ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Comparative study of meat composition of Catla catla, Labeo rohita, Cirrhinus mrigala and Pangasius hypophthalmus under different treatments

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Manuscript Info

Manuscript History:

Received: 18 August 2015
Final Accepted: 26 September 2015
Published Online: October 2015

Key words:

Meat composition, Major carps, Catfish, Pangasius hypophthalmus.

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Abstract

Experiments were conducted to evaluate the response of five treatments to observe the meat composition of Indian major carps Catla catla, Labeo rohita, Cirrhinus mrigala and cat fish Pangasius hypophthalmus for the period of 12 months from August 2013 to July 2014. The composition of nitrogen in different experiments treatment with different combinations of feed and probiotics. Among all species Rohu goes to better results in case of crude proteins and to the total fats. Mrigala also occupied high position in respect to total ash and carbohydrates. The present study also revealed that there is a significant difference ($P < 0.05$) between body composition of the studied fish species. Moreover, variations also exist between the fishes of the same species for all the constituents.

INTRODUCTION

Fish and fish products play an important role in human nutrition in India, particularly to people of coastal areas. Good quality and adequate nutrition plays a very important role in the expression of mental, physical and intellectual qualities in humans. They have the ability to reduce blood lipid level, particularly serum triglycerides (Boberg, 1990) and also have a good source for human nutrition due to their therapeutic role in reducing certain cardiovascular disorders (Stickney and Hardy, 1989; Ahmed, 2011). The per capita availability of fish in India is now 9.5 kg with 56% of Indians considered fish eaters. It is estimated that by 2010, India requirements for fish will be around 10 million tons (Gopakumar, 2003).

A common approach for increasing fish production in culture ponds is direct application of organic and inorganic fertilizers, which enhances production of plankton that serves as natural food items for fish (Heper, 1963, Schroeder, 1978). Success of any fish culture largely depends on a continual supply of food through natural (fertilization) and supplementary feed. The combination of two to three species may ensure maximum utilization of available natural and food in water bodies because of their different feeding habits. Catla, rohu and mrigala could be considered as surface, column and bottom feeders respectively. Above three species are cultures along with pangas (*P. hypophthalmus*) by using fertilization and supplementary feeding in polyculture system. Supplementary feeding in fertilized ponds resulted in significantly higher growth rates and greater yields than fertilization alone (Green, 1992; Diana *et al*, 1994).Composition of the body is a good indicator for the physiological condition of a fish but it is relatively time consuming process. Proximate body composition is the analysis of carbohydrates, proteins, lipids, moisture and ash contents of fish. The lower percentage of water, greater lipids, protein contents and higher energy density present in the fish (Dempson *et al*., 2004). An important contribution have been made on the study of the body composition and their caloric values of different freshwater fishes by following workers; Peyami *et al.,* (2006); Albrektsen *et al.,* (2006); Asdari *et al.,* (2011). Body composition of different types of fishes was also explained by : Dawson and Grimm, (1980); Shearer, (1984); Salam and Davies, (1994); Singh *et al.,* (2006); Grayton and Beamish, (1997); Jonsson and Jonsson, (1998); Berg, *et al*., (2000); Dempson, *et al*., (2004); Biswas *et al.,* (2006); Khan and Abidi, (2010); Ahmed, (2011) ;Noor Khan *et al.,* (2011)Ullah *et al*., (2014) and Lopamudra *et al*., (2015).

The present study was carried for the body composition of Indian major carp's catla, rohu mrigala and pangas using the body composition as an index of growth studies in a cultured pond located in Kaikaluru area. Analysis of body composition were done at department of Zoology and Aquaculture, Acharya Nagarjuna University. Andhra Pradesh, India.

Materials and Methods

The fish (major carp's seed) were collected from Government fish farm located in Nidubrolu, Guntur district, Andhra Pradesh and Pangas seed were collected from private fish farms located in Kaikaluru, Andhra Pradesh. Each species was separately held in oxygenated polythene bags were placed near the experimental ponds and filled with fresh pond water. Each species of fish graded, counted, weighted and immediately distributed into the ponds on August 2013 and cultured over a 12 months. Each pond was stocked in ratio of 3: 9: 3: 6 of catla, rohu, mrigala and pangas. Major carp's catla, rohu, mrigala and pangas in fertilized polyculture systems five feeding treatments are (Table 1) determined the body composition of culture organisms. The system consisted of ten one hectare earthen ponds consists water depth about 1.5-2.0 m located at the experimental station. All experimental ponds were drained and sundried for 15 days. Nylon screen enclosures were installed on the water inlet and outlet pipes of each pond to prevent escape and entry of unwanted fishes. All ponds were fertilized using a standard fertilization program (Hepher, 1963) for initiate and promote natural organism to grow. Fertilization was done on weekly basis while feeding was done on daily basis. The supplementary feed was formulated for treatment T3, T4 and T5 having 28.5% crude protein (Islam, 2002) by following Pearson method (Rath, 2000) including fish meal, rice polish, sunflower meal, vitamin and minerals premix. After one month interval, on the basis of wet fish body weights, amount of organic and inorganic fertilizer and supplementary feed to be added in fish ponds were determined for each treatment.

Table: 1: Composition of Nitrogen in different experimental ponds

Treatment	Source of Nitrogen	Nitrogen %
Treatment -1	Cow dung and Pig dung	50%+ 50%
Treatment -2	Cow dung and Nitrophos	50%+ 50%
Treatment -3	Cow dung and Supplementary feed	50% + 50%
Treatment -4	Cow dung, Nitrophos and supplementary feed	25% + 25% + 50%
Treatment -5	Cow dung, Nitrophos, supplementary feed and probiotics	25% + 25% + 50%

At the final harvest, the meat samples from culture ponds were examined for the proximate composition of cultured fish species in terms of moisture, crude protein, total fats, total ash and carbohydrates to study the effect of fertilization, supplementary feed and supplementary feed along with probiotic {Amruth fish) as feed probiotics-Pvt}, on the meat composition of catla, rohu, mrigala and pangas by using Association of Official Analytical Chemist (A O A C., 1995) standard techniques. For this purpose five fishes were randomly selected from each pond. Three meat samples were taken from each specimen. Head, viscera, bones, fins, scales and tails of these fishes were removed and only their flesh was used for analysis. The detailed procedure for each analysis is given as under

Moisture:

One gram sample of meat samples were taken in a weighted Petri dish (W_1) and placed it in the oven at 60ºC for 12 hours or until dried. The dried samples were transferred to desiccators for 5 minutes and weighted. The samples were again kept in oven for one to two hours until constant weight (W_2) was obtained. The loss in weight was recorded as moisture.

$$\text{Moisture (\%)} = \frac{W_1 - W_2}{W_3}$$

Where, W_1 = weight of Petri dish + sample before drying; W_2 = weight of Petri dish + sample after drying; W_3 = weight of the sample; Dry matter percentage was calculated by the following; Dry matter (%) = 100 - moisture (%)

Crude protein:

Crude protein of the meat samples were analyzed by using micro kjeldahl's method. A digestion mixture of K_2SO_4 and $CuSO_4$ in proportion of 93:7 was prepared. One gram of dried sample and a 5g of digestion mixture were weighed into Kjeldahl's flask. 30ml of concentrated H_2SO_4 was added to it. The mixture was boiled at low temperature and then vigorously at high temperature until the mixture turned transparent clear greenish. Digested material was cooled down and volume was made up to 250 ml with distilled water. 10ml of this diluted volume and 10ml of 40% NaOH were put in apparatus and distilled with steam. Ammonia liberated was collected in 10ml of 2% boric acid solution with a drop of methyl red indicator. Ammonia was collected for about 2 minutes after the color of indicator changed from pink to golden yellow. Then ammonia in boric acid solution was titrated against (0.1 N) H_2SO_4, volume of H_2SO_4 used was noted and Nitrogen (%) calculated as under:

$$\text{Nitrogen (\%)} = \frac{\text{Volume of } H_2SO_4 \text{ used X Normality of } H_2SO_4 \text{ X } 0.014 \text{ X } 250}{\text{Weight of the sample X } 10} \text{ X } 100$$

Where;

0.014 = Standard volume of (0.1 N) H_2SO_4 used to neutralize 1ml of ammonia.

250 = Dilution of the digested mixture

100 = for percentage of N2.

10 = Volume of the digested and diluted sample used.

Crude protein in sample was calculated by following formula.

Crude protein (%) = % N2 × 6.25

Whereby, 6.25= Assumed factor for equation of N2 % to crude protein.

Total fats:

Total fat contents of meat samples were determined following petroleum ether extraction method through the Soxtec HT2 1045 system. The sample was placed in the Soxtec thimble, which was attached to the adapter. A defatted cotton wool was plugged on the top of the sample. The thimble was inserted into the condenser. The heating plate handle was pressed down and already weighted extraction cup, having petroleum ether up to 50-70 ml inserted in it. The main switch was switched on and cold water tap was turned on. The extraction cup was then clamped into the condenser. Extraction mode knob was moved to "Boiling" position for 15 minutes. The thimble was then immersed in the solvent. The material was boiled with thimble immersed in it. It was made sure that the condenser valves were opened. The extraction mode knobs were moved to the "Rinsing" position for 30 minutes. Thimble was then hanged above the solvent surface. After rinsing, the condenser valves were closed by turning a quarter turn. The extraction cup was released and the condenser valves were opened. Later on the "Main" switch was switched off and cold water tap was turned off. Extraction cup with trace amount of petroleum ether solvent and fat was placed in oven for drying. After drying, extraction cup was transferred to desiccators for 5 minutes and again weighted. Total fat percentage of the sample was calculated by following formula:

$$\text{Total Fats (\%)} = \frac{W_2 - W_1 \times 100}{\text{Weight of sample}}$$

Where, W_1 = Weight of empty extraction cup.

W_2 = Weight of extraction cup with fat after Evaporation.

The total ash was determined by burning 2g of dried fish tissue in a pre-weighed China dish and then samples were placed in a muffle furnace for ignition at 550 – 600°C till residue was obtained after 4 – 5 hours. Then the samples residue were placed in desiccators to cool and then weight was recorded. Percentage of ash was obtained by using the following formula:

$$\text{Total ash (\%)} = \text{Wt. of ash} \times 100 \text{ Wt. of sample}$$

Carbohydrates: The total carbohydrates were determined as follows:

100- (Moisture + Crude protein + Total fats + Total Ash).

Results:

Moisture:

In the present experiment, moisture contents of catla are 77.51, 77.05, 77.65, 75.45 and 77.46 under the influence of T1, T2, T3, T4 and T5 respectively. The minimum and maximum value of moisture contents was recorded in catla as 75.45 and 77.65 % in T4 and T3, respectively. In rohu the moisture contents varied from 77.24, 78.60, 77.90, 76.25 and 77.52% in T1, T2, T3, T4 and T5 treatments respectively. The minimum and maximum value of moisture contents was recorded as 76.25 and 78.60 % in T4 and T2, respectively. The mrigala was observed as 79.24, 79.21, 79.24, 76.51 and 77.12 % in T1 to T5 respectively. The minimum percentage was found as 76.51 % in T4 under the influence of fertilization and supplementary feed while the maximum was recorded 79.24% in treatments of T1 (Table-2).

Moisture contents of pangas were observed as 76.62, 77.11, 77.12, 75.19 and 75.23 % in T1, T2 T3, T4 and T5 respectively. The minimum percentage was found as 75.19 % in T4 under the influence of fertilization and supplementary feed while the maximum was recorded 77.12% in T3. The comparison of moisture percentage value under all the treatments mean values showed that the mrigala had highest (78.3%) moisture contents followed by rohu (77.5%), *Catla catla* (77.0%) and for pangas (76.3%) which differ non-significantly (P>0.05) from each others. In all the five different treatments, the moisture contents of catla, rohu, mrigala and pangas showed non-significant difference (P>0.05). Whereas the mean values of moisture percentage was non-significant from each other in different treatments (Table -2).

Crude protein:

In the catla, the protein percentage was found to be 17.25, 17.01, 15.9, 17.95 and 18.21% in the T1, T2, T3, T4 and T5 treatments respectively. The minimum crude protein percent was found as 15.9% in T3, while maximum crude protein percentage was found as 18.21 in T5 under the influence of supplementary feed along with probiotics. The mean value of all the treatments was recorded as 17.3% of crude protein. In rohu, the crude protein percentage was recorded as 17.21, 17.37, 18.65, 18.97 and 19.95% in T1, T2, T3, T4 and T5 treatments respectively. The minimum percentage was found as 17.21% in T1 and maximum percentage was found as 19.95 in T5. The mean value of crude protein in rohu in all the treatments was recorded as 18.4%. In case of mrigala, the crude protein percentage was found to be 17.55, 17.21, 15.64, 16.65 and 17.95% in T1 to T5 respectively. The minimum value was found as 15.64% in T3 under the influence of Cowdung and supplementary feed. The maximum value of crude protein was found to be 17.95% in T5. The mean value of mrigala in all the treatments' was found to be 17.0%. In Pangas, crude protein percentage was observed as 15.45, 15.38, 12.95, 13.25 and 15.75% in treatments T1, T2, T3, T4 and T5 respectively. The minimum and maximum percentages were recorded as 12.95 in T3 and 15.75 in T5. The mean value of all the treatments of pangas was found to be 14.6%. (Table-2). There was significant (P<0.05) difference in the percentage of protein contents among the species The comparison mean of crude protein values under treatments showed that rohu has highest (18.4%) crude protein followed by catla (17.3%), mrigala (17.0%) and pangas (14.6%). Among all the treatments T5 goes to better mean value of crude protein.

Total fats:

In catla the total fat contents were recorded as 1.12, 1.1, 1.2, 2.12 and 2.29% in T1, T2, T3, T4 and T5 respectively. The minimum was observed in 1.1 in T2 while the maximum fat contents were noted 2.29% in T5 under the influence of supplementary feed along with probiotics. The rohu showed the variation in the total fat contents as 1.03, 1.01, 1.02, 1.65and 1.82 % recorded under T1 to T5 respectively. The lowest value 1.01% was observed in T2, the highest value was being noted as 1.82% (T5) under the effect of fertilization supplementary feed and probiotics. In case of Mrigala showed the percentage of fat contents recorded under T1, T2, T3, T4 and T5 which were recorded as 1.03, 1.27, 1.51, 2.12 and 2.10%, respectively. In T4, the highest percentage was being noted as 2.12%, while the lowest percentage 1.03% was observed in T1. In case of Pangas showed the percentage of fat contents reared under T1, T2, T3, T4 and T5 which were recorded as 1.03, 1.25, 1.34, 1.75 and 1.82%, respectively. In T5, the highest percentage was being noted as 1.82%, while the lowest percentage 1.03% was observed in T1. Among these four fish species, the overall performance of catla showed the maximum total fat contents (2.29%) was recorded in T5 (Table-2).

In catla, mean value of all the treatments found to be 1.55%. 1.31% was recorded in rohu which a mean value of total fats. In case of mrigala, mean value of total fats was found to be 1.61%. In pangas mean value of all the treatments recorded as 1.44%. In all the four species total mean fat was recorded in mrigala (1.61%). Statistical

analysis showed the highly significant difference in the percentage of total fat contents among the species, treatments ($P<0.01$).

Total ash:

The ash contents of catla were recorded as 1.12, 1.10, 1.10, 1.32 and 1.33%, in T1, T2, T3, T4 and T5 respectively. The minimum and maximum value of ash was observed as 1.10 and 1.33% in T2, T3 and T5. The mean value of ash content of all the treatments found to be 1.19%. In case of rohu was recorded as 1.19, 1.16, 1.16, 1.25 and 1.3% in T1, T2, T3, T4 and T5 respectively. The lowest total ash percentage as 1.16 T2 and T3 and highest total ash was found in 1.30 in T5. The mean value of rohu in all the treatments was recorded as 1.28%. Ash percentage of mrigala was found to be 1.30, 1.45, 1.43, 1.83 and 1.90 % in T1, T2, T3, T4 and T5 respectively. The lowest value of ash percentage was recorded in T1 as 1.3% and the maximum percentage was found to be 1.90% in T5 under the influence of supplementary feed along with probiotics. The mean value of mrigal under all the treatments recorded as 1.58%. In case of pangas, the total as content was recorded as 1.22, 1.20, 1.22, 1.72 and 1.77% in T1 to T5 respectively. The minimum and maximum percentage was recorded as 1.20 in T2 and 1.77% in T5. The mean value 1.43% was recorded in pangas under the all treatment. Statistical analysis revealed the highly significant ($P<0.01$) difference in the percentage of total fat contents among the species (Table 2). The comparison of ash percentage showed that mrigala had highest ash contents 1.99%, followed by pangas 1.77%, catla 1.31%, and rohu 1.30%.

Carbohydrates:

The carbohydrates percentage in the meat body composition of catla in T1, T2, T3, T4 and T5 were recorded as 1.10, 1.13, 1.15, 1.16 and 1.25 %, respectively. The minimum carbohydrate percentage was found as 1.10% in T1 and maximum value was found to be 1.25% in T5. Mean value of all the treatment for catla was found to be 1.16%. In case rohu the carbohydrate percentage was 1.13, 1.32, 1.25, 1.24, and 1.34 % in T1to T5. The minimum and maximum values of rohu were found as 1.13% in T1 and 1.45% in T5 under the influence of fertilization, supplementary feed along with probiotics. 1.28% is the mean value of rohu recorded from comparison of all the treatments. In case of mrigal, carbohydrate percentage was recorded as 1.32, 1.35, 1.42, 1.75 and 1.85% in T1 to T5. The minimum and maximum percentage of carbohydrates is 1.32 and 1.85% in T1 and T5, respectively. The mean value of 1.54% was recorded in mrigala from all the treatments. In Pangas, the carbohydrates percentages were found to be 1.2, 1.18, 1.36, 1.45 and 1.35% in T1, T2, T3, T4 and T5. The lowest value 1.18% was recorded in T2 and maximum value was recorded as 1.45 in T4 under the influence of fertilization and supplementary feed. The mean value of carbohydrates from all the treatments found to be 1.31%. Statistical analysis revealed the highly significant difference in the percentage of carbohydrates contents among the species, treatments and interaction among the species and treatments ($P< 0.01$) (Table-2).

Table 2: Comparison of mean on the proximate analysis of four fish species under different treatments

Fish Species	Treatments					Mean
	T1	T2	T3	T4	T5	
	Moisture (%)					
Catla	77.51	77.05	77.65	75.45	77.46	77.0
Rohu	77.24	78.60	77.9	76.25	77.52	77.5
Mrigala	79.24	79.21	79.24	76.51	77.12	78.3
Pangas	76.62	77.11	77.12	75.19	75.23	76.3
Mean	**77.65**	**77.99**	**77.98**	**75.85**	**76.83**	**77.26**
	Crude Protein (%)					
Catla	17.25	17.01	15.9	17.95	18.21	17.3
Rohu	17.21	17.37	18.65	18.97	19.95	18.4
Mrigala	17.55	17.21	15.64	16.65	17.97	17.0
Pangas	15.45	15.38	12.95	13.25	15.75	14.6
Mean	**16.865**	**16.7425**	**15.785**	**16.705**	**15.75**	**16.8135**
	Total fats (%)					
Catla	1.12	1.10	1.20	2.12	2.22	1.55
Rohu	1.03	1.01	1.02	1.65	1.82	1.31
Mrigala	1.03	1.27	1.51	2.12	2.10	1.61
Pangas	1.03	1.25	1.34	1.75	1.82	1.44
Mean	**1.05**	**1.16**	**1.27**	**1.91**	**1.99**	**1.48**
	Total ash (%)					
Catla	1.12	1.10	1.10	1.32	1.33	1.19
Rohu	1.19	1.16	1.16	1.25	1.30	1.21
Mrigala	1.30	1.45	1.43	1.83	1.90	1.58
Pangas	1.22	1.20	1.22	1.72	1.77	1.43
Mean	**1.21**	**1.23**	**1.23**	**1.53**	**1.58**	**1.35**
	Carbohydrates (%)					
Catla	1.1	1.13	1.15	1.16	1.25	1.16
Rohu	1.13	1.22	1.25	1.34	1.45	1.28
Mrigala	1.32	1.35	1.42	1.75	1.85	1.54
Pangas	1.20	1.18	1.36	1.45	1.35	1.31
Mean	**1.19**	**1.22**	**1.30**	**1.43**	**1.48**	**1.32**

Discussion:

The results of the present study revealed that an increase in the level of incorporated probiotics with supplementary feed resulted in significant effect on the flesh crude protein content in the major carp's catla, rohu, mrigala and pangas (cat fish). Same continued total fat, total ash and carbohydrates also. Changes in body composition in relation to type of food ingested are a common phenomenon in all species of fish (Papoutsoglou and Paparaskeva- Papouslogdou, 1978; Schwarz; Zeitler *et al.,* 1994; Desilva and Gunasekera, 1989). The quantity and quality of supplementary feed have a pronounced effect in growth rate, feed coversion efficiency and proximate composition of fish (Jena *et al*., 2002). The proximate composition of fish meat of among four species showed that maximum moisture content were observed in mrigala in T1 and T3 (79.24%) and minimum were noticed in T4 (75.19%) in pangas. The main constituent of muscle of the fish is moisture, which play an important role in their metabolism. The water content of fish is varied within the limited range in various species (Afser and Ali, 1981). The body moisture undergoes cyclic changes along with fattening of the body (Afser, 1992; Peyami *et al.,* 2006).

In body composition of the fish are an important attribute which affected by pond ecosystems, fertilization (Hassan, 1996) feed ingredients (Javeed *et al.,* 1995), probiotics (Krishna *et al.,* 2009) and feeding rates (Hassan and Mocintosh, 1993). The proximate composition of fish meat of four species shows that the crude protein content were observed maximum in rohu in T5 (19.95%) and minimum in T3 (12.85%)in pangas. The protein contributed from the supplementary feed and natural diet combination might be efficiently utilized by the fish for synthesis of tissue protein, leaving the scope for diversion to energy production through domination.

Hassan (1996) and Javed *et al.,* (1995) confirmed these results by reporting that meat quality is affected by fertilization and supplementary feed. Hassan *et al.,* (2000) reported that significant difference in carcass composition of fish was observed between the treatments for various treatments. Zeitler *et al.,* (1984) reported that the body composition of fish is influenced by the chemical composition of the diet. In the present study compare with among diets probiotic corporate T-5 recorded better growth and survival of major carp's catla, rohu, mrigal and pangas. Similar results were observed by Murthy and Naik, (2000); Kumar *et al.,* (2006); Ghodratizadesh, (2011); Lopamudra *et al*., (2015).

The total fat, the percentage goes maximum in T5 (2.29%) and minimum in T2 (1.01%). Mrigala goes to maximum percentage of total ash in T5 (2.12%) and minimum total ash in Catla in T2 (1.10%). The inclusion of supplementary feed along with probiotics the crude protein, crude lipid and carbohydrates percentage increases compare with other diets. Among the species rohu goes to better results in case of crude protein (mean value 18.4%) and total fats (mean value 1.31%). Mrigala also occupied high position in respect to total ash (mean value 1.61%) and carbohydrates (mean value 1.54%). These results are supported by (Keshavanath *et al.*, 2006). Further, Hepher (1988) stated that natural food organisms contain low energy, while protein is in excess. Therefore fish consuming only natural food have minimal fat and maximum protein accumulation in their body. Our results are also similar that crude protein content in treatments T1, T2 and total fat content in treatment T1, T2. Information regarding different fish contents such as protein, fats, carbohydrates and other nutrients and how they vary in different fish species used is very important for the consumers. This information helps them to select the most suitable fish species because of having elevated protein contents. It is also facilitates the consumer to select fish of optimum size and suitable for consumption.

The study clearly indicates that a combination of live food (natural food through fertilization) and supplementary feed provides a better nutritional profile for culture species to support quality and quantity fish production. Addition of probiotics goes to increase the production better feed management strategy by lessening pollution load. The natural and supplementary feeds solved the problems of inadequate nutrient supply encountered through the addition of the probiotics. This will provide better production objectives like high quality meat to be achieved and might be a better feeding for sustainable aquaculture practices.

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