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EFFECT OF DIETARY REPLACEMENT OF COMMERCIAL FEED WITH Moina ON MEAT QUALITY AND ANTIOXIDANT ENZYMES IN *Catla catla*

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ABSTRACT

Live feeds like phytoplankton and zooplankton serve as the best starter meal for a number of aquatic organisms. The proposed study was conducted for 60 days to check out the effect of dietary replacement of commercial feed with Moina on meat quality and antioxidant enzymes in *Catla catla.* Total of 200 fish specimens were collected and divided into 4 experimental groups T0, T 1, T2 and T3 in triplicates. T0 was the control group given 100% basal diet while T l, T2 and T3 were the experimental groups given three graded levels of Moina 10%, 20% and 30% respectively. Meat quality parameters such as moisture content, crude ash, crude fat, crude protein and antioxidant enzyme activity in terms of catalase and peroxidase were measured at the end of the trial. The average value of moisture content was higher in T3 which was 76.8 given 30% Moina showed the highest average value. The average value of crude ash in T3 which was 16.06 and given 30% Moina showed the highest average value. The average value of lipid content was higher in T3 which was 77.29 given 30% Moina showed the highest average value. The average value of catalase was higher in liver, gills T3 52.86, T3 16.04 respectively, which was given 30% Moina. The average value of peroxidase in liver and gills was higher in T3 13.7, T3 47.79, which was given 30% Moina. The data was obtained and subjected to statistical analysis by applying one-way ANOVA that showed highly significant difference as the p-value was found to be equal to 0.000 ($p<0.05$). The replacement of commercial feed by Moina has the potential to increase the meat quality and antioxidant enzymes activity.

INTRODUCTION

Aquaculture is the fastest-growing and food-producing sector in the world and supplies livelihood to millions of people (FAO, 2018). Aquaculture will be highly beneficial for providing high-quality fish for consumption and grow exponentially due to population intensification, growing incomes and more urbanization (Finegold, 2009). Fish has always played a significant role in providing food based sources of nutrients to many poor populations across the world that are otherwise impossible to get in their diets. These include protein and essential fatty acids, as well as important micronutrients including vitamin A, vitamin B12, iron, zinc and calcium that are known to be more concentrated and available in diets with an animal source (Thilsted *et al.* 2016). However, due to rising demand, global fishmeal supply deficiency and domestic animal competition, fishmeal costs have risen even more significantly. The element that affects the rate of fish feed in market. Global research efforts now include finding substitutes for fish meal, the more expensive fishmeal has been substantially or completely replaced by various plant proteins, single-cell proteins, and animal proteins (Yigit *et al*., 2006).

In Pakistan, *Catla catla* is a very common food fish that grows quickly in a polyculture system. The freshwater Indian carp, *C. catla* is a species that is indigenous to Pakistan, Bangladesh, Myanmar, Bangladesh, and India. Additionally, it is spread as an exotic species to numerous other nations. *C. catla* is a very abundant source of proteins. According to report, *C. catla* fry needed 38.5% of their diet to be protein-rich in order to grow and survive. It is a fish with significant economic importance (Ingram, 2009). Most studies showed that feeding fish fry live zooplankton instead of dry artificial diets resulted in improved performance in the fry. Zooplankton is commonly used for raising fish larval stages, because they are abundant in freshwater bodies of water, four different zooplankton families such as rotifers, cladocerans, copepods, and ostracods can be fed to fish larvae as live food (Ahmed, 2011).

Fishmeal has been replaced with plant proteins in aquaculture diets, and this trend is likely to continue. Fishmeal has many nutritional advantages over plant protein meals, especially in feed for flesh-eating species that are not altered to plant feed Furthermore, to having comparatively low protein content, the presence of anti-nutritional elements can prevent nutrient absorption or digestion, interfere with the action of vitamins and possibly even cause toxicity. This protein source has a high production cost despite being produced in relatively small quantities, and it cannot be regarded an ideal protein source for aquaculture feeding unless the processing costs are significantly decreased (Jabir *et al.,* 2012).

Live feeds like phytoplankton and zooplankton serve as the best starter meal for a number of aquatic organisms. It has significant levels of macro- and micronutrients, which is why they are called "living capsules of nutrition". Cladocerans are commonly referred to as 'water fleas'. Cladocera is a subclass of Branchiopoda and Crustacea class are members of Arthropoda. Major cladocerans, Moina and Daphnia are essential as live food. Daphnia can be present all over the world in freshwater lakes, ponds and tanks. It swims by jerking its two big antennules. Daphnia includes a wide range of digestive enzymes, including lipase, amylase, proteases, peptidases and even cellulase, an exoenzyme found in the digestive tracts of fish and prawns. It is bigger than Moina and provides live food for later stages of the fish life cycle (Aguado *et al.,* 2009). Freshwater crustacean, Moina macrocopa is used in the culture of finfish, marine fish and teleost's (Poynton *et al.,* 2013). Moina is better live feed than Artemia. Moina is mainly found in ditches or temporary ponds. It works well as an alternative for Artemia in aqua hatcheries because it is smaller (0.5 to 2 mm) and contains 70% more protein than Daphnia. Moina is also frequently utilized as live feed in several hatcheries, as well as in the management and breeding of commercially significant aquarium species. (Martin *et al*., 2003) These live feed organisms are the most valuable supply for aquaculture in aquatic ecology. Small phytoplanktonic and zooplanktonic organisms are the main sources of food for fish and shellfish larvae. Zooplankton is an essential part of the nutrition of marine fish larvae in the natural food chain and copepods are usually regarded to be capable of meeting these larval fish's nutritional needs (Evjemo *et al.,* 2003).

MATERIALS AND METHODS

The present research work entitled as "Effect of live feed Moina on meat quality and antioxidant enzymes of *Catla catla*" was designed to determine the meat quality and antioxidant enzyme profiles of *C. catla* Juveniles.

Sampling of Experimental Fish

For the present research work fingerlings of *C. catla* were taken from Fish Seed Hatchery, Satyana Road Faisalabad. A total of 200 fish

specimens having an average weight of 30 g were collected.

Acclimatization of Experimental Fish

The collected fish specimens were placed in cemented rectangular glass aquaria, where they were acclimatized to different experimental settings. The fish were given a basal diet two times a day. To prevent bacterial infection, these fingerlings were immersed in a 5g/L NaCl solution prior to the experiment.

1. Fishmeal
2. Wheat flour
3. Maize flour
4. Rice polish
5. Sunflower meal
6. Vitamins
7. Minerals
8. Soy oil

After the formulation of basal diet the fishmeal from the basal feed was replace with Moina at 10%, 20%, 30% levels.

Moina

For this purpose, Moina was cultured and used as a live feed in experimental groups. Moina was cultured in the tank and feed were added in the medium. Yeast and algae are used as feed for Moina. Chlorella serves as an important source of food for Moina. They became mature in just a few days so it does not take long to grow a culture of test organisms. Due to this significance, they are preferred to be used as a live feed in aquaculture practices. Aeration was done properly to maintain the sufficient amount of dissolved oxygen in the tank water by using an aeration pump. After 3 days of appropriate treatment, Moina increased in number and were ready to use to feed the fingerlings of *Cirrhinus mrigala.*

Procedure for culturing of Moina

1) Culture container was filled with 200 liters of freshwater.
2) 314 g of cow manure was added to the water.
3) To mix the nutrients uniformly the mixture was stirred gently 3 to 4 times a day.
4) Aquarium aerators were used with air stones to improve the aeration of the system and run continuously.
5) The insects like mosquitoes may invade the culture tanks to avoid the cover nets were used.
6) In 3 to 6 days the fertilized water developed sufficient quantities of the micro-algae.
7) Water was not allowed to develop too much microalgae and became very dark green the excessive energy would consume all the fresh air from the tank at night and would cause death of Moina.
8) Moina were collected from the fisheries research farms, University of Agriculture, Faisalabad. Plankton nets were used to collect Moina. Planktonic net of 300 to 500micrometer mesh size used for younger while 500- 1200ml mesh size was used for adult Moina.
9) 4.5 g of Yeast was added on daily basis of Moina.

Application of Feed

The fingerlings were fed according to 6% of their body weight. The collected fish samples were divided into four experimental and one control group viz. T0, T1, T2 and T3. Where T0 was the control and Tl, T2 and T3 were the experimental groups. The 20 fish samples were stocked in T0 while 180 fish specimens were stocked in nine experimental glass aquaria in triplicates, each aquarium contained 20 fish specimens. T0 was given as 100% basal diet where T1, T2 and T3 were fed with experimental feed. Tl triplicate was fed with 10% Moina, T2 triplicate was provided with 20 % Moina and T3 was provided with 30 % Moina as a live feed. The feeding lasted approximately 3-3.5 hours. After that, the tanks were cleaned and refilled with fresh water after the leftover diets were removed from them.

Growth Performance and Feed Utilization

The weekly gross weights of fish from each treatment were used to measure growth performance. Feed consumption can be measured by removing left over feed from all fish aquaria. Weight gain (%), Absolute weight gain (WG), survival rate (%) and specific growth rate (SGR), can be used to assess growth performance and feed consumption.

Absolute Weight Gain (AWG)

It can be assessed by subtracting the final weight from the initial weight of the fish.

Absolute weight gain (g) = Final weight (g) - Initial weight (g)

Length Gain

After one-week length was measured in centimeters during the period of trial.

Increase in total length (cm)-final length-initial length

Specific Growth Rate (SGR)

The SGR of fish can be calculated as:

$$\text{Specific growth rate} = \frac{\text{In (final weight) - In (initial weight)}}{\text{Experimental periods in days}} \times 100$$

Feed conversion ratio

$$\text{Feed conversion ratio} = \frac{\text{Feed provided}}{\text{Rise in body weight}} \times 100$$

Survival rate (%)

The survival rate of fish can be determined as:

$$\text{Survival rate (\%)} = \frac{\text{Final number of fish}}{\text{Initial weight of fish}} \times 100$$

Condition factor

$K = W/L^3 \times 100$

Estimation of physicochemical parameters

Fish feed conversion ratios, feed efficiency and growth rates are all influenced both directly and indirectly by water quality. Water quality criteria must be continuously inspected when producing fish. For the maintenance of physio-chemical parameters, water, like pH, temperature, alkalinity, dissolved oxygen and total hardness were weekly checked.

Temperature

Temperature is a significant water parameter to complete any fish research. The instrument used to record the temperature of water tests was a DO meter known as HANNAHI, 9143. The temperature was estimated by dipping the sensor into the water sample.

pH

Samples that were gathered from different sources including river and pond water were evaluated to check the pH by utilizing HANNA-HI, 98107 as pH meter.

Dissolved Oxygen

The Dissolved Oxygen of water tests gathered from various examples were acquired by utilizing the instrument HANNA-HI, 9143, which can likewise record the temperature of the water. The DO was estimated in 'ppm'.

Total hardness

Hardness is a measure of alkalinity such as calcium and magnesium in water. Water hardness due to higher concentration of alkalinity. The carbonates and bicarbonates of calcium and magnesium found in water bodies are what cause the water's hardness. Total hardness, which was then, calculated by using given formula:

Total Hardness (mg L) (volume of EDTA used A 1000)/ (volume of the sample (ml))

Equivalent to 1.0 ml EDTA titrate at Ca++ indicator end point.

Calcium

The amount of calcium was calculated using the A.P.H.A. standard procedure (1998). The pH of a 50ml subsample of water was raised (up to 12-13) by adding the proper amount of NaOH. An ammonium purpurate indicator was added in one drop after the subsample had been agitated. After that, the reaction was titrated against Ethylene Diamine Tetra Acetate which was added gradually while being stirred continuously until the endpoint was reached.

The calcium content of the sample was determined using the formula below.

Calcium (mg/l) = (Volume of EDTA used)/ (used sample volume (ml)) ><400.8

Total alkalinity

Titration against sulphuric acid to the point of the acid-base reaction is typically used to evaluate alkalinity, which is a measure of water's ability to neutralize acids. The total alkalinity of water maintained at least up to 20ppm necessary for good water quality while high alkaline environment damage the growth of fish by this fish may fail to thrive, and eventually die.

The Methyl orange indicator technique was used to estimate total alkalinity (A.P.H.A.1984). To prevent denaturation, the samples for measuring total alkalinity were collected in a plastic bottle and examined when feasible. In order to determine the end point, 0.1 ml of methyl orange indicator was applied in a 50 ml Erlenmeyer's flask (bright orange).

Carbonates

When the pH of the sample of natural water is above 8.4, carbonates are usually present normally as sodium carbonates. The 50 ml of a sub-sample were placed in an Erlenmeyer's flask along with 0.1 ml of phenolphthalein (0.1N) indicator, which was then titrated against standard H2S04 (0.1 ON) until the pink hue vanished.

Bicarbonates

Bicarbonate ion reacts with acid and release carbon dioxide in the solution. The pH value of complete neutralization being about 3.8, thus, bicarbonates may be measured by titration with acid to a pH of 3.8, cither potent metrically or using an indicator unaffected by

C02.

Proximate Analysis of Meat

AOAC standard procedures were used to assess the meat quality of *Catla catla* samples. The moisture content of the fish was determined by oven drying for 24 hours at 105 degrees Celsius. The crude protein (Nx 6.25) was measured using a Micro Kjeldahl apparatus. To analyze crude fat, Soxlet HT was extracted using petroleum ether.

Moisture

For 24 hours, the drying oven was set to 105 degrees Celsius, and a one gram (W) sample of

fish was placed in a pre-weighted petri dish. The dehydrated sample was shifted to desiccator for ten minute and weighted. To attain constant or final weight (W) the samples were again placed in oven for one to two hours. The difference between the final weight and initial weight was recorded and calculated by the given formula:

Moisture %= Weight of the Sample x 100

Such as,

WI = weight of empty petri dish

W2= weight of empty petri dish + after drying weight of fish sample

W3= sample weight

W4= dry matter weight of + petri dish weight

The following formula was used to compute the percentage of dry matter.

Dry matter= 100 — moisture

Crude protein analysis

The amount of crude protein in experimental fish sample can be calculated by using micro kjeldhal's method. A mix of FeS04. CuSO and k2S04 in the fraction of 3:7:90.5g dehydrated fish sample and 5g digestion mixture was digestion flask. Concentrated H2S04 was added to it. At low temperature mixture was boiled and then vigorously at high temperature until mixture showed crystal clear green colour and white fumes. The digested material was chilled and filtered. Then water was added cautiously to make volume 250ml with distilled water. In the distillation 10ml of 40% NaOH solution was added to the dilute 10ml diluted sample solution were placed in the Kjeldhal'q steam distillation apparatus. After the indicator color changed from pink to golden yellow, ammonia was collected for approximately sixty seconds.

Crude lipids extraction

The crude lipid was determined using the soxlet apparatus and petroleum ether extraction. Ig sample of *C. catla* was kept in a thimble which was attached to the adapter. On the top the sample cotton wool was placed. The thimble was pushed into the condenser and driven down the handle of heating plate that followed by the insertion of a pre-weighted extraction cup containing 50-70ml of commercial petroleum. The main button of electricity was turned on and open the cold water tap on the extraction cup which was fixed into the condenser. Material in the extraction cup and thimble was immersed in the solvent boiled for 20 minutes. It was ensured that the valves of condenser were open. For 30 minutes, the knob of extraction cup was turned to the "rinsing" position. A porous thimble draped over the surface of the solvent. At the conclusion, the water and electricity were shut off. The extraction cups were once more weighed, and the percentage of fat was determined using the formula below.

$$\text{Crude fat (\%)} = \frac{(W3-W1)}{\text{Sample weight (W)}}$$

Where:

WI empty petri dish weight in g

W initial weight of the sample

W3= petri dish weight and fat residues in g

Ash content

In dry ashing, the food material was burnt in a crucible by hot plates slightly at first to make the fish sample fumeless for at least 15 minutes. The crucibles were then heated in a muffle furnace at 600 ° c for 3-4 hours. This temperature was kept until white or light grey remains were produced. After 3:30 hours, muffle furnace was turned off and left it for 1 hour. Then crucible was placed in the desiccator, cooled and weighted immediately.

Antioxidant enzymes

To assess the biological parameters like antioxidant enzyme such as catalase, glutathione peroxidase, Superoxide dismutase and different organs of fish such as liver and gills were dissected. In the ratio of 1:4 (v/w) the dissected organs and cold buff-or phosphate (0.2)) were added and the Inixture was homogenized. Then the mixture was centrifuged at 4^0 C at 10000 rpm for 15 minutes. After the centrifugation a clear supernatant was obtained and stored at 80^0C.

SOD Assay

The ability of enzyme SOD that it inhibits the photo reduction of Nitro blue tetrazole
(NBT) was used to measure its activity.

Required solutions

a. Potassium phosphate buffer (0.06M) of PH 7.8

In a flask, 140mg of KH2P04 and 740mg of K2HP02 phosphate were mixed with 0.081 of distilled water.

b. EDTA solution (0.1M)

160mg of EDTA and 0.08mg of NaCN were taken in a flask and distilled water was added up too.00541.

c. Riboflavin (0.12M)

0.06mg of riboflavin was taken in a flask and the distilled water were added to made volume up to 0.0013L. Cold dark bottle was used to store this solution.

d. NBT solution

In a flask 3.23mg NBT was taken and distilled water was added to make the volume up to 0.00264 L and then stored in cold dark bottle.

Procedure

1 ml of buffer was taken as a blank in a cuvette and then the readings were noted by placing it into spectrophotometer and adjusting to zero. Then 0.05m enzyme extract, 1 ml buffer and 0.016 ml of riboflavin was taken and incubated för 12 minutes in a light box. After that, the cuvette was placed into the spectrophotometer, After 20 seconds of reaction, 0.067ml of EDTA, NaCN solution and 0.33ml of NBT were added to the reaction mixture, and its absorbance at A560nm was measured.

CAT assay

CAT has the ability to reduce H202 at 240nm. This ability of CAT was used to measure its activity.

Required solution

a) Sodium phosphate buffer (60mM) of PH 7.6
b) 163.2mg of Na-HPO, and 224mg of NaH-PO was taken in flask and distilled water (0.05 L) was added to flask in order to dissolve chemicals.
c) Buffer substrate solution

For the preparation of buffered solution 0.422 ml of hydrogen peroxide was added to 60mM of phosphate buffer.

Procedure

In a cuvette, 2 mL of buffer solution was used as a blank, and the cuvette was then placed in a spectrophotometer. The reading was set to zero at A240 nm. Another cuvette was filled with 1.95 mL of buffered substrate and 0.05 mL of enzyme extract. The time of reaction was about three minutes and at A240nm, the absorbance was observed by the spectrophotometer.

POD Assay

Following method was used to determine the activity of POD.

Required solutions

a. 0.2Mphosphatebuffer(pH6.5)

1000 mg of Na NPO, and 4000 mg ofNaH2PO, was taken in a flash and them distilled water (0.2 L) was added to it.

b. Buffer substrate solution

750#1 of Guaiacol was added in flask to phosphate buffer (47 ml). Then the solution was mixed well on vortex agitator and after agitation about 0.3ml of hydrogen peroxide was added.

Procedure:

The cuvette was filled with 3 ml of buffer solution as a blank and then placed in the spectrophotometer. The reading was set to zero at A470nm. 3 ml of buffered substrate 3ml of buffer solution was taken as blank in cuvette and then placed the cuvette and 0.006 ml of POD extract was taken in another cuvette. After three minutes by using a spectrophotometer the absorbance was noted at A470.

Statistical Analysis

The obtained research data was analyzed by using one way analysis of variance under CRD. The correlation analysis was done to determine the relationships between different physicochemical characteristics.

RESULTS

Proximate analysis of meat quality of *C. catla*

Moisture (%)

The maximum and minimum value for the moisture content was 71% and 69% in T0, 78 and 76.2 in the case of T1, 78.5 and 74.9 in T2 and 78 and 76 in T3 respectively. The statistical analysis showed that moisture content differed significantly.

Table 1: Observations of moisture (%) content in the treatments T0, T1, T2 and T3.

No. of obs.	T0	T1	T2	T3
1	70	76.2	77	76
2	69	74.9	78.5	77.88
3	71	78	74.9	78
Mean±SD	70±0.81	76.36±1.27	76.8±1.47	77.29±0.91

T0: The feed which contain 100 % fishmeal

TI: The feed which contain 10% replacement of fishmeal with Moina

T2: The feed which contain 20% replacement of fishmeal with Moina

T3: The feed which contain 30% replacement of fishmeal with Moina

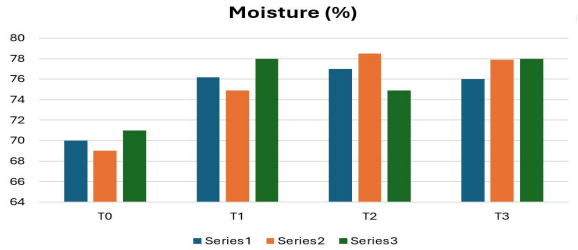

Fig. 1: Graphical representation of moisture (%) of *C. catla* in the treatments T0, T1, T2 and T3.

Graphical representation of moisture content of *C. catla* indicates that there is a slight variation between the control group having 100% commercial feed and experimental groups having (Tl, T2 and T3) that consist of T1, having 10% fish meal replaced with Moina, T2 having 20% fish meal replaced with Moina and T3 having 30% fish meal replaced with Moina.

Crude Ash

The maximum and minimum value for crude ash in T0 with 100% commercial feed was 15% and 13%, Tl 16% and 15.5%, T2 16% and 15.5%, T3 16.2% and 15.9% respectively.

Table 2: Observations of ash content (%) of *C. catla* in the treatments T0, T1, T2 and T3

No. of obs.	T0	T1	T2	T3
1	14	16	15.9	16.2
2	13	15.5	15.5	15.9
3	15	16.2	16	16.1
MEAN±SD		5.9±0.29	15.8±0.21	16.06±0, 12

T0: The feed which contain 100 % fishmeal

Tl: The feed which contain 10% replacement of fishmeal with Moina

T2: The feed which contain 20% replacement of fishmeal with Moina

T3: The feed which contain 30% replacement of fishmeal with Moina

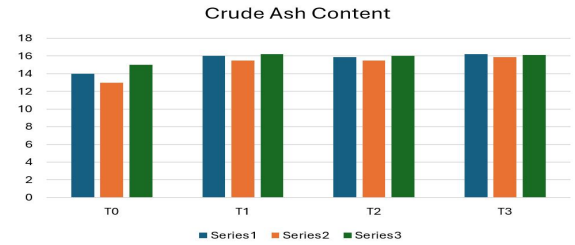

Fig. 2: Graphical representation of Crude Ash content of *C. catla* in the treatments T0, T1, T2 and T3.

Graphical representation of crude ash of *C. catla* indicates that there is a slight variation between the T0 containing 100% fish meal and experimental groups (Tl, T2 and T3) that consist of T1, having fish meal replaced with Moina, T2 having 20% fish meal replaced with Moina and T3 having 30% fish meal replaced with Moina.

Lipid content

The maximum and minimum value for lipid content in control group with 100% commercial feed was 11% and 10% respectively while 13% was the highest and 12% was the lowest value which was shown by experimental group having 70% Moina with 30% commercial feed.

Table 3: Observations of crude fat (%) of *C. catla* in the treatments T0, T1, T2 and T3.

No. of obs.	T0	T1	T2	T3
1	11	13	12	1.3
2	10	12	13	13
3	10	13	12	12
MEAN±SD	10.33±0.5	12.66±0.5	12.33±0.5	12.66+0.5

T0: The feed which contain 100 % fishmeal

TI: The feed which contain 10% replacement of fishmeal with Moina

T2: The feed which contain 20% replacement of fishmeal with Moina

T3: The feed which contain 30% replacement of fishmeal with Moina

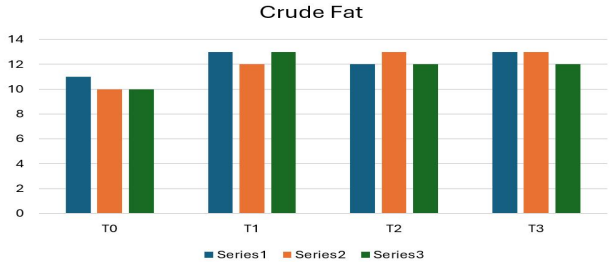

Fig. 3: Graphical representation of crude fat (%) of *C. catla* in the treatments T0, T1, T2 and T3.

Graphical representation of crude fat of *C. catla* indicates that there is a slight variation between the T0 containing 100% fish meal and experimental groups (T1, T2 and T3) that consist of T1, having 10% fish meal replaced with Moina, T2 having 20% fish meal replaced with Moina and T3 having 30% fish meal replaced with Moina.

Crude Proteins

The maximum and minimum value for crude protein in control group with 100% commercial feed was 65% and 64% respectively while 68% was the highest and 67% was the lowest and influence of T0 and Tl value which was shown by experimental group having 70% fish meal with 30% sesame seed.

Table 4: Observations of crude protein (%) of *C. catla* in the treatments T0, T1 and T3.

No. of obs.	T0	Tl	T2	T3
1	65	68	66	68
2	64	67	67	65
3	65	67	66	67
MEAN±SD	64.66±0.47	67.33±0.47	66.33±0.47	66.66±1.24

T0: The feed which contain 100 % fishmeal

TI: The feed which contain replacement of fishmeal with Moina

T2: The feed which contain 20% replacement of fishmeal with Moina

T3: The feed which contain 30% replacement of fishmeal with Moina

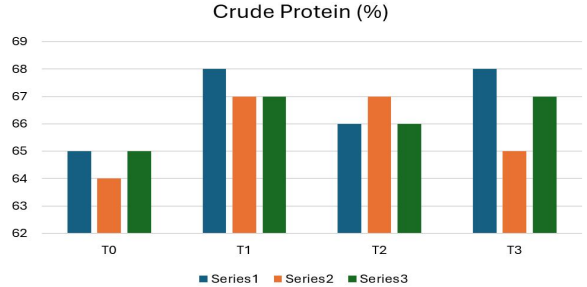

Fig. 4: Graphical representation of crude protein (%) of *C. catla* in the treatments T0, T1 and T3.

Graphical representation of crude protein of *C. catla* indicates that there is a slight variation between the T0 containing 100% fish meal and experimental groups (T1, T2 and T3) that consist of T1 having 10% fish meal replaced with Moina, T2 having 20% fish meal replaced with Moina and T3 having 30% fish meal replaced with Moina.

Antioxidant enzymes activity

Catalase activity

All oxygenated organisms produce catalase, a powerful antioxidant enzyme. If the cell was subjected to environmental stress, it had been shown to catalyze 1-1202 into oxygenated water with high efficiency. After dissecting the fish in the present study the catalase activity in gills and liver for all groups was determined by spectrophotometer at 240nm. The observations of catalase activity in gills and liver of for control and experimental groups for *C. catla* are given in the table below:

While the catalase activity in T2 and T3 are slightly higher than Tl and T0.

Glutathione Peroxidase

An important enzymes family that defends living things from oxidative damage in the glutathione peroxidase family. It is an enzyme that contains selenium (Se) which catalyzes the reduction of lipid and hydrogen peroxide by reducing glutathione.

Peroxidase activity in liver

In graph the vertical axis shows the GPx activity while horizontal axis indicates treatments (T0, T1, T2 and T3).

In graph the vertical axis shows the GPx activity while horizontal axis indicates treatments (T0, Tl, T2 and T3).

DISCUSSION

The experiment was conducted to evaluate the Effect of dietary replacement of commercial feed with Moina on meat quality and antioxidant enzymes in *Catla catla* as influenced by the replacement of commercial feed with three graded levels of Moina. Proximate analysis of meat was done and the average values of the different parameters such as crude ash, crude fat, moisture content, crude protein showed significant increase in them. The average value of moisture content in T0, T1, T2 and T3 were 70, 76.36, 76.8, 77.29, crude ash 14, 15, 15.8, 16.06, lipid content 10.33, 12.66, 12.33, 12 66 and crude protein 64.66, 67.33, 66.33, 66.66 respectively. The findings demonstrated that the meat quality of fish was improved by replacing fish meal with three graded levels (10%, 20%, 30%) of Moina. Our results ($p>0.05$) significant were in accordance with Rahman *et al.* (2022) who conducted a study to determine the meat quality and antioxidant properties of *C. catla* and showed that the protein and fat content was increased in fish and induced glycine and alanine in the fish muscles which indicate the improved meat quality of fish.

Our results are like the findings of Mohamed *et al.* (2010) who aimed to assess the meat quality of Nile fishes, including *Lates niloticus, Bagrus bayad, Oreochromis niloticus, Tetraodon lineatus and Synodontis schall.* Lipid content ranged from 1.8 to 17.3%, with moisture levels ranging from 73 to 80%. Protein content was 59.8% in *S. schall,* while the remaining species had 77 to79.1%. Our study was also compatible to Nandeesha *et al.* (1998) who conducted 120-day trial examined the impact of feeding Spirulina platensis on common proximate composition, growth etc.

Teimouri *et al.* (2016) assessed the effects of diets containing Spirulina platensis on rainbow trout's proximate composition, fatty acid profile, and lipid peroxidation. The average value of catalase in liver in T0, Tl, T2 and T3 were 50.2, 51.71, 52.33 and 52.86. The average value of catalase in gills in T0, T1, T2 and T3 were 15. 9, 15.28, 15.383 and 16.04. The average value of peroxidase in liver in T0, T1, T2 and T3 were 12.04, 12.24, 12.38 and 13.7. The average value of peroxidase in gills in T0, T1, T2 and T3 were 46.43, 46.54, 47.04 and 47.79. Three diets were used, one control and two supplemented with 5% and *C. sorokiniana.* The results showed that the 5% supplemented diet improved fish growth, antioxidant status, and immune response, making it a recommended option for enhancing fish health and performance.

Our results are similar to Peters *et al.* (2001) evaluated that sprat larvae and zooplankton were collected from the North Sea across different transects. Antioxidant enzyme activities (SOD and catalase) in sprat larvae were measured along with the levels of pollutants (PCBs, p, p-DDE, and PAHS) in the zooplankton. Higher antioxidant enzyme activities were found near estuaries, corresponding to higher pollutant levels, but decreased as the distance from estuaries increased.

CONCLUSION

The study discusses the relationship antioxidant enzyme activities of between larvae and the distribution of contaminants in the plankton. It's possible that additional pro-oxidant mechanisms could change the antioxidant enzyme activities of S. sprattus larvae in vitro. The trial was conducted in 10 glass aquaria and fishes were randomly divided into three experimental groups in triplicate. For these two diets T0 (100% commercial feed), Tl (90% commercial and 10% Moina), T2 (80% commercial and 20% Moina) and T3 (70% commercial and 30% Moina) were given to the fish *C. catla* two times a day. At the end of the experimental trial fishes were captured from each aquarium randomly and performed the proximate analysis of *C. catla* . In the present study, the meat quality in terms of moisture content, crude ash, crude fat, crude protein and antioxidant enzyme activity in terms of catalase and peroxidase were measured at the end of the trial. During the whole trial all physicochemical parameters were also recorded.

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