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Effects of Drying Methods on Proximate Compositions of *Clarias gariepinus* and *Oreochromis niloticus* in the Semi-arid zone of Nigeria

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Abstract: *The effects of different processing methods (oven drying, sun drying and smoking) on the proximate composition of two fresh water fish species (Clarias gariepinus and Oreochromis niloticus) were investigated. The result of the proximate composition of the fish species showed that the highest protein content of 54.62% and 35.95 were obtained in sundried C. gariepinus and smoke-dried O. niloticus respectively. Moisture content was consistently lower in the sundried samples of both species of fish examined, suggesting the superiority of this method for prolonged storage of fish over Smoking and oven drying. Generally, the nutrient content analysed were higher than previous results obtained from Fresh sample of both species. The results revealed that processing methods have some degrees of influence on the nutrient and storage quality of C. gariepinus and O. niloticus particularly in the semi-arid zone of Nigeria.*

Key words: *C. gariepinus. O. niloticus, Smoking, Sundrying, Oven drying*

INTRODUCTION

Fish is a nutrient rich food and a very good source of vitamins and minerals required by humans (Ojikutu *et al*., 2009; Marimuthu *et al*., 2012). It is widely consumed in many parts of the world because of it high protein content due to low saturated fat and well balanced essential amino acids. According to FAO (2008) and Gandotra *et al.* (2012), 20% of global animal protein intake however, in developing countries, it provides only 13% of the above estimate.

Fish is a most perishable product owing to its susceptibility to microbial and enzymatic deterioration and quality reduction if proper steps are not applied to process it after harvesting, because, the fish may lose its organoleptic characteristics and becomes progressively more unacceptable for human consumption (Emokpae, 1985). An estimated 50 % of the fish produced in the remote coastal settlements and hinterland perish before reaching the consumers, as a result of poor handling, preservation and processing practices adopted by the artisanal fishers, commercial fish farmers and fisheries entrepreneurs (Eyo, 1997).

Smoking and drying are among the oldest means of processing and preservation of Fish by Fisher forks all over the world. Methods of drying and smoking of fish vary between different countries and within the same country depending on the species of fish used and

the type of product desired. The fish may be dried only or smoked only or there may be a combination of smoking and drying. In some countries the fish is boiled before being smoked and/or dried. Adding to this complexity, the fish species used as raw material may be fresh water or marine species and may range from very lean to fatty fishes and its condition from fresh to stale. This variation makes it difficult to arrive at general conclusions regarding processing effects of smoking and drying on protein quality and the proximate compositions of the final products (Ogbonnaya and Ibrahim, 2009).

This is because heating, freezing and exposure to high concentration of salt lead to chemical and physical changes and therefore digestibility is increased, due to protein denaturation protein, but the content of thermolabile compounds and polyunsaturated fatty acids is often reduced (Eve and Brown, 1993, Tao and Linchun, 2008). Similarly, due to the control nature of electrically operated oven, the shelf life of fish dried using such equipment may vary from that of fish dried using a smoking kiln and or sundried. This study was therefore carried out to investigate the effects of different drying methods on proximate composition of Nile Tilapia, *Oreochromis niloticus* and *Clarias gariepinus*. The two species were chosen for this work based on the fact that they have good consumer acceptance, are economically viable and are in low fat content (Osibona, 2009). They are also the most farmed fish in Nigeria and have been playing an increasingly important role in the nation's nutrition as source of relatively cheap animal protein

MATERIALS AND METHODS

Experimental Site

The study was conducted in fish processing and post-harvest unit of Department of Fisheries, Faculty of Agriculture, University of Maiduguri, Borno state.

Sample Acquisition and Preparation

The fish species used in this study were *C. gariepinus*, and *O. niloticus* were purchases from Gamboru market in Maiduguri Borno state. The Fresh samples were transported to the fish processing unit laboratory of the Department of fisheries University of Maiduguri, were the average weight of each species of fish was obtain using sensitive electrical weighing balance. In preparation to the drying process, individual Fish were washed to remove slime, gutted then washed again to remove blood and gut content smears and left to drain moisture under shade 60minutes. Each treatment was divided into three batches one smoked over firewood, one oven dried and the remaining one sun dried in an open ambient temperature.

Drying Techniques

Sundrying: The fish were dried following the modified method of Sajib *et al*. (2015) by exposing to ambient sunlight at temperatures of 35-42°C on drying racks made of plastic coated metallic wire mesh racks. The racks with fishes were covered with fishnets during day time to prevent insects and other pests. At night, the racks were covered with plastic sheets to prevent water condensing on the drying fishes. After drying, they were allowed to cool naturally to ambient temperatures of 23-25°C. Sun-dried product was packaged with plastic bag and stored at room temperature until analyzed.

Smoke drying: The fishes were smoked in a drum kiln. Heat was generated by the burning of Firewood. The chamber was pre-heated for 15 min and then loaded the fish samples onto the removable wire mesh trays in the central chamber for the smoking process. The desired temperature (75-80°C) was maintained manually by using a thermometer. Smoking was

done approximately for 4 h. During smoking, fish samples were turned upside down in middle period, to make the sample smooth and steady in texture and appearance. Then the samples were cooled for 20-30 min at ambient temperature. The cooled smoked fish samples were then packed and sealed in vacuum condition in polythene bags until analyzed.

Oven drying: About 500g of both *C. gariepinus* and *O. niloticus* were separately arranged on metal mesh tray and dried using electric oven at a temperature of 120C for 30 minutes. Thereafter, samples were taken for proximate analysis as earlier described.

Proximate Analysis

The proximate analysis of the fish sample was determined by (AOAC, 1990) initially at the beginning of the experiment and finally at end of experiment.

Dry matter

The dry matter content of the samples were determined by weighting 10g of samples were into petri dish while placed in hot oven at 105^0C for 24 hours. And then removed and placed in dessicator to cool, after cooling you reweighting.

The dry matter content was calculated using the formular:

$$\frac{W_2 - W_3 \text{ X } 100}{W_1 - W_2}$$

Where

W2: weight of petri dish with sample in grammes before oven dried.

W3: weight of petri dish wih sample in grammes after oven dried.

W1: weight in grammes of empty petri dish.

Crude Protein

Crude protein contents was analyzed using keljedal tablets and 1g or 2g of samples was weighed into a digestion tube and 1 or 2 keljedal tablets were added, 10 or 20mins of concentrated sulpheric acid was added onto the tube and digested at 420^0C for 3 to 5 hors. After cooling 80mls or 90mls of distilled water was added into digested solution. About 50mls of 40% caustic soda (NaOH) was added on to 50mls of digested and diluted solution and their placed on heating section of the distillation chamber, 30mls of 4% boric acid, plus bromocresol green and methyl red as an indictor was put onto conical flask and placed underneath the distribution chamber for collection of ammonia, the solution of hydrochloric acid (HCL) was weighed into burrette. The conical flask containing the solution was titrated until the colour changes from green to pink. The burette reading was taken. The crude protein was calculated using the formular;

$$\%CP = \frac{(A-B) \text{ X } N \text{ X } F \text{ X } 6.25 \text{ X } 100}{\text{Mg of samples}}$$

A: mls of acid used for titrating the samples

B: ml of acid used for titrating blank samples (0)

N: normality of acid used for titration

F; factor is 14.007

6.25: is constant

100: conversion to percentage

Crude Fibre

Crude fibre was determined by weighting 2g of samples was placed in a round or flat bottom flask and 50mls of tri-chloroacetic acid reagent (TCA) was added the mixture was boiling and refluxed for 40 minutes. Filter paper was removed and cooled to room

temperature. Filter paper was used to filter the residue. The residue obtained was washed to 4 times with hot water and once with petroleum ether then the filter paper plus the sample were folded together and dried at 30^0C -60^0C in an oven for 24 hours. Reweighted and then at 650^0C and then reweighed.

%CF = Differences in weight x 100
Weight of sample on DM basis

Ether Extract (FAT)

The ether extract was determined by using soxhlet apparatus, 1 or 2g of the feed sample was weighted into a thimble and 200 mls of petroleum ether was measured to with measuring cylinder, the solution was put into round or flat bottom flask and was at 45 for 1hour interval for 2hours. The collecting flask was removed and cooled into dessicator for 15 minutes and percentage fat samples were determined by using the formula.

% fat = weight of fat x 100
Weight of the sample

Ash

To determine the ash content, 1g or 2 g of sample was sample was weighted into crucible and dried at 105^0C for 24 hours, then cooled in the dessicator for 15 minutes and reweighed, it was then chorred at 600^0C or 650^0C in muffle furnace for 2-3 hours. Then cooled for 15 minutes and reweighted dessicator.

% Ash= loss in weight x100
Initial weight

Carbohydrate (NFE)

A percentage carbohydrate was determined by computing indirectly by difference using formula.

% carbohydrate =100 – (% mc + %ash +Cp +Cf)

Data Analysis

Results obtained after the chemical analysis were subjected to One way analysis of Variance and where significant differences ($P<0.05$) were observed, LSD was used to separate mean.

RESULTS

The results obtained from proximate composition analysis of the differently processed wild *Clarias gariepinus* and *O. niloticus* are presented in Tables 1 and 2.

Effects of processing methods on Proximate Composition of *C. gariepinus*

The percentage moisture contents of *C. gariepinus* processed by sun-drying, smoking and oven-drying were 4.71, 4.49 and 4.16% respectively. The sun-dried product had the highest moisture content which is significantly different ($p<0.05$) from oven-dried. This is followed by smoked-dried with 4.49% but did not differ significantly from the two methods above.

The percentage crude protein content of *C. gariepinus* by sun-drying, smoking and oven-drying were 54.13, 47.50 and 54.62 respectively. The oven-dried sample had significantly highest crude protein content compared to smoke-dried but not significantly different compared to sun-dried sample.

The percentage lipid contents of *C. gariepinus* processed by sun-drying, smoking and oven-drying were 16.36, 20.96 and 25.37 respectively. The oven-dried samples recorded the

highest fat content which is significantly different from smoked-dried and sun-dried samples respectively. The fat content varied significantly (P<0.05) across treatments.

Table 1: Proximate composition of Smoked, Sun-dried and Oven dried *C. gariepinus*

Samples	Moisture	Protein	Fat	Ash	NFE
Smoked	4.71 ± 0.15[a]	54.13 ± 018[a]	18.29± 0.08[a]	6.52 ± 0.16[b]	16.36 ± 0.06[c]
Oven dried	4.49 ± 0.01[ab]	47.50± 0.35[b]	18.23 ± 0.04[a]	8.82 ± 0.01[a]	20.96 ± 0.37[b]
Sun dried	4.16 ± 0.13[b]	54.62 ± 0.18[a]	14.11 ± 0.09[b]	1.74 ± 0.89[c]	25.37 ± 0.85[a]

Values (Means ± SE) having dissimilar superscripts across a column differed significantly (P0.05) from one another

The percentage Ash contents of *C. garipinus* processed by sun-drying, smoking and oven-drying were 18.29, 18.23 and 14.11% respectively. The sun-dried sample had the highest Ash content which differed significantly from oven-dried but similar to values obtained from the smoked-dried sample.

The percentage carbohydrate (NFE) contents of *C. gariepinus* processed by sun-drying, smoking and oven-drying were 6.52, 8.82 and 1.74 respectively. The smoked-dried sample had the highest NFE content which is significantly different from smoked-dried and oven-dried samples respectively.

Effects of the processing methods on Proximate Composition of *O. niloticus*

The percentage moisture contents of *O. niloticus* processed by sun-drying, smoking and oven-drying were 4.71, 4.81 and 4.00 respectively. The smoked-dried product has the highest moisture content which is significantly different from the lowest value obtained from oven-dried samples.

The percentage crude protein contents of *O niloticus* processed by sun-drying, smoking and oven-drying were 35.95, 32.50 and 33.75% respectively. The sun-dried product had the highest protein while the lowest crude protein was obtained from the smoked dried samples. However, no significant differences (P<0.05) existed between from sun-dried and smoked-dried.

The percentage lipid contents of *O. niloticus* processed by sun-drying, smoking and oven-drying were 17.25, 11.64 and 20.38 respectively. The oven-dried product has the highest content which is significantly (P<0.05) different from smoked-dried and sun-dried samples respectively.

The percentage Ash contents of *O. niloticus* processed by sun-drying, smoking and oven-drying were 18.30, 18.28 and 17.88% respectively. The sun-dried sample recorded the highest ash content but no significant differences (P>0.05) existed among the three treatment groups.

The percentage carbohydrate contents of *O. niloticus* processed by sun-drying, smoking and oven-drying were 23.81, 32.28 and 24.01 respectively. The smoked-dried samples had the highest content which is significantly different from sun-dried and oven-dried.

Table 1: Proximate composition of Smoked, Sun-dried and Oven dried *O. niloticus*

Samples	Moisture	Protein	Fat	Ash	NFE
Smoked	4.71 ±0.08[a]	35.95 ±1.24[a]	18.29±0.07[a]	23.81 ± 1.23[b]	17.25 ±0.08[b]

Oven-dried	4.81 ± .07[a]	32.50 ± 0.35[b]	18.28 ± 0.15[a]	32.27 ± 1.14[a]	11.64 ±0.63[c]
Sun dried	4.00 ±0.00[b]	33.75±0.33[ab]	17.88 ± 0.18[a]	24.00 ± 0.69[b]	20.37± 0.85[a]

Values (Means ± SE) having dissimilar superscripts across a column differed significantly (P0.05) from one another

DISCUSSION

The findings of this study showed the moisture contents of all the species studied to be higher in sun-dried than smoked and oven-dried products. This could be due to variation in the intensity of heat generated by the flat forms used for the drying of the samples. High moisture content has been reported to be a disadvantage in that it increases the susceptibility of the dried fish to microbial spoilage, oxidative degradation of polyunsaturated fatty acids and consequently decreases in the storage quality of the product (Olayemi *et al*., 2011). This suggests that sun-dried products are likely to get spoiled within a short period than smoked and oven dried fish respectively.

However, crude protein contents of the products of all the species studied showed sun-dried to be the highest. This could be probably due to the effects of heat on protein which reported findings showed to have denaturation tendencies towards protein. Generally, the oven dried samples in the two species studied showed lower levels of protein compared smoked and sun dried samples respectively. This is contrary to previous findings of Doe and Olley (1982; Salan *et al*. (2006); Niwaye and Rathnakumar (2008) and Adewumi *et al* (2015) who reported increased protein concentration due to smoking and oven drying of fish.

In both species investigated, Lipid content was generally affected by the drying methods adopted. For instance, the sundried samples consistently showed lower lipid content compared to smoking and oven drying respectively. This may be as a result of extended heat treatment during which the fats exude via evaporating moisture. The phenomenon of Fat exude with the moisture evaporation through extended heat treatment had previously reported by Oparaku and Nwaka (2013) and Adewumi *et al* (2015). Smoke-drying seems to enhance this phenomenon in this experiment. Lipid is a measure of the fat content of fish and concentrated source of in the diet. Low lipid is desirable as to reduce oxidation and rancidity in the fish products which cause off-flavor and bad taste in fish products (Oparaku and Nwaka, 2013).

Generally, there were appreciable quantities of ash in both species examined and drying methods adopted. The observation in this work is in agreement with Clucas and Ward (1996) who reported that the increase in ash content when fish are smoked and oven dried is due to loss of humidity. Owaga *et al*. (2009) also reported that the inorganic content remains as ash,after the organic matter is removed by incineration. Total ash value is an indicator of the total mineral element contents in fish (Turkkan *et al*., 2008)

CONCLUSIONS

The result of moisture content indicated that sun dried products were consistently lower in both species studied suggesting that it could be the best method for fish intended for prolonged storage. However, to preserve lipid content of fish, smoke drying may be the best alternative since extended heat treatment by sun drying showed decrease lipid content of the samples studied.

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REFERENCES

Adewumi A. A., Ogunlade I., Coker Folakemi Funmilayo (2015). Effect of Processing on the Nutritive Value ofClarias gariepinusfrom Isinla Fish Pond, Ado Ekiti, Nigeria. Am. J. Bio Sci. 3 (6): 262-266.

Clucas, I. J. and A. R. Ward, Harvest fisheries development; A guide to handling, preservation, processing and quality. Natural Resources Institute, UK. 1996, 5: 428.

Emokpae, A. O. (1985). Organoleptic Assessment of Quality of Fresh Fish. Nigerian Institute of Marine Research Paper, 27: 1 – 30.

Eves, A. and R. Brown, (1993). The Effect of Traditional Drying Processes on the Nutritional Values of Fish. Tropical Sci., 33: 183-189.

Eyo, A.A., 2001. Fish Processing Technology in the Tropics. National Institute for Freshwater Fisheries Research (NIFFR), New Bussa, Nigeria, pp: 10-170.

FAO., 2008. Fisheries and Aquaculture Report. No. 889. Food and Agriculture Organization of the United Nations (FAO), Cairo, pp: 61.

Gandotra, R., M. Koul, S. Gupta and S. Sharma, 2012. Change in proximate composition and microbial count by low Temperature preservation in fish muscle of Labeo *Rohita* (Ham-Buch). IOSR J. Pharm. Biol. Sci., 2: 13-17.

Marimuthu, K., Thilaga, M., Kathiresan, S., Xavier, R., Mas, R.H. (2012). Effect of different cooking methods on proximate and mineral composition of striped snakehead fish (*Channa striatus,* Bloch). *J. Food Sci. Tech.*, 49(3). 373-377.

Niwaye , A. S. and Rathnakumar, K. (2008). Fish processingtechnology and product development: Impact of Curing(1sted). Alden Publications, New York, USA., p5: 142.

Ogbonnaya, C. and Ibrahim, M. S. (2009). Effects of Drying Methods on Proximate Compositions of Catfish (*Clarias gariepinus*). World Journal of Agricultural Sciences 5 (1): 114-116.

Ojutiku, R.O., Kolo, R.J., Mhammed, M.L, Comparative study of sun drying and solar tent drying of *Hyperopisus bebeoccidentalis*. *Pak. J. Nutr*, 8 (7). 955-957.

Olayemi, F. Adedayo, E. Bamisaye, E. and Awagu, E. (2011). The nutritional quality ofthree varieties of Zobo (Hibiscussabdariffa) subjected to the same preparation condition. Am. J. Food. Tech., 6(8): 705-708.

Osibiona AO, Kusemeju K, Akande G R (2009). Proximate composition and fatty acid profile of the African cat fish (Clarias gariepinus). Acta SACEA, 3: 85-89.

Owaga, E. Onyango, C and Njoroge. C. (2009) Effects of selectedwashing and drying temperatures on bacterial quality andsafety of dagaa (Rastrineobola argentea). J. Tropic.Microbiol. Biotech., 4(1): E. Deckere, Possiblebeneficial effect of fish and fish n-3 polyunsaturated fattyacids in breast and colorectal cancer. European J. Cancer Prev. 1999, 8: 213-221.

Salán, O. E, Juliana AG, Marilia, O. (2006). Use of smoking to add value to salmoned trout.

Braz. Arch. Biol. Technol. 49(1): 57-62.

Tao, W. and M. Linchun, 2008. Influences of Hot Air Drying and Microwave Drying on Nutritional and Odorous Properties of Grass Carp (*Ctenopharyngodon idellus*) Fillets. Food Chem., 110 (3): 647-653.

Turkkan, A. Cakli, S. and B. Kilinc, (2008). Effects of cookingmethods on the proximate composition and fatty acidcomposition of sea bass,Dicentrarchus labrax(Linnaeus1758). Food and Bioproducts Proc., 86: 163-165.