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Comparative Evaluation of Nutritional and Toxicological Implication of Consumption of Wild Fishes from Ebonyi River and Fishes Cultured in Concrete Pond with Different Feed Formulations.

Moses Eji Ogbanshi[1]*, Lilian Nwanneka Ebenyi[2], Matthias Chukwuemeka Ominyi[2], Basil Uchechukwu Nwali[1], Nzubechukwu Edwin[1], Ali Fredrick Ugadu[2] & Esther Ugo Alum[1]

[1]Department of Biochemistry, Ebonyi State University, P. M. B. 043, Abakaliki
[2]Department of Biotechnology, Ebonyi State University, P. M. B. 043, Abakaliki..

***Corresponding Author:** moses.ogbanshi@ebsu,edu,ng, ogbanshimose@yahoo.com

Abstract

Background: Comparative evaluations on the nutritional and toxicological implication of consumption of wild fishes from Ebonyi River and fishes cultured in concrete pond with different feed formulations were investigated.
Methodology: Six hundred juvenile of Claris gariepinus was procured from Ebuka aquaculture facility in Afikpo, Ebonyi State, Nigeria. The Juveniles were divided into three groups A, C, D of 200 each and stocked in three different concrete pond. The fishes were fed with foreign fish feed (A), farm-madefish feed (C) and Nigerian made commercial fish feed (D) twice daily. Group B is the wild fish caught from Ebonyi River from where water was always pumped to the concrete pond periodically. After three months, proximate composition, fatty acid and heavy metal composition were analyzed from the samples. Fatty acid was determined by gas chromatography and heavy metals were determined using a Varian AA 1475 spectrophotometer
Result::The proximate composition varied significantly ($P<0.05$) among the groups with carbohydrate> moisture>protein>fats>ash>fiber. Heavy metals present also varied significantly ($P<0.05$) with Zn>Fe>P>Cd>Si>As>Pb>Hg. The fatty acid result showed appreciable quantity with arachidonic acid>linoleic acid>linolenic acid>oleic acid>retinoic acid and palmitic acid.
Conclusion: The level of heavy metals in samples did not exceed the WHO permissible limit for drinking water. This result shows that these fish were safe for consumption irrespective of the type of feed used in breeding them.

Keywords: Nutritional. Toxicological, Aquaculture, Heavy metals, Fatty acids, Fingerlings

1.0 Introduction.

For centuries, bio-energetic models has been utilized in fisheries and ecology to investigate fish metabolism [1].These models were used to quantify energy demands of fishes [2].population density , condition and nutritional status as well as health of the species [3,4,5]. Such models were also applied in the study of product quality [6] and also in the investigation of bio-accumulation of contaminants.

Fish is one of the potential sources of animal proteins in developing nations. It is one of the major sources of essential nutrient for healthy growth and development. Fish are notable excellent sources of protein which can be seen from amino acid composition and protein digestibility. [7] Fish are widely acceptable because of its palatability, low cholesterol, tender flesh and its aroma in cooking. [8] Fish and other fish products have high protein content and are very efficient food supplement to the tubers,

grains and cereal diets which are widely consumed in Africa [9]. The major components of fish are; water, protein, lipid and carbohydrates [10], while various minerals are commonly found in fish and they includes; Sodium, Potassium, Magnesium, Calcium, Phosphorus, sulphur, Iron, Chlorine, Silicon, Manganese, Cupper, Zinc, Arsenic and Iodine. [11]

The knowledge of the nutritional content of fish is vital for its maximum utilization. The nutritional composition of fish varies from species to species depending on age, sex, feed intake, sexual changes , the environment and seasons [12]. Other factors include water quality, cultured medium and period. [13] Proper knowledge on the biochemical composition of fish finds application in several areas. Information on the biochemical constituents will help a processing technologist to define the optimum processing and storage conditions, so that the quality is preserved to the maximum extent. The consumption demand for fish as a relatively cheap sources of protein is increasing on daily bases in Africa, because of the degree of poverty in the continent. There is a considerable potential to expand fish farming in Africa so as to improve on food security. The major hindrance to development of fish aquaculture industry in Africa is the lack of locally produced high-quality feed.[14] Local production of fish feed is therefore very important to the development and sustainability of fish aquaculture in Nigeria and Africa in general especially in the rural areas. For fish aquaculture to thrive and bridge the existing gap between fish demand and supply especially in the sub-Saharan Africa, the role of locally produced fish feed in reducing product cost and hence making fish farming attractive to both private and commercial investors and ultimately boost fish production is a necessity.

Nutrient profile has shown that various species of fish provide different nutrient profile to their consumers and that nutritive values of fish depends on the season.[15]. The most vital components that act as nutritive value of fish meals are; moisture , dry matter, protein, lipids, vitamins and minerals. Assaying for proximate composition is vital in ensuring the requirements of food regulation and commercial specification. Moisture and fiber content of flesh is a good indicator of its relative energy content, proteins and lipid. [16]

Fish forms a very important nutritious part of human's diet and it is very rich in most of the vitamins, good selection of micronutrients such as minerals and proteins which make up all the essential amino acids in the right proportions..[17] Though the level of protein in fish varies a little from species to species and, on occasions, within a species, the protein content of meat and fish is roughly comparable.[18] However, fish protein are considered to be more superior from the nutritional point of view due to the excellent amount of amino acids composition and easily digestible proteins.[19] Fish are a great source of protein, vitamins, and minerals and omega-3 fatty acids, a key nutrient for brain development. [20,21] The need to compare the nutritional quality and possible differences is therefore necessary as this will help fish farmers and consumers in making choice of fish feed and the one to consume between the wild and farmed fish respectively.

2.0 **Materials and Methods**

Sis hundred Juveniles were procured from Ebuka aquaculture facility at Afikpo, Ebonyi State, Nigeria. The Juveniles were stocked in three different ponds grouped A, C, D and were fed with foreign fish feed, farm made fish feed and Nigerian made commercial fish feed. The fishes were fed twice daily and feeding lasted for three months until the fishes reached table size (average of 0.5kg per fish). Water was pumped from Ebonyi River and used to change water in the pond periodically using water pump generator.. At the end of three months, samples were collected from the three different pond and labelled group A, C, D. Another sample labelled

B was also collected from fishes caught from Ebonyi river (wild fish).

The tissues were cut with razor, washed with deionized water and blotted with blotting paper. A weighed portion (about 5g) of tissues were homogenized in 3 ml ice - cold saline (0.89% NaCl) solution for saline extract (for Carbohydrate and protein estimation) and 3 ml ethanol for ethanol extract (for lipid estimation) in a mortar. The homogenate was centrifuged at 4,000rpm (3,500xg) for 15 minute at 5°C in a cooling centrifuge to get a clear saline supernatant. The procedure is repeated to get ethanol supernatant. Aqueous extract in ice- cold saline was used for estimation of biochemical constituents like carbohydrate and protein and ethanol extract was used for lipid estimate.

2.1 Estimation of Moisture

The following equation was used to determine the moisture content of the dry fish sample: Percentage (%) of moisture = (weight of the sample – weight of the Dried sample)/weight of the sample multiplied by 100 acording Hannington et al. [22]

2.2 Estimation of carbohydrate

Carbohydrate content of the fish tissues was estimated by Anthrone reagent as described. [23]The carbohydrate content was expressed in percentage (%).2.3

2.3 Estimation of protein

Total protein was determined the method described by Lowry et al. [24]. The protein content was expressed in percentage (%).

2.4 Estimation of Ash Content

The following equation was used to determine the ash content of the dry fish samples. Ash (%) = (weight of ash/weight of the sample) ×100 , Bell and Park, [25]

2.5 Determination of heavy met

The mercury level of the samples was determined by the method described by Akirashimizu et al. [26]

Lead quantity was estimated by the method described by Yoshinary et al. [27]

Arsenic was estimated by the method of Noaki et al. [28]

Cadmium was determined by the method described by WHO. [12]

Nickel was measured by the method of Akirashimizu et al.[26]

2.6 Fatty acid profiling

The fatty acid methyl esters were obtained according to the procedure described by Hartman and Lago.[29]

3.0 Results

The proximate composition of fishes fed with foreign feed were significantly ($p<0.05$) higher than that of the wild fishes. The fishes fed with farm-made feed and Nigerian locally made commercial feeds also had significantly ($p<0.05$) higher proximate composition when compared with the wild fishes.

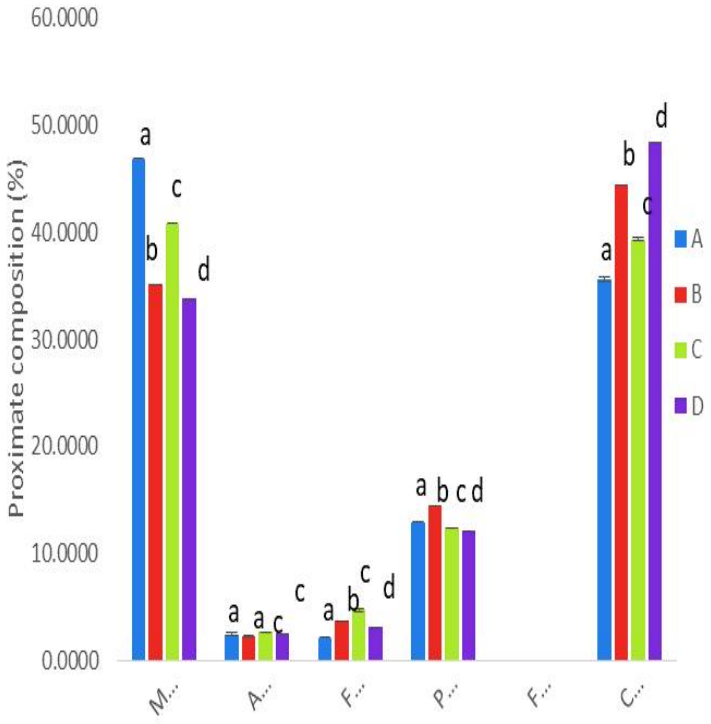

Figure1: Proximate composition of fishes fed with foreign feed (A), wild fishes from Ebonyi River (B), fishes fed with farm made feed (C) and fishes fed with Nigerian locally made commercial feed. Bars with different alphabets are significantly different at P<0.05. Values are the mean ± standard deviation of 3 replicate values

The heavy metal concentration such as zinc were significantly (p<0.05) higher in fishes fed with far-made feed than wild fishes and fishes fed with other feeds. Cd and Fe also showed significant (p<0.05) variation among the samples. There were no significant (p>0.05) variation in the level of Hg and Si among the fish samples. Pb and As shows minimal variation in level among the samples.

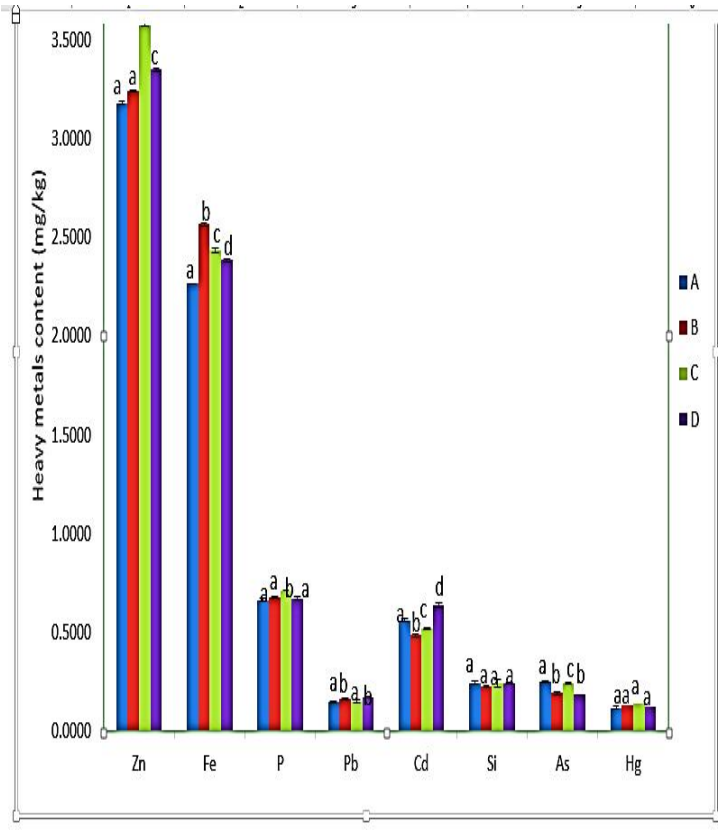

Figure 2: Heavy metal composition of fishes fed foreign feed (A), wild fishes from Ebonyi River (B), fishes fed with farm made feed (C) and fishes fed with Nigerian locally made commercial feed. Bars with different alphabets are significantly different at P<0.05. Values are the mean ± standard deviation of 3 replicate values.

The level of arachidonic linoleic acid, recinoic acids in the fish samples were significantly (p<0.05) different among the samples. Palmitic acid were not significantly (p>0.05) different between fishes fed with farm-made feed and foreign feed but they level were significantly (p<0.05) different when compared with the level found in wild fishes and fish fed with locally made Nigeria commercial feed. Oleic acid and linolenic acid levels also followed the same trend.

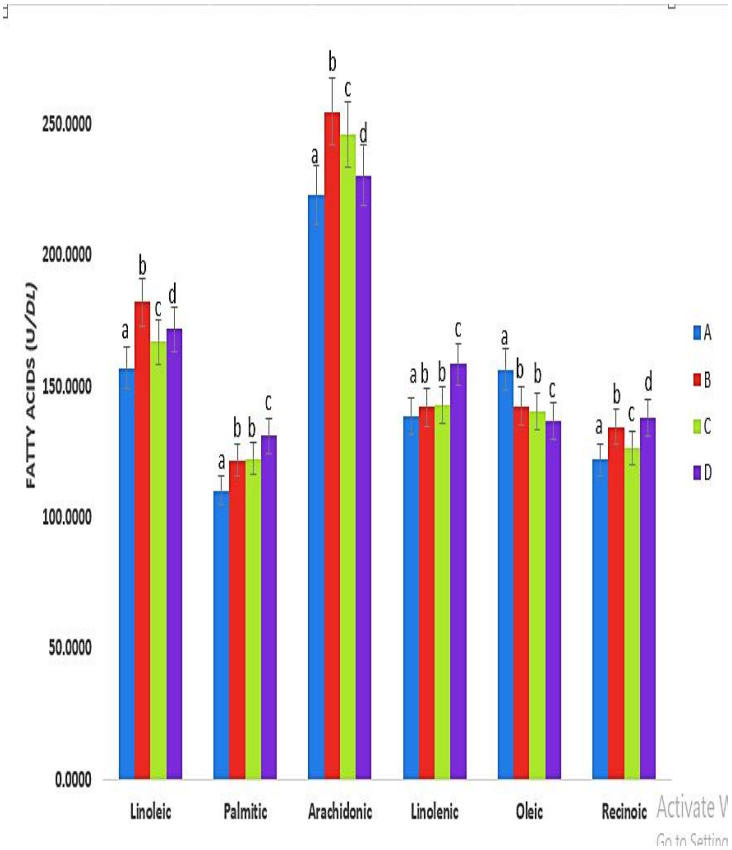

Figure 3: Fatty acid composition of fishes fed foreign feed (A), wild fishes from Ebonyi River (B), fishes fed with farm made feed (C) and fishes fed with Nigerian locally made commercial feed. Bars with different alphabets are significantly different at P<0.05. Values are the mean ± standard deviation of 3 replicate values.

4.0 Discussion

In fish farming, proper feeding is one of the main efficiency indicator. However, the exact

energy and nutritional need of the different types of fish needs to be identified, and on the other hand, the ability to use appropriate feed formulation to meet those needs. The wet body compositions of the fishes examined averaged 32-48% moisture content, ash 1-2%, crude fats 1-4%, crude protein 10-12% and carbohydrate 30-49%. With increasing moisture content, the ash content, crude fat and crude protein content decreased while the carbohydrate content increased. These variations were significantly different at ($p<0.05$) as seen in figure 1. This result contradicts the finding of Hartman and Lago.[29] who reported that as crude fat content increased, moisture content decreased while ash content increased in freshwater fishes analyzed in different seasons. This difference might .be due to seasonal variations and environmental changes. The result of other proximate in wild fishes, fishes fed with farm made feed and that fed with locally made commercial feeds were comparable.

Heavy metals accumulates in aquatic environment and hence is bio-accumulated by aquatic animals during feeding. Most heavy metals such as (Cd and Pb) are ubiquitous with no known nutritional function in animals but can heavily affect the physiology, performance and survival of the animal. The main route of exposure to most heavy metals in man appears to be through drinking water and food. In our result from figure 2, we observed that some biologically functional heavy metals such as Fe, Zn, P were significantly high in both the wild fishes and the farmed fishes irrespective of the type of feed given to the animal. The presence of these heavy trace elements in the fishes is nutritionally acceptable. However, the presence of Cd, Hg, Pb, Si and As in our samples is not a welcome development. Notwithstanding, both the farmed fishes and the wild ones did not pose any threat to health when consumed as these dangerous heavy metals did not exceed the acceptable limit in food and drinking water which is 0.05mg/g according to FAO.[30]

Oils from wild fishes and farmed fishes are unique in their variety of fatty acid compositions (Figure 3) and degree of saturations. There are significantly very high level of omegs-6 fatty acid than omega 3 fatty acids. Most of the fatty acids observed (figure3) have even number of carbon atoms for each molecule and are rarely contain functionalities apart from cis and transolefinicunsaturations. Long chain fatty acids (fig:3) are the commonest constituents observed. For every given sample, saturated and unsaturated fatty acid occur generally with their structures varying considerably in chain length and in their degree of unsaturation. The variety and the quality and quantity of fatty acids observed are mainly due to differences in diet as this is the only factor that is been varied in the experiment and environment in the case of wild fish. Polyunsaturated fatty acids attain the highest value. [31]. Ackmanreported a similar result in his work with different species of freshwater fishes. The fatty acid identified with branched chains are the C16:0, C18:2 and C20.The significant level of the fatty acids with branched chains identified is an advantage. The fatty acids with branched chains enhances lower melting point, low level of cholesterol, energy provision with a degree of formation of integral part of biomembranes.[31]

5.0 Conclusion:

The level of heavy metals in samples did not exceed the WHO permissible limit for drinking water. This result shows that these fish were safe for consumption irrespective of the type of feed used in breeding them.

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