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Minimization of cannibalism of African catfish (*Clarias gariepinus* Burchell) larvae in indoor culture system

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Abstract
For minimizing cannibalism of African catfish (*Clarias gariepinus*) larvae two trials for a period of 14 and 15 days respectively in four aquaria of size 120 x 49 x 32 cm^3 were conducted. Seven days old African catfish larvae with an initial total length and weight of 7.84 (±0.40) mm and 4.40 (±1.18) mg respectively in the first trial and similarly 7.52(±0.61) mm and 3.98 (±0.56) mg in the second trial at the rate of same stocking densities of 2500 larvae in each aquarium were stocked in both trials. Cannibalistic larvae were separated by using grader frame from each treatment at 7 days and 5 days interval during first and second trial respectively. Two mesh sizes i.e., 5 mm and 7 mm were used in the grader frame in both trials. Survival rate was significantly higher in T_1 than that of T_2 in each trial. Grading of larvae with 5 days interval resulted higher survival rate than that of 7 days interval.

Key words : *Clarias gariepinus*, Cannibalism

Introduction

African catfish has been well adopted to the environment of Bangladesh and its growth rate is highly encouraging. There is an increasing demand of its larvae. Though different techniques of larvae rearing of the species have been established through research, cannibalism is considered as one of the serious impediments for large scale larvae and fry rearing of the catfish.

Cannibalism is the process of both killing and eating an individual of the same species. As a biological phenomenon, sibling cannibalism can possibly be regarded as a specialized predation strategy developed as a mechanism to ensure survival of 'fit individuals', in the Darwinian sense, under 'harsh' or unstable environmental conditions reproductively to contribute successfully to future generation (Fox 1975). Cannibal phenotypes are morphologically similar to, but much larger than normal phenotypes.

Though in nature cannibalistic populations are self-regulated below the capacity of the environment and more resilient, cannibalism is considered as the only problem under high density fish culture since the mid 1970s. Larval and juvenile sibling cannibalism occurs in important culture species such as yellowtail (*Seriola quinqueradiata*), turbot (*Scophthalmus maximus*), eels (*Anguilla anguilla*), koi-carp (*Cyprinus carpio*), sea-bass (*Dicentrarchus labrax*) and gilthead bream (*Sparus aurata*)

(Chaudhuri & Tripathi 1979, Smith 1979, Kentouri 1980, Degani & Levanon 1983). Cannibalism has been recorded in wild populations of *Clarias gariepinus* (Corbet 1961 and Bruton 1979). Aboul-Ela *et al.* (1973) reported that heavy losses (up to 65%) have been attributed to larval and juvenile sibling cohort cannibalism of *Clarias gariepinus*. So, the present study was designed to establish a technique of minimizing cannibalism of its larvae.

Materials and methods

The experiments were conducted at the Department of Fisheries Biology and Genetics under the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh during July to September'97. Two trials were conducted during the period. Larvae of *Clarias gariepinus* for each trial were obtained by induced spawning of broods collected from the culture ponds of the department by using carp pituitary gland and 'Sumaach (HCG, India)'. The larvae were first fed after two days of hatching. They were provided with Tubificid worms in a paste form. Food particle size was gradually increased corresponding with the average mouth size of the larvae. The experiment was conducted in four aquaria of size 120 x 49 x 32 cm^3 which were marked as treatment-1 (T_1) and treatment-2 (T_2) each having two replications. Grading was done in the two aquaria under T_1 (experimental) while the aquaria under T_2 were considered as control and no grading was done. 2500 larvae of 7 days old were stocked in each aquarium containing 156 litres of water i.e., 16 larvae per litre of water in both trials. In the aquaria the larvae were fed with Tubificid worms twice a day to their satiation level. Continuous water flow was maintained in each aquarium. About two-third of water of each aquarium was changed everyday. The aquaria were cleaned by siphoning after half an hour of feeding.

For grading, a grader was developed which was a net tied to a rectangular frame of PVC (Polyvinyl Chloride) pipe. The first trial continued for 14 days while the second trial continued for 15 days. In the first trial grading was done two times - at the 7th and 14th day of starting the trial with the grader box of 5 mm and 7 mm mesh size respectively. In the second trial grading was done three times - at the 5th, 10th and 15th day of starting the trial with the grader box of 5 mm, 7 mm and 7 mm mesh size respectively. During grading, the grader was placed at one end of the aquarium carefully removing the larvae from that end. The grader was then drawn slowly from one end to the other. Feed was not provided to the larvae in the morning on the day of grading. After grading, the separated larvae from two aquaria under T_1 (in which grading was done) were counted and total length and weight of each was recorded. The separated larvae were replaced in another aquarium. After grading total length and weight of twenty larvae from each aquarium (both experimental and control) were recorded on the day of grading and released in the respective aquarium. Dead bodies of larvae were collected daily from each aquarium every six hourly interval during each trial. Usually whole dead bodies and in some instances only the head portion of larvae were collected from the bottom of the aquaria. The whole dead bodies of larvae were considered as the natural mortality while the availability of

heads and the complete disappearance of the larvae were considered as the mortality due to cannibalism. After final grading total number of remaining larvae in each aquarium was counted.

Results

Growth (total length and weight) of *Clarias gariepinus* larvae under different treatments (i.e., T_1 and T_2) as recorded during the two trials (i.e., first and second trial) are presented in Table 1 and Table 2. The initial average total length and weight of the larvae stocked in the first trial were (7.84 ± 0.40) mm and (4.4 ± 1.18) mg. The final average length and weight of the larvae were 14.33 (± 0.13) mm and 25.26 (± 1.60) mg; 31.01 (± 4.15) mm and 509.90 (± 24.84) mg in T_1 and T_2 respectively. At the end of the first trial the average number of larvae survived in T_1 and T_2 were 715 and 26 respectively. The maximum and minimum length and weight of the cannibalistic larvae at that time in T_2 were 66 mm and 2574 mg and 14mm and 23 mg respectively.

Table 1. Growth (length and weight) of both cannibalistic and non-cannibalistic *C. gariepinus* larvae in the first trial

Treatments	Stocking density (per aquarium)	Average length (mm)			Average weight (mg)		
		Initial	1st grading	2nd grading	Initial	1st grading	2nd grading
T_1*	2500	7.84 (±0.40)	11.66 (±1.35)	14.33 (±0.13)	4.40 (±1.18)	13.96 (±0.30)	25.26 (±1.60)
T_2©	2500	7.84 (±0.40)	13.66 (±0.46)	31.01 (±4.15)	4.40 (±1.10)	35.23 (±1.50)	509.90 (±24.84)

** Average growth of non-cannibalistic larvae after grading.*
© Average growth of both cannibalistic and non-cannibalistic larvae.

Table 2. Growth (length and weight) of both cannibalistic and non-cannibalistic *C.gariepinus* larvae in the second trial

Treatments	Stocking density	Average length (mm)				Average weight (mg)			
		Initial	1st grading	2nd grading	3rd grading	Initial	1st grading	2nd grading	3rd grading
T_1*	2500	7.52 (±0.61)	9.46 (±0.46)	11.30 (±0.20)	14.90 (±0.20)	3.98 (±0.56)	11.10 (±0.30)	14.35 (±0.75)	27.20 (±1.10)
T_2©	2500	7.52 (±0.61)	10.69 (±0.03)	15.81 (±0.48)	32.41 (±1.50)	3.98 (±56)	16.36 (±0.43)	62.91 (±1.33)	540.10 (±7.19)

** Average growth of non-cannibalistic larvae after grading.*
© Average growth of both cannibalistic and non-cannibalistic larvae.

In the second trial, the initial average length and weight of the larvae were 7.52 (± 0.61) mm and 3.98 (± 0.56) mg. The final average length and weight of the larvae in T_1 and T_2 were 14.90 (± 0.20) mm and 27.20 (± 1.10) mg and 32.41 (± 1.50) mm and 540.10 (± 7.19) mg respectively. At the end of the second trial the average number of larvae survived in T_1 and T_2 were 1258 and 21 respectively. The maximum and minimum length and weight of the cannibalistic larvae at that time in T_2 were 61 mm and 2456 mg and 17 mm and 56 mg respectively.

Table 3 presents the mean (± SE) of final number, total survival (%), natural mortality (%) and cannibalism-induced mortality (%) during the first and second trial. The average (± SE) of final number and total survival of *C. gariepinus* larvae were significantly higher ($P < 0.01$) in T_1 than T_2 in both trials, but the final number and total survival were higher in T_1 of second trial than that of first trial. There was no significant difference between the natural mortality of T_1 and T_2 in any of the trials. The average (± SE) cannibalism-induced mortality was significantly higher ($P < 0.01$) in T_2 than T_1 in both trials.

Table 3. Survival rate, natural mortality and cannibalism-induced mortality of *C. gariepinus* larvae during first and second trial after 14 days and 15 days respectively of rearing at the same stocking densities

Group	First trial			Second trial		
	Mean ± SE		t-values and significance level	Mean ± SE		t-values and significance level
	T_1	T_2		T_1	T_2	
Final number	715.00±33.00	25.50±4.50	20.70*	1258.00±69.00	20.50±3.50	17.91*
Total survival (%)	28.60±1.32	1.02±0.18	20.70*	1258.00±69.00	20.50±3.50	17.91*
Natural mortality (%)	10.80±0.68	9.80±2.60	0.37 IS	7.64±0.72	7.98±2.62	-0.13 IS
Cannibalism-induced mortality (%)	60.60±0.64	89.60±2.00	-13.81*	42.04±2.04	91.68±2.28	-16.23*

** $P < 0.01$*
IS, Insignificant ($P < 0.05$)

Discussion

In the present experiment it was observed that the larger larvae of *Clarias gariepinus* first turned into cannibals. Giles *et al.* (1986) working on pike larvae also observed that the largest fish in each tank first turned cannibalistic. Both types of cannibalism i.e., 'tail-first' and 'head-first' as described by Hecht and Appelbaum (1988) in case of *Clarias gariepinus* larvae occurred in the present experiment. Growth and cannibalism of African catfish (*Clarias gariepinus*) larvae in all the treatments were investigated during the experiment. The results indicated that the growth rate

of larvae varied among two treatments of both trials. Growth rate was higher in T_2 than that of T_1 in both trials. As grading was not done in treatment T_2 in both trials, there occurred a great size variation among the survivors due to cannibalism. As cannibalistic larvae were separated periodically from each aquarium under T_1 in both trials, the remaining larvae were more or less of same size. Because of the same grader used in both trials there was no remarkable difference in growth rate in T_1 in each trial.

Survival rate was significantly higher in T_1 than that of T_2 where a severe loss occurred during the rearing period of *Clarias gariepinus* larvae into culture system because of cannibalism. Van Dame *et al.* (1989) reported severe losses (upto 40%) of Koi-carp (*Cyprinus carpio*) larvae and juveniles during the rearing with artificial diets at high densities. As grading was not done in T_2 cannibalism-induced mortality was the highest in this case in both trials. So, it can be said that cannibalism of *Clarias gariepinus* larvae can be reduced by regular grading in larval rearing system.

Final number of larvae survived, at the end of the trials, was higher in second trial compared to the first. In the first trial, grading was done at 7 days interval while in the second trial, grading was done at 5 days interval with same grader box. Cannibalism-induced mortality was apparently lower in T_1 of second trial than that in T_1 of first trial due to grading variation. So, it can be concluded that regular grading of fish by size with short intervals during culture period can minimize cannibalism of *Clarias gariepinus* larvae.

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