Comparative Analysis of Processing Methods on the Sensory Properties of Four Fish Species (*Clarias gariepinus, Chrysichthys nigrodigitatus, Pseudodolithus typus, Tilapia niloticus.)*

Fakunmoju .F .A

Department of Aquaculture and Fisheries Management, Lagos State University of Science and Technology, Ikorodu, Lagos State, Nigeria
Email: *folajuwona[at]yahoo.com*
Phone no: 08033279470

Abstract: ***The effects of different processing methods on the organoleptic properties of four species of fish (Clarias gariepinus, Chrysichthys nigrodigitatus, Tilapia niloticus and Pseudodolithus typus) with the total number of 24 samples. Clarias gariepinus of 1.5kg weight, Tilapia niloticus of 1.8kg weight, Chrysichthys nigrodigitatus of 1.2kg weight and pseudodolithus typus of 1.2kg weight. The samples were divided into three (3) portions, A, B and C. The fishes were cut into pieces and well seasoned. Portion A was well cooked and tender. Portion B was fried in a hot vegetable oil in a frying pan on an open flame while portion C was smoked-dried in a smoking kiln. The sensory evaluation was conducted with questionnaires distributed to twenty (20) evaluators of different genders. The questionnaires were structured based on a 9 point hedonic scale and the data generated were subjected to descriptive and one-way analysis of variance. The result obtained revealed the sensory evaluation of the products of the smoke samples, that there is significant difference (p<0.05) across the various samples in terms of smell, sample A, C and D has the lowest rating score. The sensory evaluation for fried samples in terms of taste shows that sample A, B and C had the lowest rating score and the sensory evaluation for boiled samples in terms of taste, smell and texture, sample A, B and C had the lowest score.***

Keywords: *Clarias gariepinus, Chrysichthys nigrodigitatus, Tilapia niloticus* and *pseudodolithus typus,* Organoleptic properties

1. Introduction

Fishes are aquatic cold blooded animals which spend their lives in water with the temperature of the surrounding environment. Fishes are distinguished from other vertebrate by their possession of gills and fins adapted solely for aquatic life.

They belong to the super class Pisces and phylum chordata. Aquatic animals are those animals that live in water and breathe by the means of gills. It does not include only fishes but also other aquatic vertebrates such as crocodiles, whales, dolphins and sea turtles. Others are aquatic invertebrates such as shrimps, crabs, lobsters etc.

Aquaculture refers to the rearing of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. It involves some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators among others. Examples of aquaculture include: fish farming, shrimp farming, oyster farming, alga culture and cultivation of ornamental fish.

Fish farming is the act of rearing selected species of fish under scientifically controlled conditions in an enclosed body of water such as ponds, stream, cages, rice paddies, brackish and marine environment.

Fish constitutes a very important component of daily diet for many people, and often provides much needed nutrients for a healthy living. It is characterised as a cheap source of animal protein, which is now evident throughout the world, makes it an exceptional component of human diet (Iheagwara, 2013). Fish protein now takes precedence over other protein sources of plants and animal origin, and inexpensive in relation to other protein foods (Fawole et al., 2007).

Fish protein is considered of high quality because of its low saturated fat, richness in essential amino acids and content of Omega 3 and Omega 6 fatty acid known to promote healthy living (Zhang *et al.*, 2020). The major components of fish are moisture, protein, and fat with vitamins and minerals occurring in trace amounts (Holland *et al*., 1993). Generally, fish contains very little carbohydrate, while the moisture content is very high. In most fish species, moisture content is between 60-80%, protein between 15-26% and fat 2-13% (Pearson & Cox, 1976). The fat content of fish varies with species, age, nutrition, size, and season.

Fish has lower cholesterol content when compared with meat (Harris, 1997), and thus it is often recommended for consumption especially among young and middle-aged population.

Clarias gariepinus, that constantly serves as a research species of catfish is a highly nutritious fish that contain high amounts of vitamins, proteins, minerals and little or no saturated fat, and known to be low in carbohydrates (Idris *et al*., 2010). It is an economically important freshwater fish, and enjoys wide acceptability; it is extensively cultivated in ponds (Kumolu - Johnson *et al.*, 2010). *Clarias gariepinus* is a very important freshwater fish in Nigeria as it enjoys wide acceptability in most parts of the country because of its unique taste, flavor and texture (Ayeloja *et al.*, 2011).

Oreochromis niloticus, is an African freshwater cichlid and one of the world's most important food fishes. Owing to its hardy nature, and its wide range of tropic and ecological adaptations, it has been widely introduced for aquaculture, augmentation of capture fisheries and sport fishing (Trewavas, 1983; Welcomme, 1988), and is now found in every country in the tropics.

Since fish is not normally consumed raw, various processing methods are employed to prepare them for consumption, and some of these processes include boiling, frying, roasting, and smoking, which could have varying effects on their nutrient contents and organoleptic properties (Eriksson, 1987). Deeper understanding of the effect of processing on the nutrients composition of fish is therefore high.

Pseudodolithus typus is a species of marine ray finned fish belonging to the family sciaenidae and is closely related to the black drum. It is commonly found in bays and estuaries over sandy or muddy bottoms where it feeds on crustaceans, worms, and small fish.The name croaker is descriptive of the noise the fish makes by vibrating strong muscles against its swim bladder, which acts as a resonating chamber much like a ball.

Chrysichthys nigrodigitatus is a local freshwater catfish also known as silver catfish. Obokun is a good source of lean protein, and it is extremely rich in vitamins and fish oils such as Omega-3 and Omega-6 fatty acids (the so called good fats).

2. Materials and Methods

2.1 Research Location

The study was carried out at Lagos State University of Science and Technology, in the department of Aquaculture and fisheries Management.

2.2 Materials Used

The materials used in the course of the study includes; 24 pieces of fish, iodized salt, Cubes of maggi, Cooking vegetable oil, Cooking pot, Frying pan, Weighing scale, Tap water, Grinded pepper, Cooking gas cylinder, Matches, Stainless spoon, A plastic bowl, Smoking kiln, A knife, Onion.

2.3 Length and Weight of the Samples

A total number of 24 fresh fish samples of four different types (*Tilapia*, *clarias*, *chrysichthys* and *croaker*) were obtained from the local fish market in Ikorodu. Six pieces (6) of *tilapia* with the length of 18cm and weight of 1.8kg, (6) pieces of *croaker* with the length of 20-25cm and weight of 1.2kg, *Clarias* with the length of 25-30cm and weight of 1.5kg, *Chrysichthys* with the length of 20-25cm and weight of 1.2kg.

2.4 Methods of Preserving the Samples

The samples were carried to the processing unit where it was cut into pieces, washed with tap water several times to remove adhering blood and excessive mucus. Subsequently the fishes were divided into three groups. One part was boiled in water; the second part was deep- fried in vegetable oil using a frying pan, while the last part was smoked in a smoking kiln using charcoal.

a) **Boiling**

The fish specimen was seasoned with iodized salt, Cubes of maggi and onion was sliced to taste. The fish was boiled in distilled water for about 20 minutes until the pieces were well cooked and tender. The fishes were removed from the cooking pot and placed in a covered bowl.

b) Frying

Each fish specimen were seasoned with salt and maggi to taste, it was then deep-fry in hot vegetable oil using a frying pan on an open flame. Frying was achieved within 15 minutes.

c) **Smoking**

The fish specimen was seasoned with salt, maggi and grinded pepper to taste, and was later placed on the smoking kiln rack to smoke to dryness.

2.5 Methods for Organoleptic Characteristics Assessment

Subjective analysis was used in the organoleptic characteristics analysis; staff and students were recruited to perdition the tests. Twenty members of the panel were selected to assess each parameters flavor, texture, appearance, taste and palatability of the products by evaluators using the ranking method (a)- Excellent (b) Very Good (c) Good (d) Fair (e) Poor. The experimental process was fully explained to the evaluators before being allowed to participate in the organoleptic testing. They were briefed about the fish species which they would taste and the source of the fish as well as the processing methods. Hence, each assessor participated in the study with full knowledge of the process. The study was also conducted within the time frame when the samples were assumed to be in the conditions acceptable to consumers to allow organoleptic testing without causing any harm to them.

2.6 Statistical Analysis Cal

The data generated were subjected to statistical analysis (descriptive and one way analysis of variance). Using Microsoft Office Excel 2007 and statistical package for social sciences (SPSS). Means with $p<0.05$ were adjudged significant. Data given represent the mean + standard deviation.

3. Results

Table 1 shows the distribution of sensory evaluation of the products of the smoked samples. The result shows that there is significant difference ($p<0.05$) across the various samples. It was observed that sample A has the lowest rating in smell followed by sample C and sample D. Showing that sample A was lowly rated followed by sample C and sample D respectively. There is significant difference ($p<0.05$) with the samples under taste and texture.

Paper ID: SR23828211149 DOI: 10.21275/SR23828211149

Table 2 shows the distribution of sensory evaluation of the products of the fried samples. The result shows that there is significant difference ($p<0.05$) across the various samples. It was observed that sample A has the lowest rating in taste and smell followed by sample B and C, showing that sample A was lowly rated followed by sample B and sample C respectively. There is significant difference ($p<0.05$) among the samples under texture.

Table 3 shows the distribution of sensory evaluation of the products of the boiled samples. The result shows that there is significant difference ($p<0.05$) across the various samples. It was however observed that sample A and B has the lowest rating in taste, smell and texture. Followed by sample B and C showing that sample A and B were lowly rated followed by sample B and C respectively. There is significant difference ($p<0.05$) with the samples under smell and flavor.

Table 1: Sensory evaluation of the products by the panelists

Smoked Fish

Product A				Product B				Product C				Product D				
Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Modified Score
																Neither like Nor dislike
		1		2	2	1		2	1	2						Like slightly
2	1	1	2	4	2	3	5	2	2	2	3	10	3	4	6	Like very much
10	5	15	12	6	7	11	7	12	6	11	9	5	12	11	8	Like moderately
8	14	3	6	8	9	5	8	4	11	5	8	5	5	5	6	Like extremely

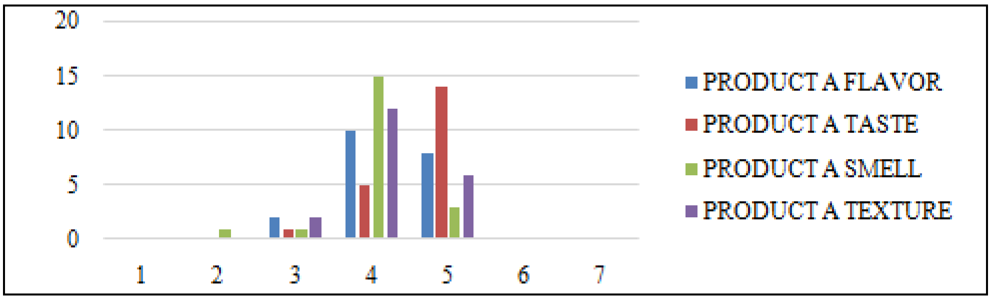

Figure 1: Product A (*Clarias gariepinus*)

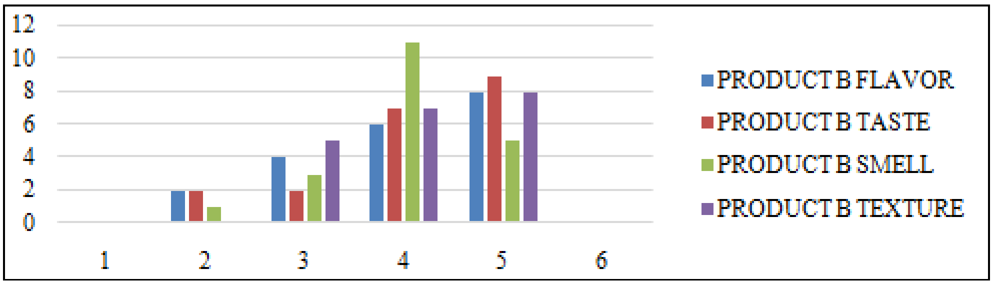

Figure 2: Product B (*Chrysichthys nigrodigitatus*)

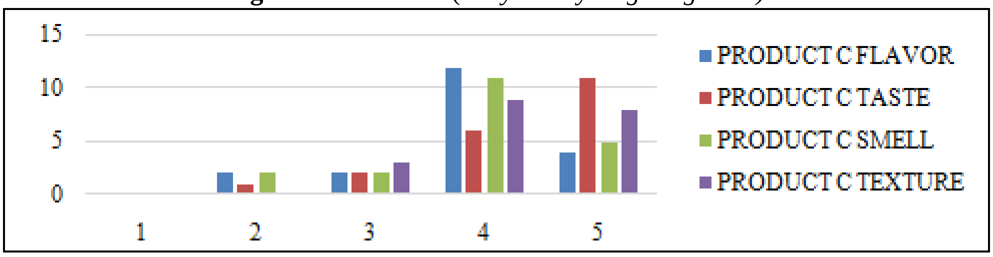

Figure 3: Product C (*Tilapia niloticus*)

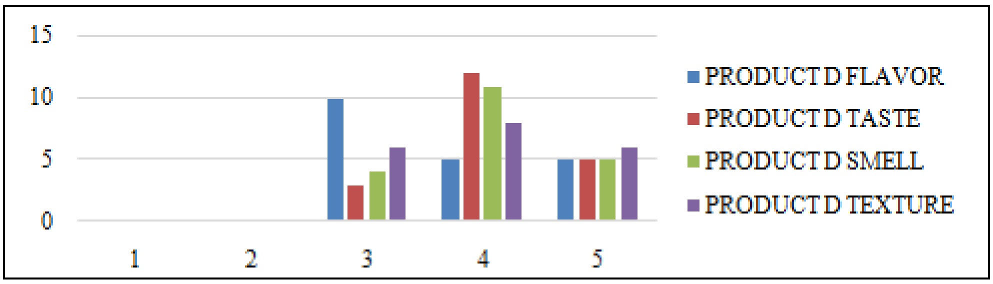

Figure 4: Product D (*Pseudodolithus typus*)

Table 2: Sensory evaluation of the products by panelists

Fried Fish

Product A				Product B				Product C				Product D				
Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Modified Score
																Neither like Nor dislike
															1	Like slightly
4			5	4	1	2	4	4	1	1	5	9	2	4	3	Like very much
8	9	15	10	10	10	13	7	11	8	13	8	5	9	12	10	Like moderately
8	11	5	5	6	9	5	9	5	11	6	7	6	9	4	6	Like extremely

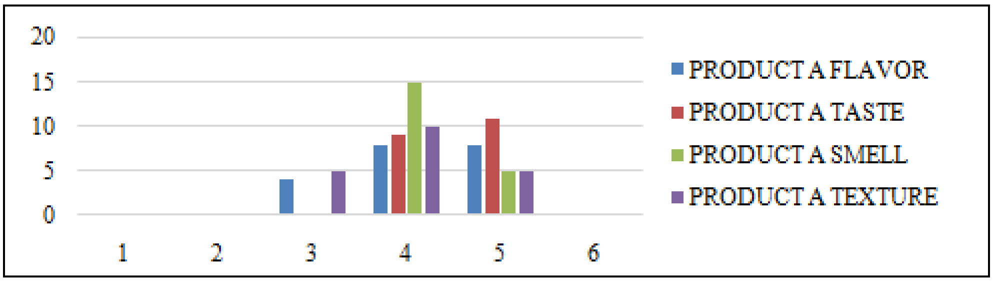

Figure 5: Product A (*Clarias gariepinus*)

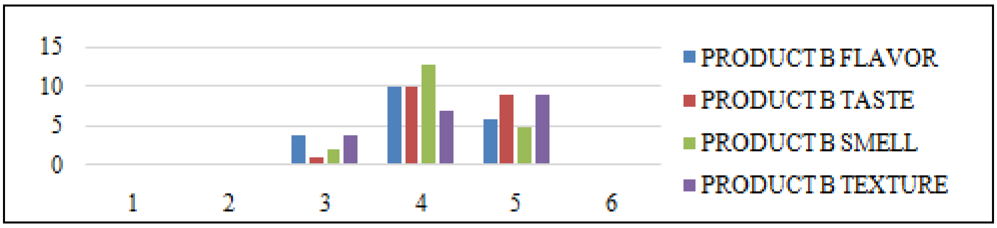

Figure 6: Product B (*Chrysichthys nigrodigitatus*)

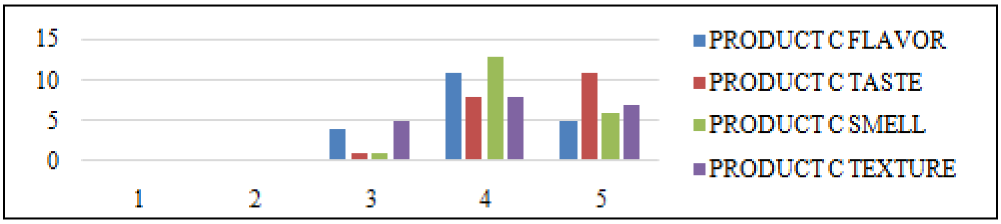

Figure 7: Product C (*Tilapia niloticus*)

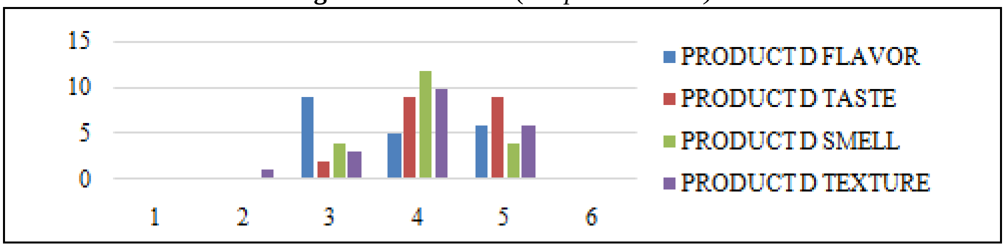

Figure 8: Product D (*Pseudodolithus typus*)

Table 3: Sensory evaluation of the products by the panelists

Boiled Fish

Product A				Product B				Product C				Product D				
Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Flavor	Taste	Smell	Texture	Modified Score
																Neither like Nor dislike
					1		1	2		1	1					Like slightly
6	3	3	3	7	3	3	4	4	6	5	6	7	4	5	7	Like very much
5	6	6	11	7	7	12	12	9	8	8	8	6	12	12	10	Like moderately
9	11	11	6	6	9	5	3	5	6	6	5	7	4	3	3	Like extremely

International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

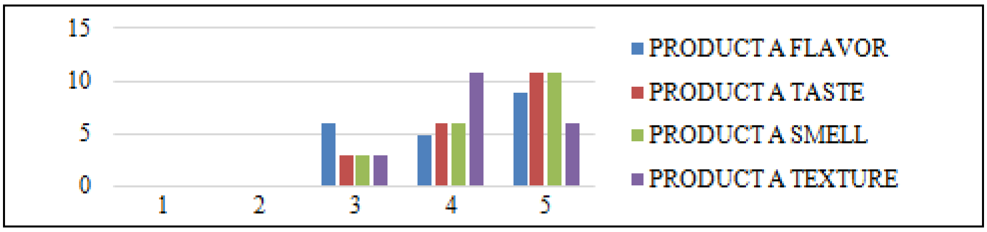

Figure 9: Product A (*Clarias gariepinus*)

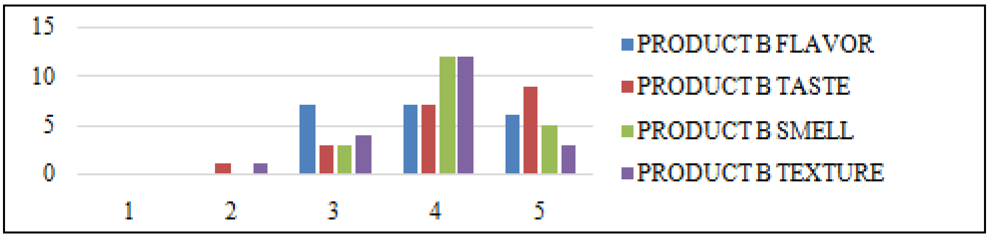

Figure 10: Product B (*Chrysichthys nigrodigitatus*)

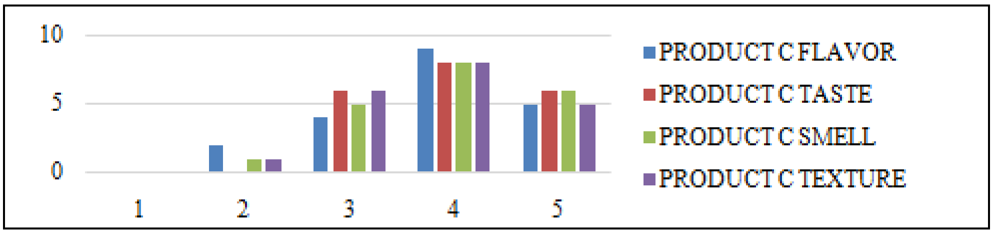

Figure 11: Product C (*Tilapia niloticus*)

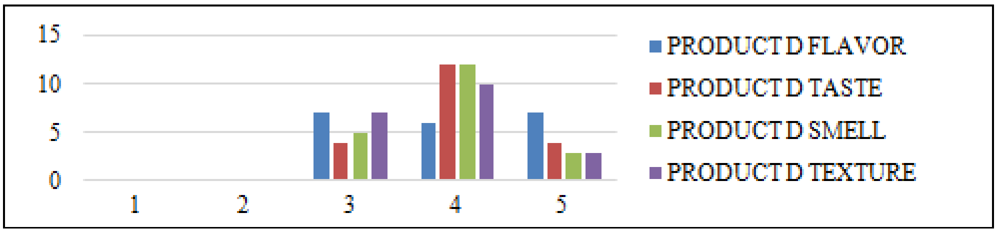

Figure 12: Product D (*Pseudodolithus typus*)

Table 4: Organoleptic properties of *Clarias gariepinus* **(Product A)**

Processing methods	Flavor	Taste	Smell	Texture
Smoked	1.7± 0.91a	1.2±0.66a	1.9 ±1.10a	3.8± 0.30c
Fried	1.9± 0.93a	2.9±0.93b	2.2± 0.7ab	2.5± 0.71c
Boiled	2.8±1.10b	1.8±0.85c	2.7 ±1.20b	3.9 ±0.02c

Values with the same superscript letter within the same column are not statistically different (p<0.05).

Table 5: Organoleptic properties of *Chrysichthys nigrodigitatus* **(Product B)**

Processing methods	Flavor	Taste	Smell	Texture
Smoked	1.9 ±0.93a	1.4± 0.66a	1.4 ±1.10a	3.4± 0.30c
Fried	1.8 ±1.09a	1.9 ±0.93b	2.4± 0.70ab	1.5± 0.71a
Boiled	2.7± 1.21b	2.1 ±0.85c	2.1 ±1.20b	3.8 ±0.01c

Values with the same superscript letter within the same column are not statistically different (p<0.05).

Table 6: Organoleptic properties of *Tilapia niloticus* **(Product C)**

Processing methods	Flavor	Taste	Smell	Texture
Smoked	1.8± 0.87a	1.5± 0.83a	1.8± 1.09a	3.8±0.31c
Fried	2.4±0.78ab	1.9±0.93b	1.5± 0.83ab	1.7± 0.62a
Boiled	3.0± 1.09b	2.0 ±1.09b	2.0± 1.09b	3.8± 0.30c

Values with the same superscript letter within the same column are not statistically different (p<0.05).

Table 7: Organoleptic properties of *Pseudodolithus typus* **(Product D)**

Processing methods	Flavor	Taste	Smell	Texture
Smoked	1.9±0.83a	1.5±0.93a	1.4±1.10a	3.8±0.32c
Fried	1.8±0.93a	1.9±0.93b	1.5±0.84ab	2.5±0.81a
Boiled	3.0±1.10b	2.0±0.85b	2.1±1.30b	3.9±0.30c

Values with the same superscript letter within the same column are not statistically different (p<0.05).

4. Discussion

The evaluator's response shows that in the entire product subjected to three methods of processing, all the sensory evaluation has a very important role to play in the evaluation process.

Flavor and taste play a major role on the general acceptability of the products. The study shows that processing methods have preferred results on the organoleptic properties of smoked, fried and boiled *Clarias gariepinus, Chrysichthys nigrodigitatus, Tilapia niloticus and pseudodolithus typus* in terms of taste, flavor, smell, texture and general acceptability. This was in agreement with the report of Taniya and Kannan (2016) and Iheagwara (2013).

Sample A, B, C and D recorded high rating generally by the 20 panelists in all the sensory evaluation of flavor, taste and texture in these two (2) processing method of smoking and boiling, while the rating was lower in sample A,B,C and D in all the sensory evaluation of flavor, taste and texture in frying method of processing. This may be linked to the fact that the processing methods employed alone does not serve as significant method in improving the organoleptic properties of smoked *Clarias gariepinus, Chrysichthys nigrodigitatus, Tilapia niloticus* and *pseudodolithus typus* (Ahmed *et al*., 2011). The different treatments had less significant effects on the appearance of the products though with a gradual increase in the rating showing wide gap between product A, C and B.

The organoleptic properties of smoked, fried and boiled *Clarias gariepinus*, *Chrysichthys nigrodigitatus*, *Tilapia niloticus* and *pseudodolithus typus* fishes are shown in Table 4.5.6 & 7. The flavor of the smoked *Clarias gariepinus* significantly differed ($p>0.05$) from that of boiled *Clarias gariepinus*. There were no significant difference ($p>0.05$) in the flavor of the smoked, boiled, fried and boiled fishes. The smell of the smoked fishes significantly differed ($p>0.05$) from that of boiled fishes, and there was no significant difference ($p>0.05$) in the smell of the smoked and fried fishes and fried and boiled fishes.

There was no significant difference ($p>0.05$) in the texture of smoked and boiled fishes. The texture of smoked and fried fishes significantly differ ($p<0.05$) from that of the fried and boiled fishes. However, there were no significant difference ($p>0.05$) in the palatability of the fried and boiled *Chrysichthys nigrodigitatus*, while the palatability of the smoked fishes significantly differed ($p<0.05$) from that of the fried fishes and boiled fishes, as shown in Table 4,5,6 and 7. The boiled fishes had the highest flavor and palatability scores. The boiled fishes had the highest smell and texture scores, closely followed by smoked fishes.

5. Conclusion

The organoleptic properties of the fish types studied were determined using questionnaires. The results showed that best texture properties were found in fried *Chrysichthys nigrodigitatus* and smoked *Tilapia niloticus.* The best smell properties were found in boiled *Clarias gariepinus,* in terms of taste Smoked *Clarias gariepinus* has the highest rating score and in terms of flavor cooked *Clarias gariepinus* had the highest rating score.

Recommendations

I hereby recommend smoking as the best processing method for a healthy living because the highest protein and the lowest fat content were found in the smoked fish, The smoked fishes had the highest rating score, Also, smoking also gave longer shelf life.

References

[1] Alasalvar, C, Miyashita, K., Shahidi, F and Wanasundara, U (2011). Handbook of seafood Wuality, Safety and Health Applications, John Wiley and Sons, p. 349.

[2] Ananoui, S., Maqueda1, M and Valdivia, E (2007). ''Biopreservation, an ecological approach to improve the safety and shelf-life

[3] Ayeloja, AA; George, FOA; Obama, SO; Sanni, LO; Ajayi, A.A.(2011). Effects of length of delay after slaughter (LODAS) on raw catfish Clarias gariepinu. J. Amer. Sci. 7 (6): 508- 521

[4] Bate, E.C., & Bendall, J.R. (2010). Changes in fish muscle after death. British Medical Bulletin, (12), 2305.Burchell, 1822). World Applied Sci. J., 2010:13: 1628-1634. 5

[5] Ayeloja, A. A., George, F. O. A., Obasa, S. O.,Sanni, L. O and Ajayi, A. A. Effects of length of delay after slaughter on raw catfish, Clarias gariepinus. *Journal of American science*.2011:7(6):508-512.6.

[6] Eriksson, C. E. (1987). Oxidation of lipids in food systems. In H. W. S. Chan (Ed.), Autoxidation of unsaturated lipids (pp. 207-231). London: Academic Press.

[7] Eyo, E. E (2002). Fish processing and Utilisation. Paper presented at the National Workshop on Fish Processing Preservation, Marketing and Utilisation, New Bussa, pp. 4-5

[8] FAO Fisheries and Aquaculture, (2008). Globalisation and Fisheries: Proceedings of an OECD-FAO Workshop Organization For Economic Co-operation and Development, OECD Publishing, p.56.

[9] FAO, (2007). Survey methods of Appraising Evaluation of traditional solar dry system in Nigeria Fisheries Resource. Fish Technical Paper, pp. 17

[10] FAO (2011). Handling of fish and fish products Fisheries and Aquaculture Department, Rome, 2011: https//www.researchgate.net.

[11] Fawole, O. O., Ogundira, M. A., Ayandiran, T.A. and Olagunju, O. F. (2007). Proximate and mineral composition in some selected fresh water fishes in Nigeria. J. Food Safety, 2007:9:52-55.

[12] Flajnik, M. F., and Kasahara, M. (2009) ''Origin and evolution of the adaptive immune system: genetic events and selective pressures.'' Nature Reviews Genetics, 47-59.

[13] Harris, W. S. (1997). n-3 fatty acids and serum lipoproteins: human studies. American Journal of Clinical Nutrition, 65(5), suppl., 1645S-1654S. PMid:9129504.

[14] Hellman, G., Collette, B and Facey, D.(2004). The

Diversity of Fishes. Blackwell Holland, Publishing.P. 375.

[15] Brown, J., & Buss, D. H. (1993). Fish and fish products: Supplement to the Composition of Foods (5th ed.). London: HMSO. http://dx.doi.org/10.1039/9781849732611

[16] Huss, H.H. (2009). Quality and quality changes in fresh fish FAO Fisheries Technical paper, Rome, p. 348 .

[17] Idachaba, F.S (2001). The Nigerian Food Problem of processed fish and had varied sources of proteins. Journal of Agriculture, Science and Technology, 1(1): 5-16.

[18] Idris, G. L., Omojowo, F. S. Omojasola, P. F., Adetunji, C. O. and Ngwu, E. O. (2010). The effect of different concentrations of ginger on the quality of smoke-dried catfish. Journal of Nature and Science. 2010:8: 59-63.

[19] Iheagwara, M. C.(2013) Effect of ginger extract on stability and sensoriality of smoke mackerel (Scomber scombrus) Fish. J. Nutritional food sci.

[20] Karube, I., Marouka, H., Suzuki, S., Watanave, E and Toyana, K. (2001). Journal of Agriculture and Food Chemistry, 32: 314-319.

[21] Kumolu-Johnson, C. A., Ndimele, P. E.,Akintola, S. L. and Jibuike, F. C.(2011). The effect of smoking on the nutritional qualities and shelf life of hot smoked catfish (*Clarias gariepinus*,

[22] Kumolu-Johnson, C. A. and Ndimele, P. E. (2011). A review on post-harvest losses in Artisanal fisheries of some African countries. J. Fish.Aquat. Sci., 2011:6: 365-378

[23] Leistner, L and Gould, G.W (2002) Hurdle technologies: combination treatments for food stability, safety, and quality Springer, p.334.

[24] Pearson, D., & Cox, H. E. (1976). The chemical analysis of foods (7th ed.). Edinburgh: Churchill Livingstone.

[25] Romer, A.S and parsons, T.S. (2011). The vertebrate Body . 5th Ed. Saunders, Philadelphia, p.576.

[26] Taniya, A. and Kannan.E, (2016). Effect of spices and herb for enhancing microbial quality and shelf life of dried Indian oil sardine (Sardinella longiceps) fish during storage at room temperature. Journal of environmental science, technology and food technology, 2016:5:23-40.

[27] Tawari, C. C. and Abowei, J. F. N. (2011). Traditional Economics of fish production in Kaduna state, Fish handling and preservation in Nigeria. Asian journal of agricultural science, 2011:3(1):20-25.