition of each treatment and organoleptic test was carried out.

## **2.5. Preparation of Smoked Meat Samples for Proximate Analysis**

The meat sample was selected and muscle of the smoked meat from each treatment of a wood species chopped into tiny pieces. They were blended and homogenized using mortar and pestle and later packed in different properly labeled bottles. The samples were analyzed for proteins fat, moisture ash and carbohydrate according to AOAC (1994).

**2.5.1. Estimation of protein**

The usual Kjeldahl method was followed to determine the amount of protein in the meat muscle. H2SO4 and 2.5g of digestion mixture (CuSO4 and trace SiO2) was added into the flask. Then the content of the flask was digested until the colour becomes greenish blue. The digested materials were diluted by adding distilled water which in turn distilled over by the slow adding of 40% NaOH solution. The end point was indicated by adding phenolphthalein.

**2.5.2. Estimation of lipid**

Lipid content was estimated by the Soxhlet method, and weight of the empty tumble taken. Then it was weighed with the sample. Difference of these two weights gave the weight of the sample. Then the sample was placed in Soxhlet extractor previously set. Fats were extracted with petroleum ether. After ensuring complete extraction, petroleum ether was evaporated and the residue dried to a constant weight at 105oC.

**2.5.3. Estimation of carbohydrate**

The percentage Nitrogen Free Extract of carbohydrate was calculated by simply subtracting the total percentage of protein, fat, moisture and ash from 100. The following equation was used to determine the amount of carbohydrate:

*Carbohydrate (%) = 100 - % of (Protein + Fat + Moisture + Ash)* *eqn. 1*

**2.5.4. Estimation of moisture**

Moisture was determined by drying the sample at +105oC in an oven. By subtraction, the moisture was calculated. For determining moisture, Aluminum dish was cleaned, dried and then the constant weight of the dish was taken. Sample was placed in the dish and weight taken. Difference between two weights, weight of the sample was ascertained. Then the dish with sample was put in a controlled oven and dried at 105oC until the constant weight is achieved. The following equation was used to determine the moisture content of the dry fish sample:

*Weight of sample – Weight of dried sample/Weight of sample x 100 eqn. 2*

**2.5.5. Estimation of ash content**

Ash was determined by muffling the sample at 6000 – 7000oC to dry ash, while subtraction of ash content was determined. Firstly, clean porcelain crucibles was heated in a muffle furnace at 6000oC and crucibles was then be weight until a constant weight obtained. The sample with the crucible was weighed and recorded. The sample was ignited at 6000oC for 6 hours or until the residue was uniformly greyish to white. Afterwards crucibles were transferred to the desecrator to cool them at room temperature for few minutes. Heating, desiccating, weighing was repeated till a constant weight was obtained. Final constant weights of the crucible were recorded.

## **2.5.6. Organoleptic assessment**

This was performed by semi-trained panelist using structured questionnaires on the following attributes (Appendix 1). The Ten (10) member panel of assessors were recruited from the staff and students of Forestry and Wildlife Department and each was presented with a questionnaire comprising the attributes. The meat samples were smoked and placed in plates according to the treatments using the four wood species. Drinking water was given to the panelist to rinse their mouth between evaluations of the samples. They were asked to tick for each parameter of all the samples. The scales which were grouped from 1-7 was denoted as follows: 1. (Extremely Unappealing), 2. (Moderately Unappealing), 3. (Slightly Unappealing), 4. (Neither Appealing nor Unappealing), 5. (Slightly Appealing) 6. (Moderately Appealing) 7. (Extremely Appealing).

## **2.6. Data Analysis**

The data from the study was analyzed using Likert scale to determine consumer’s preferences

**3. RESULTS AND DISCUSSION**

Proximate composition and organoleptic properties of wild grass cutter smoked-dried with selected wood species was carried out to determine how different wood species affect the proximate composition, taste, aroma, appearance and texture of wild grass cutter. The result from the study showed that wild grass cutter smoke-dried with *Mangifera indica* was rated higher in terms of taste, followed by *Pterocarpus mildbraidii* (Table 1).

**Table 1: Taste rating of wild grasscutter smoke-dried with different wood species**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Wood samples** | **LE (%)** | **LM**  **(%)** | **LS (%)** | **NLD (%)** | **DS (%)** | **DM (%)** | **DE (%)** | **Total (%)** |
| *Pterocarpus mildbraidii* | 2(11.1) | 5(35.7) | 0(0.0) | 0(0.0) | 5(50.0) | 6(22.3) | 7(41.2) | 25 |
| *Gmelina arborea* | 3(16.7) | 3(21.4) | 0(0.0) | 2(16.7) | 2(20.0) | 8(36.4) | 7(41.2) | 25 |
| *Mangifera indica* | 10(55.6) | 4(28.6 | 9(100) | 2(16.7) | 0(0.0) | 0(0.0) | 0(0.0) | 25 |
| *Tectona grandis* | 3(16.7) | 2(14.3) | 0(0.0) | 8(66.7) | 3(30.0) | 8(36.4 | 3(17.64) | 25 |
| **Total** | **18** | **14** | **9** | **12** | **10** | **22** | **17** | **100** |

LE = Like Extremely**,** LM = Like Moderately**,** LS = Like Slightly**,** NLD **=** Neither like nor dislike,DS **=** Dislike Slightly**,** DM **=** Dislike Moderately**,** DE **=** Dislike Extremely

Though wild grass cutter smoked-dried with *Mangifera indica* was rated higher in terms of taste, the wood species was not preferred in terms of aroma, and this conforms with the work of [1]. *Mangifera indica* was rated higher in terms of appearance of the wild grass cutter, while *Pterocarpus mildbraidii* was rated higher in terms of texture (Table 2), this aligns with the work of (Wright 2007) that people preferences for taste, aroma and texture is determined by the appearance of the bush meat and the species of wood used for smoke-drying.

**Table 2: Aroma rating of wild grasscutter smoke-dried with different wood species**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Wood samples** | **LE (%)** | **LM**  **(%)** | **LS (%)** | **NLD (%)** | **DS (%)** | **DM (%)** | **DE (%)** | **Total (%)** |
| *Pterocarpus mildbraidii* | 0(0.0) | 3(50.0) | 4(28.6) | 2(16.7) | 4(21.1) | 6(24.0) | 6(27.3) | 25 |
| *Gmelina arborea* | 3(42.9) | 3(50.0) | 0(0.0) | 2(16.7) | 4(21.1) | 7(28.0) | 6(27.3) | 25 |
| *Mangifera indica* | 4(57.1) | 0(0.0) | 6(42.9) | 0(0.0) | 5(20.0) | 8(32.0) | 2(9.1) | 25 |
| *Tectona grandis* | 0(0.0) | 0(0.0) | 4(28.6) | 3(25.9) | 6(31.6.0) | 4(16.0) | 8(36.4) | 25 |
| **Total** | **7** | **6** | **14** | **12** | **19** | **25** | **22** | **100** |

LE = Like Extremely**,** LM = Like Moderately**,** LS = Like Slightly**,** NLD **=** Neither like nor dislike,DS **=** Dislike Slightly**,** DM **=** Dislike Moderately**,** DE **=** Dislike Extremely

The differences in aroma, appearance, taste and texture observed in the wild grass cutter smoke-dried with different wood species may have been so due to different chemical and mechanical properties of the wood species. For proximate composition, *Mangifera indica* produced the highest moisture content (10.13%), followed by *Pterocarpus mildbraidii* (9.35%) with *Tectona grandis* recording the least moisture content (8.62%). The high moisture content observed in *Mangifera indica* may have been responsible for the preferred taste and appearance observed in wild grass cutter, and this agrees with the work of [5]. Wild grass cutter smoke-dried with *Mangifera indica* was rated higher in terms of appearance compared to other species of wood (Table 3).

**Table 3: Appearance rating of wild grasscutter smoke-dried with different wood species**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Wood samples** | **LE (%)** | **LM**  **(%)** | **LS (%)** | **NLD (%)** | **DS (%)** | **DM (%)** | **DE (%)** | **Total (%)** |
| *Pterocarpus mildbraidii* | 1(11.1) | 0(0.0) | 3(33.3) | 1(20.0) | 10(35.7) | 8(26.7) | 2(20.0) | 25 |
| *Gmelina arborea* | 0(0.0) | 1(11.1) | 2(22.2) | 3(60.0) | 8(28.6) | 9(30.0) | 2(20.0) | 25 |
| *Mangifera indica* | 6(66.7) | 6(66.7) | 4(44.4) | 0(0.0) | 2(7.1) | 4(13.3) | 3(30.0) | 25 |
| *Tectona grandis* | 2(22.2) | 2(22.2) | 0(0.0) | 1(20.0) | 8(28.6) | 9(30.0) | 3(30.0) | 25 |
| **Total** | **9** | **9** | **9** | **5** | **28** | **30** | **10** | **100** |

LE = Like Extremely**,** LM = Like Moderately**,** LS = Like Slightly**,** NLD **=** Neither like nor dislike,DS **=** Dislike Slightly**,** DM **=** Dislike Moderately**,** DE **=** Dislike Extremely

Also, the meat smoke-dried with *Mangifera indica* recorded the highest (2.68%) ash content, again with *Tectona grandis* recording the least (1.67%). The fat level was higher in the meat smoke-dried with *Pterocarpus mildbraidii* (6.09%) and lower in that smoke-dried with *Mangifera indica* (5.01%). *Mangifera indica* produced the highest crude protein (24.01%) in the meat it was smoke-dried with, while *Tectona grandis* produced the lowest (22.33%) crude protein [13]. Grasscutter smoked-dried with *Pterocarpus mildbraidii* was rated higher in terms of texture than other wood species (Table 4).

**Table 4: Texture rating of wild grasscutter smoke-dried with different wood species**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Wood samples** | **LE (%)** | **LM**  **(%)** | **LS (%)** | **NLD (%)** | **DS (%)** | **DM (%)** | **DE (%)** | **Total (%)** |
| *Pterocarpus mildbraidii* | 6 | 8 | 3 | 0 | 3 | 4 | 2 | 25 |
| *Gmelina arborea* | 2 | 1 | 0 | 1 | 6 | 8 | 7 | 25 |
| *Mangifera indica* | 0 | 2 | 1 | 3 | 9 | 5 | 5 | 25 |
| *Tectona grandis* | 1 | 0 | 2 | 3 | 8 | 6 | 5 | 25 |
| **Total** | **9** | **12** | **6** | **7** | **26** | **23** | **19** | **100** |

LE = Like Extremely**,** LM = Like Moderately**,** LS = Like Slightly**,** NLD **=** Neither like nor dislike,DS **=** Dislike Slightly**,** DM **=** Dislike Moderately**,** DE **=** Dislike Extremely

Dry matter was highest (61.35%) in the meat smoked-dried with *Mangifera indica*. These variations in the proximate composition of the wild grass cutter smoke-dried with these wood species was due to the fact that different wood species possess different characteristics and respond differently to different environmental conditions. These varied responses contribute to the different chemical components of smoke-dried bush meat [11]. Dry matter was highest (61.35%) in the meat smoked-dried with *Mangifera indica*, followed by *Pterocarpus mildbraidii* (Table 5).

**Table 5: Proximate Analysis of wild grasscutter smoke-dried with different wood species**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Wood samples | Moisture Content (%) | Ash (%) | Fat (%) | Crude Protein (%) | Dry Matter (%) |
| *Pterocarpus mildbraidii* | 9.35 | 2.11 | 6.09 | 23.09 | 59.36 |
| *Gmelina arborea* | 9.08 | 1.96 | 5.44 | 23.69 | 59.83 |
| *Mangifera indica* | 10.13 | 2.68 | 5.01 | 24.01 | 58.17 |
| *Tectona grandis* | 8.62 | 1.67 | 6.03 | 22.33 | 61.35 |

**3.1. CONCLUSION**

The choice of meat composition is influenced by its taste, aroma, flavor, texture and appearance. The preservation method of the bush meat also greatly impacts the proximate composition of the meat. The different organoleptic properties observed in bush meat is a function of the different wood species used for smoking. The findings of this study however, reveal that *Mangifera indica* and *Pterocarpus mildbraidii* were the best tree species for smoke-drying wild grass cutter as they indicated high preference for taste and aroma. These species of wood also contribute to the high fat, crude fiber and dry matter contents observed in the wild grass cutter. This study recommends the use of *Mangifera indica* and *Peterocarpus mildbraidii* for smoke-drying wild grass cutter. This will make the taste, aroma and appearance appealing to consumers.

**CONSENT**

This work does not require consent.

**ETHICAL APPROVAL**

This study does not require ethical approval.

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**APPENDIX**

**Appendix 1: Distribution of organoleptic attributes used for smoked meat evaluation**

|  |  |  |
| --- | --- | --- |
| **S/N** | **Attributes** | **Description** |
| 1 | Colour/Appearance | Intensity of “golden brown” colour, typical of smoked meat |
| 2 | Flavour/Odour | Intensity of perceived taste |
| 3 | Juiciness/taste | Intensity of juiciness of smoked meat flesh while chewing |
| 4 | Tenderness/Texture | Intensity of softness perceived at the time of chewing |
| 5 | Oiliness | Intensity of oiliness perceived taste of a typical smoked meat flesh |
| 6 | Overall quality | Overall impression of the smoked meat based on the above |

Source: (Alam *et al*., 2012)

**Appendix 2: Questionnaire for Descriptive analysis with scaling**

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Please evaluate the oiliness, colour, texture, taste and flavor, of those samples of smoked *Clarias garipinus* with different woods. Tick based on the scoring guide below;

**SCORING GUIDE: 1.** Like extremely **2.** Like moderately **3.** Like slightly **4.** Neither like nor dislike **5.** Dislike slightly **6.** Dislike moderately **7.** Dislike extremely

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scoring Guide** | **Treatment A** | **Treatment B** | **Treatment C** | **Treatment D** |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |

***Before***

 ***After***

**Appendix 3: Plates showing wild grasscutter before and after smoke-drying**