Proximate composition of Indian major carp *Catla catla* at different seasons in Bakhira Lake of District Sant Kabir Nagar, Uttar Pradesh, India.

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Abstract: Fishes has an excellent nutritive value and is good source of proteins, lipids and various micronutrients essential for the maintenance of good health. The fish *Catla catla* is the Indian major carp of freshwater bodies. It is the main component of aquatic food for human beings of eastern Uttar Pradesh. Fish is a good source of protein and other essential elements required for the maintenance of human health. This study was conducted to investigate the proximate composition of Indian major carp *Catla catla* in different seasons i.e., Monsoon (June, July and August); Post-monsoon (September, October and November); Winter (December, January and February) and Summer (March, April and May) at district Sant Kabir Nagar, Uttar Pradesh, India during a period of 12 months from June 2019 to May 2020. In this study we examined 120 fishes (10 per month) and found the seasonal variation in its proximate composition. Protein, Lipid, Ash, Moisture and Carbohydrate contents were 16.57 ± 0.13; 2.86 ± 0.07; 2.45 ± 0.06; 77.025 ± 0.28 and 0.85 ± 0.03 respectively during monsoon season; 17.00 ± 0.17; 3.06 ± 0.08; 2.76 ± 0.09; 76.11 ± 0.51 and 1.07 ± 0.10 respectively during post monsoon season; 17.29 ± 0.07; 3.22 ± 0.04; 2.98 ± 0.08; 75.31 ± 0.20 and 1.22 ± 0.04 respectively during winter season and 17.66 ± 0.18; 3.43 ± 0.10; 3.19 ± 0.06; 74.37 ± 0.51 and 1.35 ± 0.50 respectively during summer season. This study showed that the moisture content was higher in monsoon season > post-monsoon > winter > summer, while the protein, lipid, ash and carbohydrate contents were higher in summer > winter > post-monsoon > monsoon season. Present study provides valuable information on seasonal variation in the proximate composition of Indian major carp *Catla catla* that helps the consumers in choosing fish seasonally on nutritional point of view.

KEY WORDS: Bakhira Lake, Catla catla, Proximate composition, Sant Kabir Nagar.

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INTRODUCTION

Fishes are good source of aquatic food. It provides nutrients that give nourishment to the human`s body and promote growth. Fish is one of the most important sources of animal protein and has widely accepted as a good source of protein and other elements required for the maintenance of human health (**Mishra, 2020a**). The chief component of fish includes protein, lipids, ash, moisture and carbohydrate. The amount or percentage of each component within fish body is termed as proximate composition. The people of eastern Uttar Pradesh have crying need of dietary protein. Protein is the main source of energy and plays an important role in determining the population level, growth rate and condition of fishes. Fish provides essential nutrients especially Proteins (of high biological values) and Fats, so it is often referred to as rich food for poor people. Protein is the main component that plays an important role in determining the population levels, growth rate and condition of fishes **(Al-Dubaikel, 1996)**. The knowledge of proximate composition is essential in order to compare its values as food **(Mishra, 2021)**. It is also necessary to have data on the composition of fish in order to make the best use of fish as food and in order to develop the technology of fish processing and fish products **(Mishra, 2020d)**.

Fishes has an excellent nutritive value which provides high quality protein, fats, vitamins and minerals. Fish muscle comprises of moisture, protein and fats as a macronutrients and carbohydrate, vitamins and minerals as micronutrients. Because of presence of both macro and micro-nutrients in fishes, it is better than other animal foods (**Mishra, 2020a**). Fish protein is much more important than other protein due to the amino acid composition and protein digestibility **(Mustafa, *et.al.*, 2013)**. Fish protein comprises of all 10 essential amino acids in desirable quantity for human consumption. Fish protein is very rich in such amino acids as methionine and lysine and low in tryptophan compared to mammalian protein (**Nowsad, 2007**). Fishes have rich source of essential nutrients required for supplementing both infant and adult dietary requirements (**Abdullahi and Abolude, 2001**). Thus, the fish muscle contains the entire nutritional component that is necessary for the maintenance of human body.

The nutritional composition of fish varies greatly from species to species and individual to individual depending on age, feed intake and sex. The sexual changes connected with spawning, environment and season (**Silva and Chamul, 2000**). The development of reproductive organ, egg size and quality of hormone and enzyme production in fish depends mainly on protein composition (**Louka, *et.al.*, 2004**). In comparison to land living animals, fishes are rich source of protein (amino acids), which is the building block of tissue and have a high content of **Omega-3** long chain poly unsaturated fatty acids. Early before the beginning of civilization, humans consume fish in a variety of ways by making various dishes. Fish has better availability and affordability than other animal protein.

The aim of this study is to provide knowledge of fish composition essential for its maximum utilization. Studies on seasonal variation in the proximate composition are essential for fish and fish products to be utilized efficiently **(Mishra, 2020b)**. Non edible part can be used as a source of raw material in the feed industry. Apart from limited information, there is no published information on the proximate composition of this fish in eastern Uttar Pradesh especially District Sant Kabir Nagar. The people of this district like this fish very much, and have much knowledge about the food and feeding habit of *Catla catla* (**Mishra, 2020c**) but they do not know about the variations of its proximate composition and nutritional values in different seasons (Winter, Summer, Monsoon and Post-monsoon). The present study can give information about proximate composition and nutritional values of Indian major carp *Catla catla* to the consumers for the selection of fish seasonally.

MATERIAL AND METHODS:

STUDY AREA, COLLECTION AND PREPARATION OF SAMPLE:

The study was conducted utilizing the fishes collected from local fish market of district Sultanpur, Uttar Pradesh, India. Total 120 individuals of fish *Catla catla* were collected from different and different fishermen of the same fish market during the period of 12 months from June 2019 to May 2020. The fish samples were put in to ice box from collection site and transported to the laboratory of Post Graduate Department of Zoology, L.B.S.S., Post Graduate College Anandnagar, Maharajganj, Uttar Pradesh, India. The fish samples were stored in the freezing temperature until used.

Head, scales, fins gills and viscera were removed and washed with tap water. Only fresh muscles from dorsal region without skin and bone were taken as sample. Then the muscles were chopped and grinded by mortar and pestle to make a homogeneous sample.

ANALYSIS OF PROXIMATE COMPOSITION:

The proximate composition of fish tissue was determined by conventional method of **IOAC (1980)** with minor modification and triplicate determinations were carried out on each chemical analysis.

DETERMINATION OF CRUDE PROTEIN CONTENT:

Protein is usually determined by measuring nitrogen, the characteristic element in protein, rather than protein itself; estimation of protein directly is a more time-consuming procedure. Not all substances containing nitrogen, however, are proteins, so the quantity estimated from measurement of nitrogen is usually called crude protein, which in addition to true protein includes free amino acids, tri-methylamine oxide and its decomposition products and other substances.

Kjeldahl method was used to determine protein content of fish samples. Approximately 1g of each sample was taken in a clean Kjeldahl flask and 4g digestion mixture was added along with 25 ml of concentrated H_2SO_4 by swirling the flask. Then the Kjeldahl flask was placed in an inclined position on heating device of digestion chamber and carefully heated at more than 100^0C for about 1-1.5 hours. The end point of digestion was indicated by a completely clear and light blue color solution. Then the content of flask was cooled at room temperature. Distilled water (100 ml) and $Na_2S_2O_2$ (25 ml) were continuously added in each flask, and were mixed and cooled. A few glass beds were added in each flask to prevent bumping. Then 100-120 ml of 40% NaOH was added in each flask to make solution sufficiently alkaline. The flask was immediately connected to distilling bulb on condenser against Kjeldahl flask to collect the distillate. After completion of distillation (about 100 ml distillate) the collected distillates were titrated with standard HCl (0.1). The end point was indicated by light pinkish color. Total crude protein was calculated by using the following formula-

$$\textbf{II.}\quad \boldsymbol{Nitrogen}\,(\%) = \frac{\mathbf{0.14} \times (\boldsymbol{Titration\ final - blank})\ \boldsymbol{reading} \times \boldsymbol{Strength\ of\ HCl}\ (\mathbf{0.01})}{\boldsymbol{Weight\ of\ sample}\ (\boldsymbol{g})} \times \mathbf{100}$$

Crude protein is an estimate for total protein. A crude protein contains nitrogen from not only protein but non-protein sources as well. Crude protein is used for energy and helps build tissue. Crude Protein is based on a laboratory nitrogen analysis, from which the total protein content in a feedstuff can be calculated by multiplying the nitrogen figure by 100/16 or 6.25. This is from the assumption that nitrogen is derived from protein containing 16% nitrogen (AOAC, 1984).So the nitrogen content of a sample of fish is conventionally converted to crude protein by multiplying with 6.25.

$$\textbf{III.}\quad \text{CRUDE PROTEIN}\ (\%) = \text{TOTAL NITROGEN}\ (\%) \times 6.25$$

DETERMINATION OF LIPID CONTENTS:

Most methods of measuring lipid content depend on extracting the fat by dissolving it in a suitable solvent. In the method given below the fat is recovered from the solution by evaporating the solvent and is then weighed. Accurately weighted 5g sample was taken in the thimble paper and placed in to the hollow spaces of Soxhlet apparatus. Then 200-300 ml acetone was poured in to ground round join bottom flask of Soxhlet apparatus, and the flask was carefully heated at 70-90^0C for about 2-3 hours as acetone evaporated at this temperature. Then acetone was slowly accumulated in the hollow spaces of Soxhlet apparatus and siphoning to the ground round join bottom flask. Then acetone was taken in to pre-weighted beaker and transmitted to hot air oven at 70^0C for about 45-50 minutes to evaporate acetone. The lipid containing beaker was kept in desiccator for cooling and the weight was measured after cooling. The lipid content was estimated by using following formula-

$$\textbf{IV.}\quad \boldsymbol{Lipid}\,(\%) = \frac{\boldsymbol{Weight\ of\ lipid\ (beaker\ containing\ lipid - empty\ beaker)\ in}\ (\boldsymbol{g})}{\boldsymbol{Weight\ of\ sample}\ \textbf{in}\ (\boldsymbol{g})} \times \mathbf{100}$$

DETERMINATION OF ASH CONTENTS:

The inorganic components of fish, often collectively called ash because of the method of measuring them, are seldom of direct technological interest. Measurement of ash is sometimes a useful indicator of

the amount of leaching of soluble constituents of fish resulting from contact with water or melting ice.

The moisture free dried fish samples were grinded and finely powdered with the help of mortar and pestle for converting samples in to fine powder which was used for the analysis of other parameters such as ash contents. The fine powdered moisture free samples were taken in clean pre-weighted silica crucible and weighed again along with samples. The crucible containing samples was then placed in a muffle furnace at a temperature of 550-600^{0}C for 6 hours till the residue became completely white. The samples were then allowed to cool in desiccator for about 20-30 minutes, reweighed and the amount of ash was calculated as the difference in weight. The percentage of ash content was obtained by using the following formula-

$$\text{V.}\quad \textbf{\textit{Ash content}}\,(\%) = \frac{\textbf{\textit{Weight of Ash}}}{\textbf{\textit{Weight of samples}}} \times \mathbf{100}$$

DETERMINATION OF MOISTURE CONTENT:

For the determination of total moisture content of the whole body of fish, the viscera, fins and tail were removed from the body of the fish and then the edible portions of the fish was divided in to several parts for making three-four uniform samples from all the parts of fish. The wet samples were put in the weighed again. The Petridis with wet samples were kept in digital hot air oven for drying at 105^{0}C for about 24 hours or until the constant weight was obtained. Then dry samples were taken out from oven and put in desiccators, after 30 minutes the weight was taken, the difference in weight (wet and dry sample) was calculated and expressed as percentage moisture. The percentage moisture content was calculated by using the following formula-

$$\text{VI.}\quad \textbf{\textit{Moisture}}\,(\%) = \frac{\textbf{\textit{Wet sample weight}}\,(g) - \textbf{\textit{Dry sample weight}}\,(g)}{\textbf{\textit{Wet sample weight}}\,(g)} \times \mathbf{100}$$

DETERMINATION OF CARBOHYDRATE CONTENT:

Carbohydrates are one of the most important components in many foods. Carbohydrates may be present as isolated molecules or they may be physically associated or chemically bound to other molecules. Individual molecules can be classified according to the number of monomers that they contain as monosaccharaides, oligosaccharides or polysaccharides. Molecules in which the carbohydrates are covalently attached to proteins are known as glycoproteins, whereas, those in which the carbohydrates are covalently attached to lipids are known as glycolipids. A large number of analytical techniques have been developed to measures the total concentration and type of carbohydrates present in foods. The carbohydrate content of a food can be determined by calculating the present remaining after all the other components have been measured. The total carbohydrate components were determined as follows:

Carbohydrate contents = 100 - (Moisture +Crude protein +Total Lipid +Total Ash)

RESULTS AND DISCUSSION:

VARIATION IN PROXIMATE COMPOSITION OF FISH (*Catla catla*) IN DIFFERENT SEASONS:

In Indian major carp *Catla catla,* the proximate composition in various seasons are represented by **Table 1**. The proximate composition of protein, fat, ash, moisture and carbohydrate are between 16.42% - 16.68% ; 2.82% - 2.94% ; 2.40% - 2.52%, 76.98% - 77.54% and 0.82% - 0.88% respectively during monsoon season ; between 16.84% - 17.18% ; 2.98% - 3.14% ; 2.68% - 2.86%, 75.68% - 76.54% and 0.96% - 1.14% respectively during post-monsoon season; between 17.22% - 17.36%, 3.18% - 3.26%, 2.90% - 3.06%, 75.12% - 75.52% and 1.18% - 1.26% respectively in winter season and between 17.48% - 17.84%, 3.32% - 3.52%, 3.14% - 3.26%, 73.98% - 74.76% and 1.30% - 1.40% respectively in summer season.

In general, the proximate composition of the fish body indicates the fish quality. Therefore, proximate composition of a fish helps to assess its nutritional value in terms of energy units. Variation of proximate composition of fish flesh may also occur within same species depending upon the fishing ground, fishing season, age, sex and reproductive status of the fish. The variation in chemical composition of fish is closely related to feed intake, migratory, swimming and sexual changes in connection with spawning. The variation in proximate composition of fish flesh may vary with species variation, season, age and feeding habit of the fish (**Salam, *et.al.* 1995**). Biochemical composition, nutritive values and seasonal variation in the chemical

composition of fish tissue associated with reproductive cycle.

Table 1: Proximate Composition of the Indian major carp *Catla catla* in various seasons (During JUNE 2019 - MAY 2020).

Season	Months	Protein	Lipids	Ash	Moisture	Carbohydrate
Monsoon	JUN	16.42	2.82	2.40	77.54	0.82
	JUL	16.60	2.88	2.44	77.22	0.86
	AUG	16.68	2.94	2.52	76.98	0.88
	Mean ±S.D.	**16.57 ±0.13**	**2.86± 0.07**	**2.45± 0.06**	**77.25 ±0.28**	**0.85±0.03**
Post-Monsoon	SEP	16.84	2.98	2.68	76.54	0.96
	OCT	16.98	3.06	2.74	76.12	1.10
	NOV	17.18	3.14	2.86	75.68	1.14
	Mean ±S.D.	**17.00 ±0.17**	**3.06± 0.08**	**2.76± 0.09**	**76.11 ±0.51**	**1.07±0.10**
Winter	DEC	17.22	3.18	2.90	75.52	1.18
	JAN	17.28	3.22	2.98	75.30	1.22
	FEB	17.36	3.26	3.06	75.12	1.26
	Mean ±S.D.	**17.29 ±0.07**	**3.22± 0.04**	**2.98± 0.08**	**75.31 ±0.20**	**1.22±0.04**
Summer	MAR	17.48	3.52	3.14	74.76	1.30
	APR	17.66	3.44	3.18	74.36	1.36
	MAY	17.84	3.32	3.26	73.98	1.40
	Mean ±S.D.	**17.66 ±0.18**	**3.43± 0.10**	**3.19± 0.06**	**74.37 ±0.51**	**1.35±0.50**

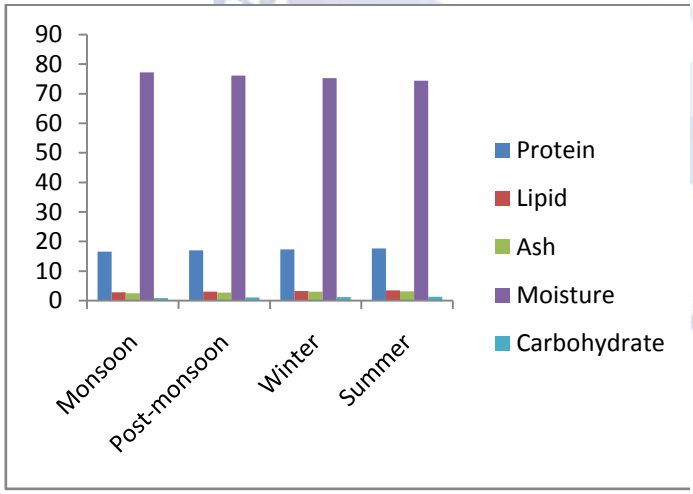

Figure 1: Average Proximate composition of Indian major carp *Catla catla* in various seasons.

SEASONAL VARIATION IN PROTEIN CONTENT:

In the present study the average percentage of protein content of *Catla catla* was 16.57 ± 0.13 in monsoon season; 17.00 ± 0.17 in post-monsoon season; 17.29 ± 0.07 in winter season and 17.66 ± 0.18 in summer season. The gradual increase in protein contents in monsoon season, post-monsoon season, winter season and summer season in fishes suggests a recovery of the fish from the strenuous act of spawning (**Bano, 1977**). The protein level of *Catla catla* were more during summer season, i.e. pre-spawning period and its level decreases during monsoon season, i.e. spawning period (**Ganeshwade, 2015**). The high value of muscle protein was observed in *Wallago attu* with ripe gonads (**Jafri, 1969**). During spawning muscle protein started declining gradually due to its transfer in to gonads to meet energy requirement of fish. **Hickling and Rutenberg (1936)** reported that protein synthesized and accumulated in the somatic tissues during pre-maturation period and would be utilized for gamete formation in addition to the growth of fish.

SEASONAL VARIATION IN LIPID CONTENT:

In the present study the average percentage of lipid content of *Catla catla* was 2.86 ± 0.07 in monsoon season; 3.06 ± 0.08 in post-monsoon season; 3.22 ± 0.04 in winter season and 3.43 ± 0.10 in summer season. The gradual increase of lipid content (monsoon season < post-monsoon season < winter season < summer season) might be due to active feeding of fish and decreased value of lipid content are found in pre-spawning period which indicates that lipid content is utilized during maturation. There was also decline in the lipid content during spawning period and this is possible due to mobilization of lipid as an energy source to meet the high energy demand during the act of ovulation and spawning, and due to low feeding intensity and low availability of food items (**Ganeshwade, 2015**). Reduction in the amount of lipid content in the muscles for the development and maturation of gonads has been well discussed by **Raina (1999)** and **Samyal, *et.al*. (2011)**.

SEASONAL VARIATION IN ASH CONTENT:

In the present study, the average percentage of ash content of *Catla catla* was 2.45 ± 0.06 in monsoon season; 2.76 ± 0.09 in post-monsoon season; 2.98 ± 0.08 in winter season and 3.19 ± 0.06 in summer season. The increase in ash content in the fish indicates higher mineral metabolism (**Bano, 1977**). It is presumed that the amount of food and concentration of minerals after the

water recedes in the post-monsoon season increased considerably. The percentages of ash content were gradually increases in monsoon < post-monsoon < winter < summer both the seasons were more or less similar (**Mishra, 2020a**).

SEASONAL VARIATION IN MOISTURE CONTENT:

In the present study, the average percentage of moisture content of *Catla catla* was 77.25 ± 0.28 in monsoon season; 76.11 ± 0.51 in post-monsoon season; 75.31 ± 0.20 in winter season and 74.37 ± 0.51 in summer season. The moisture content gradually decreases from monsoon season > post-monsoon season > winter season > summer season. The changes in moisture and fat content indicate that while fat content evidently increased, there was a decline in water content due to heavy feeding during this season, which is in good agreement with previously reported results by. The moisture content found in the present study agreed with the research findings of other workers **Huss (1988; 1995); Jafri (1969); Raina (1999); Silva and Chamul (2000)**.

CONCLUSION:

Present research work provides information about proximate composition of Indian major carp *Catla catla*. Proximate composition of fish (*Catla catla*) was also found to vary seasonally. The moisture content was higher in Monsoon season > Post-monsoon season > Winter season > Summer season, while protein, lipid, ash and carbohydrate content were higher in Summer season > Wsdinter season > post-monsoon season > Monsoon season. The result of present study suggests that the proximate composition of fish varies greatly from season to season. This might be due to physiological changes in environmental condition i.e. spawning, heavy feeding or starvation. This study clearly indicates that the proximate values obtained would be useful to help the consumers in choosing fish on the basis of nutritional values. This study provides valuable information on seasonal variation in proximate composition of the fish species in order to take necessary precaution to distinguish their nutritional value that would be useful to help the consumers for proper selection of the fish according to its nutritional values.

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