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Assessment of algae present in the gut of *Tariqilabeo latius* (Hamilton, 1822) from Arunachal Pradesh, India

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ABSTRACT

A total of 20 *Tariqilabeo latius* were collected from different locations of Senki River, Papum Pare district, Arunachal Pradesh during 2019. The gut content of the fish was carefully poured into a soil extraction solution and allowed to grow for 15 to 20 days under sufficient light for the culture. The assessment and identification of algae present in the culture were carried out and a total of 19 species of different groups were identified. Out of which, 5 species belong to Cyanophyta, 6 Chlorophyta, and 8 Bacillariophyta. The total algal population was found highest in Bacillariophyta (42.1%) followed by Chlorophyta (31.58%) and Cyanophyta (26.32%). Based on the presence of diverse algal food substance in the gut *T. latius* was found to be a herbivorous species.

Keywords: *Tariqilabeo latius;* Algae; Gut; Fish; Arunachal Pradesh.

INTRODUCTION

Algae are a varied group of largely aquatic and photosynthetic organisms which are the most important primary producers in all form of an aquatic ecosystem. Although relatively inconspicuous, they have a major role in the freshwater environment both in terms of fundamental ecology and concerning human use of natural resources (Edward and David 2010). They represent valuable sources of nearly all essential nutrients including Polyunsaturated Fatty Acid (PUFA), vitamins, and minerals. As aquatic relatives of plants, microalgae thrive in aerated, liquid cultures with sufficient access to light, carbon dioxide, and other nutrients (Rosenberg et al. 2008). About one-fifth of 5 million kg/year of the algal biomass is used to nourish the fish and shellfish that are cultivated in aquaculture hatcheries (Muller-Feuga 2004). The main applications of microalgae for aquaculture are associated with nutrition for coloring and for inducing other biological activities.

The gut analysis provides important insight into the food and feeding pattern of fishes (Nath, 2015; Manko, 2016). The assessment of food habits is an important aspect of fisheries management and the ability to manage prey resources, increasing fish production and manipulating forage fish populations to enhance sports fisheries (De Vries and Stein 1990; Kamler and Pope 2001; Pikitch et al. 2004; Chipps and Garvey 2007). An accurate report of diets and feeding habits also give the basis for understanding the trophic interactions in aquatic food webs (Zanden and Rasmunssen 2000). Hence, precise knowledge of the relationship between the fish and food organisms is essential for the production and the exploitation of the fish stock. Algae are at the base of the aquatic food chain, producing the food resources that fish are adapted to consume

(Norambuena et al. 2015). Freshwater fishes like *Garra lamta* (Kanwal and Pathani 2012), *Garra gotyla gotyla* (Gaur et al. 2013), *Oreochromis niloticus* (Abdel-Tawwab 2000), etc. have been reported to feed on algae/phytoplankton. However, there is a dearth of scientific literature on this aspect in Arunachal Pradesh and elsewhere except Awasthi et al. (2006) and Mohamed et al. (2019). *Tariqilabeo latius*, originally described as *Cyprinus latius* by Hamilton (1822) from Tista River, Darjeeling Himalaya was later on considered as *Crossocheilus latius* by Hora and Misra (1938). However, it is now considered valid in the genus *Tariqilabeo* Eschmeyer et al. (2018) under Least Concern IUCN Red List category and criteria Singh (2018). The present study attempts to investigate the presence of algae in the gut of *Tariqilabeo latius* collected from the Senki River of Papum Pare district, Arunachal Pradesh, India.

MATERIALS AND METHODS

Study Area and Sampling

The Senki River (Fig. 1) flows through the heart of Itanagar, the capital city of Arunachal Pradesh in the district of Papum Pare. It later joins with the Pare River downstream to form the Dikrong River. Senki River is fresh but moderately polluted by direct dumping of garbage (biodegradable & non-biodegradable), sewage (untreated), and direct outlet of toilets in and around it. The river is characterized by different forms of micro and macro plants or planktons that provide requisite food to the aquatic life forms. During sampling of *T. latius*, other fishes namely *Garra* sp., *Glyptothorax* sp., *Puntius* sp., *Ctenopharyngodon* sp., *Tor* sp., *Schizothorax* sp., *Neolissochilus* sp., etc. were also observed.

T. latius were sampled from different locations of the Senki River during 2019 (Fig. 2). The fish sample was collected thrice in a month to ensure the algal diversity in the gut to minimize the seasonal effects. The sampling was done by using a locally made fishing net. After the collection of fish, the gut was carefully dissected out on spot as well as in the laboratory and stored in a sterile container after double distilled water in a Petri-plate to remove the visible dirt.

Identification

Taxonomic work for the identification of fish was done using the scheme of Darshan et al. (2019). After 15 days when the growth of the algae was ensured, the morphological characters were observed and recorded under a microscope and later identified with the help of standard procedures of Desikachary (1969) and Edward and David (2010).

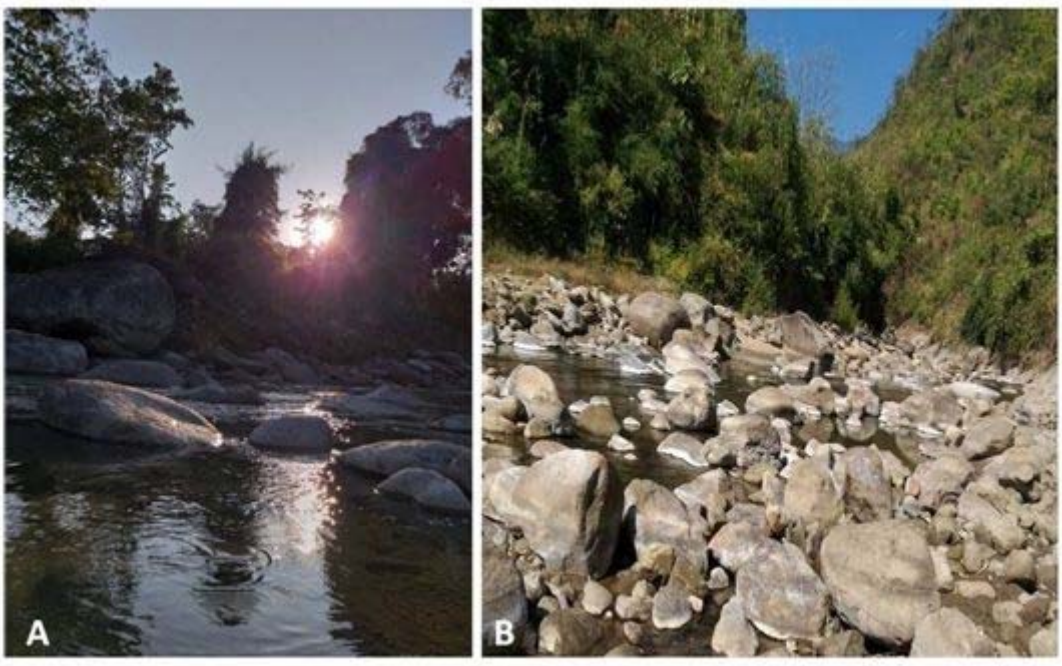

Figure 1. Panoramic view of Senki river (A & B: Sampling sites)

Figure 2. A: Dorso-lateral & B: Ventral view of *Tariqilabeo latius*

Isolation and Culture of sample

A soil decoction solution was prepared beforehand for the culture of algae present in the fish gut. The inoculation was done by the serial dilution method of Allen and Stainer (1968) and Castenholz (1988). The entire gut was put into a soil solution in a test tube containing 10 ml each for the growth of algae present in the gut. It was kept at a normal temperature inside the laboratory with proper care for 20 days. For isolation of algae from the fish gut, it is mixed with 10 ml of double-distilled water. Slide preparation was done by taking random samples with a dropper (5 times) and observed under a microscope.

Preparation of enrichment media (soil extraction method)

Enrichment media was prepared by adding soil or soil extraction in distilled water. Soil rich in organic and inorganic minerals were randomly collected from the botanic garden of Rajiv Gandhi University (RGU). It was sieve with the help of a sieving pan to remove the dirt and make it fine. Soil samples were sterilized in an autoclave at 121°C or 15 lb for 30 minutes to kill all the microbes. Further, 10 gm sterilized soil was dissolved with 100 ml distilled water to make soil water solution by proper mixing using a glass rod. The soil-water solution is filtered by using the Whatman filter paper for the separation of soil fine particles from the solution. Then the filtered solution is used for the culture of algal species as the solution is rich in nutrients that are required for the proper growth of algae. From filtrate soil water solution, 1 ml was pipette out into the test tube and 9 ml distilled water or sterilized natural water was added for culture of algae.

RESULTS AND DISCUSSION

Altogether, 20 specimens of *Tariqilabeo latius* were analyzed for the presence of algae from the gut contents. Spot dissection of fish was done to avoid the action of digestive enzymes against the algae present in the gut. Moreover, some samples were brought back to the laboratory and the dissection was carried out. The specimens were almost similar in size which ranged from 158 mm to 162 mm in length. Cyanophyta, Chlorophyta, and Bacillariophyta groups of algae were found in the culture solution of the gut contents (Table 1). A total of 19 species of the three groups were identified in the gut of *T. latius* during the study period. Out of which, 5 species belong to Cyanophyta, 6 species to Chlorophyta, and 8 species to Bacillariophyta. The Bacillariophyta and Chlorophyta constituted the highest percentages of algae (42.1% & 31.58%, respectively). Cyanophyta was found to be the lowest with 26.32% of the total

algal population (Fig. 3).

Table 1. Algal species found in the gut of *Tariqilabeo latius*

Cyanophyta	Chlorophyta	Bacillariophyta
Chroococcus sp.	*Chlorococcum* sp.	*Cyclotella* sp.
Osillatoria sp.	*Chlorella* sp.	*Fragilaria* sp.
Lyngbya sp.	*Spirogyra* sp.	*Synedra* sp.
Phormidium sp.	*Zygnema* sp.	*Diploneis* sp.
Calothrix sp.	*Cosmarium* sp.	*Navicula sp.*
	Closterium sp.	*Cymbella* sp.
		Gomphoneis sp.
		Nitzschia sp.

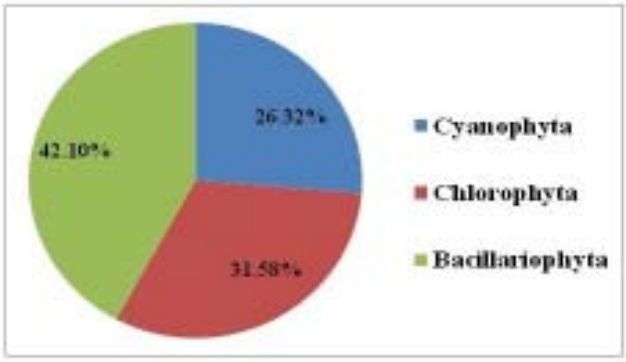

Figure 3. Composition of Algal population

Different genera of algae were noticed from the gut contents which enlighten its herbivorous feeding habit. Hence, it also indicates that *T. latius* has accepted a wide variety of algae as food. The present observations contradict the findings of Mohamed et al. (2019) where Cyanophyta and Chlorophyta constituted the most phytoplankton groups in *Tilapia* fish gut. Salazar-Torres et al. (2016) also analyzed *Tilapia* gut contents and confirmed that Cyanophyta was a major component of its diet. On the other hand, Awasthi et al. (2006) also reported that Chlorophyta constituted a major food item in *Cyprinus carpio*. Navarro and Sarasquete (1998) and Biedenbach et al. (1990) have found that algae have tremendous potential as fish feed, with varying nutritional values, particularly for crustaceans and fish larvae. Algal genera like Spirulina, Chlorella, Scenedesmus, Dunaliella, Nannochloropsis are popularly used as aquaculture feed for their high nutritious value (Avron and Ben-Amotz, 1992; Yamaguchi, 1997).

CONCLUSION

The results of this study suggests that *T. latius* is a herbivorous species as the gut contents indicate the presence of a wide variety of algae. Bacillariophyta, Chlorophyta, and Cyanophyta groups of algae have been mostly recorded in the gut contents. However, the presence of other feeds cannot be ruled out. Therefore, further studies are essential to understand the feeding habits of *T. latius* to introduce the species in fisheries.

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Authors' contributions: K. Jongkey and D. Bushi conceived, designed, collected samples, and compiled the first draft. S. K. Abujam contributed in the preparation and writing of the manuscript. O. D. Nimasow contributed in laboratory analysis and taxonomic identification of algal species. G. Nimasow edited the language & grammar and revised the first draft. D. N. Das substantially modified and approved the submission of the manuscript.

Conflict of Interest: The author(s) declare no competing interests.

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