FISH SMOKING, PRESERVATION AND SOCIO-ECONOMIC CHARACTERISTICS OF FISH SMOKERS AND TRADERS IN SELECTED FISH MARKETS IN BORNO STATE, NIGERIA

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Abstract

Some smoking methods have raised health concerns due to the methods used in processing. The study was aimed at assessing the different smoking methods, preservatives techniques, and the socio-economic characteristics of smoked fish processors and traders in some selected fish markets in Borno State. One hundred and fifty-five (155) questionnaires were designed and administered to fish processors (smokers) and traders in some selected fish markets in Borno State. The study area revealed that 84 (54.55 %) respondents use the Earth Oven, 59 (38.31 %) use Drum Kiln while 11 (7.14 %) use the traditional open smoking tray method. The study further indicates that 81 (52.6 %) stores the smoked fish in airtight vessels/room, 66 (42.86 %) subject the smoked fish to sun drying to further remove moisture while 7 (4.54 %) agreed to use preservatives (chemicals) to enhance the shelve life of smoked fish in the Study Area. The study recommends that the use of preservatives (chemicals) to preserve the smoked fish should be monitored and discouraged as it might have human health implications.

Keywords: Polycyclic Aromatic Hydrocarbons (PAHs); Drum Kiln; Earth Oven; Open tray

Introduction

Fish smoking is the commonest and oldest traditional method of fish processing. Fish provide man with the needed protein for body repairs and building of tissues and serves as part of a healthy diet.

Fish smoking business provides employment opportunities to hundreds of individuals and serves as a bridge to other businesses involved in the fish business (fishermen, fish smokers, smoked fish traders, etc.). Smoked fish business is very lucrative as it has high marginal economic returns (Onyia and Adebayo, 2007; Fapohunda, 2012).

About 61 % of fish products consumed and available in the Nigerian market are smoked fish (Adah, 2012). Smoked fish has over the years raised issues of health concerns, (Hokkanen *et al.*, 2018) because most methods used in the processing and/or smoking them involves thermal treatments at high temperature, having direct contact with combustion gases which may contaminate the processed foodstuffs with Polycyclic aromatic hydrocarbons (PAHs) (Akpambang *et al.*, 2009).

The smoked fish from Borno State is one of the commonest fish products that is widely consumed by many families across Nigeria and also being exported across to the neighboring countries of Chad, Niger, and Cameroun (The Nations Newspaper, 2019). An assessment conducted by Adah (2012) revealed that the level of hygiene during processing, preservation, and packaging is low as only 16 % were observed to practice a very high level of hygiene; this also possess serious health risks and concerns.

The study was aimed at profiling smoked fish processors and smokers, assessing fish smoking and preservation techniques in some selected fish markets in Borno State, Nigeria.

MATERIAL AND METHODS

The Study Area

The study was carried out in Maiduguri, Borno State, Northeastern, Nigeria. Borno State has a total area of 61, 435 km^2 and is the second-largest state in the Federation in terms of landmass. The State occupies the greatest part of the Chad Basin, (BORMLS, 2008) which is known for its fishing activities, most especially its smoked fish product been exported to the countries it shares borders with, the Republics of Niger to the North, Chad to the North-East and Cameron to the East (BORMLS., 2008; The Nations Newspaper, Friday, September 20, 2019).

Maiduguri (also known as 'Yerwa') is the State capital, which lies within latitude 10^{o}N and 14^{o}N and longitude 11^{o}31E and 14^{o}41E. Maiduguri Metropolis climate is characterized by a long dry – hot and short wet season, with an average annual mean temperature of 31 °C. The hottest period is March – April having a maximum temperature of 37 – 40 °C, while the coldest period is between December – January. The town has an average annual rainfall of about 500 –700 mm per annum (NMA, 2008).

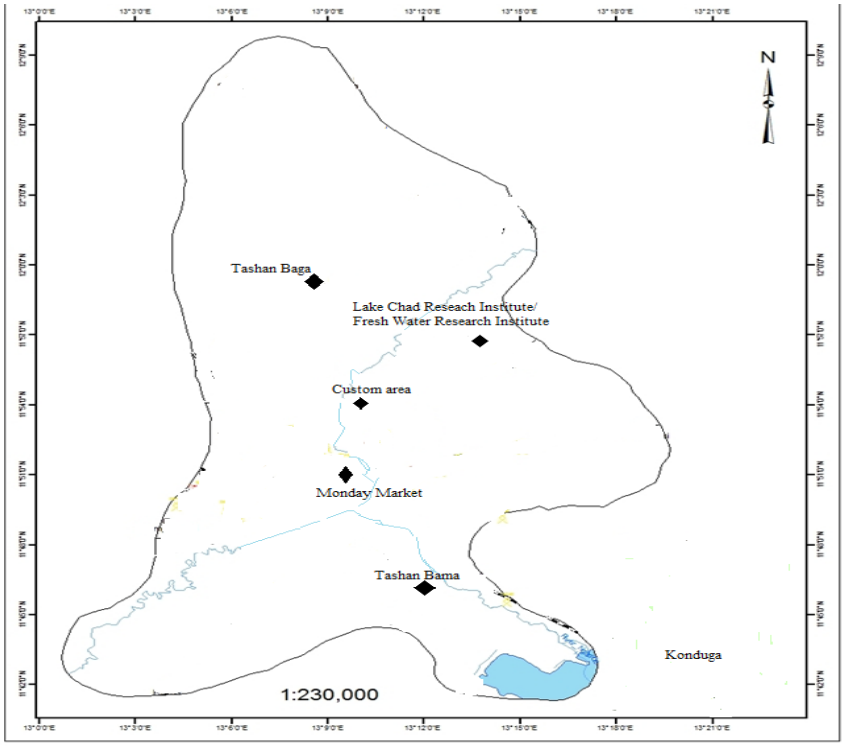

Fig 3.1 Map of Maiduguri and environs
Sources: Sharah (2020)

Research instrument

A questionnaire was designed and administered to fish processors (smokers) and traders (One hundred and fifty-five questionnaires) in some selected fish markets in Borno State.

Questionnaires

Target Group and Sample Size

The Target groups were Fish processors (smokers) and Smoked fish markers (traders).

The sample size was obtained using the statistical formular and procedures of Sample Size (SS) as adopted by Sharma *et al.*, (2020)

$$SS = \frac{Z^2 P(1-P)}{C^2}$$ cited in Sharma *et al.*, (2020)

Where Z = Z value (1.96 for 95 % Confidence level)
P = Sample proportion (0.5)
C = Confidence interval (margin error (5 %) = 0.05

Questionnaire Design

The questionnaire was a semi-structured questionnaire with both closed and opened ended questions which were divided into two (2) sections (A and B). Section A deals with the socio-demographical data of the respondents and contains the age, gender, educational status, nature of business, and years of experience in the business of the respondents. Section B relates to the objectives of the study.

Overall, the questionnaire has twelve (12) items in both sections A and B.

Questionnaire Distribution and Retrieval

The questionnaire was distributed to 60 % of the estimated population at each sampling station as shown in table 1.

Table 1: Distribution of Questionnaire

S/ N	Station	Location	Estimated Population	Required Sample
1	A	Tashan Baga Fish Market, Maiduguri	78	46
2	B	Maiduguri Monday Market	21	13
3	C	Custom Market, Maiduguri	14	8
4	D	Tashan Bama, Maiduguri	10	6
5	E	Gomburu Market, Maiduguri	13	8

6	F	Konduga village, Konduga LGA	32	19
7	G	Baga town, Kukawa LGA	87	52
8	H	Bulunkutu Kasuwa, Maiduguri	5	3
Total			**260**	**155**

Out of the total number of one hundred and fifty – five (155) questionnaires distributed; all (100 %) were retrieved. One hundred and fifty – four (154) were adequately filled and retrieved in a useful form and consequently assessed as shown in the table below.

Table 2: Retrieval of the questionnaire distributed

S/N	Questionnaire	Frequency	Percentage (%)
1	Properly filled (Valid)	154	99.35
2	Improperly filled (Invalid)	01	0.65
	Total number of Questionnaire Distributed	**155**	**100**

Out of the total number (155) of questionnaires distributed, 154 (99.35 %) were valid and used for data analysis, discussion, and presentation in this study.

Statistical Analysis

Data obtained was tabulated using Microsoft Excel 2010 and a simple descriptive statistical tool was used. The results are presented in tables and charts.

RESULTS AND DISCUSSION

The Socio-economic composition of the Respondents

Table 3: Age Distribution of the Respondents

	Age (years)	Frequency	Percentage (%)
A	15 – 20	33	21.43
B	21 – 35	39	25.32
C	26 – 45	53	34.42
D	46 & above	29	18.83
	Total	154	100

The age distribution of the respondents presented in Table 3, indicates that the majority 34.42 % (53) of the respondents are within the age bracket 26 – 45 years, 25.32 % (39) are within the age bracket of 21 – 35years old, 21.43 % (33) are within the age of bracket of 15 – 20 years old and finally 18.83 % (29) are within the age class of 46 years and above.

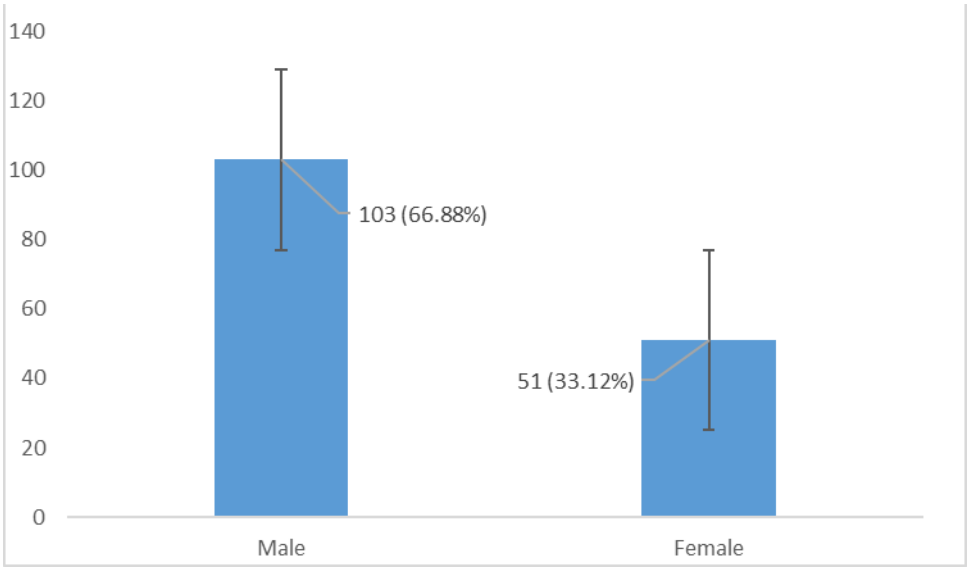

Figure 1: Gender Distribution of the Respondents

Figure 2, revealed that 66.88% (103) of the respondents were male while the remaining 33.12% (51) were female. This study agrees with the findings of Bello *et al*, (2017) in that majority of the persons involved in the fish business are male, in the Study Area

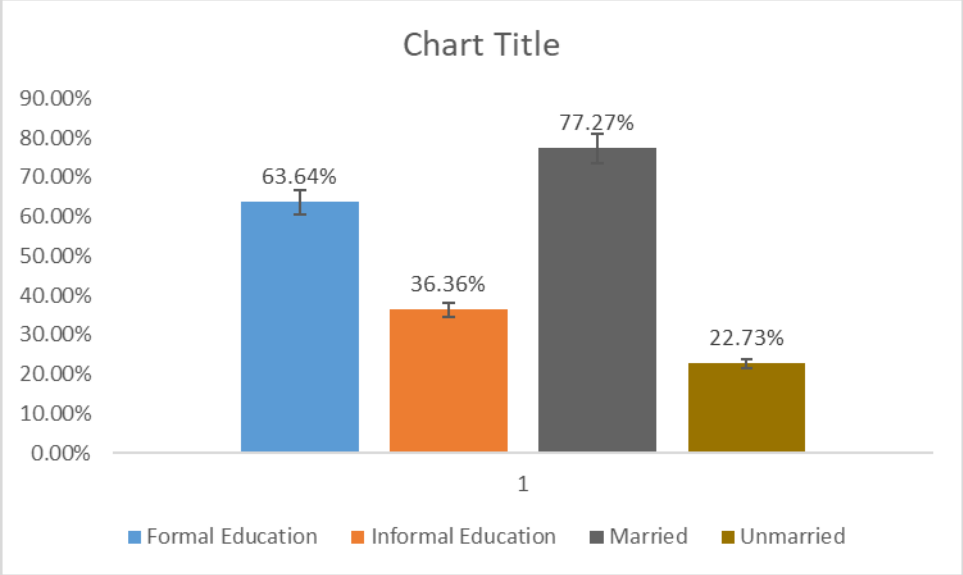

Figure 2: Education and Marital Status of the Respondents

Figure 2, presents the educational and married status of the respondents and reveals that out of the total number of 154 (100 %) respondents, 63.64 % (98) have formal education while 36.36 % (56) got the informal form of education. This study negates the findings of Bello *et al*, (2017) who reported that the majority of individuals engaged in fish business had obtained Tertiary Education.

The figure further shows the marital status of the respondents and indicates that out of the total number of 154 (100 %) of the respondents, 119 (77.27 %) were married, while 35 (22.73 %) were unmarried in the study area. This study agrees with the findings of Adah, (2012) and Bello *et al*, (2017) in that majority of persons engaging in the fish business in the Study Area are married and have family responsibilities.

Table 4: Nature of Business of the Respondents

	Nature of Business	Frequency	Percentage (%)
A	Fish processing (smoking) only	38	24.68
B	Fish Marketing only	62	40.26
C	Fish Processing & Marketing	54	35.06
	Total	**154**	**100**

Table 4 shows the nature of business embarked by the respondents and indicates that out of the total number of 154 (100 %) of the respondents, 62 (40.26 %) engaged only in Marketing Smoked Fish, 54 (35.06 %) engaged in both Fish Processing (Smoking) and Marketing business while 38 (24.68 %) engaged in Fish Processing (Smoking) business only.

Table 5: Years of Experience in the business by the Respondents

	Years of Experience (years)	Frequency	Percentage (%)
A	1 – 5	38	24.68
B	6 – 10	41	26.62
C	11 – 15	47	30.52
D	16 – 20	15	9.74
E	21 & above	13	8.44
	Total		**100**

Table 5 shows the years of experience of the respondents in fish processing (smoking) and marketing and indicates that out of the total number of 154 (100 %) of the respondents, 47 (30.52 %) has 11 – 15years experience, 41 (26.62 %) has 6 – 10 years experience, 38 (24.68 %) has 1 – 5years experience, 15 (9.74 %) has 16 – 20years experience and 13 (8.44 %) has 21 years and above experience.

The Sources of fish within the study area

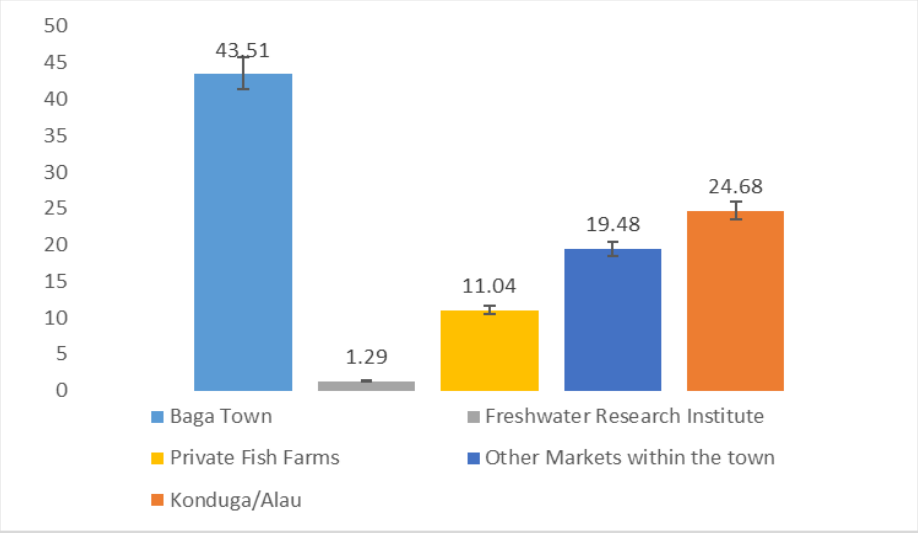

Figure 3: Sources of fish in the study area

Figure 3 presents the sources of fish within the study area. The results indicate that 67 (3.51 %) sourced their fish from Baga town, 38 (24.68 %) sourced their fish from Konduga/Alau area, 30 (19.48 %) sourced their fish from other fish markets in Maiduguri town, 17 (11.04 %) sourced their fish from private individual fish farms in Maiduguri and its environs while 2 (1.29 %) sourced their fish from Freshwater Research Institute, Maiduguri.

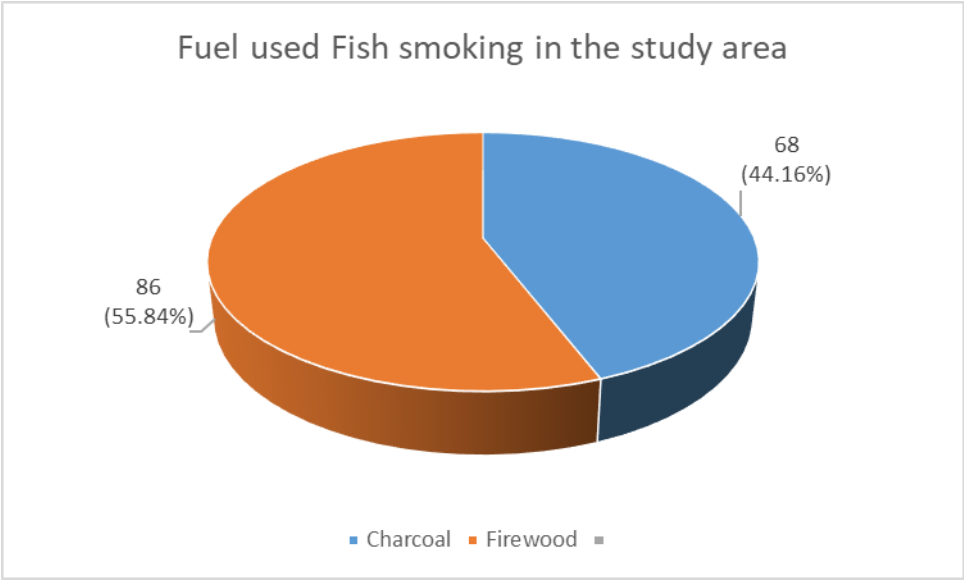

Figure 4: Type of fuel used in fish smoking in the study area

Figure 4 reveals the type of fuel used in fish smoking in the Study Area. The results show that 86 (55.84 %) use firewood in smoking fish while 68 (44.16 %) use charcoal to smoke fish. This study agrees with the findings of Adeyeye *et al*., (2015); Yerima and Ngulde, (2015) in suggesting that majority of fish processors (smokers) use firewood in processing/smoking fish.

Table 6: Factors influencing the choice of fuel used in Fish Smoking in the Study Area

	Factors influencing the choice of fuel used	Frequency	Percentage (%)
A	Availability	48	31.17
B	Economical	72	46.75
C	Aroma	27	17.53
D	Smoked fish colour	7	4.55
	Total	**154**	**100**

Table 6 presents the results of factors influencing the choice of fuel in fish smoking in the Study Area. The result of the finding reveals that 72 (46.75 %) use fuel due to its economic advantage, 48 (31.17 %) use fuel based on its availability, 27 (17.53 %) look at the different aroma each fuel possesses on smoked fish and make their choices based on the aroma perceived to be best for them and finally, 7 (4.55 %) consider the effect of the fuel used in smoking on the colour of the fish.

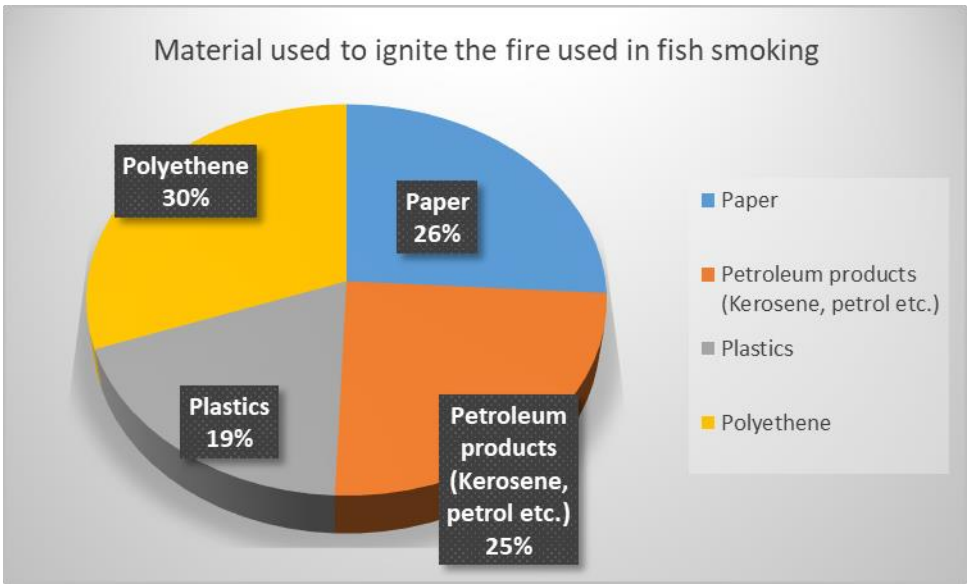

Figure 5: Material used to ignite the fire in fish smoking

Figure 5 presents the results of the findings of the different materials used to ignite the fire used in fish smoking. The results indicate that 47 (30.52 %) use polyethene, 40 (25.97 %) use paper, 38 (24.68 %) use Petroleum products (kerosene, petrol, etc.) while 29 (18.83 %) use plastics material to ignite the fire used in fish smoking.

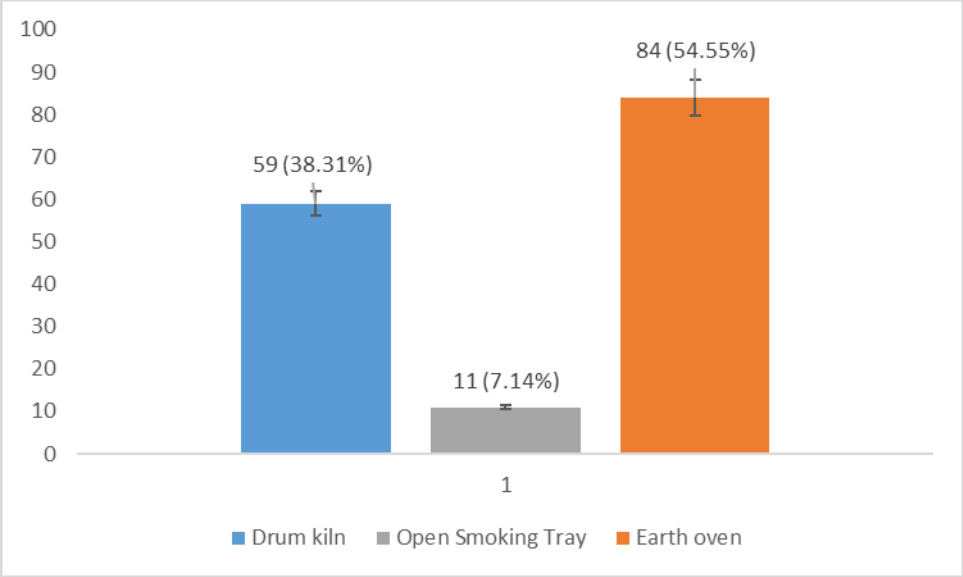

Figure 6: Fish Smoking method

Figure 6 shows the results of the different methods used in smoking fish by fish processors (smokers) in the Study Area. The results indicate that 84 (54.55 %) use the Earth Oven, 59 (38.31 %) use Drum Kiln while 11 (7.14 %) use the traditional open smoking tray method in the study area. The different methods used might contaminate the smoked fish samples with Polycyclic Aromatic Hydrocarbons (PAHs), a carcinogenic compound (Dipanjan *et al*., 2021).

Preservation Techniques Employed by Fish Traders in the Study Area

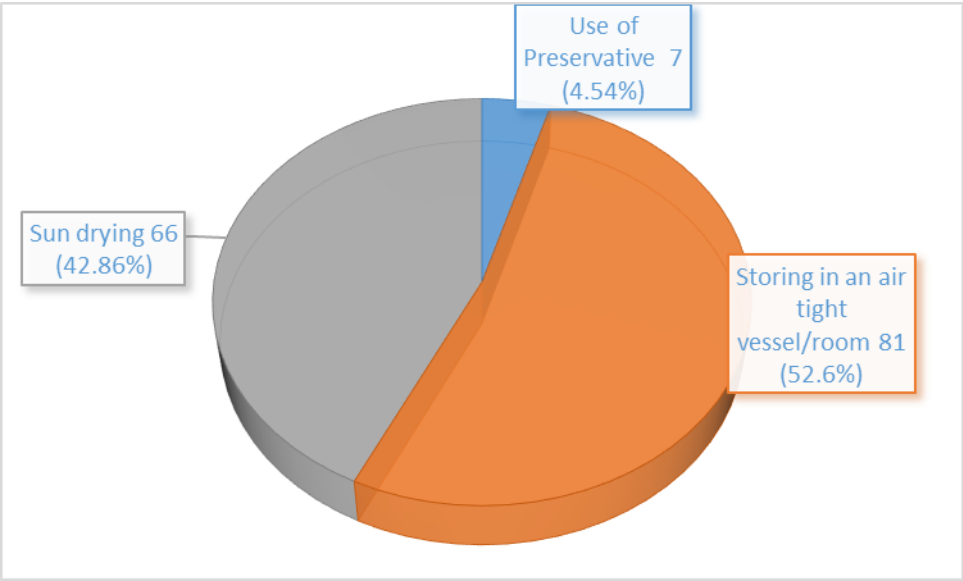

Figure 7: Method of enhancing shelf-life of the smoked fish

Figure 7 shows the results of the different methods used by fish processors (smokers) and marketers to enhance the shelf life of smoked fish in the Study Area. The results indicate that 81 (52.6 %) store the smoke fish in airtight vessels/rooms to enhance its longevity, 66 (42.86 %) subject the smoked fish to sun drying to further remove moisture while 7 (4.54 %) agreed to use preservatives (chemicals) to extend the shelf life of smoked fish in the Study Area. This study negates the findings of Adeyeye *et al*., (2015); Yerima and Ngulde, (2015) who reported that the majority of fish processors (smokers) use chemicals/preservatives in processing and

enhancing the longevity of their smoked fish.

DISCUSSION

According to the findings of this survey, the majority of fish smokers and traders were between the ages of 26 and 45, accounting for 34.42 percent (53) of the total, and their sex status revealed that the majority were male, 66.88 % (103) and married, 99(64.29 %). This study agrees with the findings of Bello *et al*, (2017) and Adah (2012) in that majority of the persons involved in the fish business are young, male, and married. Similarly, the results of the educational status further revealed that 45 (29.22 %) obtained Primary Education, 39 (35.32 %) had Secondary Education, 33 (21.43 %), attended Qur'anic/Tsangaya School, 23 (14.94 %) never attended any form of education (Not Educated) and 14 (9.09 %) attended Tertiary Institution. This study negates the findings of Bello *et al*, (2017) and Adah (2012) who reported that the majority of individuals engaged in fish business had obtained Tertiary Education

The findings of this study further revealed that 62 (40.26 %) engaged only in Marketing Smoked Fish, 54 (35.06 %) engaged in both Fish Processing (Smoking) and Marketing business while 38 (24.68 %) engaged in Fish Processing (Smoking) business only. This implies that more people engaged in marketing or combined marketing and (processing) smoking than only fish processing (smoking). The majority of the fish processors (smokers) and marketers 47 (30.52 %) have 11 – 15years of experience in the business, this agrees with Adah (2012). This translates into the high quality of the smoked fish from the area as years of engagement in the fish business and processing (smoking) helps an individual to develop mastery over the best available methods and options.

Furthermore, the results of the findings of this study indicate that 67 (3.51 %) sourced their fish from Baga town, 38 (24.68 %), from Konduga/Alau area, 30 (19.48 %) from other fish markets within the town, 17 (11.04 %) from other individual private fish farms within the town while 2 (1.29 %) from Freshwater Research Institute, Maiduguri. This implies that even with the security challenges Baga remains the major source of smoked fish and Lake Chad is still relevant in the fish economy of Maiduguri and the nation at large (Adah, 2012).

The results of the fuel used in processing (smoking) the fish in the study area show that 86 (55.84 %) use firewood in smoking fish while 68 (44.16 %) use charcoal to smoke fish. This study agrees with the findings of Adeyeye *et al*., (2015); Yerima and Ngulde, (2015) in suggesting that majority of fish processors (smokers) use firewood in processing/smoking fish. The choice of the majority of the fish processors (smokers) was influenced by its economic advantage of the fuel 72 (46.75%) and its availability 48 (31.17 %) in the study area. This implies that the price of the fuel and its availability are the influencing factors in aiding the decision of the fish smokers in deciding which fuel to use in processing (smoking) their fish.

The results of the findings of the different materials used to lit or ignite the fire used in fish smoking further indicates that 47 (30.52 %) use polyethene, 40 (25.97 %) use paper, 38 (24.68 %) use Petroleum products (kerosene, petrol, etc.) while 29 (18.83 %) use plastics to ignite the fire use in fish smoking. This suggests that the major material used in igniting fire are polyethene, paper, petroleum products, and plastics and these can contaminate the processed (smoked) fish with Polycyclic Aromatic Hydrocarbons (PAHs). The findings of the different smoking methods used in the study area revealed that 84 (54.55 %) use the Earth Oven, 59 (38.31 %) use Drum Kiln while 11 (7.14 %) use the traditional open smoking tray method in the study area. The different methods used might contaminate the smoked fish samples with Polycyclic Aromatic Hydrocarbons (PAHs), a carcinogenic compound (Dipanjan *et al*., 2021).

The results of the findings of the different methods used by the fish processors (smokers) and marketers to extend the shelf life of the smoked fish in the Study Area, indicates that 81 (52.6 %) stored in airtight vessels/room, 66 (42.86 %) subject the smoked fish to sun drying to further remove moisture while 7 (4.54 %) agreed to use preservatives (chemicals) to extend shelf life of smoked fish in the Study Area. This negates the findings of Adeyeye *et al*., (2015); Yerima and Ngulde, (2015) who reported that the majority of fish processors (smokers) use chemicals/preservatives in processing and enhancing the shelf-life of their smoked fish. Although the number of those who agreed to use preservatives (chemicals) was low 7 (4.54 %) this calls for continuous monitoring and enlightenment campaign on the danger associated with the use of such preservatives because it is capable of endangering the health of a large proportion of the consumers.

Recommendations

From the findings of this study, the following recommendations are made:

1. The Baga fish processing (smoking) market should be given attention as it's the major source of fish in the study area.

2. The majority of the fish processors (smokers) use firewood and as such this calls for serious monitoring of the level of deforestation and sources of firewood in the study area since the area is seriously affected by desertification.

3. The use of preservatives (chemicals) to preserve the smoked fish should be monitored and discouraged as it may have human health implications.

REFERENCES

Adah, P. M. (2012). Assessment of Smoke Fish Packaging in Doron – Baga metropolis, Borno State Nigeria. *26th Annual Conference of the Fisheries Society of Nigeria (FISON), Minna, Nigeria, **26**: 54 – 58.*

Adeyeye S. A, Oyewole O. B., Obadina A. O., Omemu A. M., Oyedele H. A. and Adeogun, S. O. (2015). A survey on traditional fish smoking in Lagos State, Nigeria. *African Journal of Food Science, **9**: 59-64. 10.5897/AJFS2014.1216.*

Akpambang V., Giorgia P., Labunmi L., Isiaka, A., and Lanfranco C. (2009). Determination of polycyclic aromatic hydrocarbons (PAHs) in commonly consumed Nigerian smoked/grilled fish and meat. *Food Additives and Contaminants, **26** (07):.1096-1103.*

Bello, M. M, Sani, H., Bukar, A., and Rabiu, M. M. (2017). The economic effect of insurgency on smoked fish sellers in Maiduguri Metropolis of Borno State Nigeria. *Journal of Agricultural Extension, **21**: 37-45. 10.4314/jae.v21i3.4.*

Borno State Ministry of Land and Survey (BORMLS), (2008). Borno State Office Memo File.

Dipanjan K., Sonmoina, B., Rajita, D., and Pran, J. S. (2021). Smoking Preservative of Fish. *Aquafind, Aquatic Fish Database established in 1991. http://aquafind.com/articles/Smoking_Fish.php (Retrieved on 18th February 2021)*

Fahad, S. A. and Parviz, A. K. (2008). Impact of Fatigue on Bus Transit Drivers. *Kuwait Journal of Science **35** (1): 11 – 20.*

Fapohunda, O. O. (2012). Economic Analysis of Smoked FISH marketing in Owo Local Government Area, Ondo - State, Nigeria. *Continental j. Fisheries and aquatic science, **6**(1), 38–46.*

Hokkanen, M., Ulla, L., Pirkko, K., Tiina, R., Kimmo P., and, Marika, J. (2018). Critical Effects of Smoking Parameters on the Levels of Polycyclic Aromatic Hydrocarbons in Traditionally Smoked Fish and Meat Products in Finland. *Journal of Chemistry, 2018: 31 – 45. https://doi.org/10.1155/2018/2160958*

Nigerian Metrological Agency (NMA) (2008). Annual Report, Office Memo File North-eastern Nigeria.

Onyia, L. U. and Adebayo, E. F. (2007). Economic Analysis of Smoked Fish Marketing in some Selected Local Government Areas of Adamawa State, Nigeria. *In: 21st Annual Conference of the Fisheries Society of Nigeria (FISON), 13 - 17 Nov 2006, Calabar, Nigeria, 385 - 388.*

Sharah, J. C. (2020). An Assessment of the Base Transceiver Stations (BTS) Compliance Status to Environmental Standards and Regulations in Maiduguri And Its Environs. *Unpublished Thesis submitted to the Department of Geography, University of Maiduguri.*

Sharma, S. K., Mudgal, S. K., Thakur, K., and Gaur, R. (2020). How to calculate sample size for observational and experimental nursing research studies? *National Journal of Physiology, Pharmacy, and Pharmacology, **10**(01):1-8.*

The Nations Newspaper, Friday, September 20, 2019: Dwindling fishes Doron Baga: *https://thenationonlineng.net/dwindling-fishes-doron-baga/*

Yerima, I. and Ngulde, Y. M. (2015): Sources and Uses of Fuel for Fish Smoking Around the Lake Chad in Borno State, Nigeria. *Journal of Environment and Ecology, **6**(2) 35 – 47. doi:10.5296/jee.v6i2.8707 URL: http://dx.doi.org/10.5296/jee.v6i2.8707*