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A Study On Nutritive Value Of Fishes In Freshwater Body Of Shahdol District, Madhya Pradesh, India With Reference To Khan Talab

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Abstract:

This article examines the lotic ecosystem, focusing on water quality, fish diversity, and the nutritional value of specific fish in Khan Talab and Ponang Talab from 2021 to 2023. Nutritionally, fish protein content was highest during the rainy season in Khan Talab which is located in Shahdol district of Madhya Pradesh India, while carbohydrate content in fish peaked in the summer. Lipid content also peaked during the rainy season. Overall, the findings indicate stable with the rainy season providing the most nutritious fish catch.

Keywords: Lotic ecosystem, fish diversity, nutritious fish etc.

Introduction:

The fresh fishes collected for the analysis. Fish collection was done during the Period from February 2021 to January 2023 once in every month. Local fish market was visited frequently and information about fishes was collected from local fisherman. Random samples from a mixture of fishes, 2-8 similar sized fish were taken for the analysis. They were kept in cold ice box and transported to the laboratory. Fishes were brought to laboratory immediately washed with fresh, clean water for the removal of algal biomass, mud and other waste material and dried by using blotting paper. Then fishes were identified up to the species level with the help of books and standard keys (Jhingran, 1988; Misra, 2003; Gupta and Gupta, 2006). Fishes were dissected out for the removal of bones and fleshes were separated from the fish. Only edible portions such as muscles were taken for the experiment. For the proximate analysis, muscles tissues of fishes were taken just below the dorsal fin and above the lateral line. Fish flesh then washed until it was free from blood and placed

in plastic bag, sealed and kept in freezer at -20°C before they were analysed. Fish muscles were selected for analysis of proximate composition.

METHODOLOGY:

Determination of Carbohydrates

Principle- Carbohydrates are first hydrolysed into simple sugars using dilute Hydrochloric acid. In hot acidic medium glucose is dehydrated to hydroxymethyle Hurfural. This compound forms with Anthrone reagent a green coloured product with absorption maximum at 620nm.

Tissue Extract: Fishes were killed by decapitation and dissected. Pieces of muscle Were removed and placed on tissue paper. 0.1g of the sample taken and homogenize RRMI HOMOGENIZER RQT-127A) it with 5-10 ml ice cold Ringer's solution

Method of Carbohydrate Estimation-

Carbohydrates were estimated by using Anthrone method (Dubois et al., 1956, Hedge and Hofreiter, 1962) with the minor modification (Sadasivam et. al., 2016). The homogenized tissues were centrifuged at 3000 for 15 minutes. Collect the supernatant and take 1 ml aliquots for analysis.

1ml supernatant was mixed with 1 ml of 10% trichloroacetic acid (TCA). Again, centrifuge it for 30 minutes at 3000rpm. Supernatant were collected and 1ml was used for total carbohydrates estimation. Simultaneously glucose standards freshly processed taking 0, 0.2, 0.4, 0.6, 0.8, and 1 ml of the working standard. Add distilled water and create the equal volume up to 1 ml in every test tubes.

Sample test tubes also add distilled water and make the volume 1 ml. Keep all until they become ice cold. Then added 4 ml of Anthrone reagent (0.2 N conc. H_2SO_4) in all the test tubes, mixed well and heat it in water bath for 8 – 10 min. Cool at room temperature and read the absorbance at 620 nm in a Labman spectrophotometer, model no. LMSP-UV1900. The concentration of glucose in the Sample was calculated using a standard curve. From the standard calibration graph no. 33) carbohydrates content of the fish muscles were determined. The amount of carbohydrates expressed in mg/g.

Determination of Protein

Method of Protein Estimation

Fish muscle protein was estimated by using Lowry et al., (1951) method with minor modification (Sadasivam and Manickam, 2008, Somaiah, et al., 2015, Meshram and Baile, 2016). The homogenized tissues were centrifuge for 30 minutes 3000rpm and supernatant used for estimation. Take 1 ml of supernatant and add with equal amount of 10% TCA. Again, centrifuge it for 30 minutes at 3000rpm dissolve the precipitate in 0.1N NaOH. Pipette out 1 ml of the sample extracts in pre- steam test tubes. Then it was diluted with 1.6ml of Lowry solution and kept it for 15 minutes. Working standard of Bovine serum albumin (1 mg/ml) was taken 0.2, 0.4, 86, 0.8, and 1ml into a series of test tubes. Make the volume to 1 ml in all test tubes. Take a test tube for blank fill it with 1 ml of water. Then added 5 ml of alkaline copper solution in all the test tubes. Mixed it well and allow standing for 10 minutes.

Then added 0.4 ml of reagent Folin-phenol reagent mixed it well with vigorous shaking and incubate it at room temperature in the dark for 30 minutes. After incubation, blue colour developed. Measure the intensity of test and standard against blank at 650 nm in the digital spectrophotometer (LABMAN, LMSP-UV1900). The Concentration of protein in the sample was calculated by drawing standard graph.

From the standard calibration protein content of the extracted sample were determined. The amount of protein expressed in mg/g.

Determination of Lipids-

Method of Lipid extraction-

Muscle lipids were extracted by Bligh and Dyer (1959) method with some minor modification (Khamankar, 2010). Homogenate is produced by weighing 10g fish tissues in a conical flask along with 20 ml methanol and 10 ml chloroform (REMI homogenizer, RQT-127A). 10ml chloroform again added with vigorous shaking. Add 1ml distilled water and again homogenize for 1 minutes. This solution was filtered by wing using Whatman No. 1 filter paper. The filtrate was transferred to graduated cylinder. The filter paper and blender washed with 10ml chloroform and then transferred to the cylinder. Allow to separate two layers, lower chloroform layer was recorded ('X' ml). Alcoholic layer removed by aspiration, little chloroform layer also removed to ensure Complete removal of upper layer. The chloroform layer contains the purified lipids volume of chloroform layer ('Y' ml) was recorded and transferred it to conical flask ('a' g). Chloroform in conical flask was evaporated under the stream of nitrogen gas. Cooled and dried the residue over phosphoric in a vacuumed desiccator. The flask was weighted second time ('b' g). 5ml of chloroform was added 3 times to dissolve the lipids and evaporated again. The flask was weighted third time ('c' g).

Calculation-

weight of lipids (g) = (b-a)-(c-a)='d' g

Total lipids (g)

=Weight of lipids ('d')

$$\times \frac{\text{Total vol. of Chloroform layer ('x' ml)}}{\text{Vol. of chloroform layer evaporated ('y' ml)}}$$

$$\% \text{ Total lipids} = \frac{\text{Total lipids (g)}}{\text{Weight of sample (g)}} \times 100 \text{ X}$$

Result and Observation:

Proteins content in fish in Khan Talab:

The table shows a critical evaluation of the monthly, seasonal, and yearly average protein content in three freshwater fish species—Catla, Rohita, and Mrigala—catch from Khan Talab, Shahdol (M.P.), within two years from February 2021 to January 2023. The results show that the protein content as a whole over the two years was constant, with the average content of each of the species being fairly close to one another. Particularly, Catla had the highest protein content throughout with a yearly average of 13.45% in both years.

Rohita had the lowest mean protein content with 12.72% for 2021–2022 and 12.73% for 2022–2023. Mrigala had intermediate values with means of about 13.24% and 13.25% respectively (Table 1).

Monthly data indicates protein content was highest in the monsoon months, especially August and September, when Catla had its highest reading of 13.98% in August 2021. The lowest protein contents were recorded in the summer and early spring, especially in April, when Rohita fell to 11.85% in 2021 and 11.77% in 2022. Seasonally, the rainy season had the highest average values across all three species (13.54%–13.55%), followed by winter, and then summer, with the lowest averages at 12.85%.

Standard deviation analysis indicates that Rohita experienced the greatest variation in protein content, thus being more sensitive to environmental and biological influences. Catla had the most stable protein content throughout the months. The results indicate that both season and species have a very strong effect on protein content in fish, with the rainy season being the most nutritious to catch.

Carbohydrates content in fish in Khan Talab:

The following is a table 2 of mean monthly, seasonal, and annual carbohydrate percentage in three freshwater fish species—Catla, Rohita, and Mrigala sampled from Khan Talab, Shahdol (M.P.), during two years from February 2021 to January 2023. From the data, relatively constant carbohydrate percentage is observed over the years, but the overall average increased slightly from 0.63% in 2021–2022 to 0.64% in 2022–2023. Among the three species, Catla always had the highest content of carbohydrates, followed by Mrigala, and had the lowest values in Rohita.

Monthly report indicates that the maximum carbohydrate levels were found in the month of March, particularly in Catla, which reached as high as 0.92% in 2022–2023. Conversely, minimum readings were seen in winter months, specifically January and December, where it dropped to as low as 0.46–0.48%, which reflects lower metabolic activity during low temperatures.

Seasonal patterns also validate that summer recorded the maximum mean content of carbohydrates (0.73% in 2021–2022 and 0.74% in 2022–2023), presumably because of enhanced feeding and energy accumulation during warm months. The rainy season had middle values, while the winter season reported the minimum carbohydrate content, possibly because of lowered food consumption and activity.

In the case of variability, Catla varied most in carbohydrate content from month to month, and Rohita continued to be the most consistent. In general, it can be inferred from the observations that summer is the most nutritionally profitable time of year for carbohydrate deposition in fish, and Catla is the richest in carbohydrate content among the species of Khan Talab.

Lipids content in fish in Khan Talab:

The table 3 shows the mean monthly, seasonal, and yearly lipid (fat) content in three freshwater fish species—Catla, Rohita, and Mrigala from Khan Talab, Shahdol (M.P.), for two consecutive years (February 2021 to January 2023). The lipid content is expressed as percentage and indicates the nutritional richness of these species throughout the year.

Throughout both the years, Catla maintained the highest lipid value throughout, with a peak of 1.10% in February 2021–2022 and 1.15% in February 2022–2023. Rohita and Mrigala presented relatively lower values, with Mrigala having reasonably constant but moderate lipid values throughout the months. The winter season's lowest values, January and December, presented values as low as 0.89% for Catla and 0.82% for Rohita in 2022–2023.

The yearly average lipid content was consistent from year to year at around 0.99% (2021–2022) and 0.98% (2022–2023), reflecting hardly any year-on-year change. Low variability is reflected through values of standard deviations (±0.03 to ±0.08), which support the uniformity of lipid levels. Seasonal analysis indicates rainy and summer seasons favour marginally higher lipid accrual than winter. During both years, the rainy season had the most elevated average lipid values (1.01% and 1.00%), perhaps because of greater food supply and metabolic levels. Winter months had the lowest average lipid levels (0.97% and 0.96%), perhaps because of less feeding and decelerated metabolic rates.

Generally, the lipid content of such fish species varies slightly by month and season but is generally steady year after year, with Catla richest in lipids, particularly in February and the rainy season, thus being of great nutritional value.

DISCUSSION

For assessing the nutritional values of fish, the primary components examined were proteins, lipids, and carbohydrates. Each fish species exhibits varying nutritional values. The chemical makeup of various fish species will vary based on factors such as seasonal changes, migratory patterns, sexual development, feeding cycles, and more (Ravichandran et al., 2011).

Thilsted et al. (1997) mentioned that small native fish play a significant role in the diets of impoverished and rural populations. Small fish are often consumed in small portions and shared evenly among family members, unlike larger fish. Numerous small native fish measure under 10 cm and are consumed entirely, including organs and bones. They serve as an excellent source of calcium, vitamin A, and possibly iron and zinc.

Jeyasenta and Patterson (2014) noted that the current rising global population and malnutrition issues are leading to the effective utilization of small, low-value fish as a significant nutritional resource. However, in reality, small fish are largely overlooked by individuals as they are not informed about the significant nutritional benefits these fish offer.

Zaman et al. (2014) researched small native fish and demonstrated that they contain high levels of protein, lipids, carbohydrates, and essential minerals. Consequently, initiatives should be undertaken to enhance the promotion and cultivation of these fish species. Small native fish should be consumed whole, particularly by pregnant and breastfeeding women and young children, as they can meet the nutritional needs of both mother and child, even within undernourished and poorer segments of the population

Protein content in fish in Khan Talab:

Proteins serve as beneficial materials for building blocks. Fish are a plentiful source of high-quality proteins. The primary element of fish muscles is protein. Fish possesses a high biological worth. Fish protein includes all essential amino acids needed for optimal health. Proteins are a plentiful source of nitrogenous substances. Numerous enzymes, hormones, neurotransmitters, and similar substances are composed of proteins.

This finding aligns with the findings of John et al. (2017), who noted an increase in protein value starting in March, peaking in August and September. The overall protein decreases from October to February. Jyrwa and Bhuyan (2016) additionally indicated that peak protein levels were found in the post monsoon, while the lowest occurred during the spent season.

The lowest protein levels are noted in January and February, possibly due to the gonads' resting phase; these findings align well with the work of Islam and Joadder (2005), who indicated that the protein cycle is linked to food availability and the spawning cycle. The highest protein levels were noticed mainly in winter following the spawning period. During the maturation stage of fish, most proteins are concentrated in the gonads; however, after the release of sperm and eggs, the gonads enter a recovery phase. Once the food is produced, the majority consumed by fish is primarily utilized for building muscle, leading to an increase in muscle protein content.

The table shows a critical evaluation of the monthly, seasonal, and yearly average protein content in three freshwater fish species—Catla, Rohita, and Mrigala—catch from Khan Talab, Shahdol (M.P.), within two years from February 2021 to January 2023. The results show that the protein content as a whole over the two years was constant, with the average content of each of the species being fairly close to one another. Particularly, Catla had the highest protein content throughout with a yearly average of 13.45% in both years. Rohita had the lowest mean protein content with 12.72% for 2021–2022 and 12.73% for 2022–2023. Mrigala had intermediate values with means of about 13.24% and 13.25% respectively (Table 1).

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Carbohydrates are compounds that consist of polyhydroxy-aldehyde or ketones. The small compounds that have 3 to 9 carbon atoms are referred to as monosaccharides. The condensation of monosaccharides results in the formation of larger disaccharides and polysaccharides. Carbohydrates can be kept in the liver and muscles as glycogen (Kuchel and Ralston, 2009). Carbohydrates serve as a primary source of energy within the cells. It serves a vital function as a fuel and energy source in cellular metabolism (Somaiah et al., 2015).

In this study, fish carbohydrates were measured using the Anthrone method. Numerous researchers assess fish carbohydrates through this approach, including Islam and Joadder (2005), Musa (2009), Ravichandran et al. (2011), Pilla et al. (2014), Murlidharan (2014), and Choudhary and Kumar (2017). Pilla et al. (2014) noted similar findings while studying Lutjanus johni fish at the Vishakhapatnam coast. Jyrwa and Bhuyan (2016) indicated that fishes have low levels of carbohydrates, possibly due to limited reserves in their bodies. The carbohydrate levels in fish muscles remain consistent throughout the year.

Lipids content in fish in Khan Talab:

The table 3 shows the mean monthly, seasonal, and yearly lipid (fat) content in three freshwater fish species—Catla, Rohita, and Mrigala from Khan Talab, Shahdol (M.P.), for two consecutive years (February 2021 to January 2023). The lipid content is expressed as percentage and indicates the nutritional richness of these species throughout the year. Throughout both the years, Catla maintained the highest lipid value throughout, with a peak of 1.10% in February 2021–2022 and 1.15% in February 2022–2023. Rohita and Mrigala presented relatively lower values, with Mrigala having reasonably constant but moderate lipid values throughout the months. The winter season's lowest values, January and December, presented values as low as 0.89% for Catla and 0.82% for Rohita in 2022–2023.

The yearly average lipid content was consistent from year to year at around 0.99% (2021–2022) and 0.98% (2022–2023), reflecting hardly any year-on-year change. Low variability is reflected through values of standard deviations (±0.03 to ±0.08), which support the uniformity of lipid levels. Seasonal analysis indicates rainy and summer seasons favour marginally higher lipid accrual than winter. During both years, the rainy season had the most elevated average lipid values (1.01% and 1.00%), perhaps because of greater food supply and metabolic levels. Winter months had the lowest average lipid levels (0.97% and 0.96%), perhaps because of less feeding and decelerated metabolic rates. Generally, the lipid content of such fish species varies slightly by month and season but is generally steady year after year, with Catla richest in lipids, particularly in February and the rainy season, thus being of great nutritional value.

Lipids and their constituents play a crucial role in the biological adaptation of all organisms. Lipids are the substances that significantly contribute to membrane-related functions. Osmoregulation, nutrient uptake, and the movement of particles between the inner and outer sides and vice versa. In the current study, fish lipids were measured using the method established by Bligh and Dyer (1959). Numerous researchers assess lipids in various fish types using this technique, including Musa (2009) and Khamankar (2010).

Ravichandran et al. (2011) researched six key commercial fish species and noted that low lipid levels in these fishes may result from decreased gonadal activity. Typically, the total lipid content in fish rises prior to reproductive stages.

As stated by Jeyasenta and Patterson (2014), lipids in fish served as an essential energy source and aided in the absorption of fat-soluble vitamins (A, D, E, and K). The fish that were also a good source of vitamins. They also mentioned that total lipid contents within the same fish species may differ based on age differences and stages of maturation.

Jyrwa and Bhuyan (2016) also note the highest lipid levels during the breeding season. This could be attributed to the increased energy demands during the spawning period associated with elevated temperatures. As the temperature rose, sources of nutrients also grew. They note the lowest lipid levels in the post-monsoon and spent seasons.

Table 1: Mean annual, monthly, and seasonal nutritional value of Protein Content in gram of Fish from February 2021 to January 2023 in Khan Talab, Shahdol (M.P.)

		2021 to 2022				2022 to 2023			
S.No.	Month's Name	Catla	Rohu	Mrigal	Average	RS1	RS2	RS3	Average
1	February	13.20	12.10	12.80	12.70	13.15	12.17	12.87	12.73
2	March	13.40	12.40	12.89	12.90	13.47	12.47	12.81	12.92
3	April	13.01	11.85	12.70	12.52	13.08	11.77	12.72	12.52
4	May	13.33	12.35	13.05	12.91	13.25	12.37	13.13	12.92
5	June	13.56	12.47	13.15	13.06	13.58	12.55	13.05	13.06
6	July	13.84	12.64	13.57	13.35	13.92	12.54	13.58	13.35
7	August	13.98	13.20	13.68	13.62	13.88	13.21	13.67	13.59
8	September	13.79	13.36	13.87	13.67	13.80	13.35	13.84	13.66
9	October	13.64	13.25	13.74	13.54	13.63	13.22	13.78	13.54
10	November	13.46	13.15	13.35	13.32	13.43	13.19	13.39	13.34
11	December	13.30	13.05	13.12	13.16	13.34	13.09	13.16	13.20
12	January	12.87	12.79	12.98	12.88	12.91	12.83	12.99	12.91
Average		13.45	12.72	13.24	13.14	13.45	12.73	13.25	13.14
Min.		12.87	11.85	12.70	12.52	12.91	11.77	12.72	12.52
Max.		13.98	13.36	13.87	13.74	13.92	13.35	13.84	13.70
SD±		0.33	0.49	0.39	0.37	0.32	0.50	0.39	0.36
Season's Name									
Rainy		13.81	13.11	13.72	13.55	13.81	13.08	13.72	13.54
Winter		13.21	12.77	13.06	13.01	13.21	12.82	13.10	13.04
Summer		13.33	12.27	12.95	12.85	13.35	12.29	12.93	12.85

Table 2: Mean annual, monthly, and seasonal nutritional value of Carbohydrate Content in gram of Fish from February 2021 to January 2023 in Khan Talab, Shahdol (M.P.)

		2021 to 2022				2022 to 2023			
S.No.	Month's Name	Catla	Rohu	Mrigal	Average	RS1	RS2	RS3	Average
1	February	0.75	0.69	0.73	0.72	0.70	0.76	0.80	0.75
2	March	0.85	0.75	0.79	0.80	0.92	0.82	0.71	0.82
3	April	0.73	0.65	0.75	0.71	0.80	0.57	0.77	0.72
4	May	0.78	0.68	0.75	0.74	0.70	0.70	0.84	0.75
5	June	0.72	0.62	0.69	0.68	0.74	0.71	0.60	0.68
6	July	0.68	0.60	0.67	0.65	0.76	0.50	0.68	0.65
7	August	0.65	0.60	0.65	0.63	0.55	0.61	0.64	0.60
8	September	0.62	0.58	0.63	0.61	0.63	0.57	0.60	0.60
9	October	0.56	0.53	0.56	0.55	0.55	0.50	0.60	0.55
10	November	0.56	0.53	0.56	0.55	0.53	0.57	0.60	0.56
11	December	0.51	0.48	0.51	0.50	0.55	0.52	0.55	0.54
12	January	0.48	0.46	0.47	0.47	0.52	0.50	0.48	0.50
Average		0.66	0.60	0.65	0.63	0.66	0.61	0.66	0.64
Min.		0.48	0.46	0.47	0.47	0.52	0.50	0.48	0.50
Max.		0.85	0.75	0.79	0.80	0.92	0.82	0.84	0.86
SD±		0.12	0.09	0.10	0.10	0.13	0.11	0.11	0.10
Season's Name									
Rainy		0.63	0.58	0.63	0.61	0.62	0.55	0.63	0.60
Winter		0.58	0.54	0.57	0.56	0.58	0.59	0.61	0.59
Summer		0.77	0.68	0.75	0.73	0.79	0.70	0.73	0.74

Table 3: Mean annual, monthly, and seasonal nutritional value in % (Lipids Content) of Fish from February 2021 to January 2023 in Khan Talab, Shahdol (M.P.)

		2021 to 2022				2022 to 2023			
S.No.	Month's Name	Catla	Rohu	Mrigal	Average	RS1	RS2	RS3	Average
1	February	1.10	0.97	1.01	1.03	1.15	1.05	1.00	1.07
2	March	1.07	0.98	0.98	1.01	1.00	0.96	0.99	0.98
3	April	1.03	0.90	0.96	0.96	0.96	0.82	0.99	0.92
4	May	1.02	0.93	0.98	0.98	1.10	1.03	0.94	1.02
5	June	1.02	0.94	0.98	0.98	1.00	0.92	0.94	0.95
6	July	1.04	0.94	1.00	0.99	0.96	0.95	0.96	0.96
7	August	1.04	0.98	1.04	1.02	1.14	1.01	1.03	1.06
8	September	1.02	1.02	1.02	1.02	1.01	0.98	1.00	1.00
9	October	1.04	0.97	1.00	1.00	1.05	0.93	0.97	0.99
10	November	0.99	0.95	0.97	0.97	1.02	0.91	0.93	0.95
11	December	0.96	0.94	0.95	0.95	0.92	0.93	0.94	0.93
12	January	0.93	0.93	0.94	0.93	0.89	0.91	0.92	0.90
Average		1.02	0.95	0.99	0.99	1.02	0.95	0.97	0.98
Min.		0.93	0.90	0.94	0.93	0.89	0.82	0.92	0.90
Max.		1.10	1.02	1.04	1.05	1.15	1.05	1.03	1.08
SD±		0.05	0.03	0.03	0.03	0.08	0.06	0.04	0.05
Season's Name									
Rainy		1.03	0.98	1.02	1.01	1.04	0.97	0.99	1.00
Winter		1.00	0.95	0.97	0.97	1.00	0.95	0.95	0.96
Summer		1.03	0.94	0.97	0.98	1.01	0.93	0.96	0.97

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