



Effect of Temperature on Fertilization, Hatching and Survival Rates of *Heterobranchus bidorsalis* Eggs and Hatchlings

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To determine the effect of temperature on fertilization, hatching and survival rates of *Heterobranchus bidorsalis* egg and fry in Jos Plateau, Nigeria.

Materials and Methods: This experiment was investigated under controlled temperature hatchery. Stripping was done 9 hours after hormonal injection at 28°C while the male fish was sacrificed and milt prepared for fertilization of the eggs using normal saline. The water temperature was controlled with an adjustable electric thermostat heater empowered by a generator while other water quality parameters were kept constant in acceptable ranges. The eggs were mixed with the milt using chicken feather and 500 of the eggs were spread on kaka ban in aquaria in 4 treatments (26°C, 28°C, 30°C and 32°C) in three replicates. The unfertilized eggs were counted after 6 hours from the time of mixing of the eggs with the milt. The kakabans were removed immediately after hatching and hatchlings were counted then and after 3 days.

Results: Fertilization and hatchability of the eggs were significantly highest ($p < 0.05$) at 28°C and

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30°C compared to 26°C and 32°C. Survival rate of newly hatched larvae was significantly highest at 28°C. The lowest survival rate was registered at 32°C while that of 26°C was just within the range of 40%.

Conclusion: Fertilization and hatchability of *H. bidorsalis* eggs are best achieved at temperature range of 28 - 30°C while highest survival rate of the fry was attained at 28°C.

Keywords: Temperature fertilization; hatchability; survival rate; fry.

1. INTRODUCTION

Heterobranchus bidorsalis is a freshwater reared catfish and it is one of the desirable catfish species based on taste, colour, size and growth rate [1]. This species can withstand hatchery stress such as low levels of dissolved oxygen [2]. However, most hatcheries prefer the production of *Clarias* species fry instead of *Heterobranchus* species due to difficulties on hatchability and high fry mortality rate [3]. It was reported that temperature has an important effect on hatching rate and that larvae growth rate depends on the rearing temperature [4]. It is most likely that temperature affects potential quality of viable eggs [5]. Since it was reported in *Cyprinus carpio* that none of the eggs hatched at 20°C or 38°C [5], cat fish (*H. bidorsalis* needs investigation as being a warm water fish species. In addition, temperature is known to influence the efficiency of yolk utilization [6]. It was also reported that the growth rate increases with increasing water temperature, within temperature range of 27-30°C [4,5]. Temperature influences metabolic processes and it is the single most important factor that determines growth rates in fish [7]. Although the temperature range of 27-30°C was reported to be an acceptable water temperature range for *Cyprinus carpio* [5], the appropriate one for *H. bidorsalis* needs to be studied. Therefore there is need to investigate the influence of temperature on fertilization, hatchability of *H. bidorsalis* eggs and survival rate of the hatchlings. The findings may help to establish the optimal temperature range suitable for fertilization, hatchability of *H. bidorsalis* eggs and survival of the fry especially nowadays that the production of *Heterobranchus* fry does not meet the demand and has to be supplied with wild fingerlings.

2. MATERIALS AND METHODS

The influence of temperature on fertilization rate, hatchability of eggs and survival rate of fry within the first 3 days were investigated in Jos, Nigeria, in a controlled temperature hatchery. One

hatchery raised gravid brood female and male stocks (*H. bidorsalis*). Prior to injection, broodstock was kept in 200 litres tank with aerated water. Brood stock was weighed with salter weighing balance. The amount of hormone used was 0.5 ml Ovaprim for each kilogram of female brood stock. The injection was done intramuscularly above the lateral line at 10cm from posterior end of the fish. The injected fish were returned to the tank [8]. Female broodfish were stripped 9 hours after the hormone injection at 28°C. While the male was sacrificed and the milt was prepared for fertilization of the eggs that was stripped using normal saline. The eggs were carefully mixed with milt for two minutes. A total of, 500 fertilized eggs were spread on Kakaban in aquaria under 4 treatments (26°C, 28°C, 30°C and 32°C) by three replicates. The water was aerated continuously to increase the dissolved oxygen. Water emperature for each treatment was controlled by an adjustable electric thermostat heater empowered by a generator. The unfertilized eggs were counted 6 hours after fertilization. The kakabans were removed immediately after the hatching and hatchlings were counted then and after 3 days to establish the total numbers of hatchling motility and survival within the period. One third of the water in each aquarium was replaced daily by siphoning with a rubber hose in order to maintaining the tanks' water quality. The fertilization, hatching and survival rates of the fry were determined using the following formulae according to [5,9].

- (i) Fertilization rate = (No of fertilized egg/Total no of eggs spread on kakaban) x 100.
- (ii) Hatching rate (%)= No. of hatched larvae/ fertilized eggs) x 100
- (iii) Percentage survival rate = (survived hatchlings after 3 days/ total no of hatched egg) x 100

The data obtained were analyzed using descriptive statistics, general statistic of variance of Genstat 32.22 version statistical package. Statistical difference between various means was

tested at 95% confidence level using Duncan Multiple Range Test.

3. RESULTS

The influence of temperature on fertilization and hatching rates of *H. bidorsalis* eggs are shown in Fig. 1 and 2 respectively. Results of fertilization rate at 28°C and 30°C treatments showed

values higher than 80% and were not significantly different ($p>0.05$) from each other whereas 26°C and 32°C treatments showed the lowest percentages ($p<0.05$). Hatchability of the fish eggs at 28°C and 30°C were not significantly higher between each other although they were significantly higher than those of 26°C and those of 32°C. The survival rate of the hatchlings within the first 3 days of hatching is shown in Fig. 3.

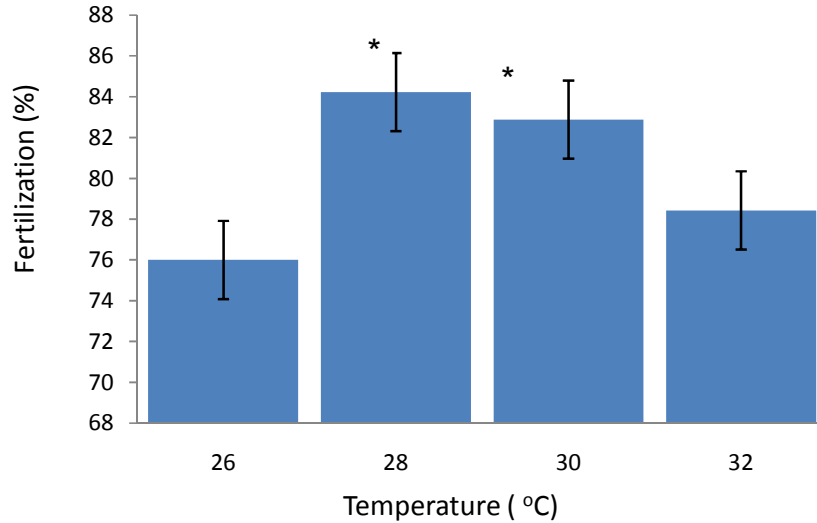


Fig. 1. Effect of temperature on fertilization rate (%) of *H. bidorsalis* eggs

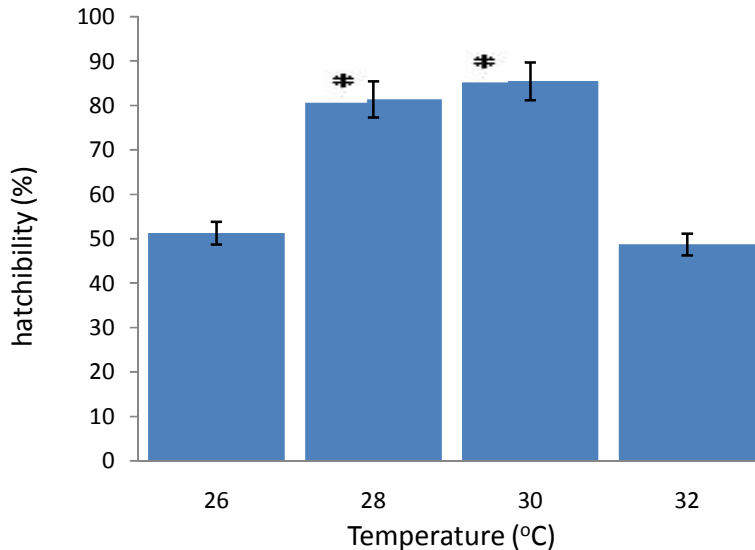


Fig. 2. Effect of temperature on hatchability (%) of *H. bidorsalis* eggs

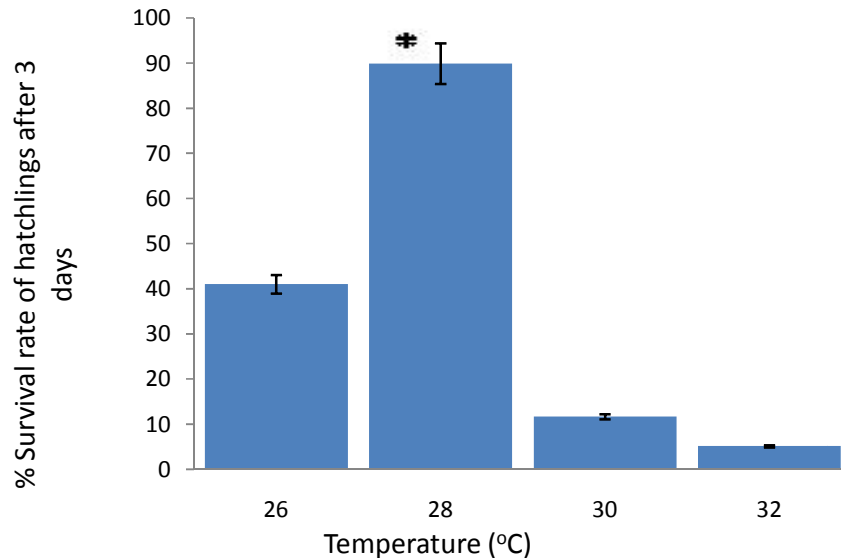


Fig. 3. Effect of temperature on survival rate of hatchlings within the first 3 days after hatching of *H. bidorsalis* eggs

The water temperature treatment of 28°C favoured significantly ($p < 0.05$) the survival rate of hatchlings more than other treatments. Treatments of 30 and 32°C showed the lowest survival rate while that of 26°C showed a survival of 40%. Survival rate at 28°C reached 90%. Survival rates were significantly different ($p < 0.05$) between treatments.

4. DISCUSSION

The study of the effect of temperature on fertilization and hatching rate of eggs and survival rate of *H. bidorsalis* fry shows an interesting water temperature range that can be established for the culture of this warm water specie, with some considerations. Fertilization and hatching rates showed values near 80% or even higher. Although the highest survival rate was achieved at 28°C. Fertilization rate of *H. bidorsalis* eggs at 28°C and 30°C was significantly not different from each other in the various treatments because this selected range of temperature support fertilization of fish eggs as one of the warm water fishes. The results of hatchability also show that temperature treatments of 28 – 30°C significantly improve the hatchability of the fish eggs as temperature has main effect on hatching of fish eggs. It was reported that growth of larvae increased at the optimum temperature range of 27-30°C and no eggs hatched at 20°C and 38°C for *Cyprinus carpio* [5]. It is most likely that temperature affects the tolerance level of viable eggs as

documented by [5]. The optimum range for good hatchability of catfish eggs was proved to be 28-30°C as this temperature range is reported to be an acceptable water temperature range for warm water fishes [5].

The results in this study indicated that the optimum temperature for hatchability of the fry lies between 28°C and 30°C. This finding agrees with the results found for other fish species according to [10]. At 26 and 32°C, hatchability was found highly reduced indicating that the temperature was very low or very high for excellent hatchability of the fish egg in hatchery. In addition, when temperature becomes super optimal, it influences negatively the efficiency of yolk utilization [4]. Temperature also affects physiological processes [7] in fish hatchlings as low temperature or high temperature affects the survival rate of fry as shown in this study.

Temperature influence is the single most important factor that determines growth rates in fish [7]. The 40% survival rate of hatchlings, found at 26°C seems reasonable but in this study 28°C gave about 90% survival of hatchlings during yolk sac larval stage. Optimum temperature range of 28-30°C plays an important role for improving fertilization, hatchability and survival mechanism during the period of the larval development. This finding is very important as 50% mortality at this stage can affect directly fish production. At 32°C, survival of most fry were affected by high temperature [7].

5. CONCLUSION AND RECOMMENDATIONS

Temperature range of 28-30°C significantly supported fertilization and hatchability rates of *H. bidorsalis* eggs while 90% survival of hatchlings during yolk sac stage was achieved at 28°C. It was only the treatment of 28°C that consistently maintained a steady high fertilization, Hatchability of *H. bidorsalis* and survival rate of the hatchlings in this investigation. Fertilization, hatchability of the fish eggs and high survival rate achieved at 28°C is highly recommendable for fry production.

COMPETING INTERESTS

Authors declare that there are no competing interests.

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