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Studies on the Grazing Rate of Culibaush, *Labeo calbasu* (Hamilton) on Periphyton

N. T. Narejo* and S. M. Rahmatullah
Department of Fresh Water Biology and Fisheries, University of Sindh, Jamshoro, Sindh (NTN) and Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh (SMR)

Abstract.- The grazing rate of *Labeo calbasu* was studied for a period of ten months from July 2000 to April 2001. It was observed that periphyton density significantly ($p<0.05$) influenced the grazing arte of *L. calbasu*. The lowest (0.0039 DMg/fish/4h) and the highest (0.1037 DMg/fish/4h) grazing rates in the same size group of fish were found at 1slide/aquarium (100cm^2) and 4 slides/aquarium (400 cm^2), respectively. Similarly, size group of fish significantly ($p<0.05$) influenced the grazing rate. The lowest (0.0030 DMg/fish/4h) and the highest (0.0826 DMg/fish/4h) grazing rates were observed in smaller size and larger size group of fish respectively. However, significantly ($p<0.05$) highest grazing rate (0.155 DMg/fish/4h) in group than an individual fish (0.060 DMg/fish/4h). The grazing rate was also significantly ($p<0.05$) influenced by time duration.

Key words: *Labeo calbasu*, periphyton, grazing rate.

INTRODUCTION

Modern fish culture involves large amount of purchased inputs feed being the important one. Feed cost generally constitutes the highest single operational cost of semi-intensive farming operation (Shang, 1983). The technology of periphyton based fish production is a new technology, which is expected to increase fish production, many folds with less investment and is attracting farmers for its simplicity. Wilham *et al.* (1978) discovered that periphyton or attached algae are the most important primary producers in a water body. The food of *Labeo calbasu* consists of decayed organic matter, mollusks, diatoms, plant matter, green algae, blue green algae and zooplankton (Kumar and Siddiqui, 1989). Considering food habit *L. calbasu* may be recommended as a suitable candidate for periphyton based fish culture. Although information of some aspects is generally available on culture techniques of *L. calbasu* (Wahab *et al*., 1999), very little is known about how the natural food, particularly periphyton is utilized. The objectives of the present study were to determine the effect of different densities of periphyton, size group of fish interactions, and time duration on grazing rate of *L. calbasu*.

* Corresponding author: nntariq@hotmail.com
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MATERIALS AND METHODS

Experimental period and site

The experiment was conducted for a period of ten months (300 days) from July 2000 to April 2001 in glass aquaria located in the wet laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Collection and acclimatization of fish

The fish were collected from field hatchery of the Faculty of Fisheries and transported to the cisterns in oxygenated polythene bags. Then the fishes were kept in a number of glass aquaria for acclimatization for 15 days. These were then grouped into different size groups (Table I) on the basis of their length (cm) and weight (g) to serve the different purposes of the experiment.

Experimental design

Scaling of substrate (rough and Perspex slides) area with metabolic weight of fish ($\sim W^{-0.8}$) *i.e.* (assuming that grazing rate is proportional to the metabolic weight of fish) is shown in Table II.

Scaling of tank size to the standard length of fish (*i.e.* assuming that grazing rate of fish is little bit influenced by the space maneuverability). Periphyton was grown on both sides of roughened Perspex slides in the cement cistern. The size of the slides ranged from 5×10 to 8×10 cm^2. Before the trial, all the faeces were scooped out from the aquarium by siphoning.

Table I.- Grouping of the experimental fishes based on length (cm) and weight (g).

Group No.	Size group	Size range (cm)	Mean weight (g)
1	Small	5 (4-6)	5.0±0.10
2	Medium	10 (9-11)	12.0±0.20
3	Higher medium	15 (14-16)	30.0±0.25
4	Large	20 (19-21)	106.0±0.20

Table II.- Scaling of substrate area of fish size.

Size class (cm)	Mean weight (g)	Slide dimension (cm^2)	No. of slides	Total area (cm^2)
4	5	5 × 10	1	100
10	12	5 × 10	2	200
15	30	5 × 10	4	400
20	100	8 × 16	4	1048

Experimental system

Static system consisting of 12 glass aquaria (70 × 35 × 25 cm^3) of 60 liters for 14-16 cm and 19-21 cm size group of fish and 12 glass aquaria (48 × 28 × 25 cm^3) 30 liters for 4-6 cm and 9-11 cm size group of fish were used. The system was enclosed by black screen to protect the fish from undue external visual disturbance and the top of the aquarium was covered by fine mesh net to protect jumping.

Experimental procedure

The slides were suspended horizontally in the periphyton-stocked cistern at about 10 cm below the water surface for three weeks before starting the grazing experiment. Then the acclimatized fish were measured (length and weight) using measuring board (TL precision 1 mm) and electronic balance (BDH-100 D, precision, 0.1 g). Finally these were transferred to clean aquaria and kept without feeding for 48h.

During the trial, the required number of labeled (at both ends) periphyton covered slides was collected from the stock cistern and suspended in water. The periphyton was then scraped by sharp knife from half of the both halves of the slides and transferred to pre-weighed and labeled pieces of aluminum foil and other halves with the periphyton were transferred to aquaria. After required unit of time (three weeks) the slides were collected and all remaining periphyton were scraped and placed on the weighed and labeled aluminum foil. Then the aluminum foils were placed in an oven (mommert) for drying at 115ºC for 24 h and kept in a desiccators and then weighed. The grazing rate was estimated by deducting the weight of second halves from the weight of first halves.

Experimental protocol

Experiment 1

The grazing rate of *L. calbasu* was determined using same size group 9-11 cm of fish at different periphyton densities *viz.* 100, 200, 300, 400, 500 and 600 cm^2 area with two replications. Single fish was allowed to graze in a single aquarium. The time duration of grazing was 4h.

Experiment II

In this experiment, 4 different size groups of fish were used to observe the grazing rate. For performing the experiment single fish was allowed in a single aquarium with 400 cm^2 slide area and 4 h period of grazing time. In all, twelve glass aquaria were used for the 4 treatments with three replications each.

Experiment III

In this experiment 1, 2 and 4 fishes of the same size 9-11 cm group were allowed in a aquarium to determine the single and group wise grazing rate. The average body weight of fish was 12.0±0.20 g. Grazing rates for one hour at different stocking densities of fish were designated as treatments with three replications.

Experiment IV

Single fish was placed in a single aquarium to find out the grazing rate considering time duration. The time duration was 1, 2, 4 and 6 h considering as four treatments with three replications.

Data analysis

Comparison of treatment means was carried out using one-way analysis of variance (ANOVA), followed by testing for pair-wise differences using Duncan's Multiple Range Test (Vann, 1972). All statistical analysis were done by using MSTAT-C statistical package.

RESULTS AND DISCUSSION

Experiment I

The grazing rate of *L. calbasu* was significantly ($p<0.05$) influenced by periphyton density. The lowest periphyton grazing rate of 0.0039 DMg/fish/4h for 9-11 cm size group was found at 100 cm^2 slide area and the highest periphyton grazing rate of 0.1037 DMg/fish/4h was observed at the density of 400 cm^2 slide area. Periphyton grazing rates different densities of slides are shown in Table III.

Table III.- Grazing rate (fish/4h) of *L. calbasu* at different densities of periphyton.

Treatments	Slide/ aquarium	Slide area/ aquarium (cm^2)	Grazing rate/ fish/4h
1	1	100	0.0039 ± 0.0003^c
2	2	200	0.0041 ± 0.0022^c
3	3	300	0.0247 ± 0.0025^b
4	4	400	0.1037 ± 0.0030^a
5	5	500	0.0973 ± 0.0093^a
6	6	600	0.0982 ± 0.0059^a

Labeo calbasu (9-11 cm) showed the highest grazing rate when offered 400-cm^2 slide areas containing 2.56 DMg (dry matter gram) periphyton. Addition of 500 cm^2 and 600-cm^2 slide (5 to 6 slides/aquarium) substrate did not influence the increase of grazing rates. This result suggested that 400-cm^2-slide area (4 slide/aquaria) of 5×10 cm^2 provide sufficient substrate area for 9-11 cm size group of *L. calbasu*. It might be due to the density of periphyton at 400-cm^2-slide area from where fish grazed easily higher amount of periphyton per snap by spending less energy. Hioling (1966) also observed similar condition in predators. In the case of *Oreochromis niloticus* and *Cyprinus carpio*, Beveridge *et al*. (1989, 1991) found that grazing rate increased with the increasing density of bacteria. Rahmatullah (1992) reported similar results in the case of *Labeo rohita*, *Catla catla* and *Hypopthalmichthys molitrix*. He also observed that the grazing rate is positively correlated with algal density. Khan (1999) observed that the ingestion rate of *Cyprinus carpio* increased with the increasing density of zooplankton.

Experiment II

Periphyton grazing rate was also significantly ($p<0.05$) influenced by different size groups of fish when they were allowed to graze on 400cm^2 slide area. The lowest grazing rate of *L. calbasu* (0.0030 DMg/fish/4hr) was found in small size and the highest grazing rate (0.0826 DMg/fish/4hr) was observed in larger size group of fish (Table IV).

Table IV.- Periphyton grazing rate (DMg/fish/4hr) and (DMg/h/gram body weight) of different size groups of *L. calbasu*.

Size group	Grazing rate	
	DMg/fish/4hr	DMg/h/gbw
Small	0.0030 ± 0.00025^b	0.00159 ± 0.00025^a
Medium	0.0761 ± 0.01367^a	0.00155 ± 0.01367^a
Higher medium	0.0659 ± 0.01109^a	0.00054 ± 0.01109^b
Large	0.0826 ± 0.01177^a	0.00020 ± 0.01177^b

It might be because larger fishes required more food to maintain metabolic activity. Similar observation was made by Dewan *et al*. (1977) in the case of *Labeo rohita*. Hoque (1998) found that the ingestion rate of *P. gonionotus* increased with increasing size group of fish. Khan (1999) also reported similar findings in the case of *Cyprinus carpio*. It was found that smaller fishes were very active during grazing than the larger fishes. Grazing rate was 0.00159 DMg/h/gbw in smaller size group and 0.00020 DMg/h/gbw in larger size group of fishes, which indicated that grazing rate/h/gbw of smaller fishes was higher than larger fishes, which is vice versa to the grazing rate/fish/4h (Table IV). It might be because smaller fish need more food per gram body weight than larger fish to sustain rapid growth. Energy loss as heat through the body surface is higher in smaller than the larger fishes. In the present study it was observed that smaller fishes required more food per gram body weight than the larger fishes, which is in accordance with the findings of Steffens (1986) and Hepher (1988).

Experiment III

In this experiment grazing rate was significantly ($p<0.05$) influenced by the number of fishes (grouping). It was found that the lowest grazing rate (0.060 DMg/fish/4h) was observed in the single fish treatment and the highest (0.155 DMg/fish/4h) in a group (4 fish). This finding

indicated that the grazing rate was positively correlated with the increasing number of fishes (Table V).

The positive correlation between the grazing rate and increased numbers of fish might be due to tendency to take high amount of feed in a group. Similar observation was reported by Drenner and O'Brien (1982) in filter feeding fishes.

Table V.- The grazing rate in different grouping patterns of same size group of *L. calbasu*.

Size of fish (g)	Density of fish No./aquaria	Grazing rate DMg/fish/h
12.0 ± 0.2	1	0.060^{c}
	2	0.100^{b}
	4	0.155^{a}

Table VI.- Grazing rate/fish on periphyton of *L. calbasu* at different time durations.

Time (h)	Grazing rate (DMg/fish) at different time durations
1	$0.0138125 \pm 0.002460^{b}$
2	$0.0384313 \pm 0.009891^{b}$
4	$0.0898438 \pm 0.133288^{a}$
6	$0.0856467 \pm 0.012687^{a}$

Experiment IV

Significant ($p<0.05$) influence of time duration on grazing rate was observed. The lowest grazing rate (0.0138 DMg) was recorded in the first hours it increased gradually up to 4th hour, which was the highest (0.0898 DMg). The grazing rate was more or less stagnant at 6th hour in comparison to 4th hour (Table VI).

CONCLUSION

It is clear from the results of the present study that *L. calbasu* grazed mainly during the first hour, showing somewhat higher rate in 4th hour after which grazing rate decreased to a constant rate during the 6th hour.

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