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Gut contents analysis of adult of *Labeo rohita* F. Hamilton 1822 from Kot dam of Jhunjhunu District, Rajasthan, India

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Abstract

This study was carried out on the food and feeding preference of Adult *Labeo rohita* from the Kot Dam of Jhunjhunu district, Rajasthan, through gut content analysis. A total of 120 stomachs were visually examined, of which 101 (84.16%) contained food and 19 (15.83%) were empty. The levels of stomach fullness were classified as follows: 23 stomachs were full, 32 were three-quarters full, 25 were half-full, 21 were one-quarter full and 19 were empty. In adult *Labeo rohita*, Chlorophyceae was the main component of food items in the gut, forming 22.18% by volume and 23.04% by occurrence. Bacillariophyceae were the second most abundant food material in gut of adult *Labeo rohita*, comprising 20.34% of the volume and 22.06% of the occurrence. Myxophyceae formed the next most abundant food item in the gut contents, constituting 18.36% by volume and 19.76% by occurrence. Percentage of Cladocera in the gut contents of adults was 12.34% by volume and 11.07 % by occurrence. Percentage of aquatic plant matter in the gut content of *Labeo rohita* adults was 8.97 % by volume and 8.76 % by occurrence. Percentage of rotifers in the gut contents of adult *Labeo rohita* was 7.22 % by volume and 5.4 % by occurrence. Aquatic insects and their larvae formed 3.48% by volume and 3.67 % by occurrence, respectively. Chlorophyceae emerged as the dominant food item, constituting 31.69 % of the diet and receiving Grade I classification in adult *Labeo rohita*. This was followed by Bacillariophyceae (diatoms) at 27.82 % (Grade II), indicating a strong preference for diatoms during the adult stage. The next three categories in order of importance were Myxophyceae (blue-green algae) at 22.50 % (Grade III), Cladocera at 8.47% (Grade IV) and aquatic plant matter at 4.87% (Grade V), demonstrating the significance

of various microorganisms in the diet. The remaining food items showed progressively lower preponderance indices and grades, with rotifers at 2.41 % (Grade VI), protozoans at 1.02 % (Grade VII) and aquatic insects at 0.79 % (Grade VIII).

Key words : *Labeo rohita*, Kot Dam, Food and Feeding, Diet, Gut content, Chlorophyceae.

Examining the contents of fish stomachs is a common method for determining dietary preferences and feeding behaviors. A clear analysis of their diet and feeding patterns is crucial for comprehending their relationship with aquatic ecosystem[14,46]. Feeding is a daily routine activity of particular animals, including fish, with the frequency sometimes varying due to breeding and non-breeding seasons[5,9,45]. Furthermore, the types of food consumed by fish can indicate the habitats they frequently inhabit[26]. Analysis of the dietary and food habitats of particular fish species is crucial for understanding the habitat of species[2,10,24,37]. Analyzing the feeding behavior and dietary patterns of fishes plays an important role in fisheries management. The diet of fish encompasses several essential ecological factors, such as behavior, physical condition, habitat utilization patterns, energy consumption and interaction between the same species members as well as other species members. Assessing food preference, feeding habits and gut contents can help identify and provide information on habitat preference, prey selection behavior, ontogenetic effects and the development of conservation strategies for a particular species[4,17,29,32]. Fish carry out physiological functions, such as growth and reproduction, by utilizing energy derived from their food. They are well adapted to their feeding habitats, making use of the most accessible food sources. Analyzing the diet of fish in their natural environments, both qualitatively and quantitatively, improves our understanding of their growth, population and the productivity of aquatic ecosystems[7,15,19,20,23,30,31,35]. Numerous studies have been conducted on the feeding behavior of different species fishes in different regions of the country[1,11,12,13,21,22,25,26,32,34,36,39,40,42,43]. However, the present study was carried out on the food and feeding content of Adult *Labeo rohita* through the analysis of gut content from the Kot Dam of Jhunjhunu district, Rajasthan.

Present study investigated the dietary preferences and feeding behaviors of the fish species *Labeo rohita*. *Labeo rohita* fish individuals were collected from the Kot Dam of Jhunjhunu district of Rajasthan. The study was conducted from July 2022 to June 2024. A 10% formalin solution was promptly injected into the fish gut to preserve the gut contents for precise analysis. The intestinal contents were thoroughly examined using a binocular microscope at the Department of Zoology Laboratory of the Vidhya Bhawan Rural Institute, Udaipur (Figure 1).

I. ***Visual estimation :*** Feeding intensity assessment approach utilizes the visual estimation technique established by Pillay[38] to gauge the level of stomach fullness in

fish. This method depends on monitoring intestinal distension and measuring the quantity of food it contains. Evaluation classifies gastrointestinal situations into seven specific tiers: gorged, full, three-quarters full, half-full, one-quarter full, trace and emptiness[38]. These categories offer a thorough framework for assessing the feeding conditions of fish, from total satiation to a lack of food in the digestive system[32]. Studies can compare feeding patterns across various species, communities and environmental situations by establishing a uniform scale for stomach fullness[32].

II. ***Volumetric estimation :*** Volumetric method serves as an effective assessment tool, particularly for herbivorous and mud-feeding fish[18]. This method entails quantifying the volume of individual food items relative to the total volume of gut contents, thereby offering a more thorough insight into dietary composition. Expressing the volume of specific food items as a ratio to the total gut content volume allows for a more effective evaluation of the nutritional significance of different dietary components. This approach addresses the limitations of other methods, including the overestimation of numerous small food items and the underestimation of larger, less frequent items. Volume method offers insights into feeding strategies and habitat utilization, rendering it a valuable tool for ecological studies and fishery management[32].

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

III. ***Occurrence method :*** Occurrence method is a prevalent technique in fishes feeding studies to evaluate the significance of various food items ingested by fish populations. This method involves analyzing the stomach contents of various fish specimens or individuals and documenting the presence or absence of specific food items in each individual fish. Aggregating data across the entire sample allowed us to calculate the percentage of stomachs containing each food item, thereby offering insights into the overall dietary composition of the fish population[2,32]. Preponderance index using the following formula:

$$\text{Index of preponderance index} = \frac{\text{Vi x Oi}}{\sum \text{Vi xOi}} \times 100$$

Where, Vi= Percentage of volume of food items
Oi= Percentage of occurrence of food items

Rohu (*Labeo rohita*) is a highly favored and rapidly growing fish among Indian main carps, recognized as a viable aquaculture species in several regions, including India, Pakistan, Bangladesh, Myanmar and other Southeast Asian nations. A study on *Labeo rohita* undertaken from July 2022 to June 2024, revealed on the feeding behavior of this fish species. A total of 120 stomachs were visually examined, of which 101 (84.16%) contained food and 19 (15.83%) were empty. The levels of stomach fullness were classified as follows: 23 stomachs were full, 32 were three-quarters full, 25 were half-full, 21 were one-quarter full and 19 were empty. The study procedure comprised random sampling of *Labeo rohita* specimens from the Kot dam, with ten samples procured monthly. The fluctuations in stomach content and fullness observed throughout the study indicate that factors such as food availability, environmental conditions and

potentially the fish life cycle stages may affect feeding behavior. The Index of preponderance and grading of various food items in the gut content of *Labeo rohita* adult are listed in Table-1.

In the case of *Labeo rohita* adult, Chlorophyceae formed the main component of food items in the gut, forming 22.18% by volume and 23.04% by occurrence. In contrast, Bacillariophyceae were the second most abundant food material in the adult stage of *Labeo rohita* and gut, containing 20.34% by volume and 22.06% by occurrence. Myxophyceae formed the next most important food item in the gut contents, constituting 18.36% by volume and 19.76% by occurrence. Percentage of Cladocera in the gut contents of adult was 12.34% by volume and 11.07 % by occurrence. Percentage of aquatic plant matter in the gut content of *Labeo rohita* adult was 8.97 % by volume and 8.76 % by occurrence. The percentage of rotifers in the gut contents of adult *Labeo rohita* was 7.22 % by volume and 5.4 % by occurrence (Table-1). The percentage of protozoans in the adult gut was observed 4.83% by volume and 3.43 % by occurrence. Aquatic insects and their larvae formed 3.48% by volume and 3.67 % by occurrence, respectively. The decayed and semi-decayed organic matter constituted only 2.28% by volume and 2.81 % by occurrence, respectively (Table-1). Analysis of food preferences in the Adult of *Labeo rohita*, an experimental fish species, revealed a clear hierarchy of dietary components based on the preponderance index and grading system.

Chlorophyceae emerged as the dominant food item, constituting 31.69% of the diet and receiving Grade I classification in adult stage of *Labeo rohita*. This was followed by Bacillariophyceae (diatoms) at 27.82 % (Grade II), indicating a strong preference for the diatoms during the adult stage. The next three categories in order of importance were Myxophyceae (blue-green algae) at 22.50 % (Grade III), Cladocera at 8.47% (Grade IV) and aquatic plant matter at 4.87% (Grade V), demonstrating the significance of various microorganisms in the diet (Table-1). The remaining food items showed progressively lower preponderance indices and grades, with rotifers at 2.41 % (Grade VI), protozoans at 1.02 % (Grade VII) and aquatic insects at 0.79 % (Grade VIII) (Table-1). Notably, decayed organic matter had the lowest preponderance index at 0.39% and was assigned Grade IX, suggesting its minimal importance in the diet of adult *Labeo rohita* (Table-1). This detailed breakdown of food preferences provides valuable insights into the feeding habits and nutritional requirements of *Labeo rohita* at the adult stage, which can be crucial for optimizing aquaculture practices and understanding the ecological roles of species in natural habitats.

Analysis of fish diet and feeding patterns is essential for fisheries management, as it encompasses multiple ecological elements, including behavior, condition, habitat use, energy expenditure and interspecies interactions[6,8,33]. Examining dietary habits and gastrointestinal or stomach contents facilitates the assessment of habitat preferences and prey selection and also contributes to the formulation of conservation strategies for particular fish species[17]. Studies on food habits can be conducted to examine the most frequently consumed prey, assess the relative significance of various food types in fish nutrition and quantify ingestion rates of specific

food items. For several years, analysis of fish feeding habits via direct gut content examination has been a conventional method. Alternative methodologies have recently emerged, including radioisotope analysis, stable isotope analysis, direct species observation and fatty acid analysis[6,16,41,44]. Recent methodologies present both benefits, such as enhanced accuracy and the capacity to detect items not visible through microscopic analysis. Direct gut content analysis, usually conducted via dissection or evacuation followed by examination, is the most commonly employed and straight-forward method. It has significant potential and is suitable for most biological studies[29]. Fish demonstrate significant adaptability in their feeding behavior by employing diverse food sources present in their aquatic habitats. This adaptability enables efficient conversion of dietary energy into essential physiological functions. The energy obtained from food is distributed in several processes such as somatic growth, gonadal development for reproduction, tissue repair and maintenance. Analyzing fish feeding behavior and dietary preferences is essential for understanding their biology and ecological functions. Examination of fish diets in natural environments yields a significant understanding of fish ecology and ecosystem interactions. Qualitative assessments of diet composition identify the types of prey consumed, whereas quantitative analyses provide insight into the relative significance of various food sources[14,35].

Dietary studies have enhanced our understanding of trophic relationships, food web structures and energy flows in aquatic ecosystems. Furthermore, these investigations clarified the factors that affect fish growth rates, population dynamics and the overall productivity of aquatic ecosystems. Examining the dietary habits of fish species allows to understand their ecological niches, habitat preferences and potential effects on prey populations[35]. This analysis describes the feeding patterns and habits of the fish[14,35]. The relationship between fish and their food sources is essential for the management and utilization of fish stocks (Panicker, 2000). Based on the index of preponderance and grading of food items in fish gut contents, certain foods are considered more significant than others for growth, survival, size structure and reproductive success. Size of the fish population in a location is influenced by food availability and varies according to species, season, dietary preferences, maturation stage and spawning period[27].

Mishra[32] carried out study on the feeding habits of the Indian major carp Rohu (*Labeo rohita*) in Meeranpur Lake, Uttar Pradesh, India. As *Labeo rohita* reaches adulthood, a substantial change in feeding behavior becomes evident[32]. Adult fish show a negative preference for zooplanktonic organisms instead of phytoplanktonic organisms and submerged macrophytes. This dietary shift is likely related to changes in the nutritional requirements and feeding capabilities of the fish as it matures. A detailed analysis of fingerling stomach contents revealed a diverse diet composition, primarily composed of crustaceans (cladocerans and copepods), followed by rotifers and diatoms. The diet also included protozoans, blue-green algae and

green algae, further illustrating the ability of *Labeo rohita* to utilize various food sources in its environment[32]. The present investigation on the feeding habitat of adult Labeo rohita also exhibited observations comparable to those of Mishra[32], who conducted a study in Meeranpur Lake, Uttar Pradesh, India. The dietary composition of *Labeo rohita* varied significantly between the adult and fingerling stages. In adult Rohu, Cladocera emerged as the primary food source, comprising over 20% of the gut content, both by volume and occurrence. This preference for crustaceans suggests that adult Rohu plays a crucial role in regulating crustacean populations in aquatic ecosystems. Conversely, *Rohu* fingerlings exhibit a different dietary pattern, with rotifers being the second most abundant food item in their gut, accounting for approximately 16-17% of their diet. This shift in dietary preferences between life stages highlights *Rohu's* adaptability to different food sources as they mature. Gut content analysis of *Labeo rohita* revealed a diverse diet that included various algal groups and microorganisms. Myxophyceae (blue-green algae) forms a significant portion of their diet followed by Bacillariophyceae (diatoms) in fingerlings and protozoans in adults. Chlorophyceae (green algae) also contributed to diet, albeit in smaller proportions. This varied dietary composition indicates that Rohu are opportunistic feeders that are capable of utilizing a wide range of food sources available in their environment. The differences in dietary preferences between the adult and fingerling stages may be attributed to factors such as changes in the feeding apparatus, habitat preferences and nutritional requirements as the fish develop and mature. Kumar and Siddiqui[28] observed that the gut contents of adult *L. calbasu* from Ganga River comprised 44.08% decaying organic matter,

Table-1. Index of preponderance and grading of different food items of gut contents of adult of *Labeo rohita* from Kot dam of Jhunjhunu district, Rajasthan, India

S. no.	Food items	% of Volume (Vi)	% of occurre-nce(Oi)	VixOi	Index of prepond-erance (I)	Grading
1	Aquatic plants	8.97	8.76	78.57	4.87	V
2	Chlorophyceae	22.18	23.04	511.02	31.69	I
3	Bacillariophyceae	20.34	22.06	448.70	27.82	II
4	Myxophyceae	18.36	19.76	362.79	22.50	III
5	Protozoans	4.83	3.43	16.56	1.02	VII
6	Rotifers	7.22	5.4	38.98	2.41	VI
7	Cladocera	12.34	11.07	136.60	8.47	IV
8	Aquatic insect	3.48	3.67	12.77	0.79	VIII
9	Decayed organic matter	2.28	2.81	6.48	0.39	IX
	Summation	100	100	1612.39	-	-

19.52% mollusca, 12.24% sand and mud particles and 8.34% diatoms, whereas those from Yamuna River consisted of 45.2% decaying organic matter, 19.27% mollusca, 11.76% sand and mud particles and 8.24% diatoms. Kumar and Siddiqui[28] also documented that decomposing organic materials constituted 46.09% and 70.72%, mollusca constituted 19.67% and 8.64%, sand and mud particles constituted 11.32% and 5.40% and diatoms 7.73% and 4.75% in the gastrointestinal tract of adult *L. calbasu* from the Kali and Keetham reservoirs, respectively, between August 1980 and September 1983.

Bakhtiyar *et al.*[83] study on the feeding habits of *Labeo rohita* in Gho- Manhasa fish ponds, Jammu, North India, provides valuable insights into the dietary preferences of this species. Study revealed a diverse diet comprising both plant and animal matter, including algae, macrophytes, various microorganisms and invertebrates. Additionally, the fish consumed unidentified matter, sand and mud and detritus. A comprehensive analysis of 420 specimens demonstrated that a significant majority (80%) had food components in their guts, indicating active feeding behavior. The index of preponderance analysis demonstrated that smaller *Labeo rohita* individuals exhibited a stronger preference for algae and microscopic organisms such as protozoans, rotifers and cladocerans. However, as the fish increased in size, this preference diminished, suggesting an ontogenetic shift in their feeding habits. This finding has significant implications for understanding the ecological role and nutritional requirements of species at different life stages, which could be valuable for aquaculture practices and conservation efforts targeting *Labeo rohita* populations.

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