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Comparative Study on Growth Performance and Proximate Composition of Meat and Internal Organs of Farmed and Wild *Cirrhinus mrigala*

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ABSTRACT

Fish play an enormous role in the diet of humans and are a great source of essential nutrients. Simple techniques determined growth performance. The tape foot was used to determine the length, and the weighing balance was used to calculate the weight. Proximate composition is the measurement of the percentage of proteins, fats, carbohydrates, ash percentage and moisture content. The present-day study was helpful in analyzing the accurate difference in body composition as well as the difference in growth rate of wild and farmed *Cirrhinus mrigala*. Twenty-one farmed and wild *Cirrhinus mrigala* in three (3) weight groups, such as W1 (250-500g), W2 (501-1000g) and W3 (1001-1500g) were taken from Satyana Road Fish Farm, Faisalabad and Trimu headworks Jhang Sadar, respectively. Each of the fish was fed on three types of treatments T1 (25% CP or 250g protein in 1kg) T2 (30% CP 300g in 1kg) and T3(35% CP 350g in 1kg) according to weight categories. At the end of the experimental trial, each fish was weighed individually (W1) and weighed after dressing loss (W2). Micro Kjeldahl method was used to determine the protein percentage and Crude fat was determined by using ether extract extraction method in the Soxhlet system. Total ash percentage was calculated by burning the sample in the muffle furnace. To determine the moisture contents, one gram of the samples of fish organs was placed in weighed Petri dishes and was dried in the oven at 105Celsius for twelve hours. The samples were taken to vacuum desiccators for five minutes and weight was recorded continuing this drying practice. For one to two hours the samples were again kept in oven until they achieve their invariable weight. Data was subjected to statistical analysis. Analysis of variance was performed to compare means.

INTRODUCTION

Fish has a keynote roll in our food as a prime source of essential amino acids (Anthoney et al., 2016). It is a wonderful animal protein and originator of essential supplements which are globally gobbled up by all of human populations of world (Abolude and Abdullahi, 2005). The flesh of fish is reported as a potent substitute for red meat (Mateen et al., 2016). In the diet of humans, the fish protein has an imperative role and it has been an enormous resource for foodstuff for humans (Nargis, 2006). According to calculations of 2015 it has given almost 17% of animal proteins and almost 7% of all protein intakes to global human race (FAO, 2018). Being a protein rich source, it can enhance dietary balance of starch or fat based diet (Salim, 2006; Yildrim, 2008). All around the world, about 3.2billion people have consumed the fish as a source of about 20% of animal protein in per capita from 2013-2015 (FAO, 2018). It is honored as a gift of nature for developing countries of the world due to its taste, digestibility, rapid absorption and assimilation of its amino acids as compared to other animal protein sources (Mateen et al.,2016; Jadhav, 2017). Not only due to proteins it is also familiar as a source of vitamins and fats which are important for the growth of human body as many scientists have proven and it is low in total fats, cholesterol and saturated fatty acids although it has a wonderful quality of fat contents like Ω-3 and Ω -6 fatty acids (Kandemir and Polat, 2007; Nova et al., 2005). Polyunsaturated fatty acids (PUFA) specifically the fatty acids having carbon number 18, 20 and 22, namely, Docasahexanoic acid (DHA C-22:6 n3), Eicosapentaenoic

acid (EPA- C20:5 n3) and Linoleic acid (C18:2 n6) and other fatty acids necessary for growth and higher amount of methionine and lysine amino acids is present in fish protein whereas lower amount of tryptophan is present in it as compared to protein of mammals (Baum et al., 2012). Fish fillets are reported to have a key role in health concerns. Its lipids like n-3 and n-6 series PUFA are helpful to overcome the chances of ailments of circulatory system especially DHA and EPA of n-3. Minerals including phosphorus, iron, calcium, iodine, zinc and selenium etc which are required to human body are also presented by fish flesh along with vitamins A, B and D that elevates normal growth and lessen the risk of non contagious diseases which occur due to combined effect of large amount of energized and imbalance food intake (Allison et al., 2013). Amino acids, moisture contents and lipids are foremost nutritional components as well as minor components including minerals, vitamins and carbohydrates of which fish muscle comprises. In this way, it can be negotiated that all of the nutrients indispensable for human body to grow finely and develop properly are present in fish muscle. The enviable amount of all of the 10 amino acids for utilization of human is present in fish muscle (Begum et al., 2012). Fetus of mothers who have fish meals are investigated to have better growth of early stages including nervous system (Chan, 2015; Lim et al., 2015). Fish is enriched in all of the vital nutrients that are obligatory as a supplement diet for newborn babies as well as for mature persons (Abdullahi et al., 2001). Its anti-pathogenic peptide cuts pathogen entry and elevates immunity (Ravichandran et al., 2010).

About 60% of the total populations of developing and developed countries obtain 30% and 20% animal proteins from fish respectively (Mateen et al., 2016). About 161million tons of fish produced in 2016 about 88% of which was directly used by people and 12% used for indirect utilization (FAO, 2018). The economy of developing countries of world is greatly dependent on industries related to processing of fish (Chalamaiah et al., 2012). About 32% of fish is used to make fish meal and oily products and sixteen percent fish is canned or cured while about quantity of fish which is freshly taken in or freeze or chilled is about 35% of all of the fish. Marine harvest and fish can be utilized as drugs, processed into makeup products, lubricants, varnishes, soap, margarine, perfumes and ground into vitamins.

For experimental and medicinal purposes, fish is used by research scholars and medical specialists mostly goldfish. Feed for livestock, glue and a lot of products including manures and other important things are made from fish wastes (Tidwell et al., 2001). Various countries of world have varied per capita per annum consumption of fish from below than 1kg to greater than 100 kg, coastal marine and freshwater countries have higher consumption rate (FAO, 2018). In developing countries fish consumption per capita per annum has been grown from 1961 to 2015 about 6.0kg to 19.3kg in under developed countries this value for same time is from m 3.4 to 7.7kg although in developed countries it is highest still today, according to survey in 2015, about 24.9kg fish consumed per capita for every year (FAO, 2018).

Total 82million tonnes having sale cost of 250 billion US dollars from the entire costs of firstly sale about 401billions US Dollars were provided by aqua cultural advancements in 2018. Almost 179 million tonnes of fish was produced throughout the globe of which about 20.5kilogram/capita/year was developed for utilization by human beings correspondent to about 156million tonnes of entire fish fabrication. Excluding European and American states the total production of fish is amplified importantly in previous ten years in all of countryside of world. Having thirty five percent shares in worldwide fabrication of fish, China has stayed behind a foremost fish manufacturing countryside and without China a critical share (about thirty four %) in fish fabrication was endowed with by Asia (FAO, 2020).

Pakistan has 8,563,820 square kilometer in the form of rivers lake ponds and water lodges making it a large source of freshwater aquaculture (Jarwar, 2008). Not only from marine waters; fish is harvested from rivers, lakes, and ponds based aquaculture (inland fisheries) which have got surveillance of researchers and food scientists in Pakistan also have drawn the concentration of commercial fish farmers with ever increasing popularity throughout country (Qasim et al., 2004). Besides its high aquaculture sources, about 1% gross domestic product (GDP) of Pakistan is contributed by aquaculture activities (Nazir et al., 2016). In developed countries, annual consumption of fish in per capita is about 20kg whereas in Pakistan, this figure remains 1.9kg per capita per annum which is comparatively very low than developed countries (FAO, 2017). Fish price has increased rapidly due to high consumer demand and considerably low output. To meet the demands our establishment is importing fish from foreign countries including Viet Nam, China, Singapore, Burma, Myanmar and Thailand (PBS, 2017). As a nation we are facing shortage of nutrition, therefore aquaculture techniques should be revised to overcome these challenges (Laghari, 2018). Due to a considerably increasing demand for fish all over the globe, aquaculture has been a hasty rising diligence (Cao et al., 2007). About 46% of total food is accounted by aquaculture (Nyanti et al., 2012).

Metabolism and growth rate is badly affected by temperature which is an important ecological factor. Decline in fish profusion and even disappearance of some of species is caused by increase in temperature due to effects of temperature on physiology of fish. Global warming which is caused by high environmental temperature is like a sound of alarm for fishery sector (Doula et al., 2019). Dissolved oxygen level reduced due to increase in ecological temperature as a result of which the metabolic reactions increase and overall amount of hemoglobin increases in fish to maintain these unpleasant environmental circumstances (Brix et al., 2004).

Proximate composition is the measurement of percentage of proteins, fats, carbohydrates, ash and moisture contents (Aberoumad and Pourshafi, 2010; Ahmed, 2011). Although composition analysis is a time consuming process and a difficult task but it is necessary to understand its biology and physiology (Ali et al., 2005). The researchers are doing the same thing to deduce the physiology health and growth of fish (Saliu et al., 2007; Aberoumad and Pourshafi, 2010). Sustenance values and

consumption rate is greatly affected by the composition of body (Azam et al., 2004). Body composition has very prominent role in determining the nutritional outputs (by that we can say it is indispensable to evaluate fish body constitution before devouring it (Fawole et al., 2007; Breck, 2014). Main external factor is diet given to fish (components of diet and quantity of feed) and second one is environmental conditions faced by fish including pH, photo intensity, temperature and salt concentration in water body etc also affect the composition but the effect of these factors is little to be underemphasized (Tsegay et al., 2016). In addition, composition also varies with sex differences (Biro et al., 2009). The percentage of ash particles in varied fish specimens' increases with an increase in body size and vice versa (Ahmed, 2011). The reactions taking place in the body are also greatly affected by contents of moisture (Babu et al., 2013).

Determination of fish composition have gained importance because of the peculiar properties of fish meat having many health benefiting compounds and good taste, being secure and safe food for the growth of humans (Jabeen and Chaudhary, 2011). The changes in proximate composition is however greatly related to feeding choices and opportunities to feed, during the excess feeding time, its protein level increases and then fats start an increase and therefore it is important to have a knowledge about the variation in proximate composition (Gokhan and Hikmet, 2011). In the field of DNA technology, health organizations and food hygienic, potent attention has been given to proximate composition (Tobin et al., 2006). It is all due to an increase in interest about fish, rising consumption rate globally and the problems related to food hygienic (Dumas et al., 2010). The concentration of fat particles changes with the change of temperature, fish age, length of body, nutritional composition and it is also changes from specie to specie (Aberoumand, 2014). Warmth of water body and body size is responsible for the changes in the feed consumption, progress in development and the food effectiveness of young fishes. Fish grow rapidly at 14oC and at 6oC they grow poorly. But their growth rate does not change largely from 100C- 18oC (Handeland et al., 2008).

Carp culture is a longstanding conventional practice in India which is affluent in Carp fauna. The suitable machinery of fish farming evolved through research exploration and survey in carp culture. In Indian prime carps well known one is Cirrhinus mrigala which is gobble up commonly all around in the Pakistan due to its flesh of high quality proteins and good relish aqua-culture Scientists has given great attention to it because of its good quality of meat to increase its yield (Tanveer et al., 2015). The Cirrhinus mrigala found in Indus and Ganges natural brook systems, but it is effectively circulated all over the world amongst Europe and the other countries of Asia because of aquaculture techniques. The Cirrhinus mrigala is found efficiently in bottom habitats and it cultured with other major Indian carps, so it is major and important constituent in poly culture system. Its commercial value is increased due to increase in demand of consumer and elevated aquaculture potential. Almost 573,627 million tons of Cirrhinus mrigala are produced per year all the way through aquaculture and it is proven by reports that it contributes about 1.6% to worldwide fish production. Cirrhinus mrigala are reported to have 1.6% contribution in worldwide fish production and per year production of Cirrhinus mrigala is almost about 573,627 million tons (FAO, 2004). Hence, due to its size and taste and easiness of its culture, Cirrhinus mrigala has a massive valued assemblage of freshwater fish production.

The Cirrhinus mrigala is a significant member of major Indian carps and has a great importance because of its higher demand amongst consumers and aquaculture prospective (Mayank, 2015). To access fish population and response of fish to a variety of aspects of managing dealings there are two main attributes, the age and growth rates of fish (Bhatt et al., 2014). Effect of different interactions amongst numerous factors including biotic and abiotic factors affecting on physiology and behavior of fish is represented by its growth which is a multi part system (Dwivedi et al., 2014). Variety of fishes produced annually is dependent on growth rate. The amount of fish production with admiration of time can be calculated by studying the growth of fish and it is the main reason behind the study of growth. Data of age symphony can be used accurately to find the difference in growth patterns of male and female specimens and entire sample of fish (Dwivedi and Nautiyal, 2012).

Many Scientists have done work on C. mrigala, but the information is not enough still today. The main reason behind this study was to find out the proximate composition of internal organs of farm cultured and wild forms of Cirrhinus mrigala which will help the Scientists of the all round the glob to improve the flesh quality and quantity of Mrigal. This study will also be helpful to examine the effect of artificial food on fish quality mainly to enhance the productivity of fish meat to meet the challenges mainly the shortage of quality food products. The objectives of the study were to calculate the proximate composition of farmed and wild Cirrhinus mrigala. To find the growth rate of farmed and wild Cirrhinus mrigala. To analyze the growth and the effect of factors affecting the growth rate of wild and farmed Cirrhinus mrigala. To compare the proximate composition and growth performance of the wild and farmed Cirrhinus mrigala.

MATERIALS AND METHODS

Growth Performance

The growth rate of wild and farmed fish samples was determined by using simple techniques. The size and weight of samples of each of the three categories of both farms cultured and wild captured (three different weight categories for both samples) fish specimen was determined fortnightly by using measuring tape and weight scale. The data of both samples were compared at the end of trial and growth performance was determined for both wild and farmed *Cirrhinus mrigala*. The groups or classes such as fork length, total length and weight which are firstly described in the process of calculating the growth performance and are basic parts to describe growth. Therefore, the growth is described in terms of these basic terms. The *Cirrhinus mrigala* from farm culture as well as from wild origins were divided into three diverse age groups nominated as W_1 (250-500g), W_2 (501-1000g) and W_3 (1001-1500) was performed and

presented in tabulated form. Growth performance was measured by simple techniques. The weight gain of fish was calculated by using weighing scale and the length of fish was measured by simple tape meter.

Proximate Composition

Fish has a keynote role in human's food being a prime resource of crucial proteins as well as fatty acids. Proximate composition is the measurement of percentage of proteins, fats, carbohydrates, ash particles and moisture contents. Fish meat composition never remains the same actually both external and internal factors influence the body constitution of fish. Although composition analysis is a time consuming process and a difficult task but is necessary to understand its biology and physiology and researchers are doing the same thing to deduce the physiology health and growth of fish. On the opposite side, internal factors in conjunction with peer group of an organism, body length, anatomy and sexual characters etc are associated with genes. In addition, composition also varies with sex differences. Main external factor is diet given to fish (components of diet and quantity of feed) and second one is environmental conditions faced by fish including pH, photo intensity, temperature and salt concentration in water body etc also affect the composition but the effect of these factors is little to be underemphasized. Percentage of ash particles in varied fish specimens increases with an increase in body size and vice versa and reactions taking place in the body are also greatly affected by contents of moisture. Sustenance values and consumption rate is greatly affected by the composition of body and has very prominent role in determining the nutritional outputs by that we can say it is indispensable to evaluate fish body constitution before devouring it. Carp fishes *Cirrhinus mrigala* of three dissimilar weight groupings (W1, W2 and W3) from freshwater both of the farmed (W1, W2 and W3) and wild (W1, W2 and W3) captured were analyzed for the biochemical composition of four structures, viz. meat, kidney, liver and gonads.

Feed Formulation

Fish were fed with three types of feed having 25percent protein (in type 1), 30percent protein (in type 2) and 35percent protein (in type 3) to W1, W2 and W3 weight categories respectively.

Components	25percent CP1	30percent CP2	35percent CP3
Soya oil	04	04	04
Fish meal	17	20	16
Wheat	25	14	05
Wheat bran	10	10	10
Corn glutton (60%)	10	22	34
Corn	10	10	10
Rice Polish	10	10	10
Canola meal	12	12	12

Procurement of Fish

Fish samples were divided into three diverse weight groupings. Twenty one wild *Cirrhinus mrigala* were purchased from Trimu Headwork Jhang of three different weight categories designated as W_3 (1001-1500gm), W_2 (501-1000gm) and W_1 (250-500gm). Similarly, 21 farmed *Cirrhinus mrigala* of three unlike weight groupings nominated W3 (1001-1500gm), W2 (501-1000gm) and W1 (250-500gm) were obtained by Satyana Road Fish Farm. All the fishes were transported to Department of Zoology Wildlife and Fisheries University of Agriculture Faisalabad.

Preparation of Fish Sample for Analysis

All fishes were cleaned by using soft towel so that the mucus and water on skin were eradicated and each fish was weighed individually. All the fins including Caudal, Anal, Dorsal, Ventral and pectoral fins were confiscated by using scissor and cutter and head removed also, after weighing each fish. After that the scales were removed from each fish individually. Weight of each individual fish was computed again and loss in weight was calculated which is called dressing loss. After that the skin of each fish was eradicated by giving a longitudinal cut from ventral surface and meat taken from each fish and placed in Petri dishes.

Determination of Proximate Composition of the Meat and Feed Samples

The proximate composition values of samples of selected body parts (in terms of percentage of crude protein, moisture contents, ash particles, carbohydrates and crude fats) of *Cirrhinus mrigala* belonging to three different weight categories were evaluated by using standard methods of Association of Official Analytical Collaboration (A.O.A.C. 2006) as given below.

Estimation of Moisture Contents (% Moisture)

To calculate the moisture contents from cadaver and feed samples, following equipment were used.

- Electrical Oven
- Desiccators (Vacuum)
- Dish (Petri)
- Forceps
- Electrical Grinder

For time period of twelve hours one gram of the sample achieved from of fish (fish organs) were obtained in Petri dishes after weighing process and these samples were placed in the oven at 106^0C temperature. These samples were relocated to vacuum desiccators for time period of five minutes and weighed again after this dehydration practice. These samples were apprehended in reserve in oven for a second time for about 70-130 minutes until a stable and constant weight (W) was achieved. Deviation in the weight of samples after drying treatment was premeditated as moisture contents and one hundredth was set up to get the percent value of moisture contents by means of given formulation.

$$\textbf{Moisture Pecentage} = \frac{W1-W2}{W3} \times 100$$

W_3= Sample weight

W_2= Weight of sample after drying + Mass of Petri dish

W_1= Weight of sample prior to drying + Mass of Petri dish

Extraction of Protein (Crude Protein-% CP)

Rough and ready crude (unsophisticated) proteins contents of samples were investigated by Micro Kjeldahl's method. An amalgamation combination of K_2SO_4, $CuSO_4$ and $FeSO_4$ in fraction of 90:7:3 correspondingly was organized. Then Five gram of digestion mixture, thirty

milliliter of marketable H_2SO_4 and one gram of desiccated sample was placed in digestion tubes which were placed in digestion chambers having exhaust at neck region. First the mixture was changed into translucent patent solution having no color or greenish coloration. After about three hours, the digestion process of samples was finished. With distilled water the digestion material was diluted in measuring flask of 250ml after cooling it completely. 10ml diluted solution and 10ml of 40%NaOH solution were placed in distillation chamber after steam washing and distilled it with steam. Ammonia liberated during distillation process was collected using two percent boric acid solution (10ml) having a droplet of an indicator namely methyl red. The ammonia in boric acid solution was titrated by using Sulphuric acid of 0.1normality and amount of acid used was computed. End point was noted when color changed from pink to golden.

Nitrogen percentage in the sample was premeditated by means of formula given below:

$$\mathbf{N_2\ (\%)} = \frac{n(n-1)\text{volume of } 0.1\text{N}\times 0.0014\times 250}{Wt.of\ \text{sanple}\times\text{volume of Sample used.}} \text{ X } 100$$

Percentage of crude protein = 6.25 ×mineral nitrogen percentage

Whereas

6.25= factor for equation of nitrogen percentage to crude protein (assumed)

10= Digestive and diluted sample volume

100= For N_2 percentage

250= Digestion mixture dilution factor

0.0014= Standard volume of Sulphuric acid of 0.1normality used to neutralize NH_3

Extraction of Crude Fat and Lipids (%CF)

To extract the lipid contents the gadgets and chemicals that were employed are given below.

Chemicals

- Oven (temperature 66˚ C)
- Petroleum ether
- Petroleum ether 120ml in each sample
- Burner highest temperature was 65°C or 60°C
- Soxhelt apparatus (six to seven hours for each of Soxhlet progression phase)

By using petroleum ether extraction method in Soxhlet apparatus the crude fat (as ether extract) was determined. Wrapped samples in filter paper (two grams (2g) of each of the samples) placed in the sheathing (jacket) of Soxhlet equipment and after that the jacket was positioned inside of the condenser. Each of the burning stove kept on and flasks having spheres in rounded shapes called as receiving flasks were placed on the furnaces. Now these flasks (receiving flasks) were linked with a component of sample holding apparatus named as Soxhlet apparatus. The fumes were formed when solvent volatilized and went up in the uppermost part via a tube where the cold water was circulated and condensation occurred. Due to condensation process the solvent molecules converted into droplets and prickle down on the sample containing filter papers. Via a siphon tube the solvent was siphoned back into the receiving flask which contained the fat solvent. Again and again this process of volatilization and condensation was repeated awaiting the sample of fats solvents present around the filter paper became colorless the shade of them disappeared and this process may take about six to seven hours. Because of presence of fats soluble in ether, this color was present. After weighing the ether extract was placed in oven of laboratory for drying purpose at 66˚ C by putting in Petri dish and was relocated to desiccators for five minutes after drying process. By using given formula, the percentage of crude fat was deliberated:

$$\mathbf{Crude\ fat}\ (\%) = \frac{\text{We}}{W1} \times 100$$

Where:

W_1 = Weight of sample

W_e = Weight of extract of ether

Total Ash

By burning for ten hours at 650˚ C in muffle furnace the ash contents were determined. The sample was put into the weighed china dish and the sample containing china dishes were then put in muffle furnace. The samples remained in furnace (muffle furnace) at about 655°C for the period of ten hours. Next day the China dish with samples weighed again and the difference in weight was noted. This difference was percentage of ash particles.

$$\mathbf{Total\ ash}\ \% = \frac{Wt.of\ Ash}{Wt.of\ sample} \times 100$$

Determination of Carbohydrates (Nitrogen Free Extract, %NFE)

A small quantity of carbohydrates is present in fish body parts in the form of glycogen, sugars and sugar phosphates. After subtraction of the total of EE (ether extract), ash contents and particles of residues, rudimentary proteins, rough fiber contents and the moisture contents from one hundred, the values of carbohydrates contents were obtained. By means of given formulation, NFE (Nitrogen Free Extract) in samples of feed and samples of remains of fish were determined.

NFE% = 100 - (% Moisture + %CP + %CF + %ash)

Statistical Analysis

Data was subjected to statistical analysis. Analysis of variance was performed to compare means. The significant difference between the means was determined by Tukey's Newman keul tests by using statistical software Statistix (version8.1).

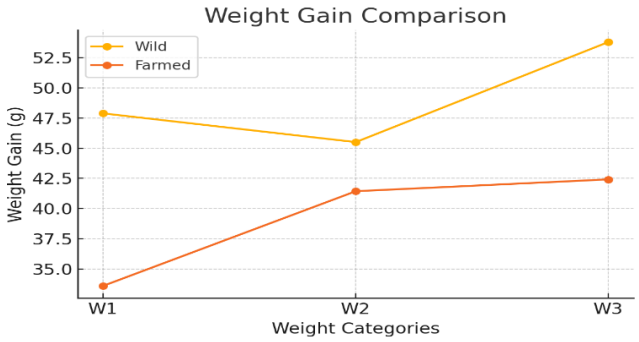
RESULTS

This chapter presents the comparative results of growth performance and proximate composition between farmed and wild Cirrhinus mrigala across three different weight categories (W1: 250-500g, W2: 501-1000g, W3: 1001-1500g). Significant differences were observed in weight gain, fork length, total length, and biochemical composition (moisture, protein, lipid, ash, and carbohydrate contents) in meat and liver samples.

Weight Gain

The weight gain was found significantly higher in wild Cirrhinus mrigala compared to farmed ones across all weight categories. The graphical representation below illustrates this comparison.

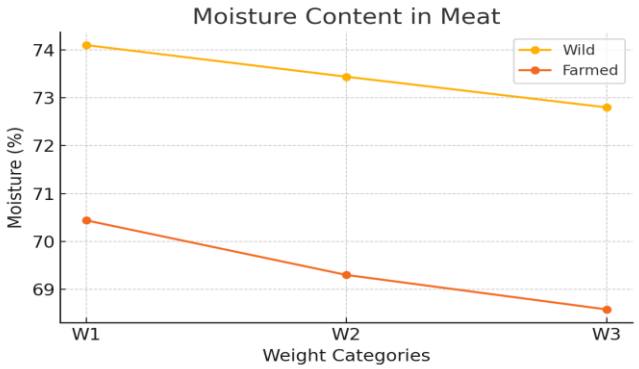
Figure 1



Moisture Content

Moisture content was higher in wild fish meat across all weight categories. As fish weight increased, the moisture percentage tended to decrease in both farmed and wild samples.

Figure 2



Proximate Composition of Meat

Moisture

Moisture content was consistently higher in wild fish. A decreasing trend in moisture with increasing weight was observed.

Table 1

Weight Group	Wild (%)	Farmed (%)
W1	74.10	70.44
W2	73.44	69.30
W3	72.80	68.58

Protein

Farmed fish exhibited significantly higher protein content than wild ones, with W3 showing maximum values.

Table 2

Weight Group	Wild (%)	Farmed (%)
W1	14.83	19.47
W2	15.26	20.17
W3	16.09	20.89

Lipids

Lipid levels were also higher in farmed fish, likely due to formulated feeds rich in energy.

Table 3

Weight Group	Wild (%)	Farmed (%)
W1	5.36	4.39
W2	5.78	5.24
W3	6.26	5.78

Ash

Wild fish had slightly higher ash content, indicating better mineral accumulation from natural diets.

Table 4

Weight Group	Wild (%)	Farmed (%)
W1	1.17	1.13
W2	1.26	1.10
W3	1.31	1.16

Carbohydrates

Carbohydrates were marginally higher in wild fish, with the highest values in W2 wild group.

Table 5

Weight Group	Wild (%)	Farmed (%)
W1	2.27	2.21
W2	2.43	2.21
W3	2.39	2.31

Proximate Composition of Liver

Similar trends were observed in liver composition:

- **Moisture:** Wild fish livers showed higher water content.
- **Protein:** Farmed fish livers were richer in protein.
- **Lipids:** Farmed fish had higher lipid content due to feed influence.

Ash and Carbohydrates

Wild fish retained more ash and carbs.

DISCUSSION

The differences in growth and proximate composition between wild and farmed *Cirrhinus mrigala* reflect environmental and nutritional effects. Wild fish benefited from a natural, variable diet promoting mineral retention and muscle development, while farmed fish showed enhanced protein and fat levels due to formulated feed. These results support the importance of tailored feeding protocols in aquaculture to balance growth rate and meat quality. Notably, moisture decline and protein/lipid increase with weight indicate maturity-related physiological changes.

CONCLUSION

This study highlights the comparative differences in growth performance and proximate composition between wild and farmed Cirrhinus mrigala. Wild specimens demonstrated higher moisture, ash, and carbohydrate content, suggesting better mineral accumulation and water retention from natural feeding environments. In contrast, farmed fish exhibited significantly higher protein and lipid content, likely due to protein-rich formulated feeds, emphasizing the role of diet in growth and body composition. Weight gain was greater in wild fish, though farmed fish showed superior nutritional composition in terms of energy and protein density. These findings underscore the biological impact of rearing conditions and feed formulation on fish physiology. Understanding these variations can help aquaculture professionals develop strategies to improve meat quality, optimize feed efficiency, and meet rising consumer demands. Overall, integrating controlled feeding with environmental management is key to enhancing fish production and ensuring nutritional benefits in both farmed and wild fish populations

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