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Research Article

ANALYSIS OF THE GUT CONTENTS OF INDIAN MAJOR CARP ROHU (*LABEO ROHITA*) FROM MEERANPUR LAKE OF DISTRICT SULTANPUR, UTTAR PRADESH, INDIA

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ABSTRACT

The present study was carried out to analyze the gut contents of Indian major carp Rohu (*Labeo rohita*) from Meeranpur Lake of district Sultanpur, Uttar Pradesh, India. Monthly samples were collected from the lake for the analysis of gut contents during August 2018 to July 2019.The analysis of gut contents of Indian major carp, *L. rohita* provides information on quality and quantity of food components and feeding habit of fish. The results so obtained were used to compute percentage volume of food items in the gut (% V_i), percentage of occurrence of guts having particular food items (% O_i), Index of preponderance and the grading of food items of gut contents of *L. rohita*. Under natural condition the fingerling stage of *L. rohita* prefers zooplankton with phytoplankton as subsidiary food. The fingerling stage of the fish exhibited a strong positive selection for all zooplanktonic organisms and smaller phytoplankton. The adult stage of *L. rohita* show a strong negative selection for all zooplanktonic organisms and positive selection for most phytoplanktonic organisms and submerged macro vegetation. The present study agreed that the Indian major carp *L. rohita* exhibits different feeding strategy during its growth from fingerling to adult.

Keywords: Gut Content Analysis, Index of Preponderance, *Labeo rohita*, Meeranpur Lake.

INTRODUCTION

The analysis of gut contents of fish provides an important insight in to the feeding pattern and qualitative as well as quantitative assessment of feeding habits. The information on diet and food habits are valuable in the decision making process related to natural resources (Kido, 1996). The analysis of food and feeding patterns of fish is an important aspect of fisheries management. Fish diet represents an integration of many important ecological components that includes behavior, condition, habitat use, energy intake and inter and intra specific interactions. The food, feeding habits and gut content analysis can be used to evaluate the habitat preferences, prey selection, effects of ontogeny and developing conservation strategies (Guy & Brown, 2007). A food habit study might be conducted to investigate the most frequently consumed prey or to determine the relative importance of different food types to fish nutrition and to quantify the ingestion rate of individual food types. The study of the feeding habits of fish based on direct examination of gut content has become a standard practice for many years (Hyslop, 1980). Recently many other methodologies such as radioisotopes, stable isotope analysis, direct species observations and fatty acid analysis are currently being used (Braga *et al*., 2012). These approaches have both positive (more accurate and can reveal even the items which cannot be identified by microscopic study) and negative (expensive, complicated procedures) effects. However, the direct gut content analysis carried out commonly through dissection or evacuation and the examination of gut content is still the most used and easiest method with great potential and good enough form most biological studies (Manko, 2016).

Fish performs their various physiological activities such as growth, reproduction; restoration etc. with the help of energy obtained from the food and is highly adopted in their feeding habits with utilizing most of the readily available food components. The qualitative and quantitative dietary analysis of fish in their natural habitats enhances the understanding of the growth, abundance, productivity of water body (Nansimole *et al*., 2014) and used to describe

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food habits, feeding patterns of fishes (Ekpo *et al*., 2014). The feeding intensity of mature fish decreases during the spawning season, as compared to the non-spawning season (Sunder *et al*., 1984).The relationship between the fish and food component is essential for the production and exploitation of the fish stocks (Panicker, 2000). It is virtually impossible to gather sufficient information of food and feeding habit of fish in their natural habitat without studying its gut contents. A thorough knowledge on the analysis of gut content (food and feeding habit) provides keys for the selection of cultivable species and successful fish farming. The food habit of different fish varies from month to month. This variation is due to changes in the composition of food organisms occurring at different seasons of the year. Many authors examined the qualitative and quantitative methods, compared and employed the best one for application in the various scenarios and for highlighting different aspects of feeding ecology (Baker *et al*., 2014; Cortés, 1997; Guy & Brown, 2007; Hansson, 1998; Hynes, 1950; Hyslop, 1980; Karim & Hossain, 1972; Liao *et al*., 2001; Manko, 2016; Pillay, 1953). Generally, on the basis of index of preponderance and grading of food items of the gut contents of fish, one presume that some food is more important than others to the growth, survival, size structure, reproductive success etc. thus, it is crucial to describe the true importance of food contents (Bowen,1996).

MATERIALS AND METHODS

The samples of experimental fish *Labeo rohita* were collected from Meeranpurlake of district Sultanpur, Uttar Pradesh, India with the help of fisherman during investigation period from August 2018 to July 2019. The month wise (10 samples per month) collection and analysis of gut contents were made to study the seasonal variation in food choice and feeding habit of the fish. Just after collection 10% formalin solution was injected into the gut of all the samples of fishes in order to stop digestion of food items. The gut was then cut open and all the contents were analyzed under binocular microscope for the food composition, preference and relative importance of various food items. All the experiments were carried out in the laboratory of Post Graduate Department of Zoology, Ganpat Sahai P.G. College Sultanpur, Uttar Pradesh, India.

Visual Estimation Method

The feeding intensity was assessed by visual estimation (Pillay, 1953) based on the distension of the gut and the quantity of food contained in it. The various gut conditions based on degree of fullness are expressed as gorged, full, 3/4full, 1/2full, 1/4full, trace and empty.

Volumetric Methods

Volume of food is considered as a more satisfactory method by many workers for quantitative analysis of gut contents. The volume forms very suitable means of assessment especially in the case of herbivorous and mud feeding fishes (Hynes, 1950). The volume of specific food is expressed as the ratio between volume of individual food item and total volume of gut contents.

$$\text{Percentage by Volume (\% Vi)} = \frac{\text{Volume of individual food item (Vi)}}{\text{Total Volume of gut contents (Vt)}} \times 100$$

Occurrence Method

Recording the presence or absence of each food items across all individuals is the simplest way to reveal the relative importance of different food items and to judge the dietary composition of a fish population; the importance is inferred from the proportions of total guts containing each food item (Baker *et al*., 2014). Each food item occurred in number of stomachs is recorded and expressed as a percentage of the total number of fish stomach examined.

$$\text{Percentage of Occurrence (\% O}_i\text{)} = \frac{\text{Number of stomach containing prey (Ni)}}{\text{Total number of stomachs examined (Nt)}} \times 100$$

Index of Preponderance

The index of preponderance (Natarajan & Jhingran, 1961) gives a single value for each attribute based on frequency of occurrence and volume of various food items. Index of preponderance provides a definite and measurable basis of grading the various food elements. A comparison of the values obtained permits a ranking of the food items in order of mathematical dominance. The index of preponderance are convinced it and has enormous advantages particularly when studying fish diet in open waters where animals have ingress to various organisms (Mohan & Sankaran, 1988). They also consider it to be an objective and suitable measure of food dominance within the diet. On the other side, the index of preponderance technique does not discriminate between the importance of food items by weight or occurrence and it is not suitable for dietary comparisons (Marshall & Elliott, 1997). The index of preponderance was obtained by using following formula:

$$\text{Index of preponderance (I)} = \frac{\text{Vi} \times \text{Oi}}{\sum \text{Vi} \times \text{Oi}} \times 100$$

Where, VI= Percentage of volume of food items.

Oi= Percentage of occurrence of food items.

RESULTS AND DISCUSSION

In the present investigation, total 120 stomach of *L. rohita* were examined visually. Out of 120, 101 (84.17%) stomach contained food and19 (15.83%) were without food, which varied from month to month. Among these 23 were full, 32were ¾ full, 25 were ½ full, 21 were 1/4 full and 19 were empty. The Index of Preponderance and Grading of various food items of gut contents of fingerlings of *L. rohita* are enumerated in Table 1. In case of fingerlings, Crustaceans (cladocerans and copepods) formed the main food items of gut contents forming 22.36% by volume and 24.48% by occurrence. Rotifers formed the second important food items in the gut contents forming 17.35% by volume and

18.52% by occurrence. *Bacillario phyceae* (diatoms) formed the next important food items of gut contents which constitute 15.68% by volume and 12.74% by occurrence. The percentage of Protozoans in the gut contents of fingerlings were 10.57% by volume and 11.36% by occurrence. The percentage of Myxophyceae (blue-green algae) in the gut contents were 8.92% by volume and 9.22% by occurrence. The percentage of Chlorophyceae (green algae and desmids) formed a part of gut contents by constituting 9.56% by volume and 7.98% by occurrence. The aquatic insects and their instars forming 7.84% by volume and 6.47% by occurrence. The remnants of macro vegetation were represented by 5.76% by volume and 6.92% by occurrence.

Decayed and semi-decayed organic matter constituted only 1.96% by volume and 2.31% by occurrence. In the present study, the Index of Preponderance and Grading of food items shows the importance of food items in order of mathematical dominance for fingerlings of experimental fish *L. rohita* are as Crustaceans (37.95%; Grade I), Rotifers (22.28%; Grade II), Bacillariophyceae (13.85%; Grade III), Protozoans (8.32%; Grade IV), Myxophyceae (5.70%; Grade V), Chlorophyceae (5.29%; Grade VI), Aquatic Insects and their larvae (3.51%; Grade VII), Remnants of macrovegetation (2.76%; Grade VIII) and the Decayed and semi-decayed organic matter (0.31%; Grade IX).

Table 1. Index of Preponderance and grading of various food items of gut contents of fingerlings of Indian major carp, *Labeo rohita* from Meeranpur Lake of district Sultanpur, Uttar Pradesh, India.

Food items	% of Volume(V_i)	% of Occurrence (O_i)	$V_i \times O_i$	Index of Preponderance (I)	Grading
Aquatic Plant Materials	5.76	6.92	39.86	2.76	VIII
Chlorophyceae	9.56	7.98	76.29	5.29	VI
Bacillario phyceae	15.68	12.74	199.76	13.85	III
Myxophyceae	8.92	9.22	82.24	5.70	V
Protozoans	10.57	11.36	120.08	8.32	IV
Rotifers	17.35	18.52	321.32	22.28	II
Crustaceans	22.36	24.48	547.37	37.95	I
Aquatic Insects	7.84	6.47	50.73	3.51	VII
Decayed Organic Matter	1.96	2.31	4.53	0.31	IX
Summation	100.00	100.00	$\sum V_i \times O_i$ = 1443.07	100.00	

The Index of Preponderance and Grading of various food items of gut contents of adult stage of experimental fish *L. rohita* are enumerated in Table 2**.** In case of adult fish *L. rohita*, Chlorophyceae (green algae) formed the main food items of gut contents forming 19.46% by volume and 20.32% by occurrence. *Bacillario phyceae* (diatoms) formed the second important food items of gut contents forming 16.74% by volume and 18.46% by occurrence. Myxophyceae (blue-green algae) formed the next important food items of gut contents forming 15.88% by volume and 17.28% by occurrence. The remnants of macro vegetations are also important food items of gut contents forming 16.42% by volume and 16.21% by occurrence. The percentage of Crustaceans in the gut contents of adult fish *L. rohita* were least in comparison to fingerlings, forming 9.92% by volume and 8.65% by occurrence. The percentage of Rotifers in the gut contents were 8.54% by volume and 6.72% by occurrence. The percentage of Protozoans in the gut contents were 5.83% by volume and 4.43% by occurrence. The percentage of decayed and semi-decayed organic matter constituted 3.99% by volume and 4.52% by occurrence. The percentage of aquatic insects and their larvae forming 3.22% by volume and 3.41% by occurrence.

Table 2. Index of Preponderance and grading of various food items of gut contents of Adult stage of Indian major carp *Labeo rohita* from Meeranpur Lake of district Sultanpur, Uttar Pradesh, India.

Food items	% of Volume (V_i)	% of Occurrence (O_i)	$V_i \times O_i$	Index of Preponderance (I)	Grading
Aquatic Plant Materials	16.42	16.21	266.17	18.44	IV
Chlorophyceae	19.46	20.32	395.43	27.40	I

Bacillariophyceae	16.74	18.46	309.02	21.41	II
Myxophyceae	15.88	17.28	274.41	19.02	III
Protozoans	5.83	4.43	25.83	1.79	VII
Rotifers	8.54	6.72	57.39	3.98	VI
Crustaceans	9.92	8.65	85.81	5.95	V
Aquatic Insects	3.22	3.41	10.98	0.76	IX
Decayed Organic Matter	3.99	4.52	18.03	1.25	VIII
Summation	100.00	100.00	$\sum V_i \times O_i$ = 1443.07	100.00	

In the present study, the Index of Preponderance and Grading of food items shows the importance of food items in order of mathematical dominance for adult stage of experimental fish *L. rohita* are as Chlorophyceae (27.40%; Grade I), Bacillariophyceae (21.41%; Grade II), Myxophyceae (19.02% ; Grade III), Aquatic Plant materials (18.44%; Grade IV), Crustaceans (5.95%; Grade V), Rotifers (3.98%; Grade VI), Protozoans (1.79%; Grade VII), decayed organic matter (1.25%; Grade VIII) and aquatic insects and their larvae (0.76%; Grade IX).

CONCLUSION

On the basis of present study we conclude that the Indian major carp rohu (*L. rohita*) is water column feeder which feeds on planktons and remnants of submerged vegetation. The juvenile and adult stage of rohu is herbivorous column feeder, preferring algae and submerged vegetation. Under natural condition, fingerling of rohu prefers zooplankton, with phytoplankton as subsidiary food (Alam *et al*., 2011). Thus, the fingerlings of rohu exhibited a strong positive selection for all zooplanktonic organisms and smaller phytoplanktons. The adult stage of rohu show a strong negative selection for all zooplanktonic organisms and positive selection for most phytoplanktonic organisms as well as submerged macrovegetation (Rahman *et al*., 2009). In conclusion, it is agreed that rohu exhibits different feeding strategy during its growth from fingerlings to adult.

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