LIPID AND FATTY ACID COMPOSITION OF POND RAISED AND WILD Oreochromis niloticus AND Clarias gariepinus

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ABSTRACT

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The percentage crude fat content and fatty acids profile of Clarias gariepinus and Oreochromis niloticus from both the wild and fish farm were determined. The pond raised C. gariepinus and O. niloticus were cultured under semi-intensive system at a stocking rate of 10 fishes m⁻². Commercial diet (coppens) containing 40% crude protein were fed to the fishes to supplement algae. The pond was also fertilized with poultry droppings at the rate of 10 kg 100m⁻² of pond water to encourage the growth of algae. Water turbidity was monitored and maintained at between 30-60 cm to moderate the turbidity due to algae. The wild fishes were collected from Ikpoba River in Benin City. The two fish species from both sources were subjected to fatty acid analyses. There was significant difference (p<0.05) in moisture (10.10% and 11.07%) for C. gariepinus and O. niloticus respectively, but there was no significant difference (p>0.05) in crude fat content of the two species (5.82% and 5.63%) for C. gariepinus and O. niloticus respectively. Also there was no significant difference (p>0.05) in moisture content (10.30% and 10.87 %) for the fishes from pond and wild sources respectively. However, there was significant difference in the crude fat content of the two fish species from the two sources (p<0.05). The Pond raised fishes were significantly higher in crude fat with a mean value of 6.06 % than the wild fishes with mean value of 5.38 %. Six different fatty acids were found in both the pond and wild fish with palmitic acid as the main saturated fatty acid and oleic acid as the main monounsaturated fatty acid. There was significant difference in the concentration of the fatty acid types (p<0.05). The fatty acids were Palmitic (28.14g/100g), Linoleic (23.48g/100g), Oleic (21.39g/100g), Stearic (15.44g/100g), Linolenic (10.28g/100g), and Behenic (0.85g/100g) in a significant decreasing order of abundance. The dominant polyunsaturated fatty acids were Linoleic (omega-6) and Linolenic (omega-3). However there was no significant difference in fatty acids in both pond raised and wild sources of fish for both species. The n-3:n-6 ratios were 1:2.3 and 1:2.2 in C. gariepinus and O. niloticus from farm and wild respectively. This proportion is in the range required for good human health. More attention should be paid to this farmed raised species by aquaculturist as supplement or replacement for wild fishes, since the fatty acid profile is not significantly different.

Keywords: Crude fat, fish species, source of fish.

INTRODUCTION

As the world’s fish stocks are limited in supply, consumers are now proposing farmed fish as an alternative. Domestic consumption of fish has remained essentially constant over the past decades (Harvey, 1999). Though consumption patterns may be amenable to change, it is unlikely however that wild caught fish could supply substantial increase in fish demand. Pressure on wild resources, efficient fish culture methods, possibility of all year fish culture and supply have positively contributed to aquaculture expansion and development. However there is concern for the nutritional difference between wild caught and farmed raised fishes, particularly the fatty acid content. Fatty acid consists of a hydrocarbon chain (CH₂) with an acid or carboxyl group (COOH) at one end and a methyl group at the other. Fatty acids are classified as saturated or unsaturated depending on the number of hydrogen atoms present. Saturated fatty acids have the maximum number of hydrogen atoms and therefore no double bonds, while polyunsaturated fatty acids contain two or more bonds. The polyunsaturated fatty acids are termed as Omega 3 and omega 6 fatty acids (abbreviated as w3and w6, or n-3and n-6) required for human nutritional benefit (Osman et al., 2001).

Environmental factors including salinity, natural food and temperature have been shown to influence the fatty acid composition of fish (Ibarz et al., 2005). There are a number of experiments demonstrating the effects of other factors such as temperature, seasonal variation, age and species type on the fatty acid composition of aquatic animals especially fish (Rasoolarhona, et al., 2004). The differences in nutritional composition of various fish species can only be known through the proximate analysis of the fish sample. Some fishes are higher in n-3 and n-6 polyunsaturated fatty acids depending on their source and type of food consumed. Fishes that feed on natural food i.e. natural fish food are believed to be high in these n-3 and n-6 fatty acids. It is of considerable interest for the farming industry and consumers to be aware of the compositional and nutritive differences between farmed and wild fish. Whether the diet is natural or compounded the fatty acid composition of fish muscle is clearly influenced by their diet (Justi et al., 2003). Thus the content in the diet provided will influence the composition in fish.

Polyunsaturated fatty acids (PUFA) are considered as the physiologically active factor in many species. They actively participate in gonad maturation, egg quality (Izquierdo et al., 2001) and larval growth of fish (Tulli and...
Tubaldi, 1997). Polyunsaturated fatty acids can enhance fluidity and flexibility of spermatozoa membrane and are believed to be actively involved in the regulation of cellular movement, gonadal metabolism of lipids. PUFAs also regulates the production of eicosanoids. Lack of essential fatty acid are associated with some symptoms such as slow growth, deformation of tail fin, faded and fatty liver, skin pigmentation and shock (Acman and Eaton 1976). In view of the importance of fatty acids in the health of fish and man, this study was carried out to determine the proportions of lipids and fatty acid profile in pond raised and wild Clarias gariepinus and Oreochromis niloticus and also establish the richest source of fatty acids in both fish species by comparing omega 3 and omega 6.

MATERIALS AND METHODS
The live and fresh wild Oreochromis niloticus and Clarias gariepinus where obtained with gillnet from Ikpoba river, located at Ikpoba-okha local government area, Benin-city, Edo state, Nigeria. Farmed fish species of Oreochromis niloticus and Clarias gariepinus were obtained from the Faculty of agriculture, department of fisheries experimental tanks, Benin-city, Edo state, Nigeria. The pond raised C. gariepinus and O. niloticus were cultured under semi intensive system at a stocking rate of 10 fishes m⁻². Growth of algae was encouraged by the application of poultry droppings (organic manure) at the rate of 10kg 100⁻² of culture water (Okonji and Obi 1999). The cultured fishes were fed with commercial diet (coppens) containing 40% crude protein till satiation at 10.00 hrs and 16.00 hrs daily. Fishes were culture for 24 weeks and whole fresh fish samples were collected from the sources. The fish were killed and oven dried at 105°C. The dried samples were manually milled using mortar and pestle to homogenous fine powder, and kept in an air tight polythene sachet to prevent microbial spoilage. Thereafter samples were taken to the laboratory for analysis.

The moisture content of the fish species was determined using oven drying method and samples were dried at 105°C until a constant weight was obtained (AOAC, 1994). Fatty acids methyl esters (FAME) were prepared by esterification with sodium methoxide (analytical grade) in methanol. The samples were then analyzed using an Agilent CP900, model gas chromatography equipped with a flame ionization detector (FID), and a fused silica capillary column CPSil86(50x0.25 mm id,0.20 um film thickness, chrompack), and hydrogen gas as a carrier gas with a flow of 1.0 ml mm⁻¹, split ratio of 1 100⁻¹. The injection and detection temperatures were set at 250°C and 280°C, respectively. The column temperature was maintained at 80°C to 180°C at10°C min⁻¹, and from 180°C to 210°C at 3°C min⁻¹, the retention time and peak areas were computed automatically by a computing integrator. Fatty acids were identified and quantified by comparison with the retention times and peak areas of known standard purchased from sigma chemicals.

The experiment was designed as 2 fish sources x 2 fish species factorial in complete randomized design. Each treatment was replicated twice. Data collected was analyzed using Genstart statistical package version 8 (2005). Result of the analysis was tested analysis of variance (ANOVA). Means were separated using Least significant difference at 5% probability level.

RESULTS AND DISCUSSION
The result of the Lipid content of Clarias gariepinus and Oreochromis niloticus obtained from both pond and wild sources are presented in table 1. There was a significant difference (p<0.05) in the percentage crude fat content of the fish species from the two sources. Pond raised C. gariepinus had slightly higher fat than that from the wild while pond raised O. niloticus had lower fat than that from the wild. This may be attributed to the fact that C. gariepinus accepted and fed more on the fatty artificial feed in pond condition better than O. niloticus that is more of an herbivores species. This may have lead to the accumulation of more fat by pond raised C. gariepinus. This agrees with Graham (1993) and Santhanam et al (1981) who noted that pond raised catfishes are more fatty than the wild catfishes. There was significantly difference (p<0.05) in the moisture level of the two species and but moisture content in the two source of fish was not significantly different. Water is the main component in fish, as much as 80% in

Table 1: Lipid Content of Pond raised and Wild C. gariepinus and O. niloticus

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Source</th>
<th>Species</th>
<th>Mean source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Fat</td>
<td></td>
<td>C. gariepinus</td>
<td>O. niloticus</td>
</tr>
<tr>
<td>Pond</td>
<td>6.543</td>
<td>5.577</td>
<td>6.060A</td>
</tr>
<tr>
<td>Wild</td>
<td>5.090</td>
<td>5.677</td>
<td>5.383B</td>
</tr>
<tr>
<td>X species</td>
<td>5.817A</td>
<td>5.627A</td>
<td></td>
</tr>
<tr>
<td>Pond</td>
<td>9.573</td>
<td>11.027</td>
<td>10.300A</td>
</tr>
<tr>
<td>Wild</td>
<td>10.633</td>
<td>11.113</td>
<td>10.873A</td>
</tr>
<tr>
<td>Mean species</td>
<td>10.103A</td>
<td>11.070B</td>
<td></td>
</tr>
</tbody>
</table>

N.B: Means with different alphabet are significantly different at 5% probability level both vertically and horizontally.
lean fish and 70% in fatty fish (Pearson, 1981). As fat rises, the moisture content in fish decreases and vice versa, as observed in *O. niloticus* having more moisture and less crude fat and *C. gariepinus* having more fat and less moisture (Table 1) as noted by Marias and Erasmus (1997). The higher moisture in *Oreochromis niloticus* after drying may also be attributed to its scaly nature that may have reduced drying rate.

**Fatty acids composition of pond raised and wild *Clarias gariepinus* and *Oreochromis niloticus***

Table 2: Fatty acid composition of pond and wild *Clarias gariepinus* and *Oreochromis niloticus* (g 100g⁻¹).

<table>
<thead>
<tr>
<th>Source</th>
<th>Species</th>
<th>Behenic</th>
<th>Linoleic</th>
<th>Linoenic</th>
<th>Oleic</th>
<th>Palmitic</th>
<th>Stearic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond</td>
<td><em>C. gariepinus</em></td>
<td>0.387</td>
<td>23.613</td>
<td>10.400</td>
<td>21.463</td>
<td>28.690</td>
<td>15.543</td>
</tr>
<tr>
<td>Wild</td>
<td><em>C. gariepinus</em></td>
<td>0.317</td>
<td>23.540</td>
<td>10.370</td>
<td>21.673</td>
<td>28.673</td>
<td>15.570</td>
</tr>
</tbody>
</table>

**N.B:** Means with different alphabets are significantly different at 5% probability. * indicate horizontal comparison only and ** indicate vertical comparison only.

Fatty acid composition of fish varied as indicated in Table 2 and there was no significant difference (p>0.05) in the fatty acid type found in the two fish species from two source. However, there was significant difference (P<0.05) in the quantity of the fatty acids types found in the fish species. Six different fatty acid types were found in both species studied. They include Behenic (C22:0), Linoleic (C18:2), Linoenic (C18:3), Oleic, (C18:1), Palmitic (C16:0) and Stearic (C18:0). Oleic acid with mean value of 21.4 g 100 g⁻¹ is the dominant mono saturated fatty acid. This major monosaturated fatty acid in these species was considered to be of exogenous origin and usually a reflection of the type of fish diet (Ackman 1980). Palmitic acid with mean value of 28.14 g 100 g⁻¹ was recorded to be the highest fatty acid. This was closely followed by Linoleic (C18:6), with a mean value of 23.48 g 100 g⁻¹ and Linoenic (C18:3) with mean value of 10.23 g 100 g⁻¹. This is in agreement with the findings of Stanbly (1882). Ackman (1980) noted that palmitic acid the highest fatty acid recorded is a key metabolite in fish whose level was not influenced by diet. Linoleic acid (C 18:6) was the dominant polyunsaturated fatty acid. This finding is similar to the report of (Ollis et al., 1999; Sathievel et al., 2009; Pourshasmain et al., 2012). Nutritive value of the examined freshwater fish is high, since their fatty acid composition is characterized by satisfactory proportion of n-3/n-6 polyunsaturated fatty acids polyunsaturated acids. Linoleic and linolnolic acid were more dominant in farmed raised *Clarias gariepinus* than in pond and wild *Oreochromis niloticus*. It was suggested that a ratio of 1.1 or 1.5 would constitute a healthy human diet (Osman et al 2001). The result from this study recorded a ratio of 2.3 for both species; a sufficient ratio for healthy human diet indicating that both fish species from the two sources offers similar nutritional benefit. The ratio of n-3/n-6 polyunsaturated fatty acid in total lipid in freshwater fish changes between 0.5 and 3.8, whereas it changes between 4.7 and 14.4 in marine fish. Wang et al (1990) reported that the ratio of n-3/n-6 PUFAs ranged from 1.7 to 2.5 and a ratio of 2.3 in this study are within the range.

**CONCLUSIONS**

Fish utilizes lipid for energy, cellular structure and maintenance of the integrity of bio-mosiosis. Neutral fat are far the most important member of the lipid groups in nutrition and cellular physiology in fish. The content of fish diet affects the quality of fish produced for human consumption. Dietary lipids are important source of energy and the only source of essential fatty acid in fish. The results from this study showed that the n-3 and n-6 ratio in the two fish species are within acceptable range for good human diet. The class PUFAs is crucial in terms of human feeding physiology. Both species of *Clarias gariepinus* and *Oreochromis niloticus* from the sources showed very little difference in their fatty acids composition. Farmed *Clarias gariepinus* had a higher fatty acid composition than wild *Clarias gariepinus* and *Oreochromis niloticus* from both pond and wild, therefore *Clarias gariepinus* from pond may be richer in the essential fatty acid required by man depending on the type of feed used for the culture.

**REFERENCES**

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NJAFE VOL. 11 No. 1, 2015