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Assessment of Smoked Fish Processing Centres in Ibadan Metropolis

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ABSTRACT

This paper assessed two fish smoking centres (FSCs) for good practices, hygiene of processors and examined the microbiological quality of smoked fish. FSC1 is located at Bodija while FSC2 is located at Akobo. Five processors from each centre were interviewed to gather information about their activities and samples of smoked fish from each centre were purchased for microbiological examination. Data were collected through field observation and one- on- one interview with processors and laboratory analysis. Smoked fish samples were purchased for microbiological examinations. The result revealed that fish from FSC2 had too numerous to count (TNC) aerobic bacteria count, $1.0x10^3$cfu/ml and $1.2 x 10^4$cfu/ml for fungi and coliform counts respectively. Fish from FSC1 had $1.0 x10^3$cfu/ml for fungi and no growth for aerobic bacteria and coliform counts. It was also revealed that a popular insecticide called sniper was used to preserve fish only in FSC1 and hygiene of fish handlers from both centres was poor. In order to check compromising the health of consumers, there is a need to educate and advocate for the importance of hygiene and good handling practices among fish handlers.

Keywords:
Smoked fish, microorganism, preservative, public health

Introduction

Fish is eaten fresh, preserved or processed and forms a much-relished meal that spans socioeconomic, age, educational and religious barriers (Adebayo-Tayo *et al.,*2008). Fish is highly nutritious food and it's particularly valued for its protein which is of high quality compared to those of meat and egg (Ojutiku *et al.,* 2009, Ikutegbe and Sikoki, 2014). Unhygienic handling of fish can cause contamination with toxic residues, poisons and different types of spoilage organisms of public health importance.
Several fish processing techniques are in operation in Nigeria. These include chilling, freezing, drying, salting and smoking. However, smoking is the most popular method of fish processing and the oldest method of preserving fish in Nigeria and in many other less developed countries (Harlow, 1987; Eyo, 2001; Alcicek and Atar, 2010; Adeyeye, 2016). Moreover, if the process is not done correctly, smoked fish products can be a good medium for the growth of bacteria (Gonzalez *et. al.,* 2002).

Smoked fish has become a delicacy in Nigeria and most regions of the world, and there is now a corresponding concern for safety issues in smoked fish consumption (Adeyeye *et. al.,* 2015). Okoruwa

et. al., (2022) identified poor application of food safety practices such as good hygiene practices, good manufacturing practices and HACCP by small-scale food processors / operators; widespread abuse and /or misuse of agrochemicals, preservatives and chemical additives in the production, processing and storage of foods; poor disposal of refuse / wastes within and outside food establishments, markets and household environment and lack of appropriate knowledge and expertise in the food hygiene and good food handling practices by most food producers and handlers as problems and potential threats to food safety across the food supply chain in Nigeria. Aiyeloja *et., al,* (2019) stated that most of the fish smoking facilities within Ibadan metropolis have poor hygiene status as their storage materials, washing materials, smoking kilns and smoked fish had microorganism above recommended level.

GMP is a quality assurance system aimed at ensuring that products are consistently manufactured, packed, repacked or held to a quality appropriate for the intended use. It is thus concerned with both manufacturing and quality control (NAFDAC, 2023). This study, therefore, assessed two fish smoking centres in Ibadan for good practices, hygiene of processors and examined the microbiological quality of smoked fish.

Materials and Methods

Study Area- The study was carried out in Ibadan city, the largest indigenous city in Sub-Saharan Africa. Ibadan, the capital of Oyo state is located between longitude70 20' and 70 40'East of the Greenwich meridian and between latitude 30 55' and 40 10' North of the equator. The city lies in the equatorial rain forest belt and has a land area of 445-445 km. Ibadan is located in South western Nigeria. It has heterogeneous population of Yoruba, Igbo and Hausa along with other ethnic groups. Agricultural activities in Ibadan include livestock production, prominent among which is fish farming and processing.

Two fish-smoking centres FSC1 and FSC2 were selected for the study. FSC1 is located at Akingbola community ($7^0$33'56.9''N and $3^0$58'38.6''E), along the Railway line near Bodija Market. The facility is dominated by male processors of Hausa tribe with average age of 29 years. The centre consists of forty (40) mud-type smoking kilns as shown in Plate 3 and produced 1000kg of smoked fish per day, a shed where smoked fish are packaged and kept before sales. There are other shops and vendors of various materials not related to fish smoking at the centre. The processors obtained their raw materials from Oyo, Abeokuta, Ijebu-Ode and Ibadan city. Smoked fish from this centre were transported to Delta and Onitsha for marketing and few sold in Ibadan (Field work).

The second centre FSC2 is located along the railway line at Akobo. Akobo is located in Lagelu Local Government Area. It ranges from the General Gas bridge to the extreme end of Olorunda-Abaa. Its geographical location is 70 25; 48'' North and 30 56' 20'' East. The processing centre is dominated by male processors of Yoruba and Egede tribes and their average age is 34 years. The site consists of a drum-type of smoking kiln and a shed where smoked fish are packaged Plate 4. They obtained their fresh fish from Asejire and Eleiyele Lakes. They produced 60 -120kg of smoked fish per day and the fish were sold on the spot (Field work).

Data Collection- The FSCs were visited in February, 2023 by the researchers. A day was chosen in first and last week of the month to have interaction with the processors and also observe the mode of operation at the centres. Data was collected through direct observation and one-on-one interview with

the head of the centres and two selected processors (those that could communicate in English or Yoruba) were interviewed for more information using a question guide. Research questions include age, sex, pre-processing operations used, preservatives used, etc.

Smoked fish already packaged, ready for the market were purchased at FSC1 and smoked fish displayed for sale was purchased at FSC2. The samples were stored in polythene bags and transported to the analytical laboratory of Forestry Research Institute of Nigeria, for microbiological examination. Samples were analysed for Total aerobic bacteria count; Total Fungi count and Total coliform count. Nutrient Agar (NA) (Micro master India), was used to enumerate obligate and facultative bacteria; Mannitol Salt Agar (MSA) (Lab M limited, Lancashire, United Kingdom) was used for culture of S. aureus counts; MacConkey Agar (MCA) (Lab M limited, Lancashire, United Kingdom) was used for the enumeration of total coliforms; Sabauround Dextrose Agar (SDA) (Lab M limited Lancashire, United Kingdom) was used to enumerate fungal growths. The pour plate method described by Pepper and Gerba (2005) and Benson (2002) were employed. The colonies that grew on the media were counted and expressed as colony forming units (cfu)/g of the samples. Thereafter, the resultant microbial colonies were isolated into pure cultures and preserved in slants for further analysis.

Results

Assessment of Facilities at the Fish Smoking Centres

Findings from the on-site inspection of the fish processing centres are as follows:

Mode of Transporting Fresh Fish to the Centres: Fresh Fish was transported on motorcycles in sacks to FSC1 (Plate 1). At FSC2, fresh fish was transported to the centre using plastic containers.

Plate 1: Mode of transporting fresh fish to FSC1.

i. Pre-processing operations

At FSC1, pre-processing operations such as washing, gutting, sorting of fresh fish were not done before smoking. The fish were placed on sack directly on the floor immediately after they were removed from the sacks. Fish were dead before they got to the processing site due to suffocation (Plate 2). The fish were folded and immediately arranged in the smoking kiln.

Plate 2: Poor pre-processing operation at FSC1

At FSC2, cutting, degutting and washing was done before smoking. The fish were killed, washed before they were arranged on the smoking kiln.

ii. Smoking Kiln

At FSC1, mud-type smoking kilns are used. About 40 pieces of the kilns are being used by the processors (Plate 3). At the FSC2, drum-type kilns are used for smoking (Plate 4). Six pieces of the drum-type were found at ate centre. Both centres used firewood as the source of heat.

Plate 3: Mud-type kiln used at FSC1

Plate 4: Drum-type kiln used at FSC2

iii. Packaging

At FSC1, smoked fish were spread on polythene sheet on the floor before packaging. Fish were sorted into different sizes and packed in previously used cartons. 100 - 180 pieces were packed in each carton depending on the size of the fish. Packaged fish were sent to Delta, Onitsha for marketing and few ones sold in Ibadan (Plate 5). At the FSC2, fish were cut into chunks/sizes for sale on the spot. Leftover fish was kept in plastic bowl before sales.

Plate 5 : Packaging materials used at FSC1

iv. Environmental hygiene of the FCSs

The Environment of the study areas was not hygienic. FSC1 was full of domestic wastes products (Plate 6a) while the environment at FSC2 was littered with plastic wastes (Plate 6b).

Plate 6a: Environmental Hygiene of FSC1

Plate 6b: Environmental Hygiene of FCS2

v. Preservation of fish at FSCs

At FSC1, an insecticide (known as sniper force), mixed with vegetable oil was used to rub smoked fish before packaging (Plates 7). The processor claimed that the insecticide will prevent spoilage in fish till it gets to destination. They claimed not to be aware of the danger the use of the insecticide posed to human health. No preservative was used at the Akobo centre.

Plate 7: Preserving smoked fish before packaging at FSC1

vi. Microbiological Analysis of Smoked fish Samples

The results of the microbial analysis of the smoked fish obtained from the FSCs are presented in Table 1.

Table 1: Results of Microbial examination of Smoked fish

Sample	Total Aerobic Bacteria Count (cfu/g)	Total Fungi count (cfu/g)	Total Coliform Count (cfu/g)
Smoked Catfish from FSC1	NG	$1.0 \times 10^3 \pm 0.01$	NG
Smoked Catfish from FSC2	TNC	$1.0 \times 10^3 \pm 0.01$	$1.2 \times 10^4 \pm 0.01$

TNC: Too numerous to Count

The table shows the microbial analysis of smoked Catfish from the FSCs. The results revealed that total aerobic bacteria organisms in smoked catfish from FSC1 was too numerous to count (TNC) while smoked catfish from FSC1 did not record any value. It was also observed that samples from FSC1 and FSC2 had the same total mould count ($1.0 \times 10^3 \pm 0.01$ cfu/g). The total coliform count in FSC2 samples was $1.2 \times 10^4 \pm 0.01$ cfu/g but no growth was found in samples from FSC1.

Discussion

Fish handling is very important in maintaining the quality of fresh and processed fish products. Poor fish handling will lead to spoilage of fish. In food processing operations, an unhygienic food processing environment are the main source of food contamination. Studies have shown that conditions in fish processing environments in Nigeria have been described as rudimentary, unhygienic and good hygiene practices are rarely practiced (Akinola *et, al.,* 2006, Aiyeloja *et.al,* 2019). This study showed that hygiene of fish processors at FSC1 and FSC2 was very poor and the environment where fish is processed was not kept clean. Montville *et al*. (2002) reported that, during handling and preparation, bacteria may be transferred from contaminated hands of food workers to food and subsequently to other

surfaces (including food contact surfaces). Dike-Ndudim *et al*., (2014) reported that sanitary conditions of fish smoking kilns in most of the fish smoking facilities within the Ibadan metropolis were very poor as faecal coliform counts, total coliform counts and Salmonella/Shigella counts in most of the facilities were beyond the recommended level.

The value of the microbial load on fish samples obtained in FSC1 falls within the recommended microbial limit in the guidelines for the microbiological quality of various ready-to-eat foods by Gilbert (2000) and ICMSF (1986). The value of the microbial load on fish samples obtained in FSC2 was above recommended microbial limits (value was too numerous to count). Aiyeloja *et. al.,* (2018) reported that smoked fish species sold in different markets within the Ibadan metropolis was fit for human consumption but cautioned that smoked-dried fish displayed openly should be reheated to de-activate micro-organisms before consumption. The reason for no growth in total aerobic bacteria counts and coliform counts in FSC1 samples may be due to the use of an insecticide called sniper force by the processors for preservation. The use of Sniper by fish processors at FSC1 should be discouraged in fisheries sector and other areas where food vendors used this insecticide to preserve food commodities and neglect its implication on consumer health. Sniper is a synthetic organophosphorus compound which belongs to the DDVP chemical family (2, 2 –dichlorovinyl dimethyl Phosphate Compound) which is injurious to human health. In Gambia, The Ministry of fisheries and Water Resources in collaboration with relevant stakeholders conducted research and found out that there was residual dichlorvos in the fish samples collected from the market with a concentration of 9.18mg/kg (Eedrissa, 2022). This made Gambia to ban the use of sniper in food products. In Nigeria, the use of sniper was banned in 2019 when it was been used by the people contemplating suicide (Ojewale, 2019). This chemical still finds its way into the hand of fish processors and mongers who are after the profit they make and endangering the lives of consumers.

Safer preservatives should be encouraged to improve the keeping quality of fish products. Recent studies revealed that *Ocimum gratissimum* juice and *Capsicum minimum* can be used to improve microbial, biochemical and organoleptic quality of stored smoked *Clarias gariepinus* (Adeosun *et.al.,* 2016; Adeosun *et.al.,*2020 and Adeosun *et.al.,* 2021). Sofos and Georgnaras (2010) stated that good hygiene and manufacture practices, appropriate cleaning, sanitation programmes and temperature control are important requirements for prevention and inhibition of microbial growth.

Conclusion

An unhygienic practice of handling food during and after production plays a major role in food contamination. It is important to apply proper cleaning and sanitation procedures to increase the quality of smoked fish produced within Ibadan metropolis. Accessibility of sniper should be regulated and fish processors should be informed about the danger of sniper on human health. Stakeholders in fisheries management should strategize and control the use of unregulated preservatives and enforce good manufacturing Practices (GMP). More studies should be carried out on the quantity of insecticide residue in smoked fish in open markets in Ibadan and Nigeria at large.

References

Adebayo-Tayo, B.C., A.A. Onilude, and U.G. Patrick (2008): "Mycoflora of Smoke-dried Fishes Sold in Uyo, Eastern Nigeria" *World J Agric* Sci. 23 FORMATTING

Adeosun O, Adegbola S. A, Bankole A.F and Olateju G. B (2021): Chemo-nutritional analysis and organoleptic quality characteristics of smoked African Catfish (*Clarias gariepinus*) treated with scent leaf (*Ocimum gratissimum*) juice. *Recent Progress in Microbiology and Biotechnology* Vol. 5, 91 – 100. http;//doi.org/10.9734/bpi/rpmb/vs/5290D

Adeosun O., Olateju G. B. and Akinyemi, A. A (2020); Sensitivity of Bacteria Isolated from Smoked *Clarias gariepinus* Treated with Scent leaf (*Ocimum gratissimum*) Juice. Proceedings of the 35th Annual Conference of FISON tagged 'MINNA 2020''pp 66-69

Adeosun O., Olateju G. B., and Akinyemi A.A (2016): Sensitivity of bacteria isolated from smoked *Clarias gariepinus* to cayenne pepper (*Capsicum minimum*) and selected commercial antibiotics. Proceedings of the 31st Annual Conference of Fisheries Society of Nigeria (FISON) pp199 -203

Adeyeye S.A.O (2016) Traditional Fish Processing in Nigeria: a critical review', *Nutrition and Food Science* Vol46 No. 3 pp321-335

Adeyeye, S.A.O., Oyewole, O.B, Obadina, A.O, Omemu A.M, Adeniran O.E, Oyedele H.A and Abayomi S.O., (2015) Quality and Safety Assessment of Traditional Smoked Fish from Lagos State, Nigeria, *International Journal of Aquaculture,* 5(15) 1-9 (doi: 10.5376/ija.2015.05.0015)

Aiyeloja, A.A, A. M. Idi-Ogede, W.A. Jimoh and S.A Abdulsalami (2019) Hygiene Status of Fish Smoking Facilities of Selected Smoking Centres in ibadan Metroplis Oyo state South-Western Nigeria *TanzaniaJournal of Agricultural Sciences* Vol. 18 No.2, 70-77

Aiyeloja, A. A; George, F.O.A; Jimoh, W.A; Shittu, M.O; Abdulsalami, S.A (2018): Microbial Load on Smoked Fish commonly traded in Ibadan, Oyo State, Nigeria Journal of Applied Science and Environmental Management Vol. 22 (4) 493 – 497 April 2018 FORMATTING

Akinola O.A, Akinyemi A.A, and Bolaji B.D (2006) Evaluation of Traditional and Solar drying systems towards enhancing fish storage and Preservation in Nigeria (Abeokuta Local Government as a case study) *Journal of Fisheries International* 1, pp 44-9

Alcicek, Z. and Atar, H. H. (2010): The effects of salting on chemical quality of vacuum-packed liquid smoked and traditional smoked rainbow trout (*Oncorhyncus mykiss*) fillets during chilled storage. *Journal of Animal and Veterinary Advances,* 9, 2778-2783. FORMATTING

Benson H.J. (2002) Microbiological application: Laboratory Manual in General Microbiology. complete version, 5th edition. McGraw-Hill, New York.

Dike-Ndudim J.N, Egbuobi R.C, Onyeneke E.N, Uduji H.I, Nwagbaraocha M.A, Ogamaka I.A, Okorie H.M, Egbuobi L.N, Opara A.U (2014): Microbial status of smoked fish, *Scombia Scombia* sold in Owerri, Imo State. Nigeria *African Journal of Clinical Experimental Microbiology* 15(1):35–39 FORMATTING

Eedrissa Jallow (2022): Factsheet: The Misuse of Sniper in Gambia and its Health Impacts. http://factcheckgambia.org FORMATTING assessed Jan. 2024

Eyo, A.A. (2001): Fish processes in the Tropics. University of Ilorin press 403pp.

Gilbert, R.J (2000): Microbiological Guidelines for Ready-to-Eat Foods *Food Watch, Western Australian food monitoring program* Pp5. FORMATTING

Gonzalez-Rodriguez, M.N., Sanz, J.J., Santos, J.A., Otero, A. and Garcia Lopez, M.C. (2002): Food-borne pathogenic bacteria in pre-package fresh retail portions of farmed rainbow trout and salmon stored at 3°C. *International Journal of Food Microbiology,* 76: 135 -140.

Harlow M, (1987): All about Smoked Fish *San Francisco Chronicle* Pp: 23. FORMATTING

Ikutegbe, V. and D. Sikoki. (2014)."Microbiological and Biochemical Spoilage of Smoked -Dried Fishes Sold in West African Open Markets" *Food Chemistry* 161: 332-336.

International Commission on Microbiological Specification for Foods (ICMSF) (1986): Microorganisms in Foods 2. Sampling for Microbiological Analysis. Principles and Specifications. 2nd edition. Oxford: Blackwell Science. FORMATTING

NAFDAC, (2023) Food Safety and Applied Nutrition (FSAN) Directorate 'Current Good Manufacturing Practice Guidelines for Food and Food Products (Revised)' 71p Doc. Ref. No: FSAN-GDL-006-01

Montville, R, Chen, Y and Schaffner, D. W (2002): Risk assessment of hand washing efficacy using literature and experimental data *International Journal of Food Microbiology,* 73 (2–3) (2002), pp. 305-313, 10.1016/s0168-1605(01)00666-3 FORMATTING

Ojewale Kayode (2019): Domestic Sniper Use: a ticking time bomb. The Guardian Online Newspaper http://guardian.ng>opinion>domestic-sniper-use FORMATTING

Ojutiku, R.O., Kolo, R.J. and Muhammad, M.L. (2009)."Comparative Study of Sun Drying and Solar Tent Drying of *Hyperopisusbebeoccidentalis*. Park. J. Nutr. 8(7):955-957.

Okoruwa A. Tehinse J. Onuigbo-Chatta N, and Elere S (2022) Overview of Nigerian Food Safety Legislation. *Advances in Nutrition and Food Sci*ence ANAFS- 234. Doi: 10.37722/ANAFS, 2022 303

Pepper I. L. & Gerba C. P. (2005). Environmental microbiology. A laboratory manual. Second edition. Elsevier Academic Press.

Sofos, J.N and Geornaras I. (2010) Overview of current meat hygiene and safety risks and summary of recent studies on biofilms, and control of *Escherichia coli* 0157:47 in noncontact, and *Listeria monocytogenes* in ready-to-eat meat products *Meat Science,* 86, pp 2-14.