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Evaluation Of The Effects Of *Anthonotha macrophylla* (Hardwood), *Dialium guineense* (Softwood) And Gas Oven On The Nutrient Composition And The Organoleptic Properties Of Smoked Dried *Clarias gariepinus.*

Okeke, P. A.[1], Adibe, A. C.[2], Ezenwenyi, J.U.[3], Ogbonnaya, H.F.[4], And Moghalu, K.[5]

[1, 2, 4 &5] Department of Fisheries and Aquaculture Management, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[3] Department of Forestry and Wildlife Management, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.
Corresponding Author: pa.okeke@unizik.edu.ng

Abstract: A comparative evaluation of the effect of using *Anthonotha macrophylla* (Hardwood), *Dialium guineense* (Softwood) and gas oven on the nutrient composition and organoleptic properties of smoked dried *Clarias gariepinus*. Thirty (30) table size *C. gariepinus* species with mean weight of 500gm were procured, killed, eviscerated, rinsed with clean water and cut into steaks. They were shared into three batches as treatments A, B and C respectively. Each treatment was immersed in 10% brine solution for 30 minutes. Treatments A and B were smoked with charcoal of *Anthonotha macophylla (*Hardwood) and *Dialium guineense* (Softwood) for 24 hours, and treatment C with gas oven for 12 hours. They were allowed to cool at ambient temperature. There was no significant difference ($p > 0.05$) in the proximate nutrient composition of the fish samples from the three treatments as determined by A.O.A.C. (2000) method. There was no significant difference ($p > 0.05$) among the sensory parameters (texture, taste, aroma and flavour), using the 9 – point hedonic scale, except for the flavour. Treatments A and B had higher score of ash than those smoked with treatment C. Although crude fat content of treatment C of 25.46% was higher than those smoked with treatments A and B with 20.19% and 21.19% respectively. The research showed that *A. macrophylla* (Hardwood), D. guineense (Haedwood) and gas oven sources of energy are suitable for smoke drying fish without negative effects on nutrient composition and organoleptic qualities. Smoking with hardwood is preferred than others as shown by this study.

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Key words: *Clarias gariepinus*, Hardwood and Softwood, Nutrient composition, Organoleptic qualities, Smoked dried,

1. Introduction

Clarias gariepinus (Mud Catfish) belong to the family clariidae, and is one of the most prevalence fish species found in the wild and cultured in sub- Saharan Africa. Qualities that endeared it to culturists include; ability to be reared in captivity, acceptability of artificial feed, high feed conversion rate (FCR), acceptability by the consumers, high fecundity, hardiness and disease resistance. It constitutes about 30% and 80% of captured and cultured fishery respectively in Nigeria and the annual production and demand continues to increase, consequence of improved culture system and increase in population.

Fish is a major alternative source of animal protein in the developing countries (Adeyemi *et al*., 2012). It contains protein of high digestibility, rich lysine and sulphur containing amino acid, required for the normal functioning of a healthy body (Ande *et al*., 2012).

Post harvest activities (processing, preservation, and marketing), has been problematic to fish farmers. Once fish is caught or harvested, spoilage sets in, which affects the organoleptics qualities (flavour, texture, taste and aroma) and sometimes the chemical composition (Gupta and Gupta, 2006). Fishes can be consumed cooked, preserved or processed (smoked or frozen) and form a more cherished delicacy that cut across socio-economic, age, religious and educational barrier (Ogbonna and Ibrahim, 2000 and Adbayo-Tayo *et al.,* 2008).

Smoking is one of the most important fish processing methods implored to prevent or reduce post-harvest fish losses and maintain nutritive value acceptable to consumers (Olagbemide, 2015). The acceptability of smoked fish depends on the type of wood used (Olorko *et al*., 2007). Eyo (2001) noted that the phenomenon of smoke production from wood is based on incomplete combustion followed

by thermal disintegration or pyrolysis of high molecular mass of organic compound to yield compounds of lower molecular mass which become volatile at the smoking temperature, which produces bacteriostatic, bactericidal and antioxidant effects on smoked fish.

Anthonotha macrophylla (Hardwood) and *Dialium guineense* (Softwood) are very prevalence types of wood in Nigeria used for smoke drying fish. They are classified as follows:

Anthonotha macrophylla:

Is an ever green shrub or tree with a wide spreading crown. It usually grow from 4 – 20m tall and exceptionally to 30m. It is often multi-spread and branching from rear to base. The bole can be 10 – 40cm in diameter. It is a hard type of wood and abounds in Nigeria. It is sometimes widening at base often with a straggling habit. The plant is harvested from the wild for local use as food medicine and source of wood material for fish smoking. It produces smoke that has bacteriostatic, bactericidal and antioxidant effects on smoked fish. It is sometimes grown as shade-producing and soil enrichment tree. It can be mistaken for *Anthonotha sympatric*. It is easy to distinguish when carrying fruits, less when in flower but difficult when in leaves.

Classification:

Kingdom - Plantae
Unranked – Angiosperm
Unranked – Eudicots
Unranked – Rosids
Order – Fabales
Family – Fabaceae
Sub family – Datariodeae
Genus – Anthonotha
Species – macrophylla

Dialium guineense:

Is a native of West African. In Nigeria, is commonly known as velvet tamarind. It is a tall tropical fruit bearing tree. It belongs to the family leguminosae and has a small typically grape sized edible fruits with hard brown inedible shells. It is ever green tree reaching up to 30m in height with a densely leaf crown but often shrub. Bole without buttresses, bark smooth grey. The leaves are composite, 5 – 13cm long, with an odd terminal leaflet and usually two pairs of opposite or alternate leaflets, the lower pair being smaller, with leaflets mostly 3.5 – 10.5cm elliptic and sometimes slightly obovate. The fruit is usually abundant, more or less circular and flattened, but sometimes almost globose and up 2.5cm in diameter, densely velvet and dark. The fruit is red with a sweet sour, astringent flavour similar to baobab, but sweeter. It is peeled and eaten raw. The thirst- quenching, refreshing fruit pulp can also be soaked in water and drunk as beverages. The leaves are edible but bitter.

The wood is soft, durable, light brown, with a fine texture. It is used for vehicle, housing, flooring and as fire-wood for making charcoal used in cooking and fish smoking. The back and leaves are used against several diseases. The tree is used as a natural fallow species for fertility restoration of the soil. It is classified as follows:-

Kingdom – Plantae
Sub kingdom – Tracheobionta - Vascular plant
Sub division – Spermatophyta – Seed plant
Division – Mangoliophyta – Flowering plant
Class – Mangliopsida
Super order – Rosanae
Order – Fabales
Family – Fabaceae – pea,legumes
Genus – Dialium
Species-guineense – velvet tamarid

This research is aimed at evaluating the proximate nutrient composition and organoleptic qualities of *C. garieepinus* smoked dried with *Anthonotha macrophylla* (Hardwood), *Dialium guineense* (Softwood) and gas oven.

Material and Methods

Thirty (30) table size *C. gariepinus* of 500gm mean weight were procured from Okeb Fish Farm, Amawbia Town, in Awka South Local Government Area of Anambra State, Nigeria. They were transported to the Organic Fish Farm of the Department of Fisheries and Aquaculture Management, Nnamdi Azikiwe University, Awka for immediate processing. They were randomly selected and grouped into three equal batches of A, B and C. Fishes in each batch were killed, eviscerated, washed thoroughly, CUT INTO steaks and subsequently immersed in 10% brine solution obtained by dissolving 1kg of salt in 10 litres of water (Oguntokun, 2000). Each batch was smoked dried using improved smoking kiln, and the energy sources were *Anthonotha macrophylla* (Hardwood), *Dailium guineense* (Softwood) and Gas oven as treatments A, B and C respectively. The fish in the kiln were constantly turned at intervals to prevent charring in order to obtain uniform smoked products. The hot smoking lasted for 24hrs. for treatments A and B, and 12hrs. for treatment C. The fish samples were allowed to cool at ambient temperature.

The proximate nutrient composition of smoked dried flesh of *C. gariepinus* of protein, crude fibre, fat, minerals and moisture, were determined using standard procedure of A.O.A.C. (2000). The organoleptic qualities assessment of taste, texture, flavour and colour of smoked *C. gariepinus*, were subjected to a 9 – point hedonic scales. Where 9 represent like extremely, 8 – like very much, 7 – like moderately, 6 – like slightly, 5

– neither like nor dislike, 4 – dislike, 3 – dislike moderately, 2 – dislike very much, 1 – dislike extremely (Munoz and King, 2007). Panellists were requested to rinse their mouths thoroughly with water after testing each sample to eliminate bias in judgement and evaluation.

Data collected were subjected to one way analysis of variance (ANOVA) at ($p < 0.05$) level and significance test for difference between samples using Least Significance Difference (LSD) in comparison.

Results

The results of weight loss of *C. gariepinus* smoked dried with treatments A, B and C are recorded in table 1.

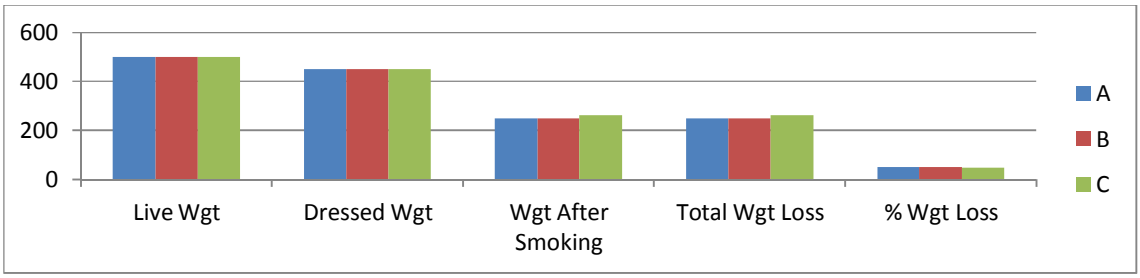

Figure 1: The various weights of *C. gariepinus* before and after smoked drying with different energy sources

Table 1: Final weight of *C. gariepinus* after smoking for 24 hrs. using treatments A and B woods and 12 hrs. with treatment C. energy sources

TREATMENTS	**A**	**B**	**C**
PARAMETERS	**(gm)**	**(gm)**	**(gm)**
Anthonotha macrophylla	***Dialium guineense***	**Gas oven**	
Live weight	500	500	500
Dressed WT Fish	450	450	450
WT After Smoking	250	260	240
Total WT loss	250	260	240
% WT Loss	50%	48%	52%

Table 2: Percentage proximate nutrient composition of *C. gariepinus* smoked with treatments A, B and C. Values with the same superscript on the same row has no significant difference ($p > 0.05$)

Treatments	**A**	**B**	**C**
Parameters	***A. macrophylla***	***D. guineense***	**Gas oven**
Protein	68.17^{a}	68.07^{a}	66.62^{a}
Ash	5.40^{a}	5.94^{a}	2.34^{b}
Fat	20.19^{a}	21.19^{a}	25.46^{b}
Moisture	6.51^{a}	6.90^{a}	5.10^{b}
N_2 Free Extract	1.27^{a}	1.84^{b}	1.33^{c}

Table 3: Organoleptic assessment of *C. gariepinus* smoked with treatments A, B and C energy sources

Treatments Parameters	A	B	C
Texture	**6.3**[a]	**6.5**[a]	**6.4**[a]
Colour	**6.8**[a]	**6.4**[a]	**6.5**[a]
Taste	**8.1**[a]	**7.9**[a]	**6.8**[b]
Flavour	**7.8**[a]	**7.9**[a]	**6.3**[b]

Values with the same superscripts on the same row has no significant difference ($p > 0.05$)

Discussion

Eyo (2001) noted that wood used for smoking of fish, composed of celluloses, hemicelluloses and lignin, which percentage content in wood are celluloses (40 – 60%), hemicelluloses (20 – 30%) and lignin which are highly cross-linked phenolic polymer (20 – 30%) and whose distribution in wood varies with hemicelluloses (20 – 30%) in hardwood and 20% in softwood.

Moisture

Fish is a very perishable commodity because of its high moisture content, which predisposes it to spoilage once caught or harvested. Smoking fish help to reduce the moisture content in order to eliminate those conditions that will trigger spoilage, which in turn will affect the odour/flavour, texture, colour and taste, and sometimes changes the chemical composition of the fish (Dewi *et al*., 2011). The percentage moisture loss in this research are 50%, 48% and52% for treatments A, B and C respectively and these are within the range of 50 - 60% recorded by Cardinal et al (2001) in smoked dried catfish.

Ash

The ash content of C. *gariepinus* were low and there was no significant difference ($p > 0.05$) as shown in table 2 and figure 1. Table 1, shows that *C. gariepinus* smoked dried with Trt. B (*D. guineense*), recorded the highest final weight of 260gm, followed by Treatments. A (*A. macrophylla*) and B (Gas oven) with 250gm and 240gm respectively.

Protein

The heat generated by the wood type has great impact on the nutrient composition of *C. gariepinus*. High temperature denature the protein which is essential for the normal function , growth and maintenance of the body tissues, which content is considered to be an important tool for the evaluation of physiological standard (Guaquelin *et al.,* 2007). Table 2 shows *C. gariepinus* smoked with treatment A recorded protein of 68.10%, followed by treatments B and C with 68.07% and 66.60% respectively and there was no significant difference ($p > 0.05$) in the protein content of the fish samples. These values were similar to the

value of 68.40% reported by Olayemi *et al.* (2011), but slightly higher than the value of 64.70% recorded by Ime – Ibanga and Fakunle (2008).

Fat

The lipid content recorded in treatment C fish sample, was the highest of 25.46%, followed by treatments B and A samples of 21.19% and 20.01% respectively. This significant difference ($p < 0.05$) can be adduced to the fact that the gas oven dried fish sample did not lose its' oil in the drying process compared to treatments A and B fish samples.

Organoleptic Assessment:

The organoleptic qualities (texture, colour, taste and flavour) of smoked dried fish, determines the acceptability to consumers and the market prize of the fish. This research shows that all the treatments of A, B and C sources of energy used in smoke drying *C. gariepinus* are good as shown in table 3. The fish sample smoked with Trt. C (*D. guineense*) had the highest ranking of 6.6 in terms of texture, followed by Trts. C (Gas oven) and A (*A. macrophylla*) with 6.4 and 6.3 respectively. Samples of treatment A, had the highest value of 6.8 for colour. This agrees with Eyo (2001) that had noted that hardwood gives best colour. But advice that the hardwood must be tested before using, reason being that some hardwood can impact dark colour and bitter taste on smoked fish. Treatment A fish sample recorded the highest value of 7.9 for flavour, followed by treatments B and C samples with 7.8 and 6.3 respectively. Treatment A recorded the highest value of 8.10 for taste, followed by treatments B and C, with values of 7.9 and 6.8 respectively. Eyo (2001) traced this high taste value of fishes smoked with hardwood to higher content of some phenolic compounds particularly quaiacol and syringol than phenol and cresol in hardwood and yield more acid than softwood which aid in fish preservation.

Conclusion

The taste and colour of smoked dried *C. gariepinus* are among the important factors in the marketability, because consumers preference of choice depend on it. This research has shown that *C. gariepinus* smoked with *Anthonotha macrophylla* (Hardwood) and *Dialium guineense* (Softwood), compared favourably and are better than *C. gariepinus* gas oven dried fish, in terms of nutrient composition and organoleptic qualities. This research shows that both hard and soft woods, possessed good potentials as fuel for smoke drying catfish – *Clarias gariepinus* without inhibiting the nutrient composition and consumer's acceptability. However, technology of kiln smoking with wood should be popularize among the rural fish processors because of the availability of cheap energy sources (wood) in the community.

Corresponding Author:
Dr. Okeke Parick Amaechi
Department of Fisheries and Aquaculture Management, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
Telephone: 08063773005
E-mail: pa.okeke@unizik.edu.ng

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