Sjournals
Scientific Journals
Scientific Journal of Biological Sciences (2013) 2(11) 219-226
ISSN 2322-1968
doi: 10.14196/sjbs.v2i11.1083

Contents lists available at Sjournals
Scientific Journal of
BiologicalSciences
Journal homepage: www.Sjournals.com

Original article

Variations in proximate and minerals composition of wild and cultivated clarias gariepinus (burchell, 1822)

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ARTICLE INFO

Article history,
Received 01 October 2013
Accepted 15 November 2013
Available online 29 November 2013

Keywords,
Proximate composition
Wild
Farmed
Catfish
Clarias gariepinus
Protein contents

ABSTRACT

The proximate and minerals composition of wild and farmed Clarias gariepinus was studied to identify nutritional difference that might induced by habitat change. Thirty six individual fish from both wild and hatchery-raised population were (average weight = 0.78+1.23kg) collected from fishermen from river Oluwa, Osun and Owena and from fish farmers in Akure, Ado Ekiti and Ilesa in Ondo Ekiti and Osun state respectively. The fish tissue were subjected to chemical analysis of protein, lipid, moisture ash and mineral content. The moisture contents recorded in muscle of wild and cultured C. gariepinus cultured was 5.75± 0.07 and 5.57 ± 0.10% respectively. Protein contents in muscle from farmed and wild C. gariepinus were measured as 69.35±0.08% and 67.23±0.07%, respectively. In wild and farmed C. gariepinus, lipids contents were measured as 16.03 ±0.08% and 18.61 ±0.09% respectively. C. gariepinus was analyzed for estimation of total ash contents which were 9.15±0.07% in wild and 8.41±0.08% in farmed C. gariepinus. The minerals analysis revealed that C. gariepinus samples from wild had significantly higher value in Mn, Cu and Mg, (1.95±0.04, 1.69±0.05 and 1.82±0.43 respectively). The mean value for S, Ca, P, Na and K were significantly higher (0.32±0.04, 2.74±0.06, 0.44±0.06, 5.08±0.05 and 5.56±0.04) in cultured samples than the wild samples. No significant difference

was observed for Zn and Co between the cultured and the wild fish. A significant difference was observed in chemical composition of the fish obtained from wild and cultured sources. Higher level of protein and lipids were observed in cultured C. gariepinus but lower in wild C. gariepinus. Values for moisture and ash content were significantly higher in wild C. gariepinus. It can be concluded that wild C. gariepinus collected from some rivers in south-west less contain protein and lipid and more moisture and ash content compared with cultured C. gariepinus from the same region.

1. Introduction

Fish has long been recognized as valuable resource of high quality food in human diet. Fish received increased attention as a potential source of animal protein and essential nutrients for human diets (Kromhou et al. 1995; Zenebe et al. 1998; Arts et al. 2001; Fawole et al. 2007).

Fish is a major source of food providing a considerable amount of dietary protein and lipid diet in many countries. Fish flesh is easily digestible because it contains long muscle fibres. Fish meat contains significantly low lipids and higher water than beef or chicken and is favoured over other white or red meats (Neil, 1996; Nestel, 2000).

Fish like other animals requires diverse of different nutrients in appropriate quantities to flourish and maintain other biological functions.

Fish can manufacture some of the essential nutrients which are require to be provided from external sources. Farmed fish is offered with nutrient rich foods couple with the natural productivity in the pond unlike the wild fish that has to depend completely on natural food production for its sustenance. These differences have direct effects on body composition, health status as well as growth of fish. The feeding habits and type of food availability is a true reflector of fish body composition. (Ashraf et al, 2011)

Proximate composition is used as an indicator of fish quality assessment (Stansby, 1962, Ashraf,et al. 2011). It differs with diet, feed rate, seasonal life cycles, (Dawson & Grimm, (1980) and Puwastien et al. 1999) genetic strain and age (Austreng & Refstie, 1979).

It is generally perceived that wild fish has better texture and nutritional value than farmed fish. Demand for wild fish and ignoring farmed fish by consumers when visit fish market, despite the limited supply has also been reported Ashraf et al. 2011

To clarify this misconceptions and at the same time provide useful information to guide consumers during meat selection between wild and cultured C. gariepinus, this research thus planned. Therefore, the objective of this study is to identify the nutritional elements of differentiation which characterize wild and cultured C. gariepinus and provide consumer the nutritional quality of this fish.

2. Materials and methods

2.1. Procurement of fish

Fifty six samples of Clarias gariepinus (670+1.25g) 28 each from cultured and wild were obtained from six different locations. The cultured were obtained from fish farms which include Federal University of Technology Teaching and Research Farm (Akure), Leventis Agricultural training school, Ilesa (Osun State), Ekiti State Ministry of Agriculture, Ado-Ekiti (Ekiti state), while the wild counterparts were obtained from fishermen at Oluwa River, Agbabu (Ondo State), River Osun, Esa-Odo (Osun-State), river Owena, Owena (Ondo State).

2.2. Sample preparation

Fishes were transported alive to the Fisheries Research Laboratory, Department of Fisheries and Aquaculture Technology, Akure, Nigeria. All the fishes were kept in six concrete tanks (150 x 150x 100 cm) with aerated water

for three days for complete defecation of stomach contents. Since the fishes are of different weight or sizes, they were groug into three using the method of Hussain et al 2011. Fishes were then slaughtered and dressed. The ventral, dorsal and tail white muscles of the fish body were selected for the analysis.

2.3. Proximate analysis

Fillets were crushed and freeze-dried at -30oC. Another portion of fresh crushed fish samples were immediately dried at 105oC in oven (model, LCON53CF) for 24 hours to determine moisture contents (AOAC, 1995). Crude protein was determined by Microkjeldahl method with 6.25 as multiplier (AOAC, 1995). Fat content was also determined with the Soxhlet method using petroleum ether as the solvent. Ash content was determined by sample mineralization at a temperature of 550°C (AOAC, 1990), while the percentage mineral elemental concentration including heavy metal concentrations were determined using (AAS) Atomic Absorption Spectrophotometer (AOAC, 1975) while phosphorus was determined by Vanado- Molybdate colometric method.

2.4. Statistical Analysis

The values obtained by the analysis of different fish samples (farmed and wild) of C. gariepinus are given as the means ± SE. The differences between the mean values of the studied parameters were calculated using single factor analysis of variance and Student "t" test. When there is significant differences between means groups ($p< 0.05$), Duncan's Multiple Range Test was used to separate the means. Data analysis was done with SPSS Statistical Package Version 14.

3. Results

3.1. Proximate composition

3.1.1. Moisture contents

When moisture contents of individual fish species were compared within two habitats, there were no significant differences but when moisture contents were compared between two habitats moisture contents were significantly higher in cultured C. gariepinus than wild C. gariepinus ($p<0.05$) (Table I).

However, when moisture contents were compared between sizes, 0.52kg to 0.87kg C. gariepinus had significantly ($p<0.05$) lower moisture contents than 0.88kg and above 1.5 kg irrespective of their habitat.

3.1.2. Crude protein

The protein contents of farm raised C. gariepinus were significantly higher than those caught from the wild ($p<0.05$) (Table II). There is no significant difference in the protein content within cultured and wild C. gariepinus. Statistical analysis revealed that farmed C. gariepinus had maximum protein content. However, the small sizes C. gariepinus has significantly higher values compared with larger size stock

3.1.3. Lipid contents

Lipid composition showed higher value in cultured C. gariepinus compared with wild C. gariepinus. Significantly ($p<0.05$) higher lipids were present in cultured wild C. gariepinus than farmed (Table III). Although, there is significant different in lipid composition with respect to size, the higher value was recorded between 0.73 and 0.87kg C. gariepinus

3.1.4. Ash content

Ash content was also observed to be significantly higher ($p<0.05$) in wild samples of C. gariepinus and lower in cultured samples, but no statistical differences was observed in various sizes of wild and cultured C. gariepinus (Table 1V).

Minerals profile, The mineral composition of wild and cultured C. gariepinus is shown in Table 5. Values of Magnesium, copper and manganese were higher in wild C. gariepinus than cultured C. gariepinus. In contrary, values for calcium, phosphorus, potassium sodium and sulphur were significantly higher in cultured C. gariepinus compared with wild C. gariepinus. When these minerals were compared within sample locations, significant difference was also noticed.

Table 1
Comparison of means (% ± S.E.) for moisture contents in muscle from wild and farmed Clarias gariepinus of three different weight categories.

Weight category	Wild	Cultured	Mean SE
W1 (520-700g)	5.49±0.09	5.61±0.08	5.55±0.09 a
W2 (730-870g)	5.60±0.09	5.39±0.08	5.50±0.09 a
W3 (880-1000g)	5.43±0.11	6.24±0.10	5.84±0.11 b
Mean± SE	5.57±0.10 a	5.75±0.07 b	

Figures with different superscript letters are significantly different from each other at P> 0.05.
S.E. = Standard Error.

Table 2
Comparison of means (% ± S.E.) for protein contents in muscle from wild and farmed Clarias gariepinus.

Weight category	Cultured	Wild	Mean SE
W1 (520-700g)	69.60±0.07	67.65±0.07	68.63±0.11 a
W2 (730-870g)	68.99±0.05	67.52±0.08	68.26±0.05 a
W3 (880-1000g)	69.45±0.08	66.52±0.08	67.99±0.06 c
	69.35±0.08 a	67.23±0.07 b	

Figures with different superscript letters are significantly different from each other at P> 0.05.
S.E. = Standard Error.

Table 3
Comparison of means (% SE) for lipid contents in muscle from wild and farmed Clarias gariepinus.

Weight category	Wild	Cultured	Mean SE
W1 (520-700g)	15.62±0.10	18.73±0.11	17.18±0.11 c
W2 (730-870g)	16.48±0.05	18.36±0.09	17.42±0.07 a
W3 (880-1000g)	15.98±0.10	18.74±0.09	17.36±0.10 b
Mean± SE	16.03 ±0.08 b	18.61 ±0.09 a	

Figures with different superscript letters are significantly different from each other at P> 0.05.
S.E. = Standard Error.

Table 4
Comparison of means (% ± S.E.) for Ash contents in muscle from wild and farmed Clarias gariepinus of three different weight categories.

Weight category	Wild	Cultured	Mean SE
W1 (520-700g)	9.29±0.08	8.01±0.11	8.65±0.10 a
W2 (730-870g)	8.93±0.08	8.73±0.05	8.83±0.07 a
W3 (880-1000g)	9.23±0.08	8.50±0.06	8.87±0.07 a
Mean± SE	9.15±0.07A	8.41±0.08B	

Figures with different superscript letters are significantly different from each other at P> 0.05.
S.E. = Standard Error

4. Discussion

4.1. Proximate composition of wild and cultured population of c. Gariepinus

Results of the present studies have revealed that culture habitat of fish has direct effect on its nutritional quality. The nutritional elements showed variable values in the fish sample analyzed; with crude protein having the highest values and moisture had the lowest in wild fish.

Similar observation was observed by Steffens (2006), who reported that protein forms the largest quantity of dry matter in fish. The highest value recorded in protein and lowest in moisture contents of wild C. gariepinus agreed with Srikanth et al. (1989) who reported that moisture contents were lowest and protein deposition

highest under the influence of fertilizer treatment with high and low protein in Cyprinus carpio. Mahboob et al. (2004) also reported high protein contents in the farmed Labeo rohita. In a study conducted by Ashraf et al (2011) on grass carps it was discovered that the protein contents of farm raised grass carp and silver carp were significantly lower than those caught from the wild. This does not conform to the present study the reason might be attributed to species differences

The differences observed in percentage crude protein within habitats may also be attributed to fish's consumption or absorption capability and conversion potentials of essential nutrients from their diet or their local environment into such biochemical attributes needed by the organism's body. (Adewoye and Omotosho, 1997). This is supported by the findings of Adewoye et al. (2003).

Lipid content of farmed C. gariepinus was significantly higher than wild C. gariepinus. this finding support the finding of Alasalvar et al. (2002) on sea bass (Dicentrarchus labrax) , Grigorakis et al. (2002) on gilthead sea bream (Sparus aurata), Grigorakis et al. (2003), and Orban et al. (2003) on seabass (Dicentrarchus labrax) and gilthead sea bream (Sparus aurata). Tahir (2003) has reported highest lipid contents in farmed Labeo rohita when he compared with wild specimens.

This differences might be as a result of a variety of factors including availability and type of food, dietary ingredients (commercial diets are usually high in fat content and also include dietary carbohydrate), higher energy consumption in farmed fish when compared to wild fish (Grigorakis et al. 2002); and possible periods of starvation encountered by wild fish (Haard, 1992). Jankowska et al. (2007) observed that water contents, protein and fats in the fillets of cultivated and wild perch (Perca fluviatilis) differed significantly ($p< 0.01$). Farmed fish muscle showed a higher ($p<0.01$) total lipid content than its wild counterparts. They opined that the feed offered to farmed specimen had direct impact on its body fat increments. Boujard et al. (2004) found similar results on European seabass (Dicntrarchus labrax) and wild yellow perch (Perca flavescens). In contrast to the present trial, Cox and Karahadian (1998) did not find significant differences in lipid contents when comparing wild and farmed yellow perch.

There is also significant difference between the ash content in the wild and cultured fish within the sampled locations, with fish from the wild having the highest ash content. This could be attributed to the level of minerals available in the water body or the materials they feed on.

4.2. Minerals

There is significant difference ($P < 0.05$) in the minerals composition except for (Co and Zn) of C. gariepinus examined within the sample location.

Copper was significantly higher in Agbabu compare with other location. The reason could be that water from Agbabu is richer in these minerals which consequently might affect their diet. Sample from Owena recorded significant higher value in Manganese, Calcium, Magnesium, Phosphorus, and Sodium. From the study, it was observed that most of the minerals analyzed show higher proportion in wild location compared with cultured environment except for Sodium that is higher in Ilesa sample. The variations recorded in the concentration of minerals in fish muscles examined could have been as a result of the rate in which they are available in the water body and the ability of the fish to absorb these inorganic elements from their diets and the water bodies where they live (Adewoye and Omotosho, 1997). The result obtained from this study agrees with the findings of (Lindsay, 1980) on yellow perch. He reported that farmed yellow perch contained higher magnesium, phosphorus and potassium, while wild yellow perch had significantly higher concentrations of sodium and sulphur ($p \leq 0.05$).

5. Conclusion

In conclusion, the higher moisture, lower protein and fat contents is a characteristic feature of wild C. gariepinus populations from southwest Nigeria.

Table 5
Comparison of mineral profile of cultured and wild Clarias gariepinus.

	Wild				Cultured			
	Agbabu	Esaodo	Owena	Mean±SE	Ado-Ekiti	Akure	Ilesa	Mean±SE
	Mg/g fish muscle							
Mn	2.03±0.03	1.70±0.06b	2.12±0.05a	1.95±0.04 a	1.18±0.04c	1.78±0.06b	2.19±0.06a	1.72±0.05 b
Cu	2.39 ±0.05c	1.25±0.05a	1.42± 0.04ab	1.69±0.05 a	1.47 ±0.06b	1.37± 0.05ab	1.30±0.06ab	1.38±0.04 b
Co	0.01 ±0.00a	0.01 ±0.00a	0.01 ±0.00a	0.01±0.00 a	0.01± 0.00a	0.01± 0.00a	0.01 ±0.00a	0.01±0.00 a
Zn	0.63 ± 0.06a	0.60± 0.05a	0.64± 0.04a	0.62±0.51 a	0.59 ±0.05a	0.68 ±0.06a	0.57 ±0.06a	0.61±0.03 a
S	0.38 ±0.05c	0.16 ± 0.03a	0.28 ±0.04abc	0.27±0.36 a	0.35 ±0.04bc	0.38 ±0.04ac	0.22 ±0.04ab	0.32±0.04 a
Ca	2.55± 0.05b	2.58 ±0.06b	3.10 ±0.06c	2.74±0.50	2.21 ±0.06a	2.27± 0.04a	3.23± 0.05c	2.57±0.06 a
Mg	1.47 ±0.04a	1.53 ± 0.05ab	2.46 ±0.04d	1.82±0.43 a	1.57± 0.06ab	1.67± 0.04b	1.97 ±0.05c	1.74±0.03 b
P	0.28 ± 0.04a	0.36 ± 0.05ab	0.49 ± 0.05b	0.38±0.46 b	0.43 ±0.07ab	0.41± 0.05ab	0.47 ±0.06b	0.44±0.06 a
Na	3.98± 0.04a	4.20± 0.06b	6.06 ± 0.06e	4.75±0.53 b	4.92 ± 0.05c	5.06± 0.05c	5.26 ±0.05d	5.08±0.05 a
K	5.15 ±0.04b	5.38 ± 0.06c	6.16 ± 0.04d	5.56±0.50 b	4.98 ±0.06a	5.06 ±0.05ab	5.49 ±0.04c	5.18±0.04 a

Figures with different superscript letters are significantly different from each other at P> 0.05.
S.E. = Standard Error.

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