Pak. J. Agri. Sci., Vol. 52(1), 203-207; 2015
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
http://www.pakjas.com.pk

COMPARATIVE PROXIMATE BODY COMPOSITION OF WILD CAPTURED AND FARM CULTURED *Cirrhinus mrigala*

Tanveer Ahmed[1,*], Syed Muhammad Aun Naqvi[2], Sajid Abdullah[1], Khalid Abbas[1], Syed Zakir Hussain Shah[1] and Muhammad Anjum Zia[3]

[1]Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad-38040, Pakistan;
[2]Department of Zoology, Government Postgraduate College, Gojra, Pakistan;
[3]Department of Biochemistry, University of Agriculture, Faisalabad-38040, Pakistan.
[*]Corresponding author's e-mail: tanvirahmeduaf@gmail.com

The purpose of present study was to analyze and compare the nutritional values of wild captured and farm cultured *Cirrhinus mrigala*. The proximate composition of fish meat, head, scales, fins and skin were examined in this study. From both sources (wild and farm), 42 fish specimens were collected and divided into three different weight categories i.e. ≤500 g, 501-1000 g and 1001-1500 g and designated as W_1, W_2 and W_3 for wild and F_1, F_2 and F_3 for farm cultured fish respectively. The farm cultured species were found to have significantly ($p<0.05$) higher nutrients than its wild counterpart. Wild fish species showed high moisture (%) in all body parts selected in this study as compared to farm cultured fish species. The protein and fat contents in farm cultured *C. mrigala* were observed significantly ($p<0.05$) higher as compared to wild captured fish species. It was found that although scales and fins of both wild captured and farm cultured fishes were not consumed directly by human beings but they have considerable amount of nutrients. Ash (%) was observed significantly ($p<0.05$) higher in those body parts that have large bone matrix e.g. head, scales and fins of both wild captured and farm cultured *C. mrigala*.
Keywords: Nutritional values, wild and farmed fish, chemical composition, protein content

INTRODUCTION

Fish has been consumed throughout the world because of its several health benefits. Its flesh has high quality protein that can easily be digested as compared to other sources of animal proteins (Louka *et al*., 2004). Moreover, its intake reduces fats particularly triacylglycerides in the blood (Boberg, 1990) and also important in reducing cardiovascular disorders (Ahmed, 2011) however, it is important to analyze body proximate composition of fish prior to its consumption (Fawole *et al*., 2007).

Cirrhinus mrigala is among one of the Indian major carps and commonly consume throughout Pakistan due to its high quality meat and taste and has acquired great attention of aqua-culturists globally, due to its high yield and meat quality (FAO, 2007). Measuring the moisture contents, protein, fat, ash and carbohydrate percentage of body in fish is called proximate composition (Aberoumad and Pourshafi, 2010; Ahmed, 2011). Proximate analysis is being commonly used by researchers to monitor the physiological condition and health of fish (Saliu *et al*., 2007; Aberoumad and Pourshafi, 2010). Moisture contents of an organism body play an important role in the metabolism (Babu *et al*., 2013). As the fish size increases, moisture contents of different body parts decrease, while protein and fat contents increases (Naeem and Salam, 2010). Love (1980) reported that different body parts in various fish species showed moisture contents in range between 70-80%, protein 20-30% and fat 2-12%. Ash percentage of different fish species is directly proportional to their body size (Al-Asgah, 1992; Ahmed, 2011).

Proximate body composition of same fish species may differ in different environmental and feeding conditions, water depth and water quality (Javaid *et al*., 1992; Drazen, 2007 and Ahmed, 2011). Mahboob *et al*. (2003) observed that farm cultured fish showed better results in terms of nutritional and commercial values than that of wild. In wild habitat, fish consumed mainly crustaceans, insects and vascular plants while, in farmed or cultured environment, fish received a balanced protein rich diet.

Although, a large number of researchers analyzed proximate composition of fish flesh (meat) but there is a scarcity of the data on proximate composition of head, scales, fins and skin of wild captured and farm cultured *C. mrigala*. The purpose of present study was to analyze proximate composition of flesh, head, scales, fins and skin of fish in relation to body weight and habitat (Natural and farmed).

MATERIALS AND METHODS

Total 42 specimens of *Cirrhinus mrigala* of three different weight categories (≤500g, 501-1000g and 1001-1500g), from both wild and farmed habitats were collected for the proximate body composition analysis.

***Fish sampling and measurements*:** Total 21 farm cultivated *C. mrigala* of three different weight categories designated as

F_1 (≤500g), F_2 (501-1000g) and F_3 (1001-1500g) were collected from local fish farm situated in Gojra. Concurrently, 21 wild *C. mrigala* of three different weight categories designated as W_1 (≤500 g), W_2 (501-1000 g) and W_3 (1001-1500 g) were captured with the help of gillnets from Trimu Headworks, Pakistan. All the fishes were immediately kept in cold iced boxes and transported to the Fisheries Research Laboratory, Department of Zoology, Govt. Postgraduate College, Gojra, where morphometric measurements included wet weight, length and width of each and every specimen were carried out.

***Preparation of fish samples for experiment*:** On arrival, all fish specimens were washed immediately. Later on, the fish were sterilized, blotted dry with paper towels and then weighed on an electric balance to check out the total weight of fish. The fish were given longitudinal cut from the ventral side and then selected the head, scales, fins and skin from the dissected fish and weighed on electrical balance. The length, width and weight of head scales and fins were noted separately. The skin was made clear from flesh (meat) and then weighed. Bones were separated from fish flesh and weighed.

***Proximate analysis*:** By following AOAC (1995) methods, various proximate components viz. moisture, crude proteins, crude fat and ash were determined. Total carbohydrate was calculated by difference of the entire proximate parameters i.e. Total carbohydrate % = 100 – (Moisture % + crude % + protein % + crude fat % + Ash %).

***Statistical analysis*:** Data were analyzed by applying ANOVA using SPSS 11.5 for windows software. Duncan's multiple range tests were used to resolve differences among means. A value of $p<0.05$ was used to indicate significant difference among groups (Ali and Kiumars, 2010).

RESULTS

***Moisture contents*:** When moisture percentage was compared among both habitat fishes, significant difference was noted at $p<0.05$. Wild fish species showed high moisture percentage in all selected body parts (e.g. meat, head, scales, fins and skin) as compared to farm cultured fish species (Table 1). Maximum moisture (74.91%) was analyzed in meat (flesh) of wild *C. mrigala* as compared to farm cultured (67.43%) *C. mrigala* meat (flesh). The inferences further showed that moisture contents differed significantly within and among both species on the basis of weight. As the weight of both wild captured and farm reared fish specimen increases, moisture contents decreases.

***Crude protein*:** The protein contents in farm cultured *C. mrigala* was noted significantly ($p<0.05$) higher as compared to wild captured fish species (Table 2). Maximum protein (25.54%) was noted in farmed *C. mrigala* meat as compared to its opponent habitat fish (22.63%). Protein contents when compared within wild and farm cultivated *C.*

Table 1. Comparison of moisture contents (%) between wild captured and farm raised *C. mrigala* of different weight categories

Fish source	Wild captured			Farm cultured		
Weight category	**W1**	**W2**	**W3**	**F1**	**F2**	**F3**
Body parts						
Meat (Flesh)	74.9±0.01a	72.6±0.01b	71.5±0.02c	69.7±0.13d	68.7±0.02e	67.4±0.02f
Head	67.9±0.02a	66.2±0.02a	62.4±0.02b	61.6±0.02c	59.6±0.06d	57.8±0.05f
Scales	58.4±0.08a	56.2±0.05b	54.5±0.15c	53.2±0.01d	52.4±0.02e	51.3±0.02f
Fins	67.8±0.02a	65.4±0.02bc	62.2±0.03f	65.3±0.02c	64.8±0.03d	63.3±0.07e
Skin	71.8±0.01a	69.9±0.03b	68.1±0.02d	68.8±0.03c	66.6±0.02e	65.4±0.02f

Data are expressed as mean±SD; Means±SD followed by the same letter, within a row, are not significantly different ($p>0.05$).

Table 2. Comparison of crude protein (%) between wild captured and farm raised *C. mrigala* of different weight categories

Fish source	Wild captured			Farm cultured		
Weight category	**W1**	**W2**	**W3**	**F1**	**F2**	**F3**
Body parts						
Meat	21.0±0.02ef	21.9±0.01e	22.7±0.03d	24.6±0.07c	25.1±0.04ab	25.5±0.02a
Head	13.7±0.05f	14.6±0.02e	16.2±0.01cd	16.8±0.04c	17.1±0.01b	18.5±0.02a
Scales	12.8±0.06f	13.5±0.05e	15.2±0.03c	14.7±0.04d	16.6±0.02b	18.4±0.03a
Fins	17.7±0.01d	18.1±0.05bc	18.5±0.02b	18.1±0.02bc	18.7±0.03a	18.8±0.04a
Skin	21.1±0.02f	22.1±0.02e	23.0±0.02d	23.5±0.01c	24.1±0.03ab	24.4±0.04a

Data are expressed as mean±SD; Means±SD followed by the same letter, within a row, are not significantly different ($p>0.05$).

mrigala on the basis of weight, W_3 and F_3 weight category showed maximum protein contents as compared to other weight categories.

***Crude fat*:** Fat contents are also called ether extract. Fat contents showed different trends as compared to other parameters of proximate composition. All body parts of farm cultured *C. mrigala* showed maximum percentage of fat contents as compared to wild cultivated fish specimen (Table 3). Head of wild and farm raised *C. mrigala* showed maximum fat contents of 11.38 and 11.93% in W3 and F3 groups respectively. Lowest fat 1.57 and 2.01% was observed in scales of both wild and farm cultivated *C. mrigala*, respectively. Results also showed significant ($p<0.05$) difference in crude fat contents on the basis of weight within wild and farm cultivated *C. mrigala*.

***Ash percentage*:** Ash percentage in both natural and cultivated fish species was recorded someone equal with slight differences due to size because a definite range of weight was selected. However, it was noted that those body parts showed maximum percentage of ash that have large bone matrix (Table 4). Maximum ash was recorded 27.58 and 27.84% in scales of both habitat *C. mrigala* underweight categories W_3 and F_3, respectively. Fins are secondly showed maximum percentage of ash both in wild and farmed *C. mrigala* in weight category W_3 and F_3.

***Carbohydrates*:** Carbohydrates are usually neglected in proximate composition analysis and do not measure directly. These are calculated by measuring the difference of all parameters of proximate composition. Maximum carbohydrates (4.59%) were recorded in farm cultured fish while minimum (0.13) amount of these carbohydrates was observed in wild captured fish (Table 5).

DISCUSSION

Fish flesh quality is considered superior than milk, eggs,

Table 3. Comparison of crude fat (%) between wild captured and farm raised *C. mrigala* of different weight categories

Fish source	Wild captured			Farm cultured		
Weight category	**W1**	**W2**	**W3**	**F1**	**F2**	**F3**
Body parts						
Meat	2.0±0.01f	2.4±0.01d	2.7±0.02b	2.2±0.02e	2.6±0.01c	3.0±0.02a
Head	9.4±0.15f	10.2±0.10de	11.4±0.03bc	10.2±0.02e	11.4±0.02b	11.9±0.02a
Scales	1.6±0.02df	1.6±0.01d	1.7±0.02b	2.0±0.02e	2.2±0.02c	2.5±0.03a
Fins	5.0±0.02f	5.1±0.02de	5.3±0.02b	5.1±0.02e	5.2±0.02bc	5.7±0.02a
Skin	4.7±0.01e	5.0±0.02d	6.0±0.02b	4.8±0.03e	5.5±0.02c	6.1±0.02a

Data are expressed as mean±SD; Means followed by the same letter, within a row, are not significantly different ($p>0.05$)

Table 4. Comparison of ash (%) between wild captured and farm raised *C. mrigala* of different weight categories

Fish source	Wild captured			Farm cultured		
Weight category	**W1**	**W2**	**W3**	**F1**	**F2**	**F3**
Body part						
Meat	1.8±0.03c	2.1±0.05b	2.2±0.03b	2.0±0.04b	2.2±0.06b	2.7±0.03a
Head	7.6±0.02e	8.1±0.03d	9.4±0.01b	7.8±0.01e	8.8±0.01c	9.8±0.02a
Scales	26.5±0.07c	27.2±0.14b	27.6±0.03a	26.5±0.05c	26.7±0.03c	27.8±0.02b
Fins	9.4±0.01c	9.9±0.04b	12.4±0.03a	9.3±0.01c	9.8±0.04b	12.2±0.08a
Skin	1.6±0.01c	1.8±0.03b	2.1±0.02a	1.6±0.02c	1.9±0.07b	2.0±0.01a

Data are expressed as mean±SD; Means followed by the same letter, within a row, are not significantly different ($p>0.05$)

Table 5. Comparison of carbohydrates (%) between wild captured and farm raised *C. mrigala* of different weight categories

Fish source	Wild captured			Farm cultured		
Weight category	**W1**	**W2**	**W3**	**F1**	**F2**	**F3**
Body part						
Meat	0.2±0.03d	0.8±0.02c	0.9±0.03c	1.4±0.02b	1.6±0.06a	1.7±0.03a
Head	1.3±0.02d	0.9±0.03e	0.5±0.01f	3.6±0.01a	3.0±0.01b	2.0±0.02c
Scales	0.7±0.03d	0.9±0.02d	1.0±0.03a	4.6±0.05a	2.8±0.03b	2.0±0.01c
Fins	0.1±0.01d	1.4±0.02b	1.7±0.02a	1.2±0.01b	0.4±0.04c	0.3±0.08c
Skin	0.8±0.01d	1.3±0.02c	0.8±0.02d	1.7±0.02b	1.9±0.07b	2.4±0.01a

Data are expressed as mean±SD. Means followed by the same letter, within a row, are not significantly different ($p>0.05$)

cereals and other animal meat due to balanced amino acid and fatty acid profiles along with essential minerals. Other than fish meat, fish skin, scales and fins are also rich source of protein and other nutrients which are usually discarded as dressing loss (Hussain *et al*. 2011). Farm raised fish are fed nutritionally balanced diet compared to wild fish which usually feed on natural food. This difference in feed sources causes the difference in body chemical composition of these fishes. In Pakistan, a few studies have been conducted on proximate body composition of fish (e.g. Mahboob *et al*. 2003; Naeem and Ishtiaq, 2011) although it is a good index of fish meat quality.

In the present study, significant differences ($p<0.05$) were observed for moisture contents in meat, head, scales, fins and skin between wild captured and farm cultured fish. Highest moisture contents were observed in wild and small sized *Cirrhinus mrigala* compared to other weight categories. Similar observations were also reported by Yeannes and Almandos (2003) in *Paralabrax clathratus*, Islam and Joadder (2005) in *Glossogobius giuris*, and Hussain *et al*. (2011) in *Catla catla*.

Improved ($p<0.05$) crude protein contents in the present study was observed in meat and other body organs of farm cultured *C. mrigala* as compared to wild fish. Higher protein deposition in farmed fish may be attributed to protein rich supplementary diet which is usually fed during rearing in ponds. While in natural water bodies fish usually feed on crustaceans, insects and vascular plants which are poor in protein. Improved protein contents in farm raised fish in comparison of wild fish were also observed in other fish species (Mahboob *et al*. 2003; Dempson *et al*. 2004; Osman *et al*. 2007). Furthermore, protein percentage ranges observed in the present study were found similar as reported by FAO (2007) in Indian Major Carps.

Similarly, all studied body parts showed increased fat contents in pond raised *C. mrigala* as compare to wild captured fish. Moreover, enhanced fat deposition was recorded in larger fish. Differences in fat deposition among wild captured and farmed raised fish may due to the difference in feeding habits. Wild fish require more efforts to obtain diet and it also has more area to feed which led to reduced fat contents in fish body as compare to pond raised fish. Yesilayer and Genc (2013) also observed higher lipid contents in farmed rainbow trout. Adeosun *et al*. (2014) also reported enhanced lipid deposition in pond raised *Clarias gariepinus* as compare to wild opponent. Similar findings were also reported in sea bass (Alasalvar *et al*. 2002) and in *Sparus aurata* (Grigorakis *et al*. 2002).

In this study, no statistical differences were observed among wild captured and farm cultured fish for ash contents. However, ash (%) showed variations among different weight categories showing maximum contents in larger fish. Similar findings were also reported by Hussain *et al*. (2011). They observed similar ash contents among wild and pond raised *Catla catla* and recorded higher ash contents in the head of large sized fish.

Fish, in contrast to human, uses lipids as energy source rather than carbohydrates. Carbohydrates are usually neglected in proximate composition analysis while they are important part of human nutrition. In this study, maximum carbohydrates were observed in farm cultured fish compared to wild opponent. Moreover, smaller sized fish showed more carbohydrates contents as compare to larger individuals. In a recent study, Babu *et al*. (2013) also observed higher carbohydrate (%) in the meat of farm cultured *C. mrigala*.

In conclusion, chemical composition of *C. mrigala* varied with size of fish. Farmed raised fish also showed higher meat quality as compare to wild captured fish. Information generated by present research will be helpful in the selection of appropriate sized fish for human consumption. Also, fish head, scales, fins and skin, which are usually not consumed by humans, can be utilized in the formulation of feeds for fish, poultry and livestock and in pharmaceutical products because of their higher protein and low fat contents.

***Acknowledgements*:** This research work was completed under the technical and kind guidance of Nazir Ahmad Kisana (Senior Lab Attendant), Department of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad and my beloved elder brother Shakeel Ahmed who helped me financially and spiritually.

REFERENCES

Aberoumad, A. and A. Pourshafi. 2010. Chemical and proximate composition properties of different fish species obtained from Iran. World J. Fish. Marine Sci. 2:237-239.

Adeosun, O., O. Olukunle and G.R. Akande. 2014. Proximate composition and quality aspects of iced wild and pond-raised African catfish (*Clarias gariepinus*). Int. J. Fish. Aquacult. 6:32-38.

Ahmed, I. 2011. Effect of dietary niacin on growth and body composition of two Indian major carps, rohu, *Labeo rohita* and mrigal, *Cirrhinus mrigala* fingerlings based on dose-response study. Aquacult. Int. 19:567-584.

Alasalvar, C., K.D.A. Taylora, E. Zubcovb, F. Shahidic and M. Alexisd. 2002. Differentiation of cultured and wild sea bass (Dicentrarchus labrax): total lipid content, fatty acid and trace mineral composition. Food Chem. 79:145-150.

Al-Asgah, N.A. 1992. Variation in carcass composition of *Oreochromis niloticus* in relation to body weight and length. Pak. J. Zool. 24(1):47-51.

Ali, A. and P. Kiumars. 2010. Chemical and Proximate Composition Properties of Fish Species Obtained from Iran. World J. Fish. Marine Sci. 2(3):237-239.

AOAC. 1995. Official methods of analysis, 7th Ed. AOAC, INC, Arlington, Virginia.

Babu, S.C., M. Shailender, D. Amarnath and B. Kishor. 2013. Comparison on meat composition of Indian major carps (*Catla catla*, *Labeo rohita*, *Cirrhinus mrigala)* and fresh water cat fish (*pangasius hypophthalmus)* under diferent treatments. Int. J. Res. Zool. 3(2):10-15.

Boberg, M. 1990. Clinical effects of fish oil. Narings one word forsking 34:133-134.

Dempson, J.B., C.J. Schwarz, M. Shears and G. Furey. 2004. Comparative proximate body composition of Atlantic salmon with emphasis on par from fluvial and lacustrine habitats. J. Fish Biol. 64:1257-1271.

Drazen, J.C. 2007. Depth related trends in proximate composition of demersal fishes in the eastern North Pacific. Deep Sea Res. 54:203-219.

FAO. 2007. Fishery statistics. Aquaculture production: In: Food and Agriculture Organization of the United Nations, Rome Italy, Year book 2005 100 (2):55-56.

Fawole, O.O., M.A. Ogundiran, T.A. Ayandiran and O.F. Olagunji. 2007. Proximate and mineral composition in some selected freshwater fishes in Nigeria. Int. J. Food Saf. 9:52-55.

Grigorakis, K., M.N. Alexis, K.D.A. Taylor and M. Hole. 2002. Comparison of wild and cultured gilthead sea bream (*Sparus aurata*); composition, appearance and seasonal variations. Int. J. Food Sci. Technol. 37:477-484.

Hussain, B., S. Mahboob, M. Hassan, F. Liaqat, T. Sultana and H. Tariq. 2011. Comparative analysis of proximate composition of head from wild and farmed *Catla catla*. J. Anim. Plant Sci. 21:207-210.

Islam, M.N. and M.A.R. Joadder. 2005. Seasonal variation of the proximate composition of freshwater Gobi, *Glossogobius giuris* (Hamilton) from the River Padma. Pak. J. Biol. Sci. 8:532-536.

Javaid, M.Y., A. Salam, M.N. Khan and M. Naeem. 1992. Weight length and condition factor relationship of a fresh water wild Mahaseer (*Tor putitora*) from Islamabad (Pakistan). Pak. Cong. Zool. 12:335-340.

Louka, N., F. Juhel, V. Fazilleau and P. Loonis. 2004. A novel colorimetry analysis used to compare different drying fish processes. Food Cont. 15:327-334.

Love, R.M. 1980. The chemical biology of fishes, 2nd Ed. Academic Press, London, UK.

Mahboob, S., S. Kanwal M. Hassan A. Hussain and S. Nadeem. 2003. Fatty acid composition in Meat, liver and gonad from wild and farmed *Cirrhina mrigala*. Aquacult. Eur. 16:15-20.

Naeem, M. and A. Salam. 2010. Proximate composition of fresh water bighead carp, *Aristichthys nobilis*, in relation to body size and condition factor from Islamabad, Pakistan. Afr. J. Biotech. 9:8687-8692.

Naeem, M. and A. Ishtiaq. 2011. Proximate composition of *Mystus bleekeri* in relation to body size and condition factor from Nala Daik, Sialkot, Pakistan. Afr. J. Biotechnol. 10:10765-10763.

Osman, F., I. Jaswir, H. Khaza'ai and R. Hashim. 2007. Fatty acid profiles of fin fish in Langkawi Island, Malaysia. J. Oleo. Sci. 56:101-113.

Saliu, J.K., O. Joy and O. Catherine. 2007. Condition factor, fat and protein content of five fish species in Lekki Lagoon, Nigeria. Life Sci. J., 4:54-57.

Yeannes, M.I. and M.E. Almandos. 2003. Estimation of fish proximate composition stating from water content. J. Food Composit. Anal. 16: 81-92.

Yesilayer, N. and N. Genc. 2013. Comparison of proximate and fatty acid compositions of wild brown trout and farmed rainbow trout. S. Afr. J. Anim. Sci. 43:89-97.