# Comparison of protein, fat, ash and dry matter content of common carp, *Cyprinus carpio* L. and silver carp, *Hypophthalmichthys molitrix* fillet

**Shirmohammadli H.[1]; Mohammad Nejad M.[2*]**

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**Abstract**

In this study, protein, fat, ash and dry matter content of common carp and silver carp fillets at different weights were compared. For this purpose, two years old common carp and silver carp were studied at the weights of 500, 700, 1000, 1300 and 1600 g, during the culture period (eight months). After selecting the desired fish, length and weight were measured and then 100 grams of fillet was isolated from the fish and the biochemical composition was evaluated. The results of the present study showed that the average protein, fat, ash and dry matter content were in the common carp fillet, respectively: 10.209±2.106%, 9.429±0.937%, 1.407±0.198%, 21.03±1.62%, and in the silver carp, respectively: 14.187±1.86%, 7.55±1.56%, 1.498±0.2% and 23.149±1.05%. In addition, the results of this study indicate that there is no significant difference between the quality factors of common carp and silver carp in different fish classes ($p>0.05$). The results showed that fish weight had no effect on fillet quality. The protein, ash, and dry matter contents of common carp fillet are lower than that of silver carp. Meanwhile the fat content in the fillet of common carp was higher than silver carp the results of the present study showed that the fillet composition of these cyprinid species was dependent of their feeding regimes.

**Keywords:** Biochemical composition, Cyprinids, Fillet quality, Nutritional benefits, Fish weight class



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1- Fishery Products Processing Group, Gorgan Branch, Islamic Azad University, Gorgan, Iran
2- Department of Fishery, Bandar Gaz Branch, Islamic Azad University, Bandar Gaz, Iran
*Corresponding author's Email: majid_m_sh@bandargaziau.ac.ir

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## Introduction

Fishes are highly favor by many over other animals in terms of low level of fillet's collagen, low level of cholesterol and favorable (Eyo, 2001; Elaigwu, 2019). On the basis of availability and palatability, fish is mostly eaten by a considerable number of people as a source of protein (Foran *et al*., 2005; Elaigwu, 2019). According to the Food and Agriculture Organization of the United Nations (FAO) report, more than 3.3 billion people depend on fish consumption that makes 20% of their animal protein intake (Chan *et al*., 2019; FAO, 2020). Currently, almost 50% of world's food fish is supplied by aquaculture and also has the potential to substantially contribute to the food demand of the growing human population of the world (Intaraka *et al*., 2015). Fish as an important part of the diet provides a cost-effective source of protein for human nutrition (FAO, 2016; Hamandishe *et al*., 2018). Carcass and flesh quality are important among consumers of the aquaculture industry as it is directly related to human health and nutrition (Bihari Sahu *et al*., 2017). This analysis is performed on fishes to ensure they meet specific and nutrient requirements (Anon, 2000; Watermann, 2000; Elaigwu, 2019). On the other hand, knowing the content of chemical constituents of fillet's helps to select the right species for human nutrition and the food industry (Velayatzadeh and Askary Sary, 2012; Askari Sari *et al*., 2016). Given the increasing demand for fish and fish products, it is necessary to determine the quality of fish fillets, as quality and nutritional value are considered as a major factor in fish sales and acceptance by consumers. Body composition is also influenced by a great number of factors such as fish size, food, season, health and life cycle" after "factor (Naeem and Ishtiaq, 2011; Naeem *et al*., 2016).

Common carp (*Cyprinus carpio*) and silver carp (*Hypophthalimichthys molitrix*) are among the main species of bony fishes in Iran as well as around the world that feed a wide range of people. Common carp an omnivorous fish are native to Asia (Sun *et al*., 2017). Annual global production of silver carp reaches about 4.8 million metric tons (Zhou *et al*., 2019; FAO, 2020). Given the nutritional and economic value of these two species, it is important to know the nutritional, biological and nutritional properties of these species. There have been many studies on changes in body compositions, fillet and carcass quality of common carp and silver carp (Baesi *et al*., 2017; Sun *et al*., 2017; Sanchooli *et al*., 2017; Saffari *et al*., 2017; Javid Rahmdel *et al*., 2018; Khorasaninejad *et al*., 2019; Sheikh Veisi *et al*., 2019; Zhang *et al*., 2019; Wang *et al*., 2020). In this study, the fillet compositions of these two species were studied by considering their weight range. But the key question is whether there is a correlation between fish weight and fish proximate composition? Thus, the present study investigated the proximate composition of fillet in common carp and silver carp in different weights. When comparing these factors in these two species, the optimum size of fish fillets for human consumption was also determined.

## Materials and methods

*Fish species examined*

The present study was conducted in 2018 on one of the carp farms in Sari city, Mazandaran province, northern Iran. In order to evaluate the proximate composition of common carp and silver carp fillets, first and after release in early spring, fish were allowed to be examined in five weight groups. The fish were at their second year of culture. Therefore, the design of the experiment was done by sampling fish with market weight and consumable by the consumer. The fish consumed in the market are usually above 500 g, and usually common carp and silver carp reach up to 1 kg at the end of the second year (up to 2 kg depending on breeding conditions and catch time). Therefore, in this study fish in groups of 500, 700, 1000, 1300 and 1600 grams were studied. The fish were fed with artificial diet (Faradaneh Co. protein 31-35%, fat 3-8%; ash 7-11%) at 2% of their initial biomass. They were fed with concentrated diet. Five fish were sampled for each weight class by special fishing nets. The fish were checked for external signs of disease to ensure they are at a healthy state. After selecting the healthy fishes, their weights were first measured with digital scales. In order to evaluate the quality of the meat (fillet), 100 grams of fillet were separated from each fish and placed in special ice pack.

*Biochemical composition*

The samples were sent to the Food Analysis Laboratory (Islamic Azad University, Azadshahr branch) for determination of protein, fat, ash and dry matter content. Meat quality analysis was carried out at the Food Lab by AOAC, 2005. After drying, the percentage of moisture and dry matter were calculated. Fillet dry matter was prepared and then the ashes were determined using an electric furnace (Shimaz Co., Tehran Iran) at 550 ° C for 6 h. Crude protein was measured by semi-automatic Kjeltec apparatus (Gerhardt, Berlin, Germany), by determining total nitrogen and multiplying it by a coefficient of 6.25 (N x 6.25) and total fat by Soxtec system (Gerhardt, Berlin, Germany) and using petroleum ether as solvent.

*Statistical analysis*

SPSS 22 software was used for analyzing all data. Since the present study was conducted in a completely randomized design (CRD), the normality of the data was first tested by the Shapiro-Wilk test and simultaneously to investigate the effect of each of the factors (different weight classes and fish species) as well as their interactions on the factors. Paired sample T-test was used to examine and analyze laboratory data.

## Results

The average quality of common carp and silver carp fillets as well as the effects of weight groups and fish species on



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changes in protein, fat, ash and dry matter content are presented in tables 1 to 4. The highest fillet protein content of common carp was observed in 1300 g fish and the lowest content in 1000 g fish but in the overall study, no difference was observed in the fillet protein content in different weights ($p>0.05$). Changes in fillet protein content of silver carp in different groups showed no significant changes and no significant difference was observed between different weights ($p>0.05$). Statistical analysis showed that there was no significant difference in the fillet protein levels between common carp and silver carp in 500, 700, 1300 and 1600 gram weight groups ($p>0.05$). But in the 1000 gram weight group there was a statistically significant difference in the fillet protein levels between the species ($p<0.05$). Also, according to the results of Table 1, the average fillet protein content of silver carp is higher than common carp.

**Table 1: Changes in fillet protein content (%) in common carp and silver carp at different weights.**

| Fish weight (g) | Common carp | Silver carp |
|---|---|---|
| 500 | 10.176 ± 3.878 [a] | 15.220 ± 2.131 [a] |
| 700 | 10.105 ± 1.641 [a] | 12.941 ± 1.861 [a] |
| 1000 | 9.22 ± 0.284 [a] | 13.754 ± 2.046 [b] |
| 1300 | 10.837 ± 2.998 [a] | 14.752 ± 2.194 [a] |
| 1600 | 10.129 ± 1.468 [a] | 14.526 ± 0.676 [a] |
| Average | 10.209 ± 2.106 | 14.187 ± 1.860 |

Non-common Latin letters in each row indicate differences between groups ($p<0.05$).

Also with the results presented in Table 2, the highest fillet fat content was observed in the common carp in the 700 gram group and the lowest in the 1600 gram group. Although the results showed a decreasing trend in the content of fillet fat with increasing weight, there was no significant difference in the final results at different weights ($p>0.05$). Changes in fillet fat content in silver carp showed the lowest fillet fat content in the low weight group (500 g) and the highest fat content in the high weight group (1600 g), but the final results of the study show no regular pattern of decreasing or increasing in the process of fillet fat changes. The results also showed that there was no statistically significant difference between different weight groups in fillet fat content ($p>0.05$). There was no statistically significant difference between common carp and silver carp in all weight groups for fillet fat content ($p> 0.05$). The results also showed that the fillet fat content of common carp was higher than silver carp.



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**Table 2: Changes in fillet fat content (%) in common carp and silver carp at different weights**

| Fish weight (g) | Common carp | Silver carp |
|---|---|---|
| 500 | 9.624 ± 1.971 [a] | 5.814 ± 1.689 [a] |
| 700 | 9.957 ± 0.432 [a] | 8.045 ± 1.590 [a] |
| 1000 | 9.287 ± 0.143 [a] | 8.120 ± 0.616 [a] |
| 1300 | 9.399 ± 1.104 [a] | 7.459 ± 2.265 [a] |
| 1600 | 8.645 ± 0.645 [a] | 8.412 ± 0.158 [a] |
| Average | 9.429 ± 0.937 | 7.550 ± 1.576 |

Non-common Latin letters in each row indicate differences between groups ($p$<0.05).

Examination of the changes of common carp fillet ash content also showed its high content at lower weights, but as shown in Table 3 this factor did not change significantly with weight changes ($p$>0.05). The fillet ash content of silver carp, despite the lowest ash content in the 500 gram group and the highest level in the 1600 gram fish, showed no regular decreasing or increasing pattern in the different weight groups. Results also showed that there was no statistically significant difference between different weight groups of silver carp fillet ash content ($p$>0.05). The results of the study on fillet ash content in two species also showed that there was no significant difference ($p$>0.05) between the two species in different weights. Overall, fillet ash content of common carp was lower than silver carp (Table 3).

**Table 3: Changes in fillet ash content (%) in common carp and silver carp at different weights.**

| Fish weight (g) | Common carp | Silver carp |
|---|---|---|
| 500 | 1.547 ± 0.293 [a] | 1.437 ± 0.015 [a] |
| 700 | 1.565 ± 0.034 [a] | 1.552 ± 0.302 [a] |
| 1000 | 1.362 ± 0.071 [a] | 1.426 ± 0.066 [a] |
| 1300 | 1.296 ± 0.245 [a] | 1.417 ± 0.096 [a] |
| 1600 | 1.294 ± 0.064 [a] | 1.776 ± 0.414 [a] |
| Average | 1.407 ± 0.198 | 1.498 ± 0.207 |

Non-common Latin letters in each row indicate differences between groups ($p$<0.05).

According to Table 4, fillet dry matter content of common carp showed no significant changes in different weight groups ($p$> 0.05). The results of dry matter analysis showed that dry matter increased with increasing weight of silver carp and as seen in Table 4 the highest value was observed in 1600 gram weight group but these changes were not significant and with according to the statistical test, it was found that in silver carp, there was no significant difference between different weights in fillet dry matter content ($p$>0.05). Fillet dry matter did not show any significant difference ($p$>0.05) between common carp and silver carp in weight groups of 500 to 1300 gram. But in the 1600 gram weight group, there was a statistically significant difference ($p$<0.05) in fillet dry matter content (Table 4) and it was lower in common carp than silver carp. Also, according to the final results, the dry matter content of fillets in common carp is less than silver carp.



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**Table 4: Changes in fillet dry matter (%) in common carp and silver carp at different weights.**

| Fish weight (g) | Common carp | Silver carp |
|---|---|---|
| 500 | 21.347 ± 2.200 [a] | 22.804 ± 0.343 [a] |
| 700 | 21.596 ± 1.246 [a] | 22.538 ± 0.619 [a] |
| 1000 | 19.821 ± 0.433 [a] | 22.725 ± 1.479 [b] |
| 1300 | 21.533 ± 1.152 [a] | 23.628 ± 0.285 [a] |
| 1600 | 20.068 ± 0.760 [a] | 24.714 ± 0.419 [b] |
| Average | 21.03 ± 1.620 | 23.149 ± 1.058 |

Non-common Latin letters in each row indicate differences between groups ($p$<0.05).

## Discussion

Studying the physical structure of fish is important for understanding the nutritional profile and changes in fish quality (Bihari Sahu *et al*., 2014). The results showed that weight gain and size in common carp and silver carp did not change the fillet quality of these species. An increase in the content of crude protein indicated good fish growth (Mohammad Nejad Shamoushaki, 2012). The protein content, which is the most important compound in healthy fish, tends to be slightly altered (Weatherly and Gill, 1987). Fish tissue protein is a favored combination of amino acids as well as a rich source of vitamin B and rich in vitamins A and D (Zmijewski *et al*., 2006). According to the results of this study, common carp and silver carp have low protein content fish. So, their protein contents are lower than in fish such as: *Oreochromis niloticus* (19.68%), and *Oncorhynchus mykiss* (22.1%) (Naghibi and Askary Sary, 2019).

Fat is a component of the chemical composition of fish fillet that shows the most differences in body composition. Even in one particular species, this difference can be observed in different seasons of the year, at least usually during the spawning season (Askari Sari *et al*., 2016). Fish fat due to the presence of unsaturated omega-3 fatty acids (EPA, DHA), has a major role in the health and prevention of many diseases including heart attack (Nankervis *et al*., 2000). In terms of fat fillets, fish are divided into high fat and low fat fish or white fillets. High-fat fish have high levels of fat in fillets such as mackerel (23.5%), sardines (18%), and herring (22%). Low-fat or white-tailed fish have very low levels of fat in the fillet, such as cod (0.99%) and haddock (0.6% - 0.6%) (Makanjuola, 2012). Based on the results of this study, common carp and silver carp are among the medium fat fish. However, their fillet fat content was higher than fish such as *Oreochromis niloticus* (6.24%) and *Oncorhynchus mykiss* (6%) (Naghibi and Askary Sary, 2019).

The total content of nutrients, regardless of moisture content, is called dry matter, which includes the content of protein, fat, crude fiber and minerals in the nutrient. Ashes often contain substances such as sodium, potassium, magnesium, manganese, calcium, iron, sulfur, phosphorus and chlorine. Ash reflects the content of minerals in organic tissue (Askari Sari *et al*., 2016). Based on the comparison, it can be stated that common carp and silver carp are good and suitable minerals.

Fish meat quality is affected by exogenous and endogenous factors (Hamandishe *et al*., 2018). Exogenous factors include diet composition, feeding frequency, and the fish environmental parameters such as salinity, pH, and temperature (Klanian and Alonso, 2015). Endogenous factors are genetic and linked to the life stage, age, size, sex, and anatomical position in the fish (El-Zaeem, 2012; Hamandishe *et al*., 2018). According to the results of the researchers, it has been found that the quality of fish fillets in different species and even in one species varies depending on environmental, nutritional, season, age, size, etc. (Mohammad Nejad Shamoushaki, 2012; Velayatzadeh and Askary Sary, 2012; Sharifian, 2014; Askari Sari *et al*., 2016). The results of studies of different factors on the meat quality of common carp have been varied in different studies. For example, Baesi *et al*. (2017) announced by optimizing the chemical composition of fish fillets of *Cyprinus carpio* using various levels of commercial probiotic Lactobacillus (*Lactobacillus acidophilus*) in the diet, crude protein content ranged between 47 to 48%, crude fat ranged from 22.81 to 32.20% and ash content ranged from 2.24 to 5.73%. It was inconsistent with the results of the present study. Sun *et al*. (2017) studied the effect of dietary lipid levels on body compositions of common carp and reported that crude fillet protein content ranged from 18.76 to 20.40%, crude fat ranged from 2.19 to 2.84% and crude ash ranged from 1.15 to 1.34%. Their results with the present study were not similar. Saffari *et al*. (2017) examined the effects of different dietary selenium sources (sodium selenite, selenomethionine and nanoselenium) on fillet composition of common carp and reported that fillet protein levels was 7.57 to 7.75%, fillet fat 1.32 to 1.51% and fillet ash 0.29 to 0.34%. Their results were inconsistent with the results of the present study.

Proximate composition of fishes is different with species and body size (Naeem and Ishtiaq, 2011; Naeem *et al*., 2016). Naeem and Ishtiaq (2011) studied proximate composition of *Mystus bleekeri* in relation to body size and reported: body size reflected on body constituents and caused increase in fat (dry weight), protein, organic contents (wet and dry weight), and no effect on fat (wet weight) with growth of fish. Naeem *et al*. (2016) studied proximate composition of rainbow trout (*Oncorhynchus mykiss*) in relation to body size. Their results showed that there was a strong correlation ($p$<0.001) in each of these body constituents (water, fat, protein and ash) with body size of the fish. Thus, with increasing body size, fat and protein contents increased in greater proportion, while ash decreased (Naeem *et al*., 2016). Similar results have been reported by other researchers regarding changes in body composition and body size in fish such as *Labeo rohita* (Ali *et al*., 2015) and *Aristichthys nobilis* (Naeem and


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Salam, 2010). Unlike many of the other studies mentioned above, the results of this study were different. There were no association between the weight of common carp and silver carp and meat quality.

Comparative evaluation of carcass quality, nutritional value and consumer preference of Nile tilapia (*Oreochromis niloticus*) from two groups with different levels of contamination in Zimbabwe showed that some consumer perceptions of fish quality could be the result of consumer beliefs and physical characteristics of the crop (Hamandishe *et al*., 2018), this is clearly seen among fish consumers in Iran, especially in the northern provinces, and people have a tendency to consume larger fish based on old beliefs, and secondly, they consider sea fish better than farmed fish. This has also had a major impact on the economic market for farmed fish in Iran. As mentioned, this is not necessarily the same everywhere in the world and varies depending on the situation. In addition, increasing pollution of Caspian Sea water in recent years can also be considered as a major limiting factor in marine fish consumption. Fish quality also includes safety aspects such as harmless bacteria, parasites, bio-toxins, chemicals, pesticides, heavy metals and other substances. Wild fish may be of poorer quality than farmed fish for various reasons, such as corruption, indirect taste, water pollution, etc. (Hamandishe *et al*., 2018). Therefore, since common carp in northern Iran is less popular than sea carp. Comparing the quality of their fillets can be of great help in future studies in northern Iran in selecting the species of carp used for fish consumers.

## Conclusions

The results of this study showed that weight gain and size in common carp and silver carp did not change the fillet quality of these two fish. Therefore, weight gain has no effect on protein, fat, ash and dry matter content of common carp and silver carp. The use of common carp and silver carp are the same in all market sizes (500–2000 g) in terms of fillet quality.

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