Annals of Animal and Biological Research, 2024; 4(1)

Original Article

Comparative study on the nutritional profiles of *Clarias gariepinus* fed with commercial diet in earthen and concrete ponds

A. O. Awosusi

Department of Animal and Environmental Biology, Adekunle Ajasin University, Akungba-Akoko, Nigeria

Article Information
Keywords
Fish, ponds, utilization, proximate, mineral.

Corresponding author
A.O. Awosusi
ayokunle.awosusi@aaua.edu.ng

Article History
Received: January 14, 2024
Accepted: March 18, 2024
Published: May xx, 2024

Article can be accessed at
www.aabrjournalaaua.org.ng

Abstract
This research is aimed at comparing the nutritional profiles of African catfish fed with commercial diet in earthen and concrete ponds. A total of 500 fingerlings were randomly distributed into Earthen (4 x 8m^2) and Concrete (1 x 2m^2) ponds with 400 and 100 fingerlings respectively. The fish were fed 5% of their body weight twice daily for 84days. The fish sampled from each treatment were smoked-dried and milled into powdered form. The proximate: Protein (Pro), Moisture (Moi), Fat (Fa), Fiber (Fib), Ash (Ah), Carbohydrate (CHO) and mineral compositions of the powdered fish were determined using the standard methods of analytical chemists. Results showed that highest values were recorded for Potassium K (88.25±0.04), Sodium Na (72.36±0.00) and Copper Cu (0.36±0.47) in earthen pond and Calcium Ca (240.58±0.04), Manganese Mn (0.15±0.00), Iron Fe (8.17±0.01) and Zinc Zn (1.26±0.01) in concrete pond respectively. The ash content showed that there was no significant ($p<0.05$) difference between the fish raised in earthen and concrete pond, but there were significant ($p>0.05$) differences in moisture, fat, fiber, protein and carbohydrate contents of fish reared in both ponds. The significant differences in the ponds chemical compositions might be due to the differences in the environment and nutrient utilizations that they were subjected to. These attributes differing significantly between earthen and concrete pond shows that they were in good condition for human consumption, but for better enhancement, fish raised in earthen pond should be consumed more as it shows higher protein content.

INTRODUCTION

Fishes are one of the good sources of animal protein and have a unique position as a high-protein food commodity for human consumption. They are also one of the potential sources of animal protein and essential nutrients for the maintenance of a healthy body in developing countries (Fawole *et al.,* 2007). It is essential for improving nutritional status, food security, cardiovascular health and other health-related disorders (Bezbaruah and Deka, 2021).

Compared to other sources of protein, fish products are considered as essential components of human diet due to their high nutritional content, particularly in terms of protein and omega-3 fatty acids, which have been proved to aid in maintenance of

How to cite this article:
A.O. Awosusi. (2024). Comparative study on the nutritional profiles of *Clarias gariepinus* fed with commercial diet in earthen and concrete ponds. *Annals of Anim. Bio. Res.,* 4(1): 18-23

good health in prevention and treatment of cardiovascular, inflammatory and neurological diseases (Jan *et al*., 2021).

However, the chemical composition of fish flesh is regarded as a reliable predictor of the fish's quality, nutritional value, physiological state and habitat (Ravichandran *et al.,* 2011). Begum *et al.* (2012) recorded that 96-98% of the body composition of fish is constituted of moisture, protein, fat and ash. The main body components of fish are water, protein, fat, carbohydrate and mineral (Love, 1970). The proximate composition of fish is the evaluation of the body components (Rani *et al.,* 2016). It is therefore, very important to know the proximate and minerals composition of a fish so that the nutritional value of the fish can be determined. The study of mineral elements presents in living organisms is of biological importance (Hays and Swenson, 1985; Ozcan, 2003) because every form of living matter requires them for their normal life processes. Variation in proximate composition of fish, however, varies with species, season, geographical location, age and feeding habit of the fish (Shija *et al.,* 2019). Variation in proximate composition also exists within the same species depending upon the fishing ground, age and sex of the individual, geographical location of catch, environmental conditions, sexual maturity, size and reproductive status of the fish (Padmavati, 2017).Seasonal variation has a great impact on the alterations of proximate composition of fishes and there are a number of researchers who have studied seasonal variation in the biochemical composition of freshwater fish (Roy and Lall, 2006;Sharma *et al*., 2020; Jeyasanta *et al.,* 2023). The comparism of the fish raised in the two ponds ascertain the quality of the best rearing system that would be of more beneficial and provides good nutritional value to the consumers. This study was, however, carried out to analyze and compare the proximate and mineral compositions of *Clarias gariepinus* raised in earthen and concrete ponds.

MATERIALS AND METHODS

Experimental site

The study was carried out in a reputable fish farm (Ode's Bam Farm Ltd) at Ayegunle, Oka-Akoko, Akoko South West Local Government Area of Ondo State, Nigeria between May and August, 2022. The experiment was conducted for a period of 84 days.

Fish source, collection and identification

A total of 500 fingerlings of pure breed *C. gariepinus* fingerlings were obtained from the hatchery unit of the farm (Ode's Bam Farm Ltd) Ayegunle, Oka-Akoko, Ondo State, Nigeria**.** The fish species were identified through Food and Agriculture Organization (FAO) Fish catalogue and Wikipedia search engine. Accessed 31st August, 2022.

Experimental Procedure

This experimental set-up consisted of an earthen pond of size 4 x 8$m^2$and concrete pond of size 1 x 2m^2 situated in the fish farm. Before stocking, parasite and other predators were eliminated by washing the concrete tanks with sodium chloride (NaCl) and rinse with fresh water. Pond management was also carried out in the earthen pond. Five hundred (500) of eight weeks old fingerlings of *C. gariepinus* ranging in total length 13.0±0.1 and weight 17.1±00 were used. 400 and 100 fingerlings were randomly distributed into the earthen and concrete ponds, respectively. The fingerlings were fed 5% of their body weight twice daily. At the end of the experimental period (12 weeks), samples from each pond were smoked-dried and grounded into powder form and proximate composition such as protein, fat, ash, moisture, fibre and carbohydrate contents were assessed by the method of Association of Official Analytical Chemists (AOAC, 2007). The mineral compositions such as calcium (Ca), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn) were analysed using atomic absorption spectrophotometer (AAS Bulk Scientific, model: Accusys 211). Sodium (Na) and potassium (K) content were determined by flame photometric method (Ajai *et al.,* 2019).

Data analysis

The data obtained were subjected to analysis of variance (ANOVA) and descriptive statistics using IBM SPSS version 20.0 software. Duncan's multiple range tests was used to find the difference between the mean. Significant level was set at $p<0.05$.

RESULTS

Proximate composition

The results of proximate composition of *C. gariepinus* that were cultured in different ponds are presented in Table 1. The moisture content ranged from 9.97±0.13 - 10.69±0.27 with the concrete pond having the highest value (10.69±0.027). However, there was significant reduction in the moisture contents of the fish raised in the earthen pond when compared with the concrete pond. Fish raised in concrete pond recorded the highest fat content (9.85±0.04) and was significantly different from those raised in earthen pond (8.85±0.15). There was, however, no significant difference in the ash contents of fish raised in earthen (5.04±0.23) and concrete (4.89±0.05) ponds respectively. The fibre contents were significantly higher in fish raised in earthen pond (2.13±0.02). Fish raised in earthen pond recorded the highest protein content (61.21±0.12) and was significantly higher than the concrete pond (57.47±0.12). However, the carbohydrate content of fish raised in earthen (20.13±0.16) pond significantly reduced in value when compared with the value recorded for the concrete (14.84±0.18) pond.

Table 1: Proximate Composition of *Clarias gariepinus* cultured in different ponds

Proximate	Earthen Pond	Concrete Pond
Moisture	9.97±0.13[a]	10.69±0.27[b]
Fat	8.85±0.15[a]	9.85±0.04[b]
Fiber	2.13±0.02[a]	2.00±0.02[b]
Ash	5.04±0.23[a]	4.89±0.05[a]
Protein	61.21±0.12[a]	57.47±0.12[b]
Carbohydrate	12.80±0.20[a]	14.84±0.18[b]

Note: Mean values with the same superscript alphabets in the rows are not significantly different from each other at (P>0.05).

Mineral Analysis

The results of the mineral composition of *C. gariepinus* that were cultured in different ponds are shown in Table 2. The recorded mean value for Calcium (Ca) ranged from 240.58±0.04 - 266.61±0.12mg/l with the highest value being the fish raised in concrete (266.61±0.12mg/l) pond. Fish in earthen pond recorded the lowest Ca (240.58±0.04mg/l) concentration. The K concentration (77.45±0.02) of fish raised in concrete pond was significantly lower than those raised in earthen pond (88.25±0.04). The Na concentration in concrete (72.00±0.01) pond was significantly lower in value than earthen pond (72.36±0.00). There was no significant difference in Mn and Cu concentrations among the two ponds. The Fe concentrations ranged from

5.54±0.01 to 8.17±0.01 with earthen pond having the lowest concentration. Fish raised in earthen pond also recorded the lowest Zn concentration (0.58±0.00) when compared to the concrete (1.26±0.01) pond.

Table 2: Mineral Composition of *Clarias gariepinus* cultured in different ponds

Mineral	Earthen Pond	Concrete Pond
Ca	$240.58±0.04^a$	$266.61±0.12^b$
K	$88.25±0.04^c$	$77.45±0.02^a$
Na	$72.36±0.00^b$	$72.00±0.01^a$
Mn	$0.07±0.00^a$	$0.15±0.00^a$
Fe	$5.54±0.01^a$	$8.17±0.01^c$
Cu	$0.36±0.47^a$	$0.11±0.00^a$
Zn	$0.58±0.00^a$	$1.26±0.01^b$

Note: Mean values with the same superscript alphabets in the rows are not significantly different from each other at (P>0.05).

DISCUSSION

The main components of fish such as protein, fat, moisture, carbohydrate and minerals had been considered in evaluating the nutritional profile of the fish studied. The fish samples raised in the two ponds contained appreciable concentrations of calcium Ca, potassium K, and sodium Na, indicating that this fish could be used as good sources of minerals. Findings of the study shows that the fish raised in earthen pond were richer in K and Na. This may be as a result of exposure to a wide variety of vegetables and natural nutrient in the water body (Yeannes and Almandos, 2003) and the ability of the fish to absorb and convert the essential nutrients from the water bodies where they live. The exposure to more varieties of feed may likely be responsible for the higher amount of most minerals in the earthen pond when compared with the concrete pond.

The low concentration of Ca recorded in this study when compared with the earthen pond could be that the Ca was not well utilized by the fish raised in the concrete pond. However, this report was not in agreement with the submissions of Adewoye *et al.* (2003) and Boyd and Davis (1978) that the high Ca content recorded in *Heterotis niloticus* and *Clarias gariepinus* could probably be due to preferential accumulation and calcification of scale and hardy tissue. Other minerals composition such as Fe and Zn except Mn and Cu of the fish samples recorded variations in their concentrations in both ponds. This observation was supported by the findings of Window *et al.* (1987) which showed that such variations in concentrations of these mineral elements from a species of fish to another was due to the chemical forms of the elements and their concentrations in the local environment. Iron content from the study was lower compared to the 3 – 102 mg/100g reported by Adebayo *et al.* (2016) who studied proximate, mineral and Heavy Metal compositions of three fish species from Osinmo Reservoir, Nigeria.

The variations recorded in the concentration of mineral in the fish examined could be as a result of the rate in which they are available in the water body. Mineral compositions of fish are usually affected by different parameters such as feed type, level of dietary intake and growth (El-Zaeem *et al.,* 2012). According to Pfenning *et al.* (2012), wild fish feeds on a wide diversity of microscopic organisms and macrophytes which may be lacking in controlled farmed systems like the concrete pond. Therefore, the additional feed nutrients as observed in the earthen pond is in agreement with the observation of El-Zaeem *et al.* (2012) who reported that the feed composition of the farmed fish may also be a major factor influencing their mineral contents.

Result of the proximate composition showed there was a significant difference in the proximate composition (moisture, fat, fiber, protein and carbohydrate content) between the two ponds. Ash content recorded the highest value in the earthen pond when compared with the concrete pond. This result concurred with the findings by Bhouri *et al.* (2010) which reported an increase in ash content in wild fish compared to farmed/cultured fish. The observed range of ash content in this study agreed with the observations of Oladipo and Bankole (2013) who stated that the present of ash content as observed 'indicated that the species is a good source of minerals since ash is a measure of the mineral content of food item'. The results of this study also agreed with the findings of a study by Adebayo *et al.* (2016) which reported that catfish contain slightly higher ash, fat and protein contents than tilapia fish. In addition, the study confirms that proximate composition of farmed/cultured fish is directly influenced by their environment. Furthermore, the variation and significant differences recorded in this study for moisture, fat, fiber, protein and carbohydrate contents, were in agreement with the reports of Fuentes *et al*. (2010) and Rani *et al.* (2016)that the variation in proximate composition of fish is as a result of differences in nutrition, living area, fish size, catching season, seasonal and sexual variations as well as other environmental conditions that relates to this study.

CONCLUSION

The significant differences in the values recorded in the two ponds and changes observed in the chemical compositions examined in this study might be due to the differences in the environment, nutritional and rearing conditions that they were subjected to. The observed nutritional composition values of the fish raised in the ponds (earthen and concrete) indicated that the fish species (catfish) is a good source of protein and minerals such Ca, K, Na, Mn, Zn Fe. The attributes of the nutritional value differed significantly between each pond and cultured catfish are of nutritional benefit to humans on consumption, hence this study recommends that people should consume more cultured catfish especially those raised in earthen pond.

Conflict of Interest

The author declares that there are no conflicts of interest.

REFERENCES

Adebayo, I.A., Fapohunda, O.O. and Ajibade, A.O. (2016). Evaluation of nutritional quality of *Clarias gariepinus* from selected fish farms in Nigeria, *American Journal of Food Science and Nutrition Research,* 3(4): 56-62.

Adewoye, S.O., Fawole, O.O. and Omotosho, J.S. (2003). Concentrations of selected elements in some fresh water fishes in Nigeria. *Science Focus.* (4):106-108.

Ajai, A. I., Inobeme, A., Nwakife, N. and Abubakar, N. A. (2019). Proximate and essential mineral composition of fresh and smoked catfish and beef sold in Minna, Niger State. *FUW Trends in Science and Technology Journal,* 4(2):569-571.

AOAC (2007). *Official Methods of Analysis.* (18th ed.). Association of Official Analytical Chemists, Inc., Gaithersburg, US.

Begum, M., Akter, T. and Minar, M. (2012). Analysis of the proximate composition of domesticated stock of pangas (*Pangasianodon hypophythalmus*) in laboratory condition. *Journal of Environmental Science and Natural Resources,* 5(1): 69-74.

Bezbaruah, G. and Deka, D.D. (2021). Variation of moisture and protein content in the muscle of three catfishes: A comparative study.

International Journal of Fisheries and Aquatic Studies, 9(1):223-226.

Bhouri, A.M., Bouhel, I., Chouba, L., Hammami, M., El Cafsi, M. and Chaouch, A. (2010). Total lipid content, fatty acid and mineral compositions of muscles and liver in wild and farmed sea bass (*Dicentrarchus labrax*). *African Journal of Food Science,* 4(8):522-530.

Boyd, C.E. and Davis J.A. (1978). Concentration of selected element and ash in Bluegill (*Lepomis macrochirus*) and certain other freshwater fish. *Transactions of the American Fisheries Society,* 6:862-867.

El-Zaeem, S.Y., El-Tawil, N.E. and Amer, T.N. (2012). Effect of direct injection of shark DNA into the skeletal muscles on the productive performance characteristics of Red Tilapia (*Oreochromis sp*.) fed different dietary regimes. *African Journal of Agriculture Research,* 7(16): 2456-2462.

Fawole, O.O., Ogundiran, M.A. Ayandiran, T.A. and Olagunju, O.F. (2007). Mineral composition in some selected fresh water fishes in Nigeria. *Journal of Food Safety,* 9:52-55.

Fuentes, A., Fernandez-Segovia, I., Serra, J.A. and Barat, J.M. (2010). Comparison of wild and cultured sea bass (*Dicentrarchus labrax*) quality. *Food Chemistry,* 119(4):1514-1518.

Hays, V.W. and Swenson, M.J. (1985). Minerals and bones.10th Edition. *Dukes' Physiology of Domestic Animals*, pp 449-466.

Jan, K., Ahmed, I. and Dar, N. A. (2021). Haematological and serum biochemical reference values of snow trout, *Schizothorax labiatus* habiting in river Sindh of Indian Himalayan region. *Journal of Fish Biology*, 98(5):1289-1302.

Jeyasanta, K.I. and Patterson, J. (2023). Seasonal variation in the nutritional compositions of fishes in Tuticorin southeast coast of India. *Journal of Advances in Food Science and Technology,* 10(1):29-47.

Love, R.M. (1970). *The Chemical Biology of Fishes.* Academic Press, London, UK.

Oladipo, I.C. and Bankole, S.O. (2013). Nutritional and microbial quality of fresh and dried *Clarias gariepinus* and *Oreochromis niloticus. International Journal of Applied Microbiology and Biotechnology Research,* 1(1): 1-6.

Ozcan, M. (2003). Mineral contents of some plants used as condiments in Turkey. *Food Chemistry,* 84:437-440.

Padmavati, G. (2017). Proximate and elemental composition of *Stolephorus commersonnii* (Lacepede, 1803) from the coastal waters of South Andaman. *Indian Journal of Geo Marine Sciences*, 46(5): 1000-1007.

Pfenning, F., Kurth, T., Meißner, S., Standke, A., Hoppe, M., Zieschang, J. and Gutzeit, H. O. (2012). The social status of the male Nile tilapia (*Oreochromis niloticus*) influences testis structure and gene expression. *Reproduction,* 143(1): 71-84.

Rani, P.S., Kumar, P.V., Rao, K.R. and Shameem, U. (2016). Seasonal variation of proximate composition of tuna fishes from Visakhapatnam fishing harbor, East coast of India. *International Journal of Fisheries and Aquatic Studies*, 4(6):308-313.

Ravichandran, S., Kumaravel, K. and Florence, E. (2011). Nutritive composition of some edible fin fishes. *International Journal of Zoological Research,* 7:241-251.

Roy, P.K. and Lall, S.P. (2006). Mineral nutrition of haddock *Melanogrammus aeglefinus* (L): a comparism of wild and culture stock. *Journal of Fish Biology,* 68:1460-1472.

Sharma, S., Kumar, S. and Singh, D. (2020). Seasonal variations in proximate composition and metallic elements of three cyprinids from a Central Himalayan river Alaknanda in Garhwal Himalaya, *India. Journal of Applied and Natural Science*, 12(4):661-669.

Shija, S.M., Shilla, D.A. and Mihale, M.J. (2019). Variation of proximate contents in selected marine fish from Tanzanian coast due to seasonality and processing methods. *Huria Journal of the Open University of Tanzania*, 26(1): 30-49.

Window, H., Stein, D., Scheldon, R. and Smith, J.R. (1987). Comparison of trace metal concentrations in muscle of a benthopelagic fish (*Coryphaenoides armatus*) from the Atlantic and Pacific oceans. *Deep Sea Research,* 34(2):213-220.

Yeannes, I.M. and Almandos, M.E. (2003). Estimation of fish proximate composition starting from water content. *Journal of Food Composition and Analysis,* 16:81-92.