Effect of Poor Handling on The Nutritional Composition of Some Imported Frozen Fishes in Nigeria

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ABSTRACT
This study aimed to determine and compare proximate composition of three commonly commercial imported frozen fish species in Nigeria (Scromber scrombrus, Trachurus trachurus and Sardinella aurita) with reference to poor handling and size. Major nutrient compositions of raw muscles like protein, fat, moisture, ash were estimated. Fish samples were collected from importing fishing company in Lagos State (loading point) (location I) and three cold rooms in Ogun State (location II). Proximate analysis revealed that the protein, carbohydrate, lipid ash and fibre contents were high in the three species in the two locations even though nutrition quality of the three frozen fish samples obtained in the location I were higher than location II. The results revealed that the correlations between weights and proximate composition were relatively precise for moisture and protein, but were much more variable for lipid content, ash and crude fibre.

Keywords: Frozen fish, proximate composition, Scromber scrombrus, Trachurus trachurus and Sardinella aurita.

INTRODUCTION
Fish consumption is on the rise globally by humans because of high nutritional value and lately health benefits associated with it. The high protein content, low saturated fat and also contains omega fatty acids known to support good health. Health benefits of fish meat has been studied extensively and there are reports which confirm its preventive effects against cardiovascular diseases and some types of cancer, including colon, breast and prostate cancer (Rose and Connoll, 1993; Marchioli, 2001). In addition, fish oil is rich sources of vitamins, including vitamin A, D, E and K which are soluble in oil and must be taken on regular basis of their key roles in human health and metabolism (Kinsella, 1987).

In Nigeria, the demand for fishery products have grown more and more even with the acute shortage of fresh fish there is wide acceptance of frozen fish. Nigeria spends N100 billion on frozen fish importation annually and the current fish demand consumption in Nigeria stands at over 2.66 million tons per annum, while the present importation rate is over 750,000 metric tons (Oota, 2012). With importation of more than 750,000 MT of fish, more than USD 600 million are spent in hard currency and thousands of jobs are exported (USAID, 2010). The European Union accounts for more than 70% of the Nigerian sea food supply while the US provides about 1% (Nezeka, 2003) and the major species imported are Sardinella eba (Sardines) Mackerel spp. (Mackerel) and Hake (Stock Fish).

The complexity of the marketing and distribution of frozen fish, couple with erratic power supply for cold storage warehouses to maintain constant freezing temperature on the fish and with higher ambient temperature make fish quality deteriorates very rapidly. As a result of poor handling of frozen fish outside the low temperature storage space fish are being warmed and even thawed and need refreezing. The partial
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thawing and refreezing may occur several times before products reach final destinations. Partial or total thawing of products also may occur after purchase and before transfer to the various homes for processing. Researchers found "freezing abuse" (temperature fluctuation) resulted in inferior quality and decreased acceptability of frozen foods.

Proximate composition generally comprises the estimation of moisture, protein, fat and ash contents of the fresh fish body. The percentage composition of these constituents accounts for about 96-98% of them total tissue constituents in fish (Nowssad, 2007). Biochemical composition of the whole body indicates the fish quality. Therefore, it is important to study the effects of thawing and refreezing on the proximate composition of three commercial frozen fish species to determine the quality. However, reports on the quality of imported frozen fish marketed in Nigeria are limited. The present study was undertaken to determine and compare proximate composition of three commercial imported frozen fish species (Scromber scrombrus, Trachurus trachurus and Sardinella aurita) with reference to poor handling and size.

**MATERIALS AND METHODS**

**Sample Collection**

Sample of frozen fishes were purchased from one of importing fishing company (loading point to other state in the country) in Lagos State (location I) and three cold room operators in Abeokuta North Local Government Area, Ogun State (location II), Nigeria.

**Proximate Composition Analysis**

Proximate composition of the three frozen fish samples (Scromber scrombrus, Trachurus trachurus and Sardinella aurita) were determined using Association of Official Analytical Chemists methods (AOAC, 1995). Moisture content was measured by weighing the differences before and after drying the fish and this was done at 100-105°C for 16 hours. Protein content (% N x 65) was determined by the Kjeldahl. A known weight (0.5g) of prepared fish sample was accurately weighted on a nitrogen – free paper and the paper wrapped round the sample and then dropped into the bottom of the Kjeldahl digestion flask together with 6 -8 glass beads, 4 -5 spatula full of granular mixture of CuSO₄ and KSO₄ as catalyst. Twenty milliliters of concentrated H₂SO₄ was carefully added. The flask was gently heated in an inclined position on a heating mantle (Gerhardt model) in a fume cupboard until full digestion when the liquid was completely clear from brown color to colorless. The content of the flask was transferred to a clean 100ml volumetric flask and made up to volume. Of the 100ml, 25 ml aliquot was used for distillation. The total nitrogen was determined calorimetrically. Ash content was analyzed using a modified version of AOAC (AOAC, 1995). The water and fat free sample was combusted at 500°C for 12 hours and ash content was determined gravimetrically. Fat content was measured by drying the samples at 100°C in an oven and then extracting the crude fat with petroleum ether in a Soxhlet extractor for 4 hours. Carbohydrate content was obtained by difference from the combined percent of moisture, protein, ash and fat from 100.

**Statistical Analysis**

Values are presented as the mean ± standard deviation of triplicate determinations. Statistical analysis was carried out by one-way analysis of variance (ANOVA) using SPSS software (Version 14.0 software, SPSS Inc, Chicago, IL, USA) and the significance was defined at p < 0.05.

**RESULTS AND DISCUSSION**

**Proximate composition of three frozen fish species (S.scrombrus, T.trachurus, S.aurita)**

The moisture, protein, lipid, ash and fiber contents in the muscle of S. scrombrus, T. trachurus, S. aurita fish species obtained from the location I are presented in Table 1.

The results showed that S. scrombrus had highest protein content (25.54%) than the others T. trachurus (23.84%) and S. aurita (20.90%). Also in terms of moisture content T. trachurus had the highest value of (55.25%) followed by S. scrombrus (59.25%) and S. aurita (59.25%). T. trachurus also had the highest ash content (2.69%) compared to S. aurita (3.48%) and S. scrombrus (2.67%). Out of the three fish species, S. aurita contained the highest level of fat (14.78%) followed by S. scrombrus (11.74%) and T. trachurus (10.03%). The fish species that had the highest crude fibre content was T. trachurus (3.07%) followed by S. scrombrus (2.96%) and S. aurita (2.73%).

Results of the proximate analysis of the fish samples from the location II are shown in Table 2.
S. aurita had the highest moisture content (63.38%) followed by T. trachurus (61.41%) and S. scrombrus (60.19%). In terms of protein content, S. scrombrus had the highest value of 22.38% followed by T. trachurus (20.69%) and S. aurita (19.30%).

S. scrombrus had the highest fat content (13.15%) compared to T. trachurus (12.48%) and S. aurita (10.68%). The fish species with the highest crude fibre content was S. scrombrus (1.89%), in comparison to T. trachurus (1.71%) and S. aurita. T. trachurus had the highest ash content (1.91%) compared to S. aurita (1.77%) and S. scrombrus (1.60%).

Analysis of Variance (ANOVA) test between means of proximate components

Results revealed that there was a significant difference in the mean protein values of S. scrombrus and S. aurita across locations.

Relationships of proximate components to weight

The mean weights of the three frozen fish species ranged from 408g to 475g. The relationships of proximate compositions to weights are presented in Fig. 1,2,3,4 and 5. The results revealed that the correlations between

### Tab. 1. Mean value for proximate composition of three fish species (S. scrombrus, T. trachurus, S. aurita) in location 1

<table>
<thead>
<tr>
<th>Species</th>
<th>Moisture</th>
<th>Fat</th>
<th>C.Fibre</th>
<th>Ash</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. scrombrus</td>
<td>55.25±2.12</td>
<td>11.74±1.75</td>
<td>2.96±1.13</td>
<td>2.69±1.16</td>
<td>25.54±1.54</td>
</tr>
<tr>
<td>T. trachurus</td>
<td>59.28±0.73</td>
<td>10.03±0.44</td>
<td>3.07±0.15</td>
<td>3.48±1.25</td>
<td>23.84±3.02</td>
</tr>
<tr>
<td>S. aurita</td>
<td>59.25±6.44</td>
<td>14.78±3.09</td>
<td>2.73±0.84</td>
<td>2.97±1.44</td>
<td>20.09±0.40</td>
</tr>
</tbody>
</table>

### Tab. 2. Mean value for proximate composition of three fish species (S. scrombrus, T. trachurus, S. aurita) in location 2

<table>
<thead>
<tr>
<th>Species</th>
<th>Moisture</th>
<th>Fat</th>
<th>C.Fibre</th>
<th>Ash</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. scrombrus</td>
<td>60.19±0.99</td>
<td>13.15±0.95</td>
<td>1.89±1.37</td>
<td>1.60±1.26</td>
<td>22.08±1.07</td>
</tr>
<tr>
<td>T. trachurus</td>
<td>61.41±6.78</td>
<td>12.48±0.37</td>
<td>1.71±2.04</td>
<td>1.91±2.12</td>
<td>20.69±1.75</td>
</tr>
<tr>
<td>S. aurita</td>
<td>63.38±1.07</td>
<td>10.68±1.03</td>
<td>1.67±0.96</td>
<td>1.77±1.66</td>
<td>19.30±0.66</td>
</tr>
</tbody>
</table>

### Tab. 3. Mean weight of three fish species (S. scrombrus, T. trachurus, S. aurita) from the two major different locations

<table>
<thead>
<tr>
<th>Species</th>
<th>Mean weight (g) Location 1</th>
<th>Location 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. scrombrus</td>
<td>466.67±33.33</td>
<td>483.33±16.67</td>
</tr>
<tr>
<td>T. trachurus</td>
<td>500.00±28.87</td>
<td>466.67±33.33</td>
</tr>
<tr>
<td>S. aurita</td>
<td>500.00±28.87</td>
<td>400.00±0.01</td>
</tr>
</tbody>
</table>

### Tab. 4. Analysis of variance on proximate composition and S. scrombrus, T. trachurus, S. aurita

<table>
<thead>
<tr>
<th>Species</th>
<th>Proximate Components</th>
<th>F-Value</th>
<th>Sig.Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. scrombrus</td>
<td>Moisture</td>
<td>0.752</td>
<td>0.544</td>
</tr>
<tr>
<td>S. scrombrus</td>
<td>Fat</td>
<td>1.769</td>
<td>0.311</td>
</tr>
<tr>
<td>S. scrombrus</td>
<td>Crude Fibre</td>
<td>0.034</td>
<td>0.967</td>
</tr>
<tr>
<td>S. scrombrus</td>
<td>Ash</td>
<td>1.096</td>
<td>0.439</td>
</tr>
<tr>
<td>T. trachurus</td>
<td>Moisture</td>
<td>0.713</td>
<td>0.558</td>
</tr>
<tr>
<td>T. trachurus</td>
<td>Fat</td>
<td>0.099</td>
<td>0.908</td>
</tr>
<tr>
<td>T. trachurus</td>
<td>Crude Fibre</td>
<td>0.776</td>
<td>0.535</td>
</tr>
<tr>
<td>T. trachurus</td>
<td>Ash</td>
<td>0.573</td>
<td>0.616</td>
</tr>
<tr>
<td>S. aurita</td>
<td>Fat</td>
<td>0.554</td>
<td>0.624</td>
</tr>
<tr>
<td>S. aurita</td>
<td>Crude Fibre</td>
<td>0.452</td>
<td>0.674</td>
</tr>
<tr>
<td>S. aurita</td>
<td>Ash</td>
<td>0.007</td>
<td>0.994</td>
</tr>
<tr>
<td>S. aurita</td>
<td>Protein</td>
<td>159.09</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

*p≤0.05 significant (**)
weights and proximate composition were relatively precise for moisture and protein, but were much more variable for lipid content, ash and crude fibre.

Discussion
Fish of various species don't provide the same nutrient profile to their consumer (Takama et al., 1999) The nutrients values however, vary considerably within and between species, and also with size, sexual condition, feeding, time of the year and physical activity (Ali et al., 2005). According to Muraleedharan et al. (1996), the chemical composition of fish varied from 16-21% proteins, 0.1-25% lipids, 0.4-1.5% ash and moisture 60-81% with extremes of 96%. Moisture is the major component in the fish muscle tissue. Data obtained from the current results revealed that the moisture percentage ranged between 55.25 and 61.41%. Judith and Jenny (1987) reported the moisture content of 69.5% and 64.0% for S. scombrus (frozen) and T. trachurus (Raw) respectively. However, the moisture content recorded on all the three species in station I was higher than the station II.

Generally moisture content shows inverse relationship with lipid content also found in the three frozen fish in this study. The inverse relationship has also been reported in marine

![Fig. 1. Relationships of proximate components (Moisture) to weight.](image1)
![Fig. 2. Relationships of proximate components (Protein) to weight.](image2)
![Fig. 3. Relationships of proximate components (Fat) to weight.](image3)
![Fig. 4. Relationships of proximate components (Crude Fibre) to weight.](image4)
![Fig. 5. Relationships of proximate components (Ash) to weight.](image5)
fishes such as *Mugil cephalus* (Das, 1978). According to (FAO, 1999) moisture and lipid contents in fish fillets are inversely related and their sum is approximately 80% with other components accounting for the remaining 20%. Apart from *S*aurita the fat content values obtained in location I was lower than the location II. The changes in fat content during frozen storage could be associated with the oxidation of fat (McGill et al., 1974; Josephson, 1989) this confirm results obtained from our study .The protein content in the locations varied between 19.30% and 25.54% which more or less coincides with the findings of Mazumder et al. (2008). Castrillón et al. (1997) reported a protein content of 20.27% and 53.56% for wet and dry samples of *Clupea pilchardus* (Sardine).The concentration of the protein content was within the range previously reported in *Scomberoides* species (Patterson and Ranjitha, 2009). In the present investigation the protein content recorded on all the three frozen fish species in location I was higher than the location II. This could be attributed to storage time and poor handling. Several workers have linked the availability of vital nutrients in fish to the method of storage (Ryder et al., 1993). Storage time and temperature are major factors implicated in the loss of quality and shelf life of fish (Whittle, 1997). The difference in protein contents in the two locations can be explained by denaturation (Reay, 1993; Mills, 1975). The availability of such high protein in investigated species indicates their high nutritive value. Fish generally contain very little fiber but in this study the high value of fiber contents were recorded on the three fish species in location I. This seeming contradiction can probably be accounted for by several factors such as the food and feeding habit, habitat and geographical location, age, methods of handling/processing, seasons and some other environmental factors (Ryder et al., 1993; Omotosho and Olu, 1995; Nadcisa et al., 2001; Suhenden et al., 2008). Similarly, the ash content recorded on the three species in location I ranged between 2.96% recorded for *S. Scombrus* and 3.48 % for *T.trachurus* which was higher compared to Udo and Azarus (2011) *S. Scombrus* 1.46% *T. trachurus* 1.53 % and *S. pilchardus* 1.30 %. The total ash content (which represents the content of inorganic elements and mineral salts in the analyzed edible portion) greatly depends on the size and the samples weight, and also from the sexual maturity, food source and external environment (Watanabe et al. 1997; Roy and Lall 2006; Ye C.X. et al. 2006; Santaella 2011). It is known that variations in the chemical composition of marine fishes is closely related to nutrition, living area, fish size, catching season, seasonal and sexual variations as well as other environmental conditions (Özden and Erkan, 2009).

The correlations between weights and proximate composition were relatively precise for moisture and protein, but were much more variable for lipid content, ash and crude fibre. Contradictory to the previous findings, in current studies protein kept on increasing with size while lipids declined accordingly. The protein content greatly depends on the presence of red muscle, the kind of diet, the age and especially the fish size (Santaella, 2011).

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 also due to seasonal changes aside from the available nutrients in varied habitats (Hassan, 1996). Kalay et al. (2008) also reported negative correlation between protein and lipid levels with age/size.

**CONCLUSION**

The results clearly indicate nutritional potential of the three species for human consumption considering their high protein content and other nutrients. The results showed that fish samples obtained in the location I is of good quality than location II. This is inevitable because of poor handling and storage time. However, the nutritional information provided in this research study would make it possible for consumers to know the benefits derivable from these fishes and the effect of freezing duration on the nutrient composition.

**REFERENCES**


