



ASSESSMENT OF QUALITY OF FROZEN FISH SOLD IN SOME SELECTED SELLING POINTS WITHIN MINNA METROPOLIS

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ABSTRACT

Three species of frozen fish were procured from three selling points (Akpajons Frozen Food Limited, Mallam Abdullahi; and Abets and Sons) within Minna metropolis. The specimens were subjected to series of analyses to assess the quality of the products with a view to establishing the safety of what consumers buy on daily basis. Specimens procured were analyzed for proximate composition and microbiological analysis weekly for eight weeks. The results from the proximate composition revealed that there was significant difference in moisture ($p < 0.05$). The value for moisture ranged from 52.90 ± 1.46^c to 68.14 ± 0.56^a . The crude protein, lipid and ash content showed no significant differences ($p > 0.05$). The value of crude protein ranged from 22.07 ± 1.82^a to 25.83 ± 1.66^a , lipid content ranged between 3.57 ± 1.43^a to 9.44 ± 0.51^a and ash content ranged between 1.22 ± 0.04^a to 1.87 ± 0.07^a . The microbial load ranged between 10.30 ± 0.68^a to 19.17 ± 0.91^a CFU/g. The study revealed that the conditions under which the frozen fish were kept have a direct bearing on the quality of fish sold at the selling point.

Keywords: proximate composition, microbiological analysis, frozen fish, fish quality

INTRODUCTION

Nigeria is endowed with many large rivers; manmade lakes, creeks and about 200 nautical miles of marine water Exclusive Economic Zone (EEZ). Presently, the country has eight maritime states namely: Lagos, Ondo, Delta, Bayelsa, Rivers, Ogun, Cross River and Akwa Ibom States. The fishery industry however has not attained the desired level of self-sufficiency in local fish production (Idachaba, 1991).

According to Olorok *et al.* (2007), fish is one of the most nutritious foods that contributes a considerable proportion of the protein diet in the developing nations particularly those of Africa. The food potential of fish has been appreciating in both developing and developed nations. This is noticeable in various fisheries developmental programmes in many countries of the world. Unfortunately of all fresh products, fish is the most perishable. This is especially so in the tropics where losses due to poor traditional handling account for 25 – 40% loss (Olorok *et al.*, 2007).

In spite of the abundant fishery resources in Nigeria, the trend of fish supply continued to be lower than demand. Numerous estimates of fish supply and demand have been given by many authors (Ita, 1997, Fatunla *et al.*, 1982). These estimates showed that performance of the fishing sector in Nigeria is below expectation. The projected fish demand in Nigeria is estimated at 2.66 million tonnes based on population of 140 million Nigerians (Rahji *et al.*, 2001). Domestic supply of fish was estimated to be 620,000 tonnes, indicating a deficit.

This unsatisfied demand for fish as related to supply can be attributed to many reasons. In reference to artisanal sub-sector, Ibu (1986) analyzed and enumerated some of the problems as inadequate inputs for fishing, poor and most often non existing access roads and other means of communication between key production areas and markets as well as administrative centers. Others are lack of proper processing, storage, distribution and marketing. Freezing is one of the most widely used methods of food preservation, which allows preservation of taste, texture, and nutritional value in foods better than any other method. The freezing process is a combination of the beneficial effects of low temperatures at which micro-organisms cannot grow, chemical reactions are reduced, and cellular metabolic reactions are delayed (Delgado and Sun, 2000).

Proper packaging of frozen food is important to protect the product from contamination and damage while in transit from the manufacturer to the consumer, as well as to preserve food value, flavour, colour and texture (Rahman, 1999). There are several factors considered in designing a suitable package for frozen fish. The package should be attractive to the consumer, protected from external contamination, and effective in terms of processing, handling and cost. There are typically three types of packaging used for frozen foods; primary, secondary, and tertiary. The primary package is in direct contact with the fish and the fish is kept inside the package up to the time of use. Secondary packaging is a form of multiple packaging used to handle packages together for sale. Tertiary packaging is used for bulk

transportation of product (Harrison and Croucher, 1993).

MATERIALS AND METHODS

Specimen Collection

The frozen Shawa Herring (*Clupea harengus*), cold fish (*Gadus morhua*) and Croaker (*Johnius dussumieri*) packed in 1 kg packets were randomly selected and 4 kg of each species were purchased at regular intervals for eight weeks from three different reputable selling points in Minna metropolis. (A) Akpojons Frozen Food Limited at rail way, (B) Mallam Abdullahi at Kasuwa Gwari Market, (C) Abets and Sons Opposite PHCN Office. The specimens were collected aseptically and transported in an insulated container under chilled condition to the Water Resources, Aquaculture and Fisheries Technology laboratory, School of Agric and Agricultural Technology, Federal University of Technology Minna for analyses. Specimens were analyzed for proximate and microbial analysis.

Microbiological Analysis

Fish flesh excised was decimally diluted with diluted peptone water and homogenized in a blender for 60 seconds. Serial dilutions in peptone water was made, 0.1ml inoculums was added to the surface of duplicate plate count agar (SPCA, oxoid) plates for total bacterial counts. *Escherichia coli* was determined using standard most probable number (MPN) technique.

Proximate Composition

Moisture determination

Empty flask (w1) was weighed and 2 g of fish sample was added and the moisture flask with first sample was weighed (w2) again, the sample was dried in an oven drier at 105 – 110 °C for 24 hrs. The sample was allowed to cool in a desiccator. The dried sample (w3) was weighed again, heating, cooling and weighing was repeated on the fixed sample until constant weight is obtained. The moisture content was calculated from the loss of sample.

$$\text{Percent moisture} = \frac{w_3 - w_2}{w_2 - w_1} \times 100$$

Ash determination

An empty crucible was weigh (w1) and 2g of fish sample was added in the crucible and weigh again (w2). The sample was fixed in a muffle furnace at 500 – 600 °C for 3 hrs and allowed to cool in a desiccator. The weight of the crucible and dry sample (w3) were then taken and calculated as follows:

$$\text{Percent Ash} = \frac{w_3 - w_2}{w_2 - w_1} \times 100$$

Determination of crude protein

The estimation of crude protein involves the estimation of total nitrogen usually by the Kjeldahl procedure. The percentage crude protein was obtained by multiplying the nitrogen content with a factor of 6.25 (Eyo, 2001).

Percent protein

$$= \frac{TV \times NA \times 0.01 \times 100}{\text{Weight of sample} \times \text{Volume of aliquot}} \times 6.25$$

Where

TV = Titer value

NA = Normality of Acid

V = volume of acid robe use

Determination of Crude Fat

The fat content of the fish tissue (muscle) was extracted using Soxhlet extraction method. Two hundred and fifty millilitres (250 ml) extraction flask (w4) would be dried in the oven at 105 – 110 °C and would be allow to cool in the desiccators, extraction flask would be weigh (w3). Two gramme fish sample was weighed in a labeled porous thimble (w2), the porous thimbles mouth was covered with white paper, 200 ml of petroleum ether was added to the dry 250 ml detracton flask (w1). The covered porous thimble was placed into the condenser and the apparatus was assembled and then extracted for a period of 5 – 6 hrs. The flask was allowed to cool in the desiccator and weighed; percentage fat was calculated using the formula:

$$\text{Percent fat} = \frac{w_4 - w_3}{w_2 - w_1} \times 100$$

Determination of Soluble Carbohydrate

The nitrogen free extract (N.F.E.) referred to as soluble carbohydrate was not determined directly but obtained as sum of crude protein, percent ash, moisture and lipid.

$NFE = 100 - (\% \text{ ash} + \text{moisture} + \text{lipid} + \text{crude protein})$

..... Lucas, 1981.

RESULTS

The mean proximate compositions of shawa herring (*Clupea harengus*), cod (*Gadus morhua*) and croaker (*Johnius dussumieri*) showed that there were significant differences ($p < 0.05$) in the percentage moisture and ash contents; however crude protein and lipid were all insignificant ($p > 0.05$) (Table 1). The percentage moisture content of frozen samples

ranged from 52.12 to 68.14. The protein content of shawa ranged between 22.47 and 25.83% while cod ranged from 22.04 to 25.02% and croaker, 22.86 – 24.72%. Lipid ranged 4.38 to 9.44% for shawa; while cod had lipid values ranging from 4.37 – 6.49% and croaker 3.57 – 8.05% (Table 1). The mean moisture

content of croaker was 57.91 ± 0.97 and differed significantly from moisture content in shawa and cod (Table 2). The results show that the higher the moisture content, the lower the protein. The highest moisture content was recorded in cod and lowest protein was equally recorded in cod (Table 2).

Table 1: Proximate Analysis of Frozen Fish Sold in Minna

Week	Sample	Parameter			
		%Moisture	%Protein	%Lipid	%Ash
1	Shawa	68.90±0.84 ^a	24.42±1.13 ^a	4.48±1.52 ^a	1.67±0.19 ^a
	Cod	60.37±0.72 ^b	25.02±1.13 ^a	5.39±1.28 ^a	1.22±0.04 ^a
	Croaker	53.20±0.35 ^c	24.43±0.79 ^a	8.05±1.70 ^a	1.50±0.16 ^a
2	Shawa	61.57±2.84 ^a	22.55±1.19 ^a	5.60±2.10 ^a	1.87±0.07 ^a
	Cod	68.14±0.56 ^a	22.07±1.82 ^a	6.49±0.84 ^a	1.34±0.08 ^b
	Croaker	60.24±4.63 ^a	24.72±1.25 ^a	6.58±0.84 ^a	1.45±0.08 ^b
3	Shawa	52.12±0.92 ^a	24.40±0.38 ^a	4.37±0.97 ^a	1.29±0.08 ^a
	Cod	52.12±0.92 ^a	23.40±1.18 ^a	4.37±0.97 ^a	1.29±0.08 ^a
	Croaker	54.04±0.67 ^a	22.86±1.53 ^a	5.79±1.10 ^a	1.55±0.03 ^a
4	Shawa	54.54±1.34 ^b	25.83±1.66 ^a	5.67±1.15 ^a	1.67±0.19 ^a
	Cod	67.75±1.85 ^a	23.73±2.22 ^a	4.42±1.79 ^a	1.28±0.09 ^a
	Croaker	57.87±0.70 ^b	23.05±0.90 ^a	5.73±1.69 ^a	1.69±0.19 ^a
5	Shawa	62.81±3.21 ^a	23.70±1.16 ^a	6.06±1.09 ^a	1.67±0.19 ^a
	Cod	62.06±1.63 ^a	23.44±1.19 ^a	5.01±1.38 ^a	1.22±0.04 ^a
	Croaker	53.48±0.62 ^b	24.10±1.00 ^a	5.48±1.31 ^a	1.68±0.04 ^a
6	Shawa	56.59±0.85 ^b	22.47±2.02 ^a	4.44±1.80 ^a	1.52±0.04 ^b
	Cod	63.64±0.47 ^a	22.87±1.52 ^a	6.05±1.81 ^a	1.73±0.04 ^a
	Croaker	58.39±0.69 ^b	23.34±1.23 ^a	5.34±0.54 ^a	1.55±0.04 ^b
7	Shawa	52.90±1.46 ^c	22.80±0.10 ^a	9.44±0.51 ^a	1.84±0.10 ^a
	Cod	69.72±0.93 ^a	22.04±1.63 ^a	5.67±0.71 ^a	1.33±0.76 ^b
	Croaker	63.12±1.52 ^b	23.03±0.10 ^a	6.77±1.62 ^a	1.56±0.27 ^a
8	Shawa	57.03±1.47 ^a	24.33±1.68 ^a	5.79±1.56 ^a	1.34±0.03 ^b
	Cod	61.80±1.24 ^a	23.50±1.04 ^a	6.31±0.95 ^a	1.26±0.26 ^b
	Croaker	62.94±1.94 ^a	24.11±0.74 ^a	3.57±1.43 ^a	1.84±0.03 ^a

Table 2: Mean Proximate Analysis of some frozen fish sold in Minna for eight weeks

Parameter	Specimen	Week 1 - 8 (Mean)
Moisture	Shawa	58.31±0.46 ^a
	Cod	63.20±1.15 ^a
	Croaker	57.91±0.97 ^b
Protein	Shawa	23.81±0.46 ^a
	Cod	23.26±0.49 ^a
	Croaker	23.71±0.35 ^a
Lipid	Shawa	5.73±0.53 ^a
	Cod	5.46±0.42 ^a
	Croaker	5.91±0.50 ^a
Ash	Shawa	1.61±0.06 ^a
	Cod	1.33±0.04 ^b
	Croaker	1.60±0.04 ^a

Table 3 shows the microbial load of shawa herring (*Clupea harengus*), cod (*Gadus morhua*) and croaker (*Johnius dussumieri*) of three species of frozen fish sold at some selected points within Minna Metropolis. The result showed no significant

difference between Shawa and Cod ($p > 0.05$). However, between Shawa and Croaker, the result shows significant difference which implies that ($p < 0.05$).

Table 3: Microbial load of frozen fish sold within Minna Metropolis

Week	Sample		
	Shawa	Cod	Croaker
1	16.83±1.20 ^a	16.30±1.23 ^a	14.00±2.74 ^a
2	13.02±2.94 ^a	14.58±2.44 ^a	12.53±1.08 ^a
3	15.32±2.39 ^a	18.65±1.08 ^a	11.02±0.81 ^b
4	13.30±1.31 ^a	15.05±2.45 ^a	10.30±0.68 ^a
5	18.65±1.08 ^a	11.32±2.94 ^a	15.32±2.39 ^a
6	16.02±3.33 ^a	14.00±2.74 ^a	14.88±1.90 ^a
7	12.53±1.08 ^b	19.17±0.91 ^a	13.67±2.14 ^b
8	15.32±2.39 ^a	15.34±2.39 ^a	14.65±1.96 ^a

There is positive relationship between bacteria and moisture content in shawa (Table 4) which implies that the higher the moisture contents the higher the bacterial load. This means that moisture under favourable conditions aid the growth of bacteria. The table shows negative correlation between the weeks and the proximate analysis. It also shows weak correlation between moisture content and protein which implies that there is inverse relationship between these parameters. Table 5 shows no

significant correlation between microbial load and proximate composition and also negative correlation was observed between moisture and bacteria however positive correlation was observed between ash and lipid content in cod.

Table 6 shows a moderate relationship between protein and bacteria at around and also between moisture and bacteria. It also shows positive relationship between protein and moisture content of the croaker.

Table 4: Correlation matrices of the proximate composition and microbial load of shawa

	Week	Bacteria	Protein	Moisture	Lipid	Ash
Week	1					
Bacteria	-0.042	1				
Protein	-0.090	0.198	1			
Moisture	-0.490*	0.258	-0.103	1		
Lipid	0.312	-0.026	0.208	-0.181	1	
Ash	-0.185	-0.083	-0.228	0.200	0.203	1

* Correlation is significant at 5% level

Table 5: Correlation matrices of the proximate composition and microbial loads of cod

	Week	Bacteria	Protein	Moisture	Lipid	Ash
Week	1					
Bacteria	-0.012	1				
Protein	-0.149	-0.106	1			
Moisture	0.231	-0.015	-0.228	1		
Lipid	0.108	0.287	-0.290	0.075	1	
Ash	0.226	-0.230	-0.162	0.076	0.264	1

Table 6: Correlation matrices of the proximate composition and microbial load of croaker

	Week	Bacteria	Moisture	Protein	Lipid	Ash
Week	1					
Bacteria	0.233	1				
Moisture	-0.135	0.045	1			
Protein	0.534**	0.032	0.102	1		
Lipid	0.365	0.106	-0.063	0.085	1	
Ash	0.442*	0.031	0.105	0.272	0.310	1

*Correlation is significant at 4% level; **Correlation is highly significant at 5% level

DISCUSSION

There is variation in the nutrient profile of the three species of fish analyzed both protein, lipid and ash. This agrees with the findings of (Takama *et al.*, 1999) who reported that various species don't provide the same nutrient profile to their consumer. Variation in protein composition was also observed within the same species. This could be attributed to different temperature regimes of the cod room which may occur due to instability and in some instances failure of power supply. Varjen *et al.*, (2003) equally reported that the nutritive value of a fish varies with season.

According to Ibru (1986), principal composition of fish is 16-21% protein, 0.2-2.5% fat, 1.2-15% mineral, 0-0.5% carbohydrate and 66-81% water. The result obtained in this study fall well within the earlier reported values.

The variation in moisture content may be due to the time taken in freezing the fish and the Temperature of fish flesh from which heat is steadily removed. It has been reported that moisture content of flesh is a good indicator of its relative content of

energy, protein and lipid (Aberoumad and Pourshafi, 2010). The percentages of moisture content recorded were higher than the percentage recorded by Eyo (2001). This might be due to frozen effect of the product. Freezing lowers temperature and slows down spoilage in fish; so much so that when the product is thawed it is virtually indistinguishable from fresh fish.

The concentration of the protein content and lipid were within the range previously reported (Patterson and Ranjitha, 2009). The total lipid and ash contents of fish are reported to vary significantly with gradual increase in the weight and length of the fish and due to seasonal changes aside from available nutrients in varied habitats (Hassan, 1996). Whenever, there is a low percentage of water, the lipid and protein content would be high and the energy density also increases in fishes (Gopakumar, 1998). This is line with findings of this study as it shown in the correlation of these parameters

The weekly protein content for each of the frozen products was not significantly different ($p > 0.05$). Similarly, the percentage protein content of the

fish product exceeded the limit given by Stansby (1962) on fish fillet. The lipid content of the product was not significantly different ($p > 0.05$). Fish can be grouped into four categories according to their fat content, lean fish ($< 2\%$), low (2-4%), medium (4-8%) and high fat ($> 8\%$). The report from this study revealed that all the three species fell within medium fat.

The percentage ash content of the frozen product was significantly different ($p < 0.05$) both between weeks and samples. This conforms to the reports of Brandes and Dietrich (1953). Tsuchiya *et al.*; (1953) Elliot (1976) and Vidal-Carou *et al.* (1990), that there is inverse relationship between lipid and water. Various researchers also reported similar findings (Abdullahi *et al.*, 2001; Magawa and Oyelese, 2000).

The presence of moisture in fish permits the growth of bacteria and mould in fish flesh during storage (Eyo, 2001). Croaker has the highest number of bacteria. This may be attributed to presence of moisture that aided bacterial growth.

CONCLUSION

The result of the crude protein, moisture and lipid of the composition for cod (*Gadus morhua*) obtained were high and can be referred to as medium fat fish. The total coliforms limit per gramme of frozen fish was within the acceptable range of 11-500 cfu/g as observed by the International Commission on Microbiological Specification Food (ICMSF) (1986). The frozen fish, shawa, cod and croaker, examined were safe for consumption.

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