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Original Research Article

Effect of some Processing Methods on the Proximate Composition of some Frozen Marine Fishes

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ABSTRACT
Fish being a significant protein contributor to our daily diet, is cheap to afford but is highly perishable due to change in climatic conditions and a favourable medium for the growth of microorganisms and hence processing method is important to extend the shelf life and add value. Boiling, smoking, salting and sun-drying methods were used to assess proximate composition of Atlantic mackerel (*Scomber japonicus*), Round Sardinella (*Sardinella aurita*), and Horse mackerel (*Trachurus trachurus*). The steaming method was used for the boiling, cold method smoking was used for the smoking, salt sprinkling and open sun-drying methods were used for the salting and sun-drying. Each of the processed fish species were analyzed for the moisture content, dry matter, lipid content, crude protein content, ash content, and the nitrogen free extract. The moisture content, dry matter, crude protein, ash content, lipid and nitrogen free extract of salting and sun-drying method ranged between 36.23-60.98%, 34.02-63.77%, 35.08-56.71%, 5.00-12.20%, 5.24-5.43% and 26.72-53.42% respectively. The smoking method ranged between 46.30-60.49% of moisture content, 39.51-53.70% of dry matter, 52.73-59.87% of crude protein, 3.07-13.15% of the ash content, 6.10-7.95% of lipid and 22.52-36.25% of nitrogen free extract. The boiling method ranged between 47.47-57.27% of moisture content, 42.73-52.53% of dry matter, 35.93-65.60% of crude protein, 6.23-8.35% of the ash content, 5.09-6.23% of lipid and 26.77-50.69% of nitrogen free extract all against the raw fish species which also ranged between 51.50-62.89% of moisture content, 39.11-48.50% of dry matter, 48.55-55.67% of crude protein, 2.21-6.67% of ash content, 6.50-8.05% of lipid content and 30.55-38.85% of nitrogen free extract. The processing methods used (smoking, boiling, salting and sun-drying) showed no negative effect on the proximate composition after analysis. Boiling, smoking, salting and sun-drying processing method has more positive effect on the proximate composition of *Trachurus trachurus* than *Sardinella aurita* and *Scomber japonicus*.

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INTRODUCTION

Fish is one of the significant protein contributors to our daily diet, and it is consumed globally due to its high protein content, high polyunsaturated fatty acids (PUFA), minerals, and vitamins (Abraham *et al*., 2018). Moisture, protein, and fat are the primary components of fish, with trace amounts of vitamins and minerals (Aberoumand, 2014). Fish is one of the most important vertebrate groups (Mahaliyana *et al*., 2015). Fish contains high omega-3 polyunsaturated fatty acids which help in preventing heart disease and decreasing the risk of certain cancer and other diseases such as cancer, hypertension, and atherosclerosis (Kannaiyan *et al*., 2019). According to the Food and Agriculture Organization of the United Nations Yearbook of Fishery and Aquaculture Statistics (FAO, 2018), fish utilization for human consumption increased from 2011 to 2016. Many people like fish since it is the cheapest source of animal protein and other key elements for human health (Mahaliyana *et al*., 2015). Fish is highly perishable because it provides favorable medium for the growth of microorganisms after death (Aliya *et al*., 2012) due to factors such as high moisture content, availability of nutrients for microbial growth, ambient temperature and poor handling. Fish spoilage in Nigeria is influenced to a large extend by high ambient temperatures, considerable distances of landing ports to points of utilization and as well as inadequate infrastructure for postharvest processing and landing (Saliu, 2018). Fish processing is done to extend the shelf life and also add value to the fish product (Issa *et al*., 2020).

Nutritional quality of fish may be influenced by how it is processed and cooked. These methods include frying, grilling, freezing, steaming, boiling, sun drying, and smoking. Salting, smoking and sun drying are the cheapest methods and do not require the use of sophisticated techniques. These cooking methods have a wide range of uses, techniques, and effects on the nutritional and proximate composition of processed fish (Abraham *et al*., 2018). Proper cooking methods are essential for retaining maximum nutritional value, including proximate composition, vitamins, minerals, and fatty acid composition (Golgolipour *et al*., 2019). Processing techniques play a crucial role in the transformation of raw fish into various processed fish products (Smith *et al*., 2018). These methods may introduce changes that can potentially affect the nutritional and proximate composition of fish protein, including its content, digestibility, and amino acid profile (Anderson *et al*., 2019; Kim and Park, 2021). The extent to which different processing methods alter the protein value of fish is essential for optimizing fish processing techniques and ensuring the delivery of high-quality, nutritionally valuable fish products to consumers (Martins *et al*., 2017; Silva *et al*., 2022). Investigating the effect of processing methods on the protein value of fish, it can provide valuable insights to consumers, enabling them to make informed choices about processed fish products (Silva *et al*., 2022).

Fish meat is made up of several nutrients that are useful to humans, including proteins, carbohydrates, lipids, amino acids, trimethylamine oxide (TMAO), and others (Adrah and Tahergorabi, 2022). Fish improves growth, enables tissues to recover and increases healthy gum and teeth (Haruna, 2003). Regular consumption of fish can promote the defense mechanism for protection against invasion of human pathogens since fish food has antimicrobial peptide (Ravichandran *et al*., 2010).

The vulnerability of aquatic food products to microbial spoilage is due to the presence of high moisture content and nutrient availability (Singh *et al*., 2021). Yeast is a type of microorganism that can spoil food products by reducing their sensory properties, which is harmful, but it also plays an important role in food preservation and production (Tofalo *et al*., 2020). Bacteria is another type of microorganism that causes spoilage in fish, Gram-negative pyschrotolerant bacteria like *Shewanella* spp. and *Pseudomonas* spp. May cause chilled fish to deteriorate while raw fish may deteriorate due to fermentative gram-negative bacteria such as *Vibrionaceae* (Rathod *et al*., 2022).

Preservation and processing techniques may introduce changes that can potentially affect the nutritional and proximate composition of fish protein (Anderson *et al*., 2019). Fish are prepared in different ways, e.g. boiling, grilling, frying and smoking. It has been inferred that the element content of fish meat can be influenced by processing or cooking method. (El-Lahamy *et al*., 2019). The effect of some processing methods on the proximate composition of Atlantic Horse Mackerel (*Trachurus trachurus*), Round Sardinella (*Sardinella aurita*), and Chub mackerel (*Scomber japonicus*) is therefore assessed in this study.

MATERIALS AND METHODS

Study Area

Biochemical laboratory, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Kaduna State located in the North Western region of Nigeria

Sample Collection and Preparation

Four fish species each of *Trachurus trachurus*, *Sardinella aurita* and *Scomber japonicus* were purchased and grouped into four groups each having one each of the samples. The first group were washed thoroughly with clean water and salted with NaCl by sprinkling and sundried using the open-sun drying method for about one hour (Chin, 2017). The second group were smoked on a drum type smoking kiln with a low section for insertion of

wood using the cold smoking method (Puke and Galoburda, 2020), it was smoked for 30 minutes and the smoked was produced by the burning of *Parkia biglobosa* and a wire guage was placed untop of the drum. The third group were washed, kept inside a clean pot with water and placed on the stove to cook for 15 minutes using the boiling method (Cirilo *et al*., 2020). The fourth group were unprocessed and used as the control.

Proximate Composition Analysis

The routine analysis of food is termed the proximate analysis. Main components of different fractions in the proximate analysis of foods are moisture, lipid, crude protein, ash and carbohydrate.

Dry matter

$DM=\frac{c}{a}\times 100$

Where DM = Dry matter, a = weight of wet sample, c = weight of dried sample

Moisture content

$MC=\frac{(W2-W3)}{(W2-W1)}\times 100$

Where, MC =Moisture content, W1 = Weight of crucible, W2 = first weight of dried sample,
W3 = second weight of dried sample after 3 hours

Crude protein content

The amount of Nitrogen was calculated using the formula:

$\%\ N = 0.01\times 0.14\times t-\left(\frac{250}{5}\times\frac{100}{a}\right)$

Where, 0.01 = Molarity of HCl, 0.14 = mole equivalent of N, t = titre value of HCl, a = weight of sample, Crude protein = 6.25 × N

Crude fat content

The crude fat content was calculated as:

$\text{Fat content}=\frac{(d-b)}{a}\times 100$

Where a = weight of sample, b = weight of container,
d = weight of container + extracted fat

Ash content

The ash content was calculated as:

$\%\text{Ash}=\frac{\text{Weight of ash (d}-\text{a)}\times 100}{\text{Weight of sample (b}-\text{a)}}$

Where a = weight of the sample, b = weight of the container, d = weight of crucible + ash

Nitrogen Free Extracts (NFE)

NFE = 100 – (% moisture + % crude protein + % crude fat + % ash)

Statistical Analysis

Data was subjected to one-way analysis of variance (ANOVA) and expressed as mean ± S.D (Standard deviation). Values of $P<0.05$ was considered significant to determine the processing method with the best effect on the proximate composition of the fish species. The Duncan test were used to compare the means using SPSS (Statistical Package of Social Science version 20.0).

RESULTS AND DISCUSSION

The result of this study showed the proximate analysis of raw, smoked, boiled and salted and sun-dried, fish samples of Horse mackerel (*Trachurus trachurus*), Round sardinella (*Sardinella aurita)*, and Atlantic mackerel (*Scomber* japonicus) are shown in Table 1.

There are no significant difference in the mean % of salting and sun-drying on the proximate composition of the three fish species with values in % ranging from 36.23 to 60.98% of moisture content, 34.02 to 63.77% of dry matter, 35.08 to 56.71% of crude protein, 5.00 to 12.20% of ash, 5.24 to5.43% of lipid and 26.77 to 53.42% of Nitrogen (Table 1). There is no significant difference in the three fish species as against the raw samples.

There is no significant difference in the mean % of smoking on the proximate composition of the fish species. Mean % of moisture content among the three species ranges between 46.30 to 60.49 %, dry matter (39.51 to 53.70%), crude protein (52.73 to 59.87%), lipid (6.10 to 7.95%), ash (3.07 to 13.15%), and nitrogen (22.52 to 36.25%) as showed in Table 2 below. There is no significant difference in the three species against the raw samples.

There is no significant difference in the mean % of boiling on the proximate composition of the fish species with the values ranging from 42.73 to 52.53% of dry matter, 35.93 to 65.60% of crude protein, 6.23 to 8.355% of ash content, 5.09 to 6.23% of lipid, 47.47 to 57.27% of moisture content and 20.96 to 50.69% of nitrogen as showed in Table 2. There is no significant difference in the three species against the raw samples.

Table 1: Mean Proximate Composition of Raw, Smoked, Boiled, Salted and Sun-dried Chub Mackerel (*Scomber japonicus*), Round Sardinella (*Sardinella aurita*), and Horse Mackerel (*Trachurus trachurus*)

Sample	Moisture content (%)	Dry matter (%)	Crude protein (%)	Ash (%)	Lipid (%)	Nitrogen free extract (%)	Crude fiber (%)
Scomber japonicus							
Raw	51.50	48.50	48.55	4.55	8.05	38.85	0.00
Smoked	46.30	53.70	52.73	3.07	7.95	36.25	0.00
Boiled	47.47	52.53	35.93	7.15	6.23	50.69	0.00
Salted and Sundried	46.30	53.70	52.73	3.07	7.95	36.25	0.00
Sardinella aurita							
Raw	62.89	37.11	55.67	6.67	7.11	30.55	0.00
Smoked	60.49	39.51	59.87	11.51	6.10	22.52	0.00
Boiled	57.27	42.73	60.50	6.23	5.57	26.77	0.00
Salted and Sundried	60.98	34.02	55.79	12.20	5.24	26.77	0.00
Trachurus trachurus							
Raw	58.87	40.13	53.13	2.21	6.50	38.16	0.00
Smoked	57.02	42.98	56.75	13.15	6.45	23.65	0.00
Boiled	55.97	44.03	65.60	8.35	5.09	20.96	0.00
Salted and Sundried	60.25	39.75	56.71	5.00	5.43	32.86	0.00

Table 2: Mean Proximate Composition of Raw, Smoked, Boiled, Salted and Sun-dried

Sample	Moisture (%)	Dry matter (%)	Crude Protein (%)	Ash (%)	Lipid (%)	Nitrogen free extract (%)	Crude fiber (%)
Raw	58.08±5.90[a]	41.91±5.90[a]	52.45±3.61[a]	4.48±2.23[a]	7.22±0.78[a]	37.68±13.96[a]	-
Smoked	54.60±7.39[a]	45.39±7.39[a]	56.45±3.57[a]	9.24±5.40[a]	6.83±0.98[b]	32.80±15.75[a]	-
Boiled	53.57±5.32[a]	46.43±5.32[a]	54.01±15.86[a]	7.24±1.06[a]	5.63±0.57[b]	27.47±7.62[a]	-
Salted and sun-dried	52.48±14.08[a]	47.51±14.08[a]	49.19±12.23[a]	7.79±3.86[a]	5.32±0.09[b]	35.85±4.61[a]	-
P-value	0.88	0.88	0.85	0.46	0.03	0.72	-

Note: Data are represented as Means ± Standard deviation. Means with the same superscripted alphabet are not significantly different (p<0.05).

Discussion

The mean dry matter of boiled, and smoked increases in *Scomber japonicus* and *Sardinella aurita*, while boiled, smoked, salted and sun-dried all increases in *Trachurus trachurus*. The lipid content mean of smoking and boiling processing methods increases and it is due to high temperature (Aguiler *et al*., 2020), research shows that the lipid content of different processing methods increases (Hernandez-Sanchez and Aguilera-Morales, 2012) and it decreases across the different processing methods used here among the three different fish species in this research. Temperature has influence on fish fat by reducing it (Cirilo *et al*., 2020)

Crude protein content mean increased in all the processing but there was decrease in boiling, salting and drying in *Scomber japonicus*. The protein contents level increases with decreasing moisture content (Aliya *et al*., 2012 and Daramola *et al*., 2017), higher values of protein were observed in smoked *Scomber japonicus*, boiled Sardinella aurita and Trachurus trachurus. The increase in crude protein level was compared to Brooks *et al*., (2010), reduction in crude protein could be associated to time of drying process of fish which could give rise to microbial contamination and prolonged sun-drying of fish could also increase the enzymatic breakdown of the protein level (Ahmed *et al*., 2011) but it decelerated in this study except for *Trachurus trachurus*.

Ash content mean was higher in salted and sun-dried *Sardinella aurita* and the smoked and boiled were higher in *Trachurus trachurus*. The moisture content mean of boiled, smoked and salted and sun-dried were higher in *Sardinella aurita* than those of *Trachurus trachurus* and *Scomber japonicus*. The moisture content reduces after each processing methods on each fish species, that of smoking was because the fish loses a lot of water and a protective coating was formed due to the partial carbonization of the tissues and other compounds by wood smoke (Ahmed *et al*., 2011).

The lipid content was significantly different among the processing methods while the remaining composition was not significantly different.

CONCLUSION

Salting and Sun-drying has more effect on the proximate composition of *Trachurus trachurus* than *Scomber japonicus* and *Sardinella aurita* as the proximate composition level increases against the raw species. The effect of smoking was higher in *Trachurus trachurus* and then *Sardinella aurita* with *Scomber japonicus* been the least. Boiling method was discovered to have more increased proximate composition on *Trachurus trachurus* than the other species against the raw species. Smoking method generally had the best result in the proximate composition of the three fish species against each of the raw species.

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REFERENCES

Aberoumand, A., & Ziaei-Nejad, S. (2015). Effect of cooking on quality commonly consumed marine fish Platycephalidae (*Platycephalus indicus*) in Iran. *Turkish Journal of Agriculture Food Science and Technology*, 3(11): 891–893.

Abraham, B., Admassu, H., Fang, Y., Mahmud, A., Shui, X.W. and Tsighe, N. (2018). Effect of processing methods on nutritional and physico-chemical composition of fish: a review. *Food Processing and Technology*, 6(4): 376-382. https://doi.org/10.15406/mojfpt.2018.06.00191

Adrah, K., and Tahergorabi, R., (2022). Ready to eat products elaborated with mechanically separated fish meat from waste processing. *In sustainable fish production and processing*, *Academic press*, 227-257.

Ahmed A, Ahmadou D and BA Mohamadou (2011). Influence of traditional drying and smoke drying on the quality of three fish species (*Tilapia nilotica, Silurus glanis* and *Arius parkii*) from Lagdo Lake, Cameroon. *Journal of Animal and Veterinary Advances,* 10: 301-306.

Aliya, G., Aziz, K., Humaid, K., Nashwa, M., Nasser, A., Ponnerassery, S.S., Sami, G., (2012). Effect of the freshness of starting material on the final product quality of dried salted shark. *Advance Journal of Food Science Technology*, 4(2): 60-63.

Anderson, L. P., Hicks, D. T., and Joyce, J. L. (2019). Effects of processing on the nutritional composition of fish. Critical reviews in *food science and nutrition*, 59(9): 1447-1456.

Brooks M.S., Budge S., Dave D., and Ghaly, A.E. (2010) Fish spoilage mechanisms and preservation techniques: Review. *American Journal of Applied Sciences,* 7(7): 859-877.

Chin, K.S., (2017). Industrial fish drying processes: Origin and Benefits. In *Fish Drying Technologies* CRC Press, 3-24.

Cirilo, N., Fabiola, H., Jose L.L., Martha, E.A., Leticia, G.N., and Yie-Hua, T. (2020). Effect of different cooking methods on the nutritional composition of Tilapia. *Journal of Applied Sciences and Process Engineering*, 7(1): 489-499.

Daramola, J.A., Osofero, S.A., Kester, C.T., and Gbadamosi, O.K., (2017). Overview of the status of Aquaculture in Nigeria with reference to Ekiti State. *Agricultural journal*, 2(3): 447-452.

El-Lahamy A.A., El-Sheriff S.A., Ibrahim H.R., Khalil K.L., and Mahmud A.A. Changes in fish during cooking methods (frying and grilling): a review. *Journal of Public Health Catalog*, 2: 169 – 172.

Food and Agriculture Organization (FAO). (2018). Food and Agriculture Organization of the United Nations (FAO) *Yearbook of Fishery and Aquaculture Statistics*. Retrieved from FAO website: https://www.fao.org/fishery/en/global-search?q=yearbooks&lang=en

Golgolipour, S., Ghanemi, K., and Khodanazary, A., (2019). Effects of different cooking methods on minerals, vitamins and nutritional quality indices of grass crap (*Ctenopharyngodon idella). Iranian Journal of Fisheries Science*, 18: 110-123.

Haruna, A. B., (2003). Aquaculture in the tropics theory and practice. Kano, *Al-Hassan Publishers*, 432.

Issa, W., Abdulmumuni, B., (2020). Design and fabrication of a charcoal fish smoking kiln. *International Journal of Recent Technology and Engineering*, 9(1): 2277-3878.

Kannaiyan, S.K., Bagthasingh, C., Vetri, V., Aran, S.S. and Venkatachalam, K. (2019). Nutritional, textural and quality attributes of white and dark muscles of little tuna (*Euthynnus affinis*). *Indian Journal of Geo Marine Sciences*, 48(2): 205-211.

Kim, M., and Park, S. (2021). Nutritional changes in fish during processing: A review. *Food Science and Animal Resources*, 41(2): 241-250.

Mahaliyana, A., Liyanage, N.P.P., Jayasinghe, T., Jayamanne, S., and Jinadasa, B.K., (2015). Nutritional composition of Skipjack tuna. *American Journal of Food and Nutrition*, 3: 106-111.

Martins, D., Gouveia, L., Rema, P., and Batista, I. (2017). Fish processing wastes as a valuable source of proteins, amino acids, and oils: A review. *Journal of Food Science*, 82(6): 1419-1428.

Puke, S., and Galoburda, R., (2020). Factors affecting smoked fish quality. *A review In Proceedings of the Research for Rural Development, Jelgava, Latvia*, 35: 132-139.

Rathod, N.B., Ranveer, R.C., and Benjakul, S., (2021). Recent developments of natural antimicrobials and antioxidants on fish and fishery food products. *Comprehensive Reviews in Food Science and Food Safety*, https://doi.org/10.1111/1541-4337.12787

Saliu, J.K., (2018). Effect of smoking and frozen storage on the nutrient composition of some African fish. *Advances in Natural and Applied Sciences*, 2(1): 16-20.

Silva, L. M., Pimenta, A. I., Morais, H. A., Ramos, S. J., Carvalho, I. S., Del Pino-Garcia, R., and Garcia-Lomillo, J. (2022). Impact of different drying methods on nutritional and bioactive properties of fish: A review. *Food Research International*, 153: 110-946.

Singh, A., Turko, J.A., Rathak, A., Salena, G.M., Hughes, E., Brown, C., and Balshine, S., (2021). Understanding fish cognition: A Review and Appraisal of current practices, Animal cognition, 24: 395-406.

Smith, J., Andrews, T., & Johnson, C. (2018). Spawning dynamics and fecundity estimation of Pacific mackerel (*Scomber japonicus*) in the Southwest Pacific Ocean. *Fisheries Research*, 207: 95-103.

Tofalo, R., Fusco, V., and Bohnlein, C., (2020). The life and times of yeasts in traditional food fermentations. *Critical reviews in Food Science and Nutrition*, 60(8): 1-30.