©2017 The Academy of Environmental Biology, India
ISSN (Print): 0972-4397
ISSN (Online): 0974-0805
Journal of Ecophysiology and Occupational Health, *Vol 17(1&2), DOI : 10.18311/jeoh/2017 /16360, 40-49, January-June 2017*

Studies on the Feeding habits of Labeo rohita (Ham.) from Gho-Manhasa Fish Ponds, Jammu, North India

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Abstract

The present study was carried out to study the feeding habits of Labeo rohita from culture ponds of Gho-Manhasa fish farm, Jammu. Monthly samples were collected from the ponds to study the gut contents. In case of L. rohita in LrfI (lowest size group) and LrfII, LrfIII 40 guts/group, LrfIV 50 guts (due to non-availability of the size categorized) and 120 guts each in case of LrfV and LrfVI (largest size group) were analysed. For every group 10 guts/month were analysed to study feeding ecology in case of L. rohita. Individual stomach fullness scale was estimated to a subjective scale, ranging from 0 (empty) to 5 (full). The results so obtained were used to compute percentage volume of food items in the gut (%V), percentage of occurrence of guts having particular food item (%O) and Index of preponderance (IOP). The food of Labeo rohita consisted of plant (algae and macrophytes) and animal matter (protozoa, rotifers, cladocerans, copepods, molluscs, annelids and insects) besides unidentified matter (UM), sand/mud and detritus. Of the total 420 specimens analyzed, only 84 (20%) were found with empty guts and 336 (80%) were found with food components. Index of Preponderance (IOP) revealed that algae, along with protozoans, rotifers and cladocerans were the most preferred food items in the smaller size groups and marked a decline as the size of the fish increased. In the advanced stages, macrophytes, detritus and sand/mud were found to form a major share of food. Subsequently rohu has been categorized as omnivore-planktophage in early stages of life and herbi-omnivore in adult stages.

Keywords: Feeding, Fish, Gut Contents, Index of Preponderance, Jammu, Labeo rohita, Ponds

1. Introduction

Low survival rates of fish during larval stages constitute a major bottleneck in the successful culture of many marine and some freshwater fish (Rao, 2003). Fish, prawn and other aquatic animals are quite fragile and delicate at the time of their first feeding. A heavy larval mortality occurs especially during the time when they transit from endogenous to exogenous mode of feeding. It is the most "critical phase" of their life when they need right type of nourishment for their survival and growth. If this requirement is not satisfactorily met majority of them perish and this results in the loss of biological potential of fish resource. In nature such a loss is compensated by enhanced fecundity (Malhotra and Munshi, 1985; Pillay, 1990). Availability of optimal sized prey organisms at appropriate concentrations in the medium is a central factor influencing the larval survival, it is thus essential to understand the ecology and ethnology of feeding in larval stages of cultured species. Indian major carps are the important fishes from aquaculture point of view have still certain lacunae in their culture. Information is still needed in terms of feeding parameters such as optimal size, density of food organisms, prey capture, feeding success, preference, habit, frequency of feeding and daily feed intake. Such information is very useful in rearing fish particularly larvae. Such information also helps in formulating acceptable and nutritionally balanced complete artificial fish diets. (May, 1974; Mookerji and Rao, 1995).

Freshwater aquaculture has witnessed an unprecedented increase for the last few decades with quality

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production especially of carps such as *Catla catla, Labeo rohita, Cirrhinus mrigala* and *Labeo calbasu* being accorded highest priority. Among Indian major carps, rohu (*Labeo rohita)* is probably the most sought and intensively cultured species (Jhingran and Pullin, 1985). *Labeo rohita*, which accounts for 15% of the world's freshwater aquaculture production, reports on the feeding of rohu on natural organisms in semi-shallow or shallow aquatic environments are few and scattered. An attempt has been made to study the feeding habits of *Labeo rohita* from ponds of Gho-Manhasa fish farm, Jammu.

2. Materials and Methods

To identify the food of various developmental stages of *Labeo rohita*, the animals of different size groups were collected from Gho-Manhasa fish ponds (32° 33' N- 74° 57' E) at a distance of about 12 Kms from Jammu city from August 2005-July 2006.

3. Collection of Samples

Labeo rohita were collected from the Gho-Manhasa fish farm ponds with the help of mosquito net gently dragged along the sides of pond. The larger size groups however, were collected with the large drag net. The categorization on the basis of sex was made to reveal the feeding stratagem of animals under investigation right from larval stage to adult stage and between males and females. The fish were divided into six size groups: **LrfI** (Size 5.0 mm – 10.0 mm); **LrfII** (Size 11.0 mm – 20.0 mm); **LrfIII** (Size 21.0 mm – 100.0 mm); **LrfIV** (Size 101.0 mm – 250.0mm); **LrfV** (Size 251.0 mm – 500.0 mm Male); **LrfVI** (Size 251.0 mm – 500.0 mm Female)

The plankton samples were collected from pond by filtering 100 litres of surface water through silk bolting round mouth conical plankton net (50-100μm mesh size), preserved in 5% formalin and examined under stereomicroscope (100-400X) with Reyne's mount (Chloral hydrate, 50gm; water, 50ml; Glycerine, 12.7ml; Gum Arabic, 30g) and identified to lowest possible taxonomic level with the help of Ward and Whipple (1959), Needham and Needham (1962), Adoni (1985).

The benthic samples were collected from pond with the help Ekman dredge. Samples collected were then sieved through sieve no. 40 having 256 meshes/cm^2. Macrobenthic organisms were picked up from the sieved material with the help of foreceps/brush and preserved in 5% formalin and examined under stereomicroscope (100-400X) for further identification. The identification was carried out by following Ward and Whipple (1959), Needham and Needham (1962), Adoni (1985).

The preserved specimens were then brought to the wet lab of the Department of Zoology, University of Jammu for further analysis. The preserved specimens were measured for their total length (TL) (nearest to 0.1mm using a divider under stereomicroscope). The alimentary tracts were removed, weighed (nearest to 0.1grams) and measured (nearest to 1.0 grams). The gut contents were emptied in petridishes containing freshwater. All the food items were examined using a stereomicroscope (100-400X) and identified to the lowest possible taxonomic level with the help of Ward and Whipple (1959), Needham and Needham (1962), Adoni (1985).

In case of *L. rohita* in LrfI and LrfII, LrfIII 40 guts/group, LrfIV 50 guts (due to unavailability of the size categorized) and 120 guts each in case of LrfV and LrfVI were analysed. For every group 10 guts/month were analysed to study feeding ecology in case of *L. rohita*. Individual stomach fullness scale was estimated to a subjective scale, ranging from 0 (empty) to 5 (full) as referred in Collins (1999). The results so obtained were used to compute percentage volume of food items in the gut (%V), percentage of occurrence of guts having particular food item (%O) and Index of preponderance (IOP)) (Natrajan and Jhingran, 1961) was calculated as follows:

$$IOP = V_i O_i (\Sigma V_i O_i)^{-1} X100$$

Where:

V_i = volume (percentage) of "i" item

O_i = frequency of occurrence (percentage) of "i" item

4. Results and Discussion

During the present course of investigations *Labeo rohita* was studied to know their potential food sources (**Table 1**). A total of 420 specimens of *Labeo rohita* were analysed by categorizing them into six categories based on size and sex. Out of total 420 specimens analysed 84 (20%) guts were found to be empty while 336 (80%) contained food. Food items identified in the gut of *Labeo rohita* were categorized into 12 main groups' viz., protozoa, algae, rotifers, cladocerans, copepods, molluscs, annelids, insects, macrophytes, unidentified matter (UM), sand/mud and detritus.

The results so obtained were used to compute percentage volume of the food items in the gut (%V), percentage occurrence of the guts having the particular food item (%O) and Index of Preponderance (IOP) of the food items in the gut for *L. rohita*.

LrfI (**Table 2-3**): Out of the total 40 guts analyzed, 12 (30%) were found empty and 28 (70%) had food components. Stomach fullness scale revealed higher values on scale 1 (40.0%) and 2 (25.0%). Analysis of the stomach contents on the basis of IOP unveils the dominance of Algae (70.24%) followed by Protozoans (12.14%), Rotifers (6.68%), Unidentified matter (2.14%), Detritus (1.87%), Cladocerans (0.46%).

LrfII (**Table 2-3**): Of 40 guts analyzed, 8 (20%) were found without food while 32 (80%) were full. Furthermore, stomach fullness scale indicate higher values on scale 1 (45.0%) followed by scale 2 (20%) and scale 3 (15.0%) respectively. Stomach content analysis of LrfII revealed Algae (60.04%) as dominant food item on the basis of IOP followed by Protozoans (11.04%),

Table 1. List of the Food Items Recorded During Study Period (I) Gho-Manhasa Pond (II) Gut of *Labeo rohita*.

Food items	I	II	Food items	I	II	Food items	I	II
ALGAE			*Polyarthra* sp.	+	-	ARTHROPODA		
Cyanophyceae			*Lecane* sp.	+	+	Odonata		
Oscillatoria sp.	+	+	*Filinia* sp.	+	+	*Anax* sp.	+	-
Spirulina sp.	+	+	*Monostyla* sp.	+	-			
						Diptera		
Euchlorophyceae			ANNELIDA			*Tabanus* sp.	+	-
Volvox sp.	+	+	*Tubifex* sp.	+	-	*Chironomus* sp.	+	+
			Lumbriculus sp.	-	-	*Forcipomyia* sp.	-	-
Zygophyceae						*Tipula* sp.	+	-
Zygnema sp.	+	+	CRUSTACEA					
Cosmarium sp.	+	+	Cladocera			MOLLUSCA		
Spirogyra sp.	+	+	*Daphnia* sp.	+	+	Gastropoda		
			Moina sp.	+	+	*Lymnea* sp.	+	-
Bacillariophyceae			*Ceriodaphnia* sp.	-	+	*Gyralus* sp.	+	-
Navicula sp.	+	+	*Simocephalus* sp.	+	+	*Pelecypoda* sp.	+	-
Cymbella sp.	+	+	*Bosmina* sp.	+	-	*Uniomerus* sp.	+	-
Fragillaria sp.	-	+	*Alona* sp.	+	+			
Diatoma sp.	+	+	*Chydorus* sp.	-	-	VEGETAL REMAINS	+	+
			Leydigia sp.	+	-			
Ulithricophyceae			*Macrothrix* sp.	+	-	SAND	+	+
Ulothrix sp.	+	+						
Microsporas sp.	+	+	Copepoda			**UNIDENTIFIED MATTER**	+	+
			Mesocyclops sp.	+	+			
Euglenophyceae			*Cyclops* sp.	+	+			
Euglena sp.	+	-	*Diaptomus* sp.	+	+			
Phacus sp.	+	-						
			Ostracoda					
ROTIFERA			*Cypris* sp.	+	+			
Brachionus sp.	+	+	*Stenocypris* sp.	+	+			
Keratella sp.	+	+						

Table 2. Number of Empty Guts and Stomach Fullness Scale of *L. rohita* Observed during the Study Period.

Parameters	LrfI		LrfII		LrfIII		LrfIV		LrfV		LrfVI		Mean	
	N Guts	%O	N Guts	%O	N Guts	%O	N Guts	%O	N Guts	%O	N Guts	%O	N Guts	%O
No. of Empty guts	12	30	8	20	11	22	8	16	19	15.83	26	21.66	84	20
Total no. of guts with food	28	70	32	80	39	78	42	84	101	84.16	94	**78.33**	336	80
Stomach fullness scale														
1	16	40	18	45	17	34	11	22	18	15	21	17.5	101	24.04
2	10	25	8	20	12	24	12	24	20	16.66	17	14.16	79	18.09
3	2	5	6	15	10	20	14	28	18	15	20	16.66	70	16.66
4	0	0	0	0	0	0	5	10	22	18.33	17	14.16	44	10.47
5	0	0	0	0	0	0	0	0	23	22.77	19	15.83	42	10

Table 3. Percentage Volume (%V), Frequency of Occurrence (%O) and Index of Preponderance (IOP) of the Food Items in the Guts of *L. rohita* Analyzed during the Study Period.

Food Items	LrfI			LrfII			LrfIII			LrfIV			LrfV			LrfVI		
	%V	%O	IOP	%V	%O	IOP	%V	**%O**	**IOP**	**%V**	**%O**	**IOP**	**%V**	**%O**	**IOP**	**%V**	**%O**	**IOP**
Algae	60.75	100	**70.24**	47	87.5	**60.04**	26.6	82.05	**34.36**	21.2	47.61	**22.36**	13.25	67.32	**14.61**	14.41	63.36	**13.28**
Protozoa	14	75	**12.14**	11	68.75	**11.04**	10.4	66.66	**10.91**	7.2	64.28	**10.25**	2.83	31.68	**1.47**	2.08	19.8	**0.59**
Rotifera	9.5	60.7	**6.68**	11	53.12	**8.53**	10.2	56.41	**9.06**	5.8	50	**6.42**	3.58	38.61	**2.26**	2.58	22.77	**0.85**
Cladocera	2.25	17.8	**0.46**	15.5	43.75	**9.9**	24.2	51.28	**19.54**	9.8	40.47	**8.78**	3.16	35.64	**1.84**	2.08	27.72	**0.83**
Copepoda	0	0	**0**	6.25	59.37	**5.41**	14.2	69.23	**15.48**	8.4	61.9	**11.52**	5.0	44.55	**3.64**	4.16	50.49	**3.05**
Mollusca	0	3.5	**0**	0	0	**0**	0	0	**0**	0	0	**0**	2.91	24.75	**1.18**	0.83	18.81	**0.22**

Annelida	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	3	33.66	**1.65**	1.66	33.66	**0.81**
Insecta	0	0	**0**	1.5	15.62	**0.34**	2.2	30.76	**1.06**	10.6	19.04	**4.47**	7.16	47.52	**5.57**	10.08	54.45	**7.98**
Macrophytes	0	0	**0**	0	0	**0**	0	0	**0**	9	47.61	**9.49**	22.16	73.26	**26.6**	20.08	80.19	**23.42**
UM	6.25	89.28	**6.45**	3.5	34.37	**1.49**	4.2	43.58	**2.88**	13.6	38.09	**11.47**	12.75	66.33	**13.85**	14.58	76.23	16.16
Sand	4	46.4	**2.14**	2	31.25	**0.91**	4.2	38.46	**2.54**	7.2	33.33	**5.31**	13.83	66.33	**15.03**	14.16	82.17	**16.93**
Detritus	3.25	50	**1.87**	2.25	62.5	**2.05**	3.8	69.23	**4.14**	7.2	61.9	**9.87**	10.33	72.27	**12.23**	12.91	84.15	**15.89**

Cladocerans (9.9%), Rotifers (8.53%), Copepods (5.4%), Detritus (2.05%), Unidentified matter (1.49%), Sand (0.91%) and Insects (0.34%).

LrfIII (**Table 2-3**): Out of the total 50 stomachs analyzed during the current study, 11 (22%) were empty and 39 (78%) had filled stomachs. The stomach fullness scale revealed higher values on scale 1 (34.0%), 2 (24.0%) and 3 (20.0%). Analysing the contents of gut on the basis of IOP, Algae (34.36%) recorded its dominance followed by Cladocerans (19.54%), Copepods (15.48%), Protozoans (10.91%), Rotifers (9.06%), Detritus (4.14%), Unidentified matter (2.88%), Sand (2.54%) and Insects (1.06%).

LrfIV (**Table 2-3**): Of the total 50 guts analyzed, 8 (16%) were found to be empty while 42 (84%) were having food components in their guts. The stomach fullness scale revealed higher values on scale 3 (28.0%), 2 (24.0%), 1 (22.0%) and 4 (10.0%) respectively. Analysis of stomach contents of LrfIV revealed Algae (22.36%) as the dominant food succeeded by Copepods (11.52%), Unidentified matter (11.47%), Protozoans (10.25%), Detritus (9.87%), Macrophytes (9.49%), Crustaceans (8.78%), Rotifers (6.42%), Sand/mud (5.31%) and Insects (4.47%).

LrfV (**Table 2-3**): Out of 120 guts analyzed, 19 (15.83%) were found empty while 101 (84.16%) contained food. Stomach fullness scale indicated higher values on scale 5 (19.16%), 4 (18.33%) and 2 (16.66%). Further, gut content analysis of LrfV showed the dominance of macrophytes (26.6%) thereafter sand/mud (15.03%), algae (14.61%), UM (13.85%), detritus (12.83%), insects (5.57%), copepods (3.64%), rotifers (2.26%), cladocerans (1.84%), annelida (1.65%), protozoans (1.47%), mollusca (1.18%) respectively.

LrfVI (**Table 2-3**): 26 (21.66%) guts out of the total 120 guts analyzed were found to be empty and 94 guts (78.33%) contained the food items. Stomach fullness scale indicated higher values on scale 1 (17.5%), 3 (16.66%) and 5 (15.83%) respectively whereas 2 and 4 showed 14.16% each. Moreover, analysis of guts on the basis of IOP in case of LrfVI indicated the pre-eminence of Macrophytes (23.42%) followed by Sand/mud (16.93%), Unidentified matter (16.16%), Detritus (15.89%), Algae (13.28%), Insects (7.98%), Copepods (3.05%), Rotifers (0.85%), Cladocerans (0.83%), Annelids (0.81%), Protozoans (0.59%) and Molluscs (0.22%) respectively.

The low percentage of empty stomachs in *Labeo rohita* and high percentage of stomach fullness recorded presently might be due to voracious feeding habit of the fish and abundance of food in the study area. Contrary to the present observation Divita *et al*. (1983) and Brewer *et al*. (1991) recorded higher percentage of empty stomachs.

As a consequence of the present investigation, it was observed that early stages of Labeo rohita feed exclusively on algae but the amount of algal intake decreased with an increase in the size of fish. The algal contents were found to be maximum in LrfI (70.24%) followed by LrfII (60.04%), LrfIII (34.36%), LrfIV (22.36%), LrfV (14.61%) and LrfVI (13.28%). Similarly protozoans, rotifers and cladocerans were observed to be the most preferred food items for LrfI, LrfII and LrfIII but the preference of the fish recorded a decrease as the size of the fish increased. Similarly, copepods due to their large size were observed to be totally absent in LrfI due to the small gape size of the predators but they were found in fairly good amounts in LrfII and LrfIII and decreased thereafter corresponding to an increase in age. Molluscs and annelids were found to be absent in LrfI, LrfII and LrfIII due to the large size of prey and small size of the gape of predator. Insects recorded their absence in LrfI and presence in LrfII (0.34%), LrfIII (1.06%) and LrfIV (4.47%). More so over, table 3 stands witness to the variety of food consumed by the rohu of different size groups. Similar variability in the food items of L. rohita (rohu) collected from different environments has been recorded by Ayotunde et al., (2007). The seasonal variation in the diet of the fish is a function of period abundance of the choicest food items available in adequate quantity in the environment. Rohu has been categorized as bottom feeder and column feeder by Chacko (1951).

Table 3 depicts omnivore-planktophage feature of rohu in early stages of life cycle, with algae forming the main component of its diet. Algae, as major food item in the guts of early stages, mostly inhabit the epilimnion

Table 4. Mean of the Percentage Volume (%V), Frequency of Occurrence (%O) and Index of Preponderance of the Food Items in the Guts of *L. rohita* Analyzed during the Study Period.

Food Items	**Mean±SD %V**	**%O±SD**	**IOP±SD**
Algae	30.53±19.21	74.64±18.84	35.81±24.13
Protozoa	7.91±4.75	54.36±22.76	7.73±5.23
Rotifera	7.11±3.60	46.93±14.00	5.63±3.34
Cladocera	9.49±8.94	36.11±11.94	6.89±7.43
Copepoda	6.33±4.74	47.59±24.87	6.51±5.81
Mollusca	0.62±1.16	7.84±11.041	0.23±.472
Annelida	0.77±1.27	11.22±17.38	0.41±.68
Insecta	5.25±4.61	27.89±20.52	3.23±3.25
Macrophytes	8.54±0.36	33.51±38.27	9.91±12.29
UM	9.14±5.04	57.98±22.55	8.71±6.01
Sand	7.56±5.25	49.65±20.37	7.14±7.02
Detritus	6.62±4.29	66.67±11.50	7.67±5.84

of the aquatic base and consequently detritus and sand/mud is present in very less amount in the guts of early stages. The present studies are also in accordance to the results achieved in case of *L. gonius* wherein Mookerjee and Ganguly (1949) described larvae below 16mm to be omnivore, feeding mainly upon algae and protozoa. Parmeswaran *et al.* (1974) also described post larvae (6-10mm) as surface feeder, exclusively feeding on planktons. Subsequently it can be concluded that larvae, fry's and fingerlings are surface or column feeders. In the advanced stages (i.e. adults) however, macrophytes, detritus and sand/mud are found to form the major share of the food thereby depicting its benthic and omnivorous feeding habits. This projection gets reinforcement from the findings of Dewan *et al.* (1979) who recorded appreciable quantities of sand and mud in the gut contents of rohu as the animal food was scarce. Moreover during the present observation, it was noticed that the plant matter constitute a significant proportion (**Table 4&5**) along with animal matter and detritus in the gut of the fish thereby indicating herbi-omnivory mode of feeding of the *Labeo rohita*. Corroborating the present observation, El Moghraby and El Rahman (1984) categorized rohu as bottom feeder, Mookerjee and Ganguli (1949) described adults as herbivore and bottom feeder and Ayotunde (2007) projected *Labeo coubie* as detritivore/herbivore and a benthic feeder as well showing a wide range of feeding habits.

The occurrence of algae, protozoans, rotifers, cladocerans, copepods, molluscs, annelids, insects, macrophytes, unidentified matter, sand/mud and detritus (Table 3) in the gut of *Labeo rohita* indicated that this species fed on a variety of food items. In fact Dewan *et al.* (1979) and Ayotunde (2007) recorded variations in the preponderance of different food items of *L. rohita* (rohita) collected from different environments. Moreover, Mookerjee *et al.* (1944) and Mookerjee and Ghose (1945) also recorded a variety of food items like unicellular algae, protozoans, rotifers, crustaceans, sand particles and unidentified matter from the gut. In spite of the fact that fish gorged their stomachs with algae and zooplanktons in earlier stages, the later/adult stages had macrophytes, unidentified matter, sand/mud, detritus and insects in their gut contents. Substantiating the present results, Kumar and Siddiqui (1989) suggested *L. calbasu* to be a bottom dwelling, illiophagic fish, feeding upon decayed organic matter, molluscs, diatoms, plant matter, algae and zooplankton. This differential mode of feeding in young and adult stages has also been proposed by Chacko (1951), Alikunhi (1957) and Hora and Pillay (1962) who recorded herbivorous nature of the fry stages and omnivorous nature of the adults of Labeo.

Perusal of table 5 reveals that plant matter contributed about 45.72%, animal matter about 30.63% and detritus about 23.52% thereby indicating omnivorous nature of *L. rohita*. But Das and Moitra (1963) recorded more than 75% plant food in the diet of rohu and hence addressed the fish as herbivorous.

Table 5. Overall Percental Contribution of Plant and Animal Matter and Detritus in the Diet of *Labeo rohita*.

S. No.	Food Item	IOP	Overall Contribution in percent
1.	Plant Matter		45.72
	Algae	35.81	
	Macrophytes	9.91	
2.	Animal Matter		30.63
	Protozoans	7.73	
	Rotifers	5.63	
	Cladocerans	6.89	
	Copepods	6.51	
	Molluscs	0.23	
	Annelids	0.41	
	Insects	3.23	
3.	Detritus		23.52
	UM	8.71	
	Sand/Mud	7.14	
	Detritus	7.67	

A marked difference in the preference of food was observed in different age groups viz, LrfI, LrfII, LrfIII, LrfIV, LrfV and LrfVI. While algae along with zooplankton was found to be most preferred item of LrfI, LrfII, LrfIII and LrfIV, for adults, the zooplanktons were found to be insignificant food items and macrophytes stood premier in the diet of adult fishes. Khan and Siddiqui (1973) also found zooplankton to be the dominant food of fry and fingerlings of major carps (*Labeo rohita*, *Cirrhina mrigala* and *Catla catla*) and as the fishes grew, it gradually changed its food from zooplankton to phytoplankton in the first two species while latter remained primarily a zooplankton feeder.

The fishes are known to change their feeding habit as they grow. Nikolsky (1963) suggested that variation in the composition of food with age and size as a substantial adaptation towards increasing the range of food supply of population by enabling the species as a whole to assimilate a variety of food. Prakash (1962) found that in salmon, feeding habit changes with respect to its locality and time (season) and sometimes when normal food was not available salmon fed on alternate food. But Oliveira (2005) noticed an ample trophic plasticity in the feeding behavior of juvenile pirarucu in their natural environment. Saliu (2002) however reported plant seeds as the most important food items in *Brycinus nurse* in wet season and *P. adusta* eggs were the most important food item in all the length groups except 12-14 cm which fed on *Ceriodaphnia* sp in dry season.

Bhatnagar and Karam-Chandani (1970) reported that *Labeo fimbriatus* fed on the available food showing no preference to any particular food and the same has been corroborated by El Mograbhy and El Rehman (1984) in case of *L. niloticus*. However, Ivlev (1961) suggested that the tendency of a particular animal to consume certain food items selectively in comparison to other is determined by its inherent properties.

The feeding pattern of adult *L. rohita* during the present study period showed a variation with the stage of sexual maturity (**Table 2-3**), reproductive state and the availability of food items in its environment and the same has been propagated by Ricker (1956). An increase in the feeding activity was noted in *Labeo rohita* (LrfV and LrfVI) from September-December (post monsoon and early winter) with remarkably less feeding rate from July to August (Monsoon) which coincided with the spawning season of the species in the pond. Saikia et al (2013) reported *Labeo rohita* exhibited a greater diet breadth in the closed area. Initially it preferred plankton, but later it shifted to both plankton and periphyton food resources from the closed area efficiently. The rohu intelligently shifts its food niche from plankton to the plankton-periphyton interface zone accelerating ingestion of planktonic food whenever required.

Present studies revealed *L. rohita* to be an omnivore-planktophage during its early life history which subsequently showed preference for plant matter (Herbi-omnivore) in later stages.

The earlier research based on the gut content analysis revealed it to be a zooplankton feeder (Miah *et al.*, 1984) or both a zoo-and phytoplankton feeder (Wahab *et al.* 1994) or a periphyton feeder (NFEP 1997; Ramesh *et al.* 1999; Azim *et al.*, 2001)

Table 6 also indicates a variation in the values of RLG (Relative length of the gut) which is lesser but near to 1 for smaller size groups suggesting its tendency towards omnivory. The RLG was found to increase with the increase in plant matter. Similar results have been reported by several authors (Das and Moitra, 1958; Das and Shrivastava, 1979; Dasgupta, 2004) who opined that the gut length of animal depends upon the nature of food they consume, and the length of the gut progressively increases with increasing proportions of vegetable/plant matter in the diet.

Table 6. Relative Length of the Gut of *L. rohita*

S. No.	Size Group	Average RLG
1.	LrfI	0.7±0.2
2.	LrfII	1.1±0.3
3.	LrfIII	4.2±1.5
4.	LrfIV	6.8±2.1
5.	LrfV	8.1±1.8
6.	LrfVI	8.4±1.3

5. Acknowledgements

The authors are thankful to Head of the Department of Zoology, University of Jammu for providing necessary facilities to carry out the research work successfully.

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