Survival rate of African Catfish (Clarias gariepinus) larvae reared in a hatchery

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Abstract: The study was conducted to determine the cannibalism intensity among C.gariepinus larvae in hatchery for 30 days. The experiment was divided into four treatments with different grading intervals. The treatment T1 (no grading), treatment T2 (grading daily), treatment T3 (once a week), and treatment T4 (once per two weeks) were evaluated. The result showed that the maximum survival rate was 80 percent at T4 and the lowest survival rate was 56 percent at T2. Among treatments, T2 has shown a significant difference in survival rate ($P<0.05$) other than T1. The variation in survival rate was not the intensity of cannibalisms among siblings, but it was the natural mortality caused by water contamination with fungal and the indigestibility of the ingested feed that caused the larval bell to swell, and some of the eaten too much feed and unable to be digest it all together brought mortality. Several studies indicate that the survival rate of C.gariepinus larvae and fry in a hatchery is low, and that providing the high quality fry at the appropriate time is a considerable challenge.

Keywords: Cannibalism, Survival rate, Mortality, African catfish (Clarias gariepinus), Larvae

Introduction

African catfish (Clarias gariepinus) has been cultured in ponds due to its good adaptation to captivity, its fast growth rate in poor water quality and its omnivorous feeding habits (Ponzoni and Nguyen, 2008). The production of fry and rearing to the fingerling stages are the main problems for most fish farmers due to the low survival rates of larvae and fry in a hatchery. The main restrictions for culturing of C.gariepinus are low and highly variable survival rates in larval stages, especially with the fluctuating water quality parameters and poor feed digestion under controlled conditions (De Graaf and Janssen,1996).

Cannibalism is one of the low survival problems for catfish larvae and fry. It is a predator that hunts others and/or the same species. In natural systems, cannibalism can occur between parents and offspring, or between siblings of the same age group or a population of different species (Smith and Reay, 1991; Baras and Jobling, 2002; Qin et.al,2004). Hence, cannibalism regulates the population density below the capacity of the environment (Van den Bosch et.al, 1988). Cannibalism in natural ecosystems is more resilient, but can bring a total mortality in captivity. For example, 65% of larvae and juvenile losses in African catfish due to cannibalism at the same age have been reported (Bruton, 1979; Corbert, 1991).

In culture conditions, cannibalism does not necessarily consume the entire body of the prey fish, but creates the scratch and/or wounds on the tail part, disrupts the welfare and ultimately kills the fish. The rate and frequency of cannibalism is high in farmed fish and more common in predatory fish species (Baras, 1998; Baras & Jobling, 2002). Interspecific aggression behavior is of course common in many fish species such as yellowtail, turbot, eels, koi carp, seabass, and gilthead bream (Chaudhuri and Tripath,1979; Smith, 1979, Kentouri,1980; Degani and Levanon,1983). Even with intensive care and management, the mortality of catfish larvae and fry in a hatchery is common due to interspecific competition. According to Król and Zakes (2016) more than 50% of mortality is recorded in the larvae and breeding season due to cannibalism and antagonistic behaviors.

Cannibalism in African catfish fry and fingerlings is size-dependent; primarily caused by starvation, light intensity, stocking density and agonistic behavior under culture conditions. Our attempt to artificially breed the African catfish (C. gariepinus) is successful. However, larvae nursing to fry and fingerlings is still a major challenge that ends with high mortality. Therefore, the aim of this study was to minimize the cannibalism rate among siblings of larvae fish through regular grading techniques.

Materials and Methods

African catfish fry was obtained by artificial propagation conducted at the National Fishery and Aquatic Life Research Center's hatchery before the experiment started. Matured female and male parents were selected from the fish pond and transferred and kept in the hatchery for injection. Female catfish were injected with Common carp pituitary gland solution 2 ml per kilogram from 7:00 to 2:00 pm. After the injection, fish were kept in different water tanks to avoid cannibalism among parents at a water temperature of 25°C. Stripping of each injected female was done the next morning at 10:00 am, and eggs were collected with a dry bowl. To get sperm male catfish were sacrificed and testes were dissected. Then the milt sac was removed, the testicles cut into bits and sperm was released over the eggs and mixed thoroughly using 0.9% saline solution. Once the egg and milt were thoroughly mixed using a feather a drop of water was added into the bowel to fertilize the eggs then the eggs were spread on the incubation unit (a mosquito net suspended on water in a plastic basin connected with a continuous flow of water. To regulate overflow of water from the plastic basin, fine screens were fitted in the outlet which was cleaned regularly. The water temperature in the plastic basin was kept at 26°C and watching the hatching of eggs started after 24 hours. The hatched larvae stayed on their yolk sack for four and started feeding live foods (Artemia nuplii). Larvae were fed with artemia nauplii twice a day for ten days. In the meantime, leftovers were removed daily. The water temperature was kept constant in the range between 24 to 25°C during larval rearing.

Experimental setup

A total of 4 experimental plastic basins (35 liter each) with replicas were seated in the hatchery. The treatments were four: T1 (no grading), T2 (graded daily), T3 (once a week) and T4 (once per two weeks). In each experimental trial, pieces of PVC were fixed as a shelter and dark hiding place for the larvae. The water was circulated on a daily basis and the water temperature was kept between 24 and 25°C with a thermostatically controlled heater in each replica. The larvae were fed commercially available Alema privet fish feed twice a day in powder form twice daily. The experiment was carried out for 30 days.

Routine activities such as monitoring and counting the dead larvae, checking the type of scratch and the wound under the microscope were conducted daily. Those dead larvae that showed scratches and a wound in their body were considered as cannibalism, while those larvae showed no signs of wound but rather signs of stomach swelling, stomach blast and empty stomach were considered natural mortality due to other causes. The survival rate of larvae was calculated by subtracting the total dead larvae from the initially stocked larvae. A subsample weight measurement was taken in each experimental basin, but the length was not measured because they are fragile and easily injured to handle them.

Statistical analysis

All data were analyzed using SPSS (version 25), graph pad prism, and MS excel, the result was interpreted as significant at $P<0.05$. To determine the mean value of mortality and survival in percentage in treatments Duncan test was employed.

Results and Discussion

At the end of the study, the highest number of mortality rate was observed in T_2; the mortality rate ranged between 85-140 individuals, while the lowest mortality rate was recorded in T_4; the number of mortalities ranged between 24-51 larvae. Among treatments, T_2 has shown a significant difference in survival among treatments ($p<0.05$) other than T_1. The lower survival rate could be due to increased contamination with bacteria, fungi, viral infections and cannibalisms. In our experience, larval mortality usually begins shortly after the start of exogenous feeding. The reason for the development of a poor digestive system of the larvae and inability to digest the ingested food, while some others died because they ate a lot of Artemia cysts, which led to blockages in the stomach. The survival rate of the larva in hatchery is affected not only by cannibalism, but also by the temperature of the water and interaction between light and darkness. Previous studies on the survival rate of C.gariepinus found that it was 82% under dark conditions with a water temperature of 28°C (Orina et al., 2016). A study carried out in hatchery by Tarkegn et al., (2015) found that 84 % survival rate were recorded for those fed commercial diets and 76% for those fed live ostracodes. This study found that the highest survival rate in T4 was in agreement with previous findings (Tarkegn et al., 2015; Orina et al.,2016). A study by Seble Getahun et al. in 2015 found that the fry with the highest (92.8%)

was recorded in dark conditions. In general, the larvae and fry are fragile and the survival rate is mainly influenced by the hatchery water quality, light conditions, water temperature, feed quality and hunger as well as the biological safety within the hatchery.

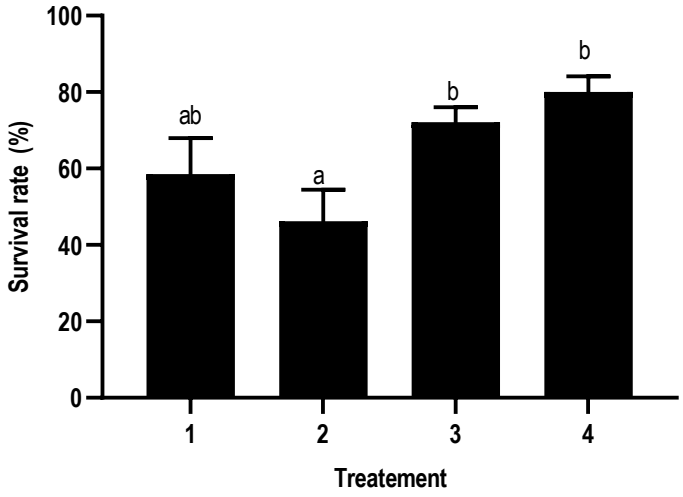

Figure 1. percent of the larvae survival in each treatment

The line graph shows that the highest daily mortality rate was observed in the first two weeks and has since declined sharply (fig. 2). The variation in mortality and trends tell us that the older the larvae, the less prone to natural mortality and cannibals. The diversity of cannibalism rate was high at the beginning of the experiment and went down and vanished at the end. Different studies indicate that the cannibalism rate increased with age, but our results contradicted this; it was higher for the first week and eventually vanished. In this study, the lowest larval survival rate was not due to sibling cannibalism, but due to natural mortality from pathogens infection and loss of appetite.

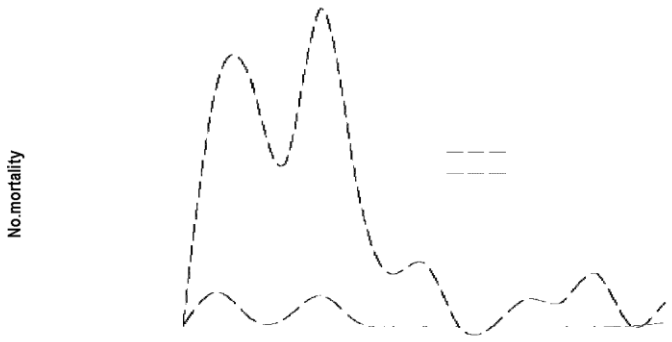

Figure 2. The number of daily larvae mortalities during the culture period

On the other hand, the feed given to the larvae can be contaminated with aflatoxin, which is above the limit values and leads to death. Some of the dead larvae show white colony spathes attached above the head (Fig. 3-c), which are strictly a sign of a Saprolegnia fungal infection that comes from spoiled eggs during incubation and leads to mortality (Fig.3). African catfish are tolerant of Aflatoxin as reported by Jantratail and Lovell (1990). In contrast, the 250µg/kg of aflatoxins in a feed are poisonous and affect the performance of catfish (Oluwafemi and Dahunsl, 2009). In this study, the suspicious fungus was cultured from the feed and morphologically identified in the laboratory. Saprolegnia and Aspergillus flavus fungus were grown and identified using keys (Kilch, 2002). The

Aspergillus flavus can grow at a water temperature of 5-35°C with an optimum at 25°C. They are by nature a potential toxin substance producer and in the experiments most likely a cause of larval death.

Hammere Melaku et.al (2017) identified seven species of fungi (Saprolignia, Tricophyton, Rhizopus, Pencicillium, Mucor and Macrospourm) incubated eggs and water in our hatchery. Of these, saprolegnia is the most common and fatal to eggs and larvae during rearing period. In this study, these examinations under a microscope showed white cottony stains over dead larvae. The white cottony coloring on the head, gills of dead larvae most likely a saprolegnia symptom.

On the other hand, some larvae died from stomach ruptures because they could not digest the food they ingested. While some others have died of swelling in their stomach and developing a pink color under their stomachs, pathogens have not been clearly identified to suggest such symptoms. The feed leftover has been enhancing and promoting the growth of pathogenic microbes, which ultimately leads to fish mortality in the hatchery (Charlon and Bergot, 1984).

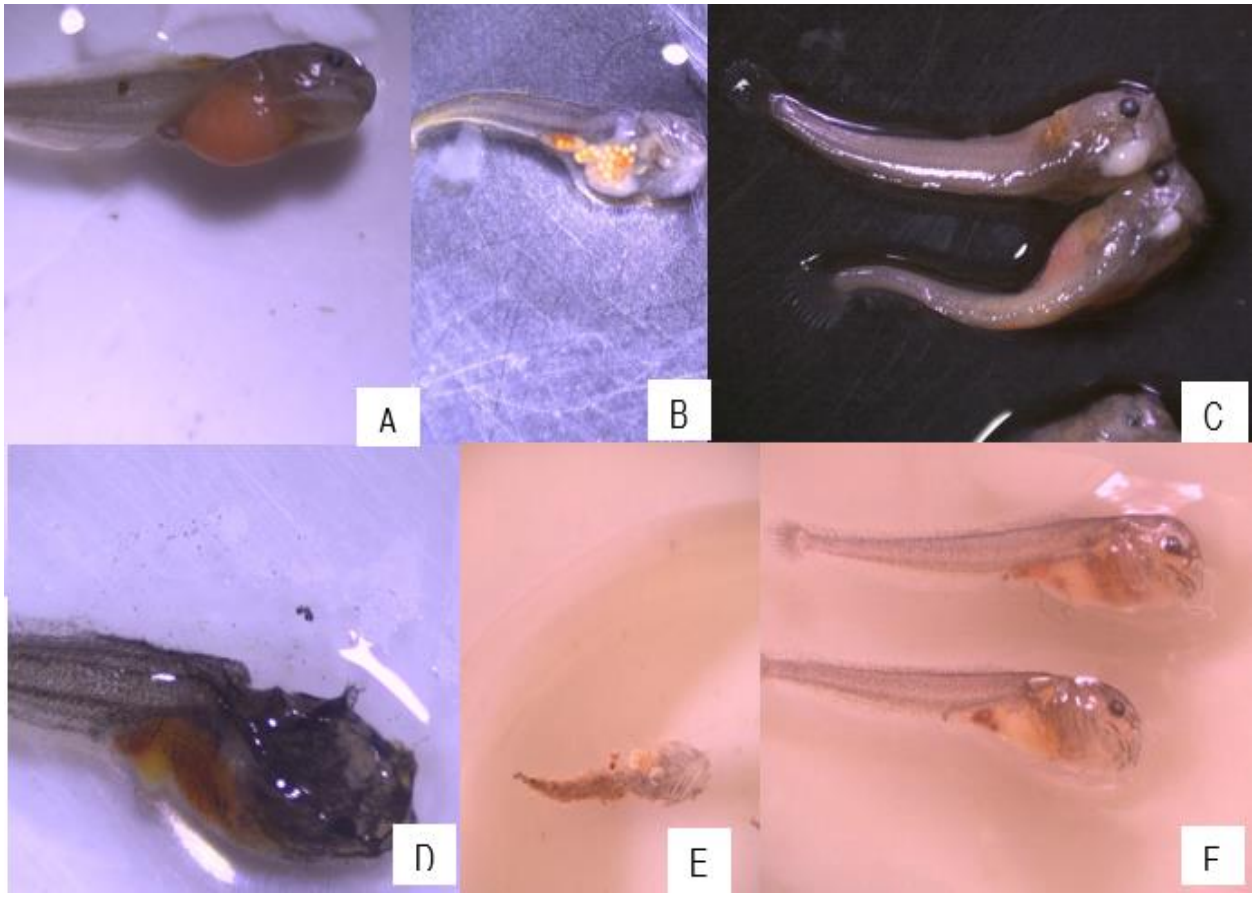

Figure 3. Different sign observed on dead larvae body (A-a swollen belly, B-full artemia cysts, C- white cottony fungus over the head, D-Cannibalism, E- attached debris and F-empty stomach with no clinical sign)

The frequency graph indicated that the lowest weight measurement was 0.05 g and the highest 0.94 g recorded. Most of the larvae weight measurements ranged between 0.2g to .4 g. The five percent of the larval weight measured was over 0.4 g (fig.3). The growth rate shows a significant difference between the larval siblings ($P<0.05$).

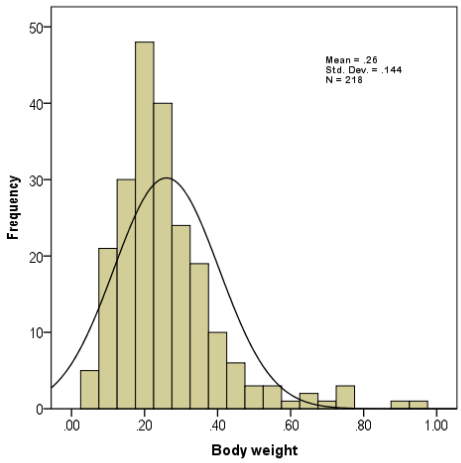

Figure 3. Larvae weight frequency graph during the culture period.

Conclusion and recommendation

It is concluded that the cannibalism at larval stage was not a serious problem, but a natural mortality from pathogens and water pollution main problems. As we noted, the cannibalism mortality of larvae among siblings was lower than the natural mortality indicated on the line graph. This could be due to a potential fungal infection with pathogens and feed contamination leads to mass mortality in the larvae stages. Therefore, the eggs, larvae and incubation facilities in the hatchery should be disinfected with chemicals and the healthy statues should be monitored regularly. Make sure that feed should not be over supplied and avoid contamination from leftover feed. The larvae should be fed hygienic and nutritious feed and be easily digestible by larvae and fry stages in a hatchery.

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