EFFECT OF SELECTED HEAT SOURCE ON MICROBIAL LOAD AND WATER HOLDING CAPACITY OF TILAPIA FISH

[1]Awolumate, S., [2]Oshibanjo, D. O., [2]Mohammed, M. Y., [3]Ositimehin, K. M., [2]Oyedapo, F. A., [2]Kakwi, D. G., Dashe M.P and Anthony Benjamin

[1]Department of Animal Science and Fisheries, Faculty of Agricultural Sciences,
National Open University of Nigeria.
[2]Animal Production Department, University of Jos, Jos.
[3]Department of Fisheries, Lagos State University, Lagos State Nigeria.
sawolumate@noun.edu.ng, 08033895066

ABSTRACT

The influence of three heat sources on the microbial load of Tilapia (*Oreochromis niloticus)* was investigated. Twelve *Oreochromis niloticus* averaging 658±25g in weight were utilized. The fish flesh was smoked using charcoal, gas, and microwave. Standard technique was used to analyze the microbiological load and water holding capacity (WHC) of the smoked Oreochromis niloticus. The data were analyzed using graph pad prism and one-way ANOVA with a significance level of 0.05. Microwave-smoked Tilapia had the highest microbial count and WHC of 2.00 (CFU/g) and 47.78%, while gas-heated Tilapia had the lowest values of 1.00 (CFU/g) and 37.78%, respectively. Using a gas heat source to smoke Tilapia fish has good potential as a smoking fuel due to its capacity to reduce microbial load, as shown by the results of this experiment.

Keywords: Charcoal, gas, microwave, bacterial count and *Oreochromis niloticus*

INTRODUCTION

Fish is an essential animal protein source for human diet. Fish is a highly healthy food, and its protein, which is comparable to that of meat and egg, is particularly valued (Ojutiku *et al.*, 2009). It contains high-quality protein, amino acids, and dietary minerals (Bruhiyan *et al.*, 1993). It has become increasingly important to ensure that fish once caught is fully and efficiently utilized to avoid deterioration. Fish is preserved using a variety of methods, including sun drying, solar drying, canning, and smoking, among others, to extend its shelf life. Dried fish is a significant component of the harvested fishery in numerous nations, including Nigeria. 25 to 30 percent of the world's fish catch is consumed dried, salted, smoked, or as a mix of these methods (Aliya et al., 2012). It has been found that different processing and drying methods have varying effects on the nutritional contents of fish, despite the fact that some of these preservation processes are essential (Oparaku and Mgbenka, 2012). The effects of smoking fish have piqued the interest of a number of researchers (Ahmed et al., 2011; Olayemi et al., 2011; Aliya et al., 2012; Omodara and Olaniyan, 2012). Several of these authors have found that smoking fish hastens drying (that is, reduces moisture content or water activity) and inhibits microbiological activity on the fish. The aim of this study is to determine the impact of three heat sources on the microbial load and water-holding capacity of *Oreochromis niloticus*).

MATERIALS AND METHODS

Experimental Site

This experiment was carried out at Animal Products and Processing Laboratory, Department of Animal Production, University of Jos, Jos, Plateau State.

Procedure

A total of fifteen *Oreochromis niloticus* mean weight of 658±25g were purchased. The live weights were taken using digital weighing balance. The fish were gutted, washed thoroughly with water to remove slime and blood; thereafter, the dressed weights were taken. The fish were transferred into a basket for proper draining of water prior to smoking. They were also covered with a muslin cloth to prevent dust and flies.

Smoking process

To ensure uniform smoking, charcoal (charcoal pot), gas heat source, and microwave, the fish was covered with a cardboard box to retain heat from the smoke and prevent dust and flies from contaminating it. The smoked products were measured for moisture loss by weighing them.

Microbial Analysis: Microbial load of the dried fish was conducted using the pour plate water method of Harrigan and McCanee (1976).
Water holding capacity: Water Holding Capacity (WHC) was determined according to the methods of Wardlaw *et al.* (1973).
Statistical Analysis
The multiple t-tests of graph on excel was used to plot graph with results presented as mean ± standard deviation. A 95% confidence interval was used to determine the statistical.

RESULTS
Effect of heat sources on microbial count of roasted Tilapia fish.
Figure 1 reveal the influence of the heat sources on the microbiological count of dried Tilapia fish. Tilapia fish dried with microwave heat source had the highest microbial count of 2.00 (CFU/g), followed by Tilapia fish dried charcoal heat source 1.33 (CFU/g) and Tilapia fish dried with gas heat source 1.00 (CFU/g).
Effect of heat sources on water holding capacity of roasted Tilapia fish.
Figure 2 shows the effect of heat sources on water holding capacity (WHC) of dried Tilapia fish. Tilapia fish dried with microwave heat source had the highest water holding capacity of 47.78%, followed by Tilapia fish dried with charcoal heat source with 38.89% and Tilapia fish dried with gas heat source had the least WHC 37.78%.

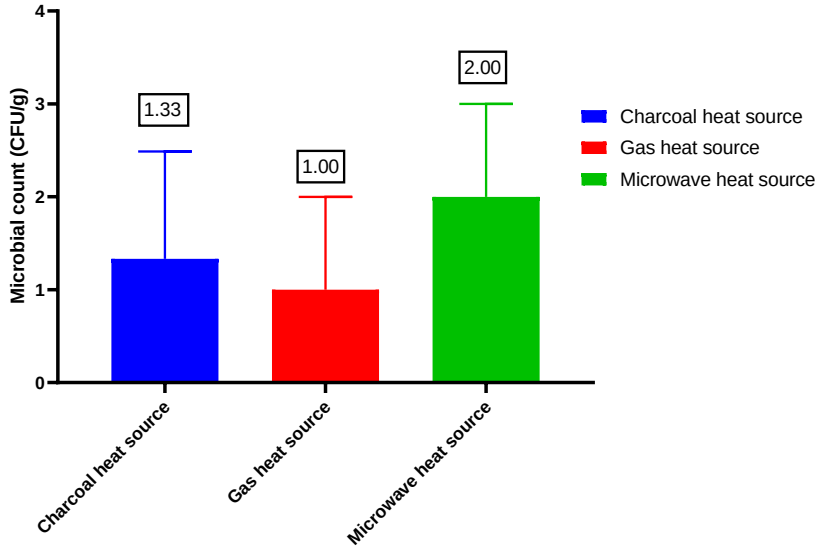

Figure 1: Effect of heat sources on microbial count of dried Tilapia fish

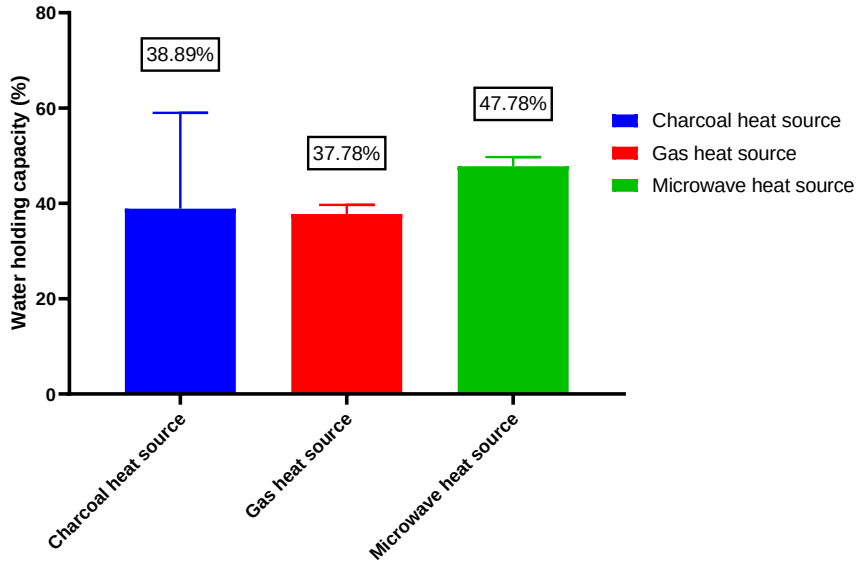

Figure 2: Effect of heat sources on water holding capacity of dried Tilapia fish

DISCUSSIONS

Bacterial load in fish might increase with the increase of water temperature (Fernandes *et al,* 1997). Choudhury *et al,* (1989) reported intestinal bacterial load of Tilapia fish as 5.5 x 109 cfug. It has been discovered that microbial load increases as available water increases for microbial growth increases. The existence of bacteria in the microwave heat source may be attributable to the amount of water present in the fish, often known as water activity. Agnihorti and Pal (2000); Oshibanjo (2017). Dharrmaveer, *et al*. (2007) reported higher values (2007) of water holding capacity. This was in agreement with the higher TCA soluble peptides and lower total collagen content when applied more severe SV cooking condition. Actin and myosin hold 80% of the total water in muscles so with denaturation of these filaments the water. holding capacity is reduced. The decrease in WHC of the fish flesh may lead to increased cooking loss and detrimental changes in texture. During cooking, particularly when increasing the temperature or time of cooking, extracellular spaces of the fish flesh can expand, and the breakage of pericellular layers along with the shrinkage of myofibrils and collagen can induce. This phenomenon results in the emergence of intracellular gaps in the flesh, leading to impaired muscle integrity and reduction in texture parameters ofthe fish (Cropotova *et al.,* 2018).

CONCLUSION

Result obtained from this investigation indicated that using gas heat source to smoke Tilapia fish had good potential as a fuel for smoking due to its ability to reduce microbial

References

Agnihortri, M. K. & Pal, U. K. (2000): Effect of Tetra sodium pyrophosphate (TSPP) on quality of chevon sausages. *Indian Journal of Animal Science.* 67:1000-1003.

Ahmed A, Dodo A, Bouba A, Clement S, Dzudie T (2011). Influence of traditional drying and smoke-drying on the quality of three fish species (Tilapia nilotica, Silurusglanis and Arius parkii) from Lagdo Lake, Cameroon. *J. Anim. Vet. Advan*. 10(3):301-306

Aliya G, Humaid K, Nasser A, Sami G, Aziz K, Nashwa M, Ponnerassery SS (2012). Effect of the freshness of starting material on the final product quality of dried salted shark. *Advan. J. Food Sci. Technol*. 4(2): 60-63.

Bruhiyan AKM, Ratnayake WMN, Aukman RG (1993). Nutritional composition of raw fish and smoked Atlantic mackerel, oil and water soluble vitamins. *J. Food comp Anal*. 6:172-184.

Chowdhury, M.B Munirzzaman, M and Uddin, M.N. (1989) Study on the intestinal bacterial flora of Tilapia. Oreochromis niloticus. Bangladesh aquaculture 11:65-70

Cropotova, J., Mozuraityte, R., Stadal, I. B., & Rustad, T. (2018). A non-invasive approach to assess texture
changes in sous-vide cooked Atlantic mackerel duringchilled storage by fluorescence imaging. Food Control,92, 216-224.

Dharrmaveer, S., Rajkumar, V. And Mukesh, K. P. (2007): quality and shelf life of smoked chevon sausages packed under vacuum and stored at 4± ºC. *American Journal Of food Technology*. 2:238-247

Fernandes, C.F., Flick, G.J., Sivia J.L and McCasky, T.A. (1997). Influence of processing schemes on indicative bacteria and quality of fresh aquacultured cat fish filts. 60: 54-58.

Harrigan, W. F. and McCanee, M. E. (1976): Laboratory methods in food and dairy microbiology. Academic Press, London. pp 17-68

Ojutiku RO, Kolo RJ, Mhammed ML (2009). Comparative study of sun drying and solar tent drying of Hyperopisus bebeoccidentalis. *Pak. J. Nutr.* 8(7):955-957

Olayemi FF, Adedayo MR, Bamishaiye EI, Awagu EF (2011). Proximate composition of catfish (Clarias gariepinus) smoked in Nigerian stored products research institute (NSPRI) developed kiln. Int. J. Fisheries Acquacult. 3(5):96-98.

Omodara MA, Olaniyan AM (2012). Effects of pre-treatments and drying temperatures on drying rate and quality of African catfish (Clarias gariepinus). J. *Biol. Agric. Healthcare* 2(4):1-11

Oparaku NF, Mgbenka BO (2012). Effects of electric oven and solar dryer on a proximate and water ctivity of Clarias gariepinus Fish. European *J. Sci. Res.* 81(1):139 -144

Oshibanjo, D.O. (2017): Yield and quality characteristics of breakfast sausage prepared with different dietary flours, salts and oils. A Ph.D. thesis, University of Ibadan

Wardlaw, F.B., Maccaskill, L.H. and Acton, J.C. (1973) Effect of postmortem muscle changes in poultry meat loaf properties. *Journal of Food Science,* 38, 421–424