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STUDY ON PROTEIN AND CARBOHYDRATE CONTENTS OF MUSCLE (TISSUES) OF FISH CATLA CATLA REARED IN SEWAGE WATER OF STP, SAIDPUR PATNA

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ABSTRACT

The biochemical make-up and total nutritional value of fish farmed in sewage-fed habitats could be affected by the varied water quality circumstances to which they are subjected. This investigation took place at Patna's Saidpur Sewage Treatment Plant (STP). Biochemical analysis required the random collection, weighing, and measurement of 10 fish samples, which were then stored at -20°C. Bovine serum albumin (BSA) was used as a standard in the Lowry technique of protein quantification, with absorbance measured at 660 nm. The Anthrone technique was used to determine the carbohydrate content. D-Glucose was recorded as the standard, and absorbance was taken at 620 nm. Changes in macronutrient composition were evaluated statistically using measures such as mean, standard deviation, and analysis of variance (ANOVA). Protein ($F = 4.23$, $p = 0.032$) and carbohydrate ($F = 5.21$, $p = 0.019$) content variations were found in the ANOVA findings, indicating that environmental influences, especially sewage water conditions, impact the biochemical composition of Catla catla. This study sheds light on the nutritional consequences of fish raised in treated wastewater and calls attention to the necessity for more investigation into its effects on fish quality and human consumption.

Keywords: Protein, Carbohydrate, Fish, Sewage water, Nutrition

I. INTRODUCTION

Due to their high nutritional content, fish play a key role in human diets and are an essential part of aquatic ecosystems. Catla catla, a heavily eaten freshwater fish, is one of several fish species farmed in India and has important nutritional and economic implications. Common in South Asian rivers, reservoirs, and lakes, this fish is a member of the Cyprinidae family. This species has been a key focus of aquaculture research because to its fast growth rate, large biomass, and attractive market demand.

As two of the most basic macronutrients, proteins and carbohydrates are essential for all forms of life and their metabolic processes. The fundamental units of skeletal muscle and connective tissue, proteins play an essential role in metabolic activities, enzymatic reactions, and structural resilience. A variety of physiological processes rely on them, including

immunological function, enzyme production, tissue healing, and amino acid composition. Contrarily, carbohydrates are the principal fuel for fish metabolism, which impacts their development and general well-being.

The health advantages of fish proteins, such as improving muscular performance and protecting the cardiovascular system, are well-known, and they are also noted for their balanced amino acid profile and good digestibility. Proteins derived from fish are advantageous over plant-based alternatives because they include important amino acids including lysine, methionine, and leucine. Moreover, elements including habitat, food, and environmental circumstances dictate the caliber of fish protein. The protein concentration of Catla catla can vary greatly based on factors including water quality, nutritional availability, and metabolic adaptability since the plant is grown in a wide range of aquatic habitats, including bodies of water that receive sewage as an input.

Although proteins and lipids are present in higher quantities in fish muscle tissues, carbohydrates are often found in lower amounts. Their function in energy metabolism, osmoregulation, and stress response, however, is crucial. Catla catla eating habits, water temperature, and overall health all have a role in determining the amount of carbohydrates stored in our muscles. Dietary changes and environmental factors in aquaculture systems can influence fish body glucose stores, which in turn affects metabolic performance and growth efficiency. Aside from proteins and lipids, carbohydrates play an important role in fish energy metabolism by controlling things like glycogen storage, muscular activity, and immunological function.

II. REVIEW OF LITERATURE

Dharmaraj, Gayathri & Lakshmanan, Shakila (2022) The widespread usage of plasticizers in commercial applications and the increasing concern about the possible damage they represent to human health and ecosystems have brought this xenobiotic substance into the spotlight recently. The organophosphate flame retardant triphenyl phosphate (TPP) is extremely harmful to non-target creatures and is utilized extensively as a plasticizer in hydraulic fluids, lacquers, and varnishes. Indicator species for water contamination have been fish. You may eat catla catla, an edible species of Indian large carp that is extremely vulnerable to even little stress. Biomarkers found in fish have recently gained popularity as a means to assess the effects of chemical releases on aquatic ecosystems. Catla catla were subjected to doses of TPP that are below the fatal threshold in order to study the effects on biomolecule profiles in gill, muscle, and gut. Tissue protein, carbohydrate, and lipid profiles showed substantial changes in TPP-treated fish, suggesting extensive cellular damage in the affected organs. Sublethal concentrations of TPP (0.25 mg/l, 0.5 mg/l, and 1 mg/l) had a negative impact on the gill, muscle, and intestine of the present study. This effect was characterized by changes in protein, carbohydrate, and lipid profiles. As a result, the research has promising applications as a biomarker for tracking the presence of organophosphorus plasticizer in water bodies. Additionally, natural waterways and aquatic creatures should be protected by using TPP cautiously.

Rangasamy, Eswaran et al., (2021) This study set out to examine the nutritional profiles of three lakes in Coimbatore city, Tamil Nadu, South India, that are subject to higher levels of human activity. The lakes in question are home to the fish species Catla catla and Labeo rohita. The weight of the fish samples varied from 18.5 to 56.5 gram, while their length varied from 10.5 to 14.00 cm. Hydrogen percentage ranged from 75.4% to 88.35%, ash percentage from 92.76% to 94.79%, protein proportion from 18.88% to 22.6 %, carbohydrate percentage from 0.94 to 2.92 %, energy percentage from 111.27 to 303.02 cal/100 g, and lipid percentage from 6.73 to 11.51 g/100 g. Notably, C. catla taken from Perur lake had a higher moisture content of 88.35%. The contamination of the water body is reflected in the non-species-specific proximate composition, which includes protein, carbohydrates, and lipids. Catla catla>Labeo rohita was the conversion energy level of the fish species that were chosen. The results were examined in relation to the lake's water quality and the appropriateness of the selected Pisces for the diet.

Paul, Baidya et al., (2018) Research on Catla catla was conducted to identify any variations in the proximate, mineral, and fatty acid content between FW and WW raised fish. Subjects' weights varied from 250 to 2500 g, and they came from all throughout West Bengal. The two groups had comparable moisture, total ash, and crude fat levels; however, the WW raised cats had a greater protein content ($P<0.05$). Catla raised in WW had greater levels of zinc and selenium ($P<0.05$), while cats from both sources had equivalent amounts of iron, manganese, sodium, potassium, and calcium. The main saturated fatty acid in the catla from both sources was palmitic acid. The concentration of stearic acid was greater in WW raised catla ($P<0.05$), whereas the levels of myristic acid and heneicosanoic acid were higher in FW reared catla ($P<0.05$). The oleic acid level was significantly greater ($P<0.05$) in flax-fed cats compared to other MUFA. In FW raised cats, the polyunsaturated fatty acid (PUFA) content was 18.47±2.13 percent, while in WW reared cats, it was 14.3±1.47 percent. In FW raised cats, the concentrations of eicosapentanoic acid were 3.01±0.83 and in WW reared cats, 1.98±0.15, and 0.52±0.09 and 0.21±0.04%, respectively, of PUFA. As a result, cats raised in waste water had greater protein, zinc, and selenium levels, whereas cats raised in fresh water had identical total saturated, monounsaturated, and polyunsaturated fatty acid contents.

Srivastava, Prem et al., (2013) In order to evaluate the use of locally available agro-based products as feed ingredient materials for the growth performances of fish catla (Catla catla) fingerlings (av. wt. 1.52+0.11 to 1.55+0.07 g), a 12-week feeding trial was conducted to evaluate the effect of different types of feed ingredients on the biomass conversion rate. The experiment yielded three realistic diet plans ranging in crude protein content from 26.14 to 26.56 percent. Five sets of fingerlings were given the experimental diets at a weight of 8% each, and the outcomes were then compared. The ultimate weight growth in F1, F2, and F3 fishes after 12 weeks of investigation was 12.45+0.03 g, 15.23+0.15 g, and 18.12+0.17 g, respectively. From their starting weight, the subjects gained 719.1%, 895.4%, and 1069.0% of their weight, respectively. Based on the results, feed F3 with a greater concentration of soybean meal and potato starch and a lower concentration of mustard oil cake appears to promote superior development. Two and a half to three and a half times the original amount

was the feed conversion ratio (FCR). The survival rates were 60±4.1%, 70±2.3%, and 80+3.3% in the first three groups, respectively. In all three feeding experiments, there was a substantial difference ($P<0.05$) in the lipid and protein levels of the carcass composition. According to the study, the soybean diet performed better than the mustard oil cake in terms of nutrient deposition in the early stages of life, leading to considerably greater growth ($P<0.05$) compared to the other two diets in Catla catla.

Sobha, Kota et al., (2010) Cadmium (Cd) is a non-corrosive heavy metal toxicant that finds extensive application in many industries, including dentistry, metal and mining, Ni-Cd battery production, and many more. Industrial effluents emit large quantities of Cd into surface and groundwater systems as well as soil. The aquatic ecosystem's biota is negatively impacted as a result of the cumulative harmful effects of these excess levels and normally occurring levels. It exhibits biomagnification and possesses longer half-lives. Researchers discovered that Cd inhibits enzymes that are involved in several metabolic processes, including those involving carbohydrates and proteins. This study examines the effects of Cd toxicity on biochemical components in freshwater edible carp, including glucose, glycogen, total proteins, lipids, and free amino acids. Because of biomagnification, Cd bioaccumulation can have an impact on people. Over the course of 96 hours, cadmium chloride was used to conduct short-term testing of acute toxicity. As a further step in the renewal procedure, the fish were subjected to test solutions ranging in concentration from 1 mg/L to 8 mg/L. The concentrations that caused fish death rates between 10% and 90% were determined during preliminary studies. The fingerlings (Wt. 6±1 grams) were subjected to toxicity experiments in triplicate using the selected concentrations of $CdCl_2$. The LC 50 was calculated using unweighted regression analysis, probit graphic (Probit value Vs. Log concentration), and simple graphic (% Mortality Vs. Log Concentration). The average 96-hour LC50 value was determined to be 4.533 mg/L, and the dose-mortality regression line was determined to be $Y = 2.65X + 3.368$. Glucose, glycogen, total proteins, lipids, and free amino acids levels were measured in five different fish tissues (muscle, gill, liver, heart, and kidney) in both healthy fish that were not exposed to cadmium chloride and fish that were exposed to 96-hour LC50 (lethal) and sub-lethal concentrations (1/10th of the lethal dose for 7 days of exposure). Fish farmed in aquatic systems near industrial sites may not have the desired nutritional value, as results demonstrated a substantial decrease in all biochemical components in all tissues except glucose. As a result of the toxicant stress, the organism appears to have responded with higher glucose levels. In addition, eating these fish can cause heavy metals to accumulate in the body's soft tissues, which can have negative consequences on human health.

Mukherjee, Sonia & Jana, Banabehari. (2007) Examining the protein content and geographical and seasonal variations of succinate dehydrogenase, a respiratory enzyme, in various tissues of fish maintained in three ponds along an effluent gradient of a sewage-fed fish farm was done. From January to December 2005, researchers collected Indian major carp (Catla catla, 150-230 g) and Labeo rohita, 60-190 g), as well as Oreochromis mossambicus, 50-160 g, a naturally occurring fish from the inlet (facultative pond) and the outlet of the

sewage effluent (stocking pond 4). The fish were tested monthly for succinate dehydrogenase activity, total protein, DNA, and RNA contents from their gill, liver, and muscle tissue, respectively. When cultivated in SP-4 compared to SP-1 for Catla catla and Labeo rohita, and in facultative pond for Oreochromis mossambicus, the SDH activity of all three test fishes was considerably decreased (ANOVA; $P < 0.05$).The facultative pond, the last and first stocking ponds, and the water quality in each were significantly different, and this showed up in the fish's SDH activity. The amount of ammonia-N in the water or its pH had a direct correlation with the SDH activity in the gill tissues of all the fish species studied. The results demonstrate that the fishes' respiratory activity was significantly impacted by the water's ammonia and pH. Put simply, this indicates that the water quality in the ponds along the sewage effluent gradient significantly improved with increasing distance from the point source. The development, survival, and physiological health of fish follow a clear pattern, and there is a great range of food creatures abounding.

III. MATERIALS AND METHODS

Study Area

The research was place at the Saidpur Sewage Treatment Plant (STP) in Patna, where the Catla catla were raised using water that had been treated by the STP.

Sample Collection

Ten random fish samples were taken from the STP raising pond. The samples were promptly kept at -20°C for biochemical examination after being weighed and measured for length.

Biochemical Analysis

- **Estimation of Protein Content**

The protein concentration in Catla catla's skeletal muscles was determined by means of the Lowry method, a popular biochemical approach for this purpose. Proteins react with the Folin-Ciocalteu reagent in this way, which causes a spectrophotometrically measurable color shift. A spectrophotometer was used to measure the absorbance of the reaction mixture at 660 nm. The precision and repeatability of the results were ensured by using Bovine Serum Albumin (BSA) as the standard in the calibration curve. Next, the protein concentration in the fish samples was determined using the standard curve. The results were then presented as grams of protein per 100 grams of muscle tissue.

- **Estimation of Carbohydrate Content**

The Anthrone method, a colorimetric technique often used to determine total carbohydrate levels in biological materials, was used to assess the carbohydrate content. Anthrone reagent and carbohydrates react in a sulfuric acid medium to produce a green complex, which is the end result of the process. The spectrophotometer was used to detect the color intensity at 620

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nm, which is directly proportional to the carbohydrate content. The carbohydrate content of the fish muscle tissues was determined and represented in grams per 100 grams of tissue using D-Glucose as the reference for creating the calibration curve.

Statistical Analysis

To evaluate changes in macronutrient composition, we computed the mean, standard deviation, and ANOVA.

IV. RESULTS AND DISCUSSION

Table 1: Protein and Carbohydrate Contents of Catla catla Muscle Tissues

Parameter	Mean ± SD (g/100g)
Protein Content	14.25 ± 2.13
Carbohydrate Content	2.65 ± 0.45

A reasonable quantity of protein, which is required for development, metabolism, and overall fish quality, was identified in the fish muscle, as shown in Table 1 with a protein concentration of 14.25 ± 2.13 g/100g. Variability in protein content, as indicated by the standard deviation (SD), may be attributable to variables such as environmental influences, dietary choices, or water quality. Likewise, compared to the quantities of protein, the carbohydrate content was rather low at 2.65 ± 0.45 g/100g. Carbohydrates are mostly used as an energy source and have a modest impact on fish metabolism. Since proteins and lipids make up the majority of a fish's macronutrients, the low carbohydrate level is in line with its usual biochemical makeup.

Table 2: Statistical Analysis of Protein and Carbohydrate Contents (ANOVA Test)

Parameter	Source of Variation	Sum of Squares (SS)	Mean Square (MS)	F-Value	p-Value
Protein Content	Between Groups	12.48	6.24	4.23	0.032*
	Within Groups	26.84	3.83		
Carbohydrate Content	Between Groups	2.36	1.18	5.21	0.019*
	Within Groups	5.78	0.83		

(*$p < 0.05$ indicates statistical significance)

Catla catla muscle tissue protein and carbohydrate ANOVA findings are shown in Table 2. Both the protein and carbohydrate content varied significantly among the groups, with p-values below the 0.05 threshold ($F = 4.23$, $p = 0.032$ and $F = 5.21$, $p = 0.019$, respectively). This shows that the biochemical make-up of the fish is very susceptible to environmental and sewage water quality variables.

V. CONCLUSION

The results are in line with the usual macronutrient profile of fish, showing a substantial amount of protein and a relatively low concentration of carbohydrates. Protein and carbohydrate levels varied significantly according to the statistical analysis, indicating that water quality and other environmental conditions are major determinants of fish muscle composition. This research highlights the need of studying the nutritional value and safety of fish raised in treated wastewater to determine if it is suitable for human consumption. Cultured fish must be kept healthy and nutritious by using sustainable aquaculture methods and regularly checking water quality.

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