

EFFECT OF SMOKING AND OVEN DRYING ON THE PROXIMATE COMPOSITION AND SENSORY CHARACTERISTICS OF SOME SELECTED BUSHMEAT

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ABSTRACT

The study focused on the effect of smoking and oven drying on the proximate composition and sensory characteristics of some selected bush meat samples. Three samples were used (grey duiker, canerat and bush pig), the samples were procured from Uwa market, washed thoroughly then cut into smaller chunks and salted only. Two procedures were adopted for the study, they included proximate analysis of the different smoked and oven dried samples while the other was the use of structured questionnaire relating to the sensory characteristics. Two treatments were applied which included smoking parts of the samples in a smoking kiln with fuel wood and coal for 6hours while the other half were oven dried for 6hours. In terms of the chemical analysis obtained; moisture content (oven dried duiker 15.31%, cane rat 12.30%), ash (duiker 3.24%, cane rat 2.17%), and dry matter (duiker 92.73% and cane rat 89.75%) showed oven dried samples had higher values than smoked samples however general fat (smoked duiker 6.24%, smoked cane rat 5.12% and bush pig 4.54%) and crude protein (duiker had 23.95%, cane rat had 21.00%, and bush pig 20.42%), smoking had higher values. The results showed that smoked samples were preferred compared to oven dried. To encourage sustainable utilization of bush meat in urban and rural areas, smoke drying of bush meat is the most appropriate. Duiker, cane rat and bush pig should be smoke dried with fuel wood to improve their acceptability.

Keyword: Proximate composition, Bush meat, Smoking Kiln, Sensory characteristics, Samples.

INTRODUCTION

Bush meat plays an important role in nutrition as a contributor of high quality protein. Meat protein also plays important physiological role in that it promotes iron absorption and prevents calcium losses. The B-vitamins and mineral contents of meat are important nutritional factor. People get less than one fifth animal protein of the required recommendation (Cowlshaw *et al.*, 2005), which reflect the extreme shortage in supply of meat for human consumption. So it is seen that a good amount of meat production is occurred in special occasion which needs to be preserved for further use and consumption. Unfortunately we do not have appropriate techniques of meat preservation that are suitable for our sellers. Some butchers, meat sellers and urban housewife use freezing technique Wright J. 2007 and in most rural areas meat is being preserved by sun drying. A major problem associated with sun drying of meat is the infestation of fly and insect larvae during drying and storage which deteriorate the product before consumption. Besides this sun drying is problem during monsoon period. In Africa, the meat is smoked and dried mainly by the village women who are mostly illiterate and have no scientific knowledge about its quality. Obviously, their products do not meet the quality standards.

Bushmeat is meat from the wild animals hunted in Africa and Asia. The term bush meat has particularly been used to refer to meat from animal in west and central Africa. Today the term is often used in many countries and in reference to the hunting of endangered species (Wright, 2007). Hunting for either subsistence or commerce can profoundly affect the structure of tropical forest vertebrate assemblages, as revealed by both village-based kill-profiles (Jerozolinski and Peres 2003; Faet *et al.*, 2002). Hunting refers to predominantly unregulated (and often illegal and unsustainable) harvesting of wildlife for human consumption as ‘bushmeat hunting’ or ‘wild meat’ hunting. This is distinguished from legal or regulated hunting of wildlife which can be sustainable. This global bushmeat hunting crisis is a fundamentally distressing problem to address because it is intimately tied to human development challenges such as food insecurity, emergent disease risks and land-use changes. While many ethnic groups have hunted wildlife for subsistence over millennia, often with highly detrimental effects (Smith 2016), the unsustainability of this practice has accelerated in many areas due to growing human populations, an increasing tendency for wild meat to be traded commercially, and the widespread adoption of firearms and motorized transport that increase the efficiency and spatial extent of hunting.

Wildlife provides significant calories to rural communities, as well as essential protein and fats for a comprehensive review of the importance and role of wildlife in nutrition. (DeMérode *et al.*, 2003) reported that wild meat does not necessarily play a major role in the nutrition of poor forest households; they also demonstrate clearly that it plays an important food security role during the lean season. (Fa *et al.*, 2002) shows that if bush meat harvests were reduced to a sustainable level; all Central African countries except Gabon would be dramatically affected by the loss of wild protein supply.

Bush meat is central to the livelihood of many poor rural dwellers that consume and trade in it (ACET., 2014). Projections suggest that the take-off of wild animals from nature in Africa is six times higher than a sustainable use would be, Wildlife Conservation Society (2003), (Barnett, et al., 2000). Bush meat is a global health concern, because consuming bush meat has unique food safety risks. In addition to the microbiological hazards associated with other meat, bush meat may contain emerging

or re-emerging pathogens, such as bacillus anthrax, monkey pox, tubercle bacillus and trichinella (Poirson *et al.*, 2012) many diseases can jump between non-human primates and humans, because of the similar genetic backgrounds. Therefore, consumption of bush meat increases the risk of contracting zoonotic diseases. The purpose of this work is to investigate and compare the effect of smoking and oven drying methods on the nutritional quality of bush meat, to provide adequate processing handling method for bush meat in order to eradicate the incidence of zoonotic disease in bush meat consumption since bush meat can be contaminated at several points during the processing operations.

MATERIALS AND METHODS

Study Area

The experiment was carried out in the Wildlife Section of the Department of Forest Resources and Wildlife Management and in the Faculty Kiln house, Federal University of Benin, Benin City with a geographical reference of N06° 24' 11'' and E05° 37' 25''. The annual rainfall in the area varies from between 1500mm and 2500mm with a temperature range of 27.31°C. The topography is described as a low terrain that is sloppy and gentle. The natural vegetation of the area is rainforest that encourages the growth of tropical rainforest trees such as *Entandrophragma spp.*, *Khaya spp.*, *Milicia excelsa*, etc., numerous shrubs, and other plants.

Study Design

The study was carried out in two (2) phases. Phase one involved carrying out the proximate analysis of the different smoked and oven dried samples. Phase two consisted of using structured questionnaire to answer some questions relating to the sensory characteristics of the selected smoked and oven dried bush meat samples, this phase was carried out with the use of two different questionnaire one for the oven dried (PART A) and second for the smoked bush meat samples (PART B), forty copies of the questionnaire was produced in total. Twenty copies were administered for the first part of the questionnaire (oven dried) and another twenty for the smoked part of the questionnaire. Proximate analysis was carried out in the Faculty of Agriculture central laboratory.

Consumer Sensory Evaluation

Evaluation of consumer's preference of the different treatment procedures was carried out in the Faculty of Agriculture, University of Benin with a 20 member panel that comprised of students and lecturers of the Faculty. The panel members were served different meat samples to evaluate the flavor, taste, colour, aroma and texture of the various bush meat samples. A nine score scale was drawn to rate the different score attributes; from 9 – 1 with 9 been the highest possible value and 1 as the lowest value of preference.

Statistical Analysis /Data Collection

The experimental design used was Completely Randomized Design (CRD). The three (3) species were regarded as the treatments, each replicated three (3) times under the two (2) heat regimes. The data was collated using descriptive statistics of

percentages subjected to analysis of variance (ANOVA) procedures, and the means subjected to Duncan new multiple range test at 0.05% level of significance.

RESULTS

SENSORY CHARACTERISTICS

The respondents are presented in the tables under the grades of poor, good and excellent. The respondents suggested that appearance 48.3% was excellent and 5.0% was poor (Table 1).

Table 1: Appearance rating of smoked and oven dried bush meat samples

Bush meat samples	Poor	Good	Excellent	Total
Smoked bush pig		14(70%)	6(30%)	20(100%)
Oven dried bush pig	2(10%)	18(90%)		20(100%)
Smoked duiker	2(10%)	6(30%)	12(60%)	20(100%)
Oven dried duiker	2(10%)	2(10%)	16(80%)	20(100%)
Smoked cane rat		8(40%)	12(60%)	20(100%)
Oven dried cane rat		8(40%)	12(60%)	20(100%)
Total	6(5.0%)	56(46.7%)	58(48.3%)	120(100%)

Source: Field Survey, 2017

From the table 1 above, 20 of the respondents representing 100% rated the appearance of smoked bush pig as good and excellent and none rated it as poor. For oven dried bush pig, 10% rated it as having a poor appearance while 90% rated it as good in appearance. For the duiker, both smoked and oven dried showed no difference in terms of the appearance rating. Respondents (10%) rated it as having a poor appearance while 90% rated the appearance as good and excellent. For the cane rat, 100% rated both the smoked and oven dried as good and excellent in appearance. None of the respondents rated it as having a poor appearance and this is in agreement with the findings of Eves (1996).

Table 2: Texture rating of smoked and oven dried meat samples

Bush meat samples	Poor	Good	Excellent	Total
Smoked bush pig		8(40%)	12(60%)	20(100%)
Oven dried bush pig		10(50%)	10(50%)	20(100%)
Smoked duiker		12(60%)	8(40%)	20(100%)
Oven dried duiker		6(30%)	14(70%)	20(100%)
Smoked cane rat	2(10%)	10(50%)	8(40%)	20(100%)
Oven dried cane rat		10(50%)	10(50%)	20(100%)
Total	2(1.7%)	56(46.7%)	62(51.7%)	120(100%)

For the smoked and oven dried bush pig, 100% rated them as good and excellent while none rated the texture as poor. Respondents (100%) rated the texture of smoked and oven dried duiker as good and excellent. No respondent rated the texture as poor. For the smoked cane rat, 10% of the respondents rated the texture as poor, while 90% rated the texture as good and excellent while for the oven dried cane rat, 100% of the respondents rated the texture as good and excellent. None rated the texture as poor (Scone *et al*, 1992).

Table 3: Taste rating of smoked and oven dried meat samples

Bush meat samples	Poor	Good	Excellent	Total
Smoked bush pig		16(80%)	4(20%)	20(100%)
Oven dried bush pig		8(40%)	12(60%)	20(100%)
Smoked duiker		6(30%)	14(70%)	20(100%)
Oven dried duiker		4(20%)	16(80%)	20(100%)
Smoked cane rat		4(20%)	16(80%)	20(100%)
Oven dried cane rat		4(20%)	16(80%)	20(100%)
Total		42(35.0%)	78(65.0%)	120(100%)

From table 3 above, 100% of the respondents rated the taste of smoked and oven dried bush pig as good and excellent while none rejected the taste. For the smoked and oven dried duikers, 100% rated it as good and excellent while none rejected the taste. 100% of the respondents rated the taste of smoked and oven dried cane rat as good and excellent while none rejected the taste. Thus from the above, the taste of smoked and oven dried bush meat samples were all rated as good and excellent by the respondents (Mbetete *et al.*, 2011).

Table 4: Aroma rating of smoked and oven dried meat samples

Bush meat samples	Poor	Good	Excellent	Total
Smoked bush pig		14(70%)	6(30%)	20(100%)
Oven dried bush pig		10(50%)	10(50%)	20(100%)
Smoked duiker		14(70%)	6(30%)	20(100%)
Oven dried duiker		8(40%)	12(60%)	20(100%)
Smoked cane rat		10(50%)	10(50%)	20(100%)
Oven dried cane rat		12(60%)	8(40%)	20(100%)
Total		68(56.7%)	52(43.3%)	120(100%)

Respondents (100%) rated the aroma smoked and oven dried bush pig as good and excellent while none rejected the aroma. For the smoked and oven dried duiker, 100% rated the aroma as good and excellent while none of the respondents rejected the taste. The aroma rating of the smoked and oven dried cane rat by the respondents showed that 100% of the respondents rated it as good and excellent while none rejected the taste.

Table 5: Acceptability Rating of Smoked and Oven dried meat samples

Bush meat samples	Poor	Good	Excellent	Total
Smoked bush pig		12(60%)	8(40%)	20(100%)
Oven dried bush pig	2(10%)	8(40%)	10(50%)	20(100%)
Smoked duiker	2(10%)	4(20%)	14(70%)	20(100%)
Oven dried duiker		4(20%)	16(80%)	20(100%)
Smoked cane rat		10(50%)	10(50%)	20(100%)
Oven dried cane rat		12(60%)	8(40%)	20(100%)
Total	4(3.3%)	50(41.7)	66(55.0%)	120(100%)

From the table 5, respondents (100%) rated the acceptability of smoked bush pig as good and excellent while none felt it was not acceptable. For the oven dried bush pig, 10% rated the acceptability as poor, while 90% rated it as good and excellent. 10% rated the acceptability of smoked duiker poor while 90% rated it as good and excellent. For the smoked and oven dried cane rat, 100% of the respondents rated the acceptability of smoked and oven dried meat samples as good and excellent (Koppert *et al.*, 1996).

Table 6: Proximate Analysis

	DUIKER		CANE RAT		BUSH PIG	
	SMOKED OVEN-DRIED		SMOKED	OVEN-DRIED	SMOKED OVEN-DRIED	
MOISTURE CONTENT (%)	7.27	15.31	10.25	12.30	11.25	11.75
FAT (%)	6.243	5.717	5.120	3.203	4.537	4.283
ASH (%)	1.210	3.240	1.327	2.167	1.230	1.367
CRUDE PROTEIN (%)	23.95	22.25	21.00	17.90	20.42	19.83
DRY MATTER (%)	84.69	92.73	87.70	89.75	88.75	88.25

The moisture content of smoked duiker has 7.27% and oven dried 15.31%, oven dried has higher moisture content. For cane rat smoked has 10.25% and that of oven dried 12.30%, which is a slight difference between the two treatments. While that of bush pig smoked has 11.25% and 11.75% oven dried and shows no difference between the treatments used (Fargeot, 2000). While the level of fat present in the smoked duiker is 6.243% and oven dried has 5.717% and slight difference can be observed. For smoked cane rat, the fat level is 5.120% and oven dried has 3.203%, which shows a bigger difference in the fat level. The fat level for smoke bush pig is 4.537% and oven dried 4.283% showing no difference in the fat level of the treats used (Anstey, 1991). Ash of smoked duiker has 1.210% and oven dried has 3.240%, oven dried has higher ash percentage. For cane rat, smoked has 1.327% and that of oven dried 2.167% for ash, which is a slight difference between the two treatments. While that of bush pig smoked has 1.230% and 1.367% and shows no difference between the treatments used. Crude protein of duiker has 23.95% for smoked and 22.25% for oven dried with difference slightly shown. Cane rat has 21.00% for smoked and 17.90% for oven dried while that of smoked bush pig is 20.42% and 19.83% for oven dried showing slight difference (Abernethy *et al.*, 2013). Dry matter of smoked duiker has dry matter of 84.69% and oven dried duiker 92.73%, smoked grass cutter has 87.70% and 89.75% oven dried cane rat while 88.75% smoked bush pig dry matter and 88.25 for oven dried. Each of the treatment showed slight difference except for dry matter of duiker.

DISCUSSION

Results for sensory characteristics (Tables 1-5) show the effect of smoke-drying and oven-drying treatments on some portions of bush pig, cane rat and duiker meat. The appearance and texture of smoke-dried bush pig meat was rated by the respondents higher than that of oven-dried treatments since 10% of the respondents rated it as having poor appearance. This finding agrees with Berkelet *et al.*, (2004) that smoke particles have a positive effect on the taste and colour of meat products. While for both duiker and cane rat, respondents rated both methods (smoke-dried and oven-drying) as excellent as there was no significant difference ($P < 0.05$) between both methods on appearance and texture and this is in agreement with the findings of Eves *et al.*, (1996). In some sensory characteristics, the absence of smoke on the oven-dried treatments may have been responsible for its poor rating by some respondents in respective of the numerous advantages it has shown earlier reports (FAO, 2001). However, data analysis showed that there was no significant difference ($P < 0.05$) between the methods of processing parameters studied (appearance, texture, taste, aroma, and acceptance). According to the findings of Boles and Pegg (2005), in processing colour has been identified as the single most important factor of meat products that influences consumer buying decision and affects their perceptions of the freshness of the products. Respondents gave generally good ratings for all the sensory characteristics.

The proximate analysis of the smoke-dried and oven-dried portions of the duiker, cane rat and bush pig meats are as shown in table 6. In all three cases of the bush meats, oven-dried method produced higher moisture content in comparison with smoke-dried cane rat, duiker and bush pig meats. This again can be attributed to the effects of smoke-drying on various products as reported in previous findings (Van Berkel *et al.*, 2004, Boles and Pegg, 2005). It has been reported that smoke-drying by fuel wood/hard wood has been shown to be economic and efficient means of lowering the moisture contents of treated samples, thereby lowering water activity and incidences of microbial spoilage. This finding agrees with Igene and Tukura (1986) who opined that bush meat with lowered moisture content will extend the shelf life and low spoilage propensities. Crude protein content of smoke-dried and oven-dried duiker parts was 23.95% and 22.25% respectively. This value is higher than that of cane rat and bush pig as shown in table 6. This agrees with the findings of Abernethy *et al.*, (2013) but disagrees with the findings of both Abulude (2007), who investigated the chemical composition of various bush meats found in Nigeria and Emelue *et al.*, (2013) whose results showed that cane rat had higher CP for both smoke-dried and oven-dried methods than duiker. The protein content of bush meats have been found to be of higher quality than meat and fish thus making it a major alternative in meeting dietary protein shortages in Africa (Ebabhamiegbho and Ohanaka, 2012; Abulude, 2007; Ntlamoah-Bajdu, 1998).

The ash content of smoked and oven dried duiker was 1.21% and 3.24% respectively. This value is slightly higher than that of cane rat and bush pig meats as indicated in table 6 above, this value suggest that smoke-dried and oven-dried duiker samples have higher mineral profile than cane rat and bush meats, as ash content of any sample is a measure of the likely mineral content of that sample and showed slightly varied amounts with the type of treatments used. This finding is agreement with Abulude (2007) that bush meats are ideal sources of mineral necessary for healthy living. This further indicates why these bush meats are delicacies in Nigeria.

From the study, smoked bush meat had lower moisture content, improved sensory characteristics compared with oven dried bush meat. The lowering of the moisture content lowers water activity and the incidence of microbial spoilage that induces

zoonotic diseases. To encourage sustainable utilization of bush meat consumption in urban and rural areas, smoke drying of bush meat is the most appropriate method.

CONCLUSION

The effects of smoke-drying and oven-dried processing techniques on the sensory and chemical characteristics on three wildlife species were investigated in this study. Findings from this study revealed that there is no much significant difference in the two treatments used. However, smoke-dried processing methods gave rather better results on the sensory characteristics for the different wildlife used which will encourage the sustainable use of bush meat and reduce microbial spoilage. The findings from this study supports (Janky et al., 1978) and (Ikeme and Uwagbute, 1998) who opined that smoked products are generally preferred to other drying treatments and the use of smoking kiln have been found to produce more acceptable products. The results of proximate analysis revealed that all three types of meat had high nutrient profiles with duiker ranking the highest and this wildlife should be reared under semi-intensive system to compliment the supply of bush meat from the wild.

REFERENCES

- Abernethy, K.A., L. Coad, G. Taylor, M.E. Lee & F. Maisels 2013. Extent and ecological consequences of hunting in Central African rainforests in the 21st century. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 368(1631).
- Abulude, F.O (2007): Determination of the chemical composition of bush meats found in Nigeria. *Am. J. Food Tech.* 2(3): 154-160.
- ACET (The African Centre for Economic Transformation) (2014); Bushmeat and the future of protein in West African.
- Anstey, S. (1991) Wildlife utilization in Liberia wwf/FDA survey report, WWF International, Gland Switzerland.
- Barnett, R. (2000) Food for Thought: The Utilisation of Wild Meat in Eastern and Southern Africa. TRAFFIC/WWF/IUCN, Nairobi, Kenya.
- Boles, J.A and Pegg, R. (2005): Montana State University and Saskatchewan food product innovation programme, University of Saskatchewan.
- Cowlshaw, G., Mendelson, S. & Rowcliffe, J. M. (2005). Structure and operation of a bush meat commodity chain in South Western Ghana. *Conservation Biology*, 19, 139-149.
- DeMerode E, Homewood K and Cowlshaw G. 2004. The value of bushmeat and other wild foods to rural households living in extreme poverty in Democratic Republic of Congo. *Biological Conservation* 118(5):573–81.
- Ebambahiegbegho, P.A. and Ohanaka, M.C. (2012): Consumer preferences for different types of bush meat sold in Benin City, Nigeria. *J. Appl. Sci.* 30:105-110.
- Emelue, G.U., Evivie, S.E and Uwaifo, D.I. (2013): Effect of Smoking and Oven drying on the Proximate and Sensory Characteristics of grasscutter and antelope. *Biological and Environmental Sciences Journal for the Tropics* 10(4), ISSN 0794-9057.
- Eves, H., & Ruggiero, R.G. (1996) Socio economic study 1996, Nouabale-Ndoki National Park, Congo. Wildlife Conservation Society.
- Fa, J.E., Peres, C.A. & Meewig, J. (2002) Bush meat exploitation in tropical forests: an intercontinental comparison. *Conserv. Biol.* 16, 232–237.

Fargeot, C. & Dieval S. (2000). – La consommation de gibier à Bangui, quelques données économiques et biologiques. *Canopée*, 18, 5-7.

Food and Agriculture Organization (2001): *Improved meat drying in Asia and Pacific*. FAO Rome.

Igene, J.O and Tukura, D.H. (1986): Effect of processing methods on product characteristics, lipid, fatty acid composition and oxidative stability of smoke-dried beef. *J.Sci. Food Agric* 37:818

Ikeme A.J. and Uwagbute A.C. (1988): Effect on different method of smoking on proximate composition of lean and fatty fish proceeding of the 20th F.A.O. Expert consultation on technology in Africa. Abijan 28-29th April, 1988.

Janky O. M. Oblinger, J.L. Koburger, J.A. (1978) Sensory and micro biological evaluation of smoked cornished games hens, poultry, 54.

Jerozolinski A, Peres CA. 2003 Bringing home the biggest bacon: a cross-site analysis of the structure of hunter-kill profiles in Neotropical forests. *Biol. Conserv.* 111, 415–425.

Koppert, G., Dounias, E., Froment, A. & Pasquet, P. (1996). Consommation alimentaire dans trois populations forestières de la région côtière du Cameroun: Yassa, Mvae et Bakola. In *L'alimentation en forêt tropicale, interactions bioculturelles et perspectives de développement*, 477

Mbete RA, Banga-Mboko H, Racey P, Mfoukou- Ntsakala A, Nganga I, Vermeulen C, Doucet JL, Hornick JL and Leroy P. 2011. Household bushmeat consumption in Brazzaville, the Republic of the Congo. *Tropical Conservation Science* 4:187–202.

Ntiamoah-Baidu, Y. (1998): *Wildlife development plan 1998-200: sustainable use of bush meat*. Wildlife Department, Ministry of Lands Forestry, Accra, Ghana.

Peres CA. 2000 Effects of subsistence hunting on vertebrate community structure in Amazonian forests. *Conserv. Biol.* 14, 240–253.

Peres CA. 2011 Conservation in sustainable-use tropical forest reserves. *Conserv. Biol.* 25, 1124–11

Peres, C. A. and Lake, I. R. (2003). Extent of non-timber resource extraction in tropical forests: accessibility to game vertebrates by hunters in the Amazon basin. *Conservation Biology*, 17, 521–535.

Poirson, Jean-Michel. "Wild Meat/Bushmeat - Food Safety Implications." Lecture. Wild Meat, Bushmeat, Livelihoods, and Sustainability: Implications for Food Security, Zoonoses, Food Safety, and Biodiversity Conservation. Rome. 26 Oct. 2011. www.fao.org. UN Food and Agriculture Organization. Web. 24 May 2012.

Scones, I, Melnyk, M. And Pretty J. (1992); *The hidden Harvest; wild foods and Agricultural systems: A literature review and Annotated Bibliography*. ITED SIDA and WWF London, UK and Gland Switzerland.

Smith FA, Doughty CE, Malhi Y, Svenning J-C, Terborgh J. 2016 Megafauna in the Earth system. *Ecography* 39, 99–108.

Van Berkel, B.M., van den Boogaard, B. and Heijnen, C. (2004): *Preservation of fish and meat*. Agromisa foundations, Wageningen, pp46-52.

Wright, J. (2007): The value and significance of Bushmeat to rural communities in the Lebialem Highland of Cameroun: *The Geographical Journal Volume 171: Pp 10-16*.

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