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Assessment of Meat Quality and Dressing Losses in Wild and Farmed *Cyprinus carpio*

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Abstract.- Meat quality of three different weight groups of farmed and wild *Cyprinus carpio* was analyzed in this study. Proximate composition of meat and dressing losses of wild and farmed *C. carpio* of three different weight categories was analyzed in this study. The farmed raised *C. carpio* of three different weight categories designated as F_1 (600-1000 g), F_2 (1100-1500 g) and F_3 (1600-2000 g), were procured from a commercial fish farm. Concurrently, wild *C. carpio* of three different weight categories designated as W_1 (600-1000 g), W_2 (1100-1500 g) and W_3 (1600-2000 g) were captured with the help of gill nets from the Balloki Headworks Ravi River, which is about 60 Km away from Faisalabad. The farmed *C. carpio* showed the contents of protein (18.92± 1.37%), lipids (6.23±0.80 %) and ash (2.27±0.12%). The maximum moisture contents were estimated as 75.68% in wild *C. carpio* of weight group W_1. The maximum dressing losses were recorded as 37.14% in wild *C. carpio* of weight group F_3 (1600-2000 g). Farmed raised *C. carpio* was found better as compared to wild due to its nutritional contents.

Key words: Proximate composition, dressing losses, fish meat, farmed fish, weight groups.

INTRODUCTION

In human alimentation, fish represent an important proportion due to its meat quality. The fish meat has excellent sensitive qualities and a high nutritive value due to its big content in proteins and lipids with superior biological value and a high digestibility degree**.** The high nutritional value of fish meat is reflected in favorable content of proteins, carbohydrates, minerals and vitamins (Ćirković *et al*., 2010). It represents the most important dietary source of n-3 highly unsaturated fatty acids (HUFA), eicosapentaenoic (EPA) and docosahexaenoic acid (DHA), that have particularly important roles in human nutrition, reflecting their roles in critical physiological processes (Calder and Grimble, 2002; Zhenga *et al.,* 2004; Mahboob *et al.,* 2004).

These acids (EPA and DHA) appear to play a key role in neutral development, functioning of the cardiovascular and immune systems (Lauritzen *et al.,* 2001), besides the prevention of some types of cancer, including colon, breast and prostate (Connor, 2000), brain aging and Alzheimer disease. It is necessary to take into account the nutritional quality of meat because fish is also one of the best sources of animal protein (Ozogul *et al.,* 2006). Composition of fish proteins is better than the composition of proteins of other animals, which is mainly due to more favorable amino acid composition and many free amino acids (Buchtová *et al.,* 2010). High biological value of fish proteins results from the presence of small content of connective tissue and lack of fascia and aponeurosis. Better digestibility of fish, meat comes from the content of short muscle fibers, lacks of sclerproteins, collagen and elastin (Ćirković *et al.,* 2011). Fish proteins contain the enormous amount of essential amino- acids for the human beings and they can be used as the sole source of protein in the diet (Toppe et al., 2007; Vladau *et al.,* 2008). The results referring to meat quality of carp are different in communications by various authors, with differences mostly caused due to the analysis of fish of different age, breeding systems and food. There

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are wide ranges of fat content in carp, from 2.3 to 16.8%, while varying slightly less in the case of protein and protein content was ranged from 14 to 18% (Vladau *et al.,* 2008; Trbović *et al.,* 2009, Ćirković *et al.,* 2010).

Fish farming and aquaculture industry play a significant role in contributing the fish protein to a large human population (Ravenhalt, 1982). Hoffman *et al*. (1993) percentage yield and fillet chemical composition of wild and farmed male and female African sharptooth catfish *Clarias gariepinus*. Farmed males yielded 26.7% fish fillets as compared to 44.7% for wild males, 44.2% for wild females and 38.9% for farmed females. Fish body composition appeared to be largely influenced by feed composition and increase in other parameters such as feed ratio and fish size resulted in enhanced adipose deposition and decreased in water contents in the fish's body (Rasmussen, 2001).

Meat production with aquaculture origins had a quite big fluctuation in Pakistan in the last two decades, which is the main reason for decline in the export of fish and fisheries products. *C. carpio* is commonly cultured in freshwater reservoirs in the country. This species was introduced in numerous countries of the world being considered an important source of food for humans. *C. carpio* is a widespread freshwater fish of eutrophic waters in lakes and large rivers in Europe and Asia. The wild populations are considered vulnerable to extinction, but the species has also been domesticated and introduced into environments worldwide, and is often considered a very destructive invasive species. *C. carpio* is commercially important fish species due to its faster growth rate and acceptance by the consumers. This reason was considered great opportunity to do some research regarding the meat quality of the fish species *C. carpio* (carp). The present study was planned to compare proximate composition of meat and dressing losses in wild and farmed *C. carpio*.

MATERIALS AND METHODS

Freshwater carp, *C. carpio* of three different weight groups, both farmed and wild were analyzed for the estimation of proximate composition of meat and dressing losses. The farmed raised *C. carpio* of three different weight groups designated as F_1 (600-1000 g), F_2 (1100-1500 g) and F_3 (1600-2000 g), were procured from a commercial fish farm, Faisalabad. Concurrently, wild *C. carpio* of three different weight categories designated as W_1 (600-1000 g), W_2 (1000-1500 g) and W_3 (1600-2000 g) were captured with the help of gill nets from the Balloki Headworks Ravi River, which is about 60 Km away from Faisalabad. The farmed *C. carpio* were fed on a commercial diet (30% crude protein), whilst the wild *C. carpio* diet evidently consisted mainly of crustaceans, insects, phytoplankton and some insect larvae.

Fish were transported live to the Fisheries Research Laboratory, Department of Zoology, Government College University, Faisalabad., Pakistan All the fish specimens were freshened out in running dechlorinated tap water for two days, thereby facilitating the emptying and removal of stomach contents. Fish were, then, slaughtered and dressed which consisted of removing the visceral organ, scales and fins followed by filleting.

Preparation of fish samples

Each fish specimen was washed in tap-dechlorinated water, and then fish were weighed and dissected by a longitudinal cut from the ventral side to remove viscera. Fish flesh from the dorso - lateral side were removed and analyzed for its moisture, protein, lipid and ash contents. Meat was minced and freeze-dried at –30°C. A freshly minced sample was immediately, oven dried (60°C) for 24 h to determine moisture contents (AOAC, 1990).

Moisture contents

Each of the fish samples were minced and immediately oven dried (65-70^{o}C) for 24 h on less than 100 mm of Hg to determine the moisture contents (loss in weight was calculated as a moisture percentage).

Crude protein

The automatic analyzer made by Tecator of Sweden, based on Kjeldahl's method using a digestion unit, a distillation unit and a titration unit, determined total nitrogen. Freeze dried sample weighing one gram was digested in concentrated H_2SO_4, K_2SO_4, $CuSO_4$ and Se and HgO in digestion

Table I.- Comparison of proximate composition of meat of wild and farmed *Cyprinus carpio*.

Type of fish	Weight category	Moisture (%)	Protein (%)	Lipid (%)	Carbohydrates (NFE) (%)	Ash (%)
Wild fish	600-1000 g	75.68±1.25*[a]	15.50±0.66[e]	3.98±0.58[d]	2.20±0.28[d]	2.64±0.11
	1100-1500 g	74.20±0.85[b]	16.50±0.40[d]	4.02±0.44[e]	1.80±0.12[b]	3.48±0.33
	1600-2000 g	72.60±1.40[c]	17.81±0.72[c]	4.35±0.50[f]	1.60±0.10[a]	3.64±0.40
Farmed fish	600-1000 g	74.60±1.16[c]	16.52±0.87[c]	4.21±0.66[c]	2.40±0.26[cd]	2.27±0.17
	1100-1500 g	71.75±1.22[d]	18.44±1.33[a]	5.76±0.70[b]	1.50±0.31[e]	2.55±0.06
	1600-2000 g	70.56±0.95[e]	18.92±1.37[b]	6.23±0.80[a]	2.02±0.40[c]	2.27±0.12

*Mean±SD: Means within column with different letters differ significantly (P>0.05).

tube (50-375°C) and digested the sample for 03-04 h and greenish color were obtained *i.e.* NH_3SO_4. The samples were distilled at Kjeldahl's apparatus and titrated with H_2SO_4 and released ammonia is captured in boric acid.

Extraction of lipids

Soxhlet extraction apparatus was used for extraction of fat contents.

Ash contents

A definite amount of fish meat samples was transported into the crucible (weighed). Covering the crucible with lid, placed in an electric furnace at the ~ 550 OC for 12 h until white ash was obtained. The results were converted to the percentage.

Dressing losses

Dressing losses were also worked out as dressing percentage of body weight.

Statistical analysis

The data obtained was subjected to statistical analysis by using a one-way classification (factorial experiment). Analysis of Variance and Duncan's Multiple Range tests was performed to analyze differences between the parameters under study (Steel *et al.*, 1996).

RESULTS

Proximate composition of meat

In the present study, the farmed *C. carpio* of the weight category F_3, showed the highest total protein contents (18.92%), closely followed by F_2 (Table I). While, minimum (15.50%) protein contents were found in wild *C. carpio* of weight group W_1. In the present experiment, lipid contents varied from 3.98±0.58 and 6.23±0.80% in wild and farmed *C. carpio*, respectively. The maximum lipid contents (6.23%) were recorded in farmed *C. carpio* of weight group F_3. The marked difference in the protein and lipid contents of wild fish seems to be due to scarcity of food, and weight and size of the fish. This state of scarcity resulted in the decreased growth of fish due to the long period of restricted food supply to fish. The higher protein contents of farmed fish of the weight group F_3 were probably due to the better food consumption and its conversion into protein in the fish flesh, while, in wild fish the highest protein contents were also recorded in the fish of weight category W3 (17.81%). The relationships among the various constituents of proximate composition of wild and farmed *C. carpio* worked out and presented in Table III. Correlation coefficient values among moisture and protein remained negative, so they were inversely correlated. Nevertheless, their relationship was highly significant. Similar findings were observed in case of correlation among lipid, ash and moisture. Whereas, correlation coefficient values of carbohydrate (NFE) with moisture remained positive and non-significant. There were also an inverse correlation between carbohydrate and other proximate composition viz., protein, lipid and ash.

Dressing losses

The average total losses (Table II) during the dressing of fish were corresponded directly to their live body weight. Dressing percentage was always highest (37.14%) for wild *C. carpio* of weight group W_3 closely followed by farmed *C. carpio* of weight group F3. This was due to higher weights of external losses in wild fish as compared to other

Table II.- Average losses in finished fish meat, percentage of visceral and external weights with live body weight in wild and farmed *Cyprinus carpio* of three weight categories.

Type of fish	Weight category	Average live weight (g)	Average dressed weight (g)	Average visceral % of average live body weight	Average external loss % of average live body weight	Average fresh fish total loss (g)	% Loss
Wild fish	600-1000 g	731.28±6.45	541.32±5.40	11.85±0.62	17.75±1.12	189.96±2.60	29.60±1.90
	1100-1500 g	1192.55±10.60	808.35±8.70	13.32±1.44	18.84±1.68	384.20±1.66	31.16±1.56
	1600-2000 g	1750.40±12.60	1311.22±9.60	15.76±1.80	19.92±1.80	439.18±3.60	35.68±2.20
Farmed fish	600-1000 g	749.32±11.71	556.79±6.51	12.92±1.05	17.98±0.85	192.53±2.30	30.90±1.71
	1100-1500 g	1181.64±10.25	822.12±7.90	14.05±0.65	19.60±1.40	359.52±2.70	33.65±2.40
	1600-2000 g	1762.80±12.34	1326.20±8.65	16.94±1.70	01.20±1.76	436.60±2.94	37.14±2.60

Table IV.- Relationship of dressed fish weight and various dressing losses with total fish weight of wild and farmed *Cyprinus carpio*.

	Wild fish				Farmed fish			
	Dressed fish weight	Visceral organs loss	External loss	Total fish loss	Dressed fish weight	Visceral organs loss	External loss	Total fish loss
Total weight	0.990	0.957	0.970	0.990	0.995	0.962	0.987	0.994
Dressed fish	-	0.979	0.984	0.992	-	0.970	0.980	0.990
Visceral organs loss	-	-	0.987	0.991	-	-	0.945	0.977
External loss	-	-	-	0.980	-	-	-	0.965

Table III.- Relationship among various constituents of proximate composition of meat in wild and farmed *Cyprinus carpio*.

	Protein	Fat	Ash	Carbohydrate
Moisture	-0.86^{**}	-0.84^{**}	-0.92^{**}	0.41^{NS}
Protein	-	0.80^{**}	0.87^{*}	-0.62^{NS}
Fat	-	-	0.83^{*}	-0.69^{NS}
Ash	-	-	-	-0.46^{NS}

*Significant (P<0.05); NS = Non-significant (P>0.05). **Highly significant (P<0.01)

weight categories of wild and farmed fish. Viscera percentage was always maximum in the farmed fish of weight group F3 (16.94%) followed by W3 (15.76%) which increased with body weight in the wild and farmed fish (Table II). The Viscera percentage seemed to be a major variable that explained the dressing percentage. The relationships of various dressing losses, and dressed fish weight with total fish weight of wild and farmed *C. carpio* were worked out and presented in Table IV. There existed highly significant and positive correlations between various dressing losses, dressed fish weight and total fish weight of wild and farmed *C. carpio*. The results of the present study regarding the estimation of chemical components and dressing losses of wild and farmed *C. carpio* revealed that farmed fish has more nutritional and commercial value than wild *C. carpio*.

DISCUSSION

Lipids are generally regarded as the most important constituents, which determines the quality of fish meat (Caulton and Brusell, 1977; Love, 1988). Fish showed progressive reduction in fat reserves, yet before reaching a critical low level proteins began to be utilized for energy purpose, and ultimately a reduction in their protein contents with increased water contents was resulted (Mahboob, 1992; Hassan, 1996; Mahboob *et al.*, 2004). According to Love (1980), the fish at first consumes

lipids from the liver and starts to mobilize muscle protein only when fat derived energy has been nearly used up. After that, as protein is utilized, water moves into taking its place. Such a shift resulted in the increased water contents that were inversely correlated with protein and fat reserves of their meats (Shimma and Sato, 1985; Mahboob *et al.*, 1996; Toppe *et al*., 2007).

Srikanth *et al*. (1989) reported that in *C. carpio*, the moisture content was lowest and protein deposition highest with the application of fertilization treatment with high protein and low protein contents. Shimma (1986) mentioned that differences of protein and moisture were not significant in the two races of *C. carpio* and Mirror carp, fed at a similar level of commercial feed. Jayaram *et al.* (1980) observed that the fish *Catla catla, Labeo rohita* and *C. carpio* reared with different manuring and feeding regimens were not significantly different in their chemical composition. Hoffman *et al*. (1993) mentioned that the fillet chemical composition of farmed *Clarias gariepinus* is better than that of wild fish. The present results are in line with the findings of the above-mentioned workers. In farmed fish, there was an increase in protein content with an increase in body weight. It was interesting to note in the present study that the fat contents were also remained highest in the farmed fish as compared to wild *C. carpio*, which was probably due to less effort by the farmed fish to get the food and high intake of food. The chemical composition of fish meat is very different depending on species inherent potential, the breeding conditions, and the biological and physiological aspects. For the fishes obtained in aquaculture, these chemical composition differences are lower because in these systems the breeding factors are controlled. Domaizon *et al*. (2000), who examined one-year and three-year old silver carp and measured the lipid content in fillets in the range of 4.51 to 6.7%. According to the obtained results, fat content in catfish was 3.43, slightly higher compared to a value of 2, 33 obtained by Jankowska *et al*. (2004) for catfish farmed in ponds with natural food. The obtained values for proteins in zander are higher compared to studies of Celik *et al*. (2005) by which the percentage of protein was in the range of 18.1 in the cold, to 18.8 in the warm lake. Fat content in our examination was, also, higher than the values obtained by the mentioned authors for zander. These results are substantiated by the findings of the Al-Asgha (1992) and Mahboob (1992). Love (1980) mentioned that moisture contents showed an inverse relationship with lipids in the meat of fatty fish and with the protein in non-fatty fish. The results of the present study were in conformity with the findings of the above-mentioned worker.

The relationship in dressing losses and body weight of the fish could be due to the genetic function of the fish as described by Mahboob and Sheri (2002). Bondari (1980) and Smitherman *et al*. (1983) were of the view that this is a physiological activity rather than a genetic function of the fish.

CONCLUSION

We concluded dressing losses were more in wild *C. carpio* compared to farmed raised fish. Farmed raised *C. carpio* was found better as compared to wild due in its nutritional contents. The relationship in dressing losses and body weight of the fish was due to the genetic potential of the fish rather than a physiological function.

Conflict of interest declaration

The authors declare that they do not have any kind of conflict of interests and/or any financial benefit from any trademark mentioned in the paper.

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