

THE NUTRITIONAL, SENSORY AND BACTERIAL ATTRIBUTES OF FOUR MARINE FISH SPECIES IN STORAGE

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Abstract

Deterioration of fish and fish quality is an important issue in protein security, particularly in humid tropical regions with poor refrigeration facilities. This study evaluated the quality of Argentine hake, herring, mackerel and horse mackerel, and the changes in these quality parameters when these fish are stored on the shelf. Nutrient content, sensory values, as well as the microbial status of the fishes were evaluated immediately and 2 days after storage. Results showed that the crude protein and ash values of the herring fish were highest, but the Mackerel was highest in fat content, while Argentina hake had the highest moisture content. The sensory values were highest for Mackerel fish. All the fish types supported bacterial growth, but the rate of growth was much higher ($p < 0.05$) in horse mackerel. It is recommended that harvesting and processing facilities of fish be directed more towards mackerel and herring than horse mackerel, to reduce fish loss due to spoilage.

Keywords; Protein security, sensory values, bacterial growth.

Introduction

Seafood is an important constituent in the human diet and fish is one of the main food constituents and healthy living materials (Sargent and Tacon, 1999). The supply of animal protein from fish is massive, but from more than 30,000 known species of fish, only about 700 of these species are commercially fished and used for food production (Rehbein and Oehlenschläger, 2009). Fish is highly acceptable for being the healthiest and cheapest source of protein, with amino acid compositions that are higher in cysteine than most protein sources (Neil, 1999). Fish is particularly desirable to the adult population and is nutritionally precious for its easy digestibility, high content of minerals, vitamin and protein as well as compositions of lipid fraction (Murray and Burt, 2001; Tochler, 2003). The spoilage of fish is a deficit to protein supply as it is extremely perishable commodity due among other reasons, to its high water content (Pal and Mahendra, 2015). Spoilage of fish starts upon death due to autoxidation, autolytic activity and metabolic activities of microorganisms

present in the fish. Within 15-20 hours of death, particularly where temperature is high, fish becomes inedible, unacceptable and unsafe for human consumption with apparent discolouration, slime formation, changes in texture, off-odors, off-flavors, and gas production (Adedeji and Adetunji, 2004). The spoilage is facilitated, according to Pal (2012) by the growth of microorganisms including bacterial species (*Aeromonas*, *Alcaligenes*, *Bacillus*, *Enterobacter*, *Enterococcus*, *Escherichia coli*, *Listeria*, *Pseudomonas*, *Shewanella*) and fungal species (including *Aspergillus*, *Candida*, *Cyriococcus* and *Rhodotorula*). This study determines the nutritional and sensory quality of Argentine Hake, Herring, Mackerel and Horse Mackerel, their bacterial status over a 3 day storage, and the effect of spoilage on the nutritional quality.

Materials and Methods

Sample	Preparation:	
hake (<i>Merluccius hubbsi</i>),		Argentine Herring

atlantic(*Clupeaharengus*), Mackerel (*Scomberscrombus*), and Horse mackerel(*Trachurustrachurus*) were obtained from Unity market, Ilorin and transported immediately to Animal Production Laboratory of the University of Ilorin. The fish pieces were cut, gutted, cleaned with water, packed in labeled polyethylene bags and kept frozen until used. The proximate composition, sensory analysis and bacterial status of the fish were determined.

Nutritional Assay: The proximate value and mineral content of the fish samples were analysed on the day of fish harvest (day 0) according to the methods of AOAC (1995). Three replicates were selected for analysis from every treatment group.

Sensory Assay: Frozen fish samples were removed from the freezer and allowed to thaw under room temperature. The samples were coded with random letters and served to be evaluated for appearance, aroma, taste, texture and general acceptability. The sensory scores of each sample were determined (Lammond, 1970; Badmos *et al.* 2017).

Bacterial Count: Three replicates of each group was kept on the shelf, and from each group, samples were taken for Total Bacterial Count (TBC) on the day of fish capture as well as the third day (day 0, and day 2), in line with the methods of Fawole and Osho (2017).

Statistical Analysis: The data collected in the analysis above were subjected to one way analysis of variance and while the means were separated using Tukey's studentized range (HSD) test at significance level of $P < 0.05$ (Steel and Torrie, 1980).

Results and Discussion

Nutritional Value: The crude protein and ash values of the herring fish were highest, but the mackerel was highest in fat content, while Argentina hake had the highest moisture content. The crude protein value of 18.03 and 19.90% (Table 1) is similar to 18.45 and 20.20 % reported

by Olagunjuet *al.* (2012) respectively for mackerel and herring. Ondo-Azi *et al.* (2013) similarly reported that the crude protein content of five species of marine fish consumed in Gabon ranged between 16% and 20%. After three days of storage on shelf, the moisture content of all fish samples decreased, while the protein and fat content of all fish samples increased. Decrease in moisture content is expected from dehydration as the samples were kept on the shelf at room temperature (Table 2). This is expected to lead to increase in content of other nutrient on analysis. Differences in protein content between the fishes could be related to their peculiarity and genetic makeup of the fishes or absorption capability as well as conversion potentials of essential nutrients from their diets (Adewoye and Omotosho, 1997; Ackman, 1989). The 7.73 % fat content obtained for Mackerel in this study is lower than 12.33 % obtained in report of Olagunjuet *al.* (2012), possibly due to the reasons cited earlier. The moisture content values obtained in this study are similar to those reported by Boran and Karacam (2011) for horse mackerel (65 - 75%) from the Black Sea of Turkey.

Bacterial count: Herring fish significantly supported the highest bacterial population on day 1, while horse mackerel supported highest bacterial growth on days 2 and 3. The relatively high protein of horse mackerel on day 3 might have resulted from the digestion of bacterial cells protoplasm. The rate of bacterial multiplication and spoilage after 3 days storage on the shelf was highest in horse mackerel, but lowest in mackerel (Table 3). The rapid spoilage of mackerel has been earlier reported. Torleifsson (2014) observed that the flesh of mackerel spoils easily.

Sensory Analysis: The herring was most appealing in appearance and aroma to the panelist, while the taste, texture and general acceptability of mackerel was most preferred (Table 4).

Conclusion and Recommendation

It can be concluded from this study that among the fish types assessed, mackerel was highly nutritious while mackerel and herring were most acceptable. There was decrease in moisture content with storage on shelf for all the fish types and increase in protein and fat content. Horse mackerel is highly prone to bacterial deterioration. Fish processors would assist in protein security and have less spoilage difficulties by harnessing more of mackerel and herring than horse mackerel.

Appendix

Table 1: Proximate Composition of Selected Marine Fishes (Day 1)

Nutrient	Mackerel	Herring	H. Mackerel	A. Hake
Moisture	68.87 ^b	70.8 ^b	73.61 ^{ab}	75.52 ^a
Fat	7.73 ^a	3.04 ^b	2.37 ^c	2.41 ^c
Crude Protein	18.03 ^{ab}	19.90 ^a	16.88 ^b	14.83 ^c
Ash	2.60 ^d	4.24 ^c	3.98 ^b	4.08 ^a

Abc: Values with different letter superscripts along the row are significantly different ($P < 0.05$)

Note: H. Mackerel is Horse mackerel. A. Hake is Argentina Hake.

Table 2: Proximate Composition of Selected Marine Fishes (Day 3)

Nutrient	Mackerel	Herring	H. Mackerel	A. Hake
Moisture	35.29 ^a	34.68 ^d	34.04 ^a	42.39 ^b
Fat	10.50 ^a	4.21 ^b	3.46 ^c	3.28 ^d
Crude Protein	41.70 ^a	44.78 ^a	37.60 ^a	36.20 ^a
Ash	4.59 ^a	4.69 ^a	4.48 ^a	4.52 ^a

Abc: Values with different letter superscripts along the row are significantly different ($P < 0.05$)

Table 3: Total Bacteria Count X 10³(Cfu/g) of Selected Marine Fishes

Storage days	Mackerel	Herring	H. Mackerel	A. Hake
Day 1	1.01 ^c	3.02 ^a	1.22 ^b	1.01 ^c
Day 2	10.21 ^d	1310.00 ^c	1845.00 ^a	1755.00 ^b
Day 3	7305.00 ^d	15100.00 ^b	36750.00 ^a	13899.38 ^c

Abc: Values with different letter superscripts along the row are significantly different ($P < 0.05$)

Table 4: Sensory Values of Selected Marine Fishes

Nutrient	Mackerel	Herring	H. Mackerel	A. Hake
Appearance	7.57 ^{ab}	7.67 ^a	5.93 ^c	6.77 ^{bc}
Aroma	7.30 ^{ab}	7.47 ^a	6.40 ^b	6.63 ^{ab}
Taste	7.70 ^a	7.50 ^{ab}	6.47 ^c	6.50 ^{bc}
Texture	7.50 ^a	7.50 ^a	6.50 ^b	6.90 ^{ab}
G acceptability	7.83 ^a	7.73 ^a	6.70 ^b	6.57 ^b

Abc: Values with different letter superscripts along the row are significantly different (P<0.05)

References

- Ackman, R. G. (1989). Nutritional composition of fats in seafoods. *Prog. Food Nutrition Science*. 1989;13:161-241.
- Adediji, O. B. and Adetunji, V.O. (2004). Pests in farm animals and stored animal products. *agriculture, renewable natural resources, animal husbandry and health*. Published by General Studies Programme (GSP), University of Ibadan. Nigeria. Pp. 141 – 151.
- Adewoye S.O. and Omotosho, J.S. (1997). Nutrient Composition of some freshwater Fishes in Nigeria. *Biological Science Research Communication*. 1997;11(4):333-6.]
- AOAC (1995). Official methods of analysis of AOAC International. In: International A, editor. 16th ed. Arlington.
- Badmos, A. A., Ahmad-El Imam, A., Annongu, A.A., Yusuff A.T., Kayode, R.M.O., Salami .K.O., Ahutu, I.A., And Lawal A.O. (2017) Preservative effects of aqueous and ether extracts of *Aframomum melegueta* on West African soft cheese. *Bangladesh Journal of Animal Science*, 46 (1): 51-56.
- Boran, G. and Karacam, H. (2011). Seasonal Changes in Proximate Composition of Some Fish Species from the Black Sea. *Turkish Journal of Fisheries Aquatic Sciences*, 11. (01). 2011.
- Larmond E (1977). Laboratory methods for sensory evaluation of food. Publication no .1637. Ottawa: Canada, Department of Agriculture. (1977).
- Murray, J. and Burt, J.R. (2001). The Composition of Fish. Torry Advisory Note No. 38, Ministry of Technology. Torry Research Station, U.K., 14 pp.
- Neil J.S. (1996) Fish consumption, fish oil, lipids, and coronary heart disease, *Circulation*. 1996;94:2337-40.

- Oehlenschläger, J. and Rehbein, H. (2009). Fishery Products: Quality, Safety and Authenticity. Basic facts and figures. 1-18.
- Olagunju, A, Muhammad, A, Mada, S.B., Mohammed, A., Mohammed, H.A, Mahmoud, K.T. (2012). Nutrient composition of *Tilapia zilli*, *Hemisyndontismembranacea*, *Clupeaharengus* and *Scomberscombrus* consumed In Zaria. World Journal of Life Science and Medical Research 2012;2:16 ISSN 2249-0574
- Ondo-Azi, A. S., Kumulungu, B. S., Mewono, L., Koumba, M. A., Missang, C. E. (2013). *African Journal of Food Science*, **2013**, 7(8) 227.
- Pal, M. (2012). Food spoilage. Ph.D. Lecture Notes. Addis Ababa University, College of Veterinary Medicine, Debre Zeit, Ethiopia. Pp.1-8.
- Pal, M. and Mahendra, R. (2015). Sanitation in Food Establishments. Lap Lambert Publishing, Germany
- Sargent, J.R. and Tacon, A.G.J., (1999). Development of farmed fish: a nutritionally necessary alternative to meat. P. Nutr. Soc. 58(2), 377–383.
- Steel R.G.D and Torrie J.H. (1980). Principles and Procedures of Statistics, Second Edition, New York: McGraw-Hill; 1980.
- Torleifsson, A. (2014). Effects of frozen storage on quality of Atlantic mackerel (*Scomberscombrus*) caught in Icelandic Waters. Thesis for the fulfilment of the requirement of the degree of Master of Science in Food Science. Icelandic Food and Biotech R&D, Iceland University. Iceland. 28th May 2014