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The Effect of Water Temperature on Incubation Period, Hatching Rate, Normalities of The Larvae and Survival Rate of Snakehead Fish *Channa striata*

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Abstract

Muslim Muslim, Mirna Fitrani, Ahmad Medi Afrianto. 2018. The Effect of Water Temperature on Incubation Period, Hatching Rate, Normalities of The Larvae and Survival Rate of Snakehead Fish *Channa striata*, 19 (2): 90-94. The aims of this research were to determine the hatching performance of snakehead fish egg which incubated at different water temperature. This research had been conducted in the Fish Breeding Unit "Batanghari Sembilan", Indralaya South Sumatera Indonesia. This research was conducted in an experimental design with 5 treatments of water temperature: P1 (26 ± 0.5°C), P2 (28 ± 0.5°C), P3 (30 ± 0.5°C), P4 (32 ± 0.5°C), P5 (34 ± 0.5°C) and 3 repetitions. To keep temperature at that levels during the experiment used an electric heater and a thermostat. Wild stocks induced in semi natural condition with ®ovaprim 0.5 ml.kg^{-1}. Selected eggs were then incubated in aquaria (30x30x30cm^3) with density of 100 egg/aquaria. The results showed that incubation period needed at P1: 30.01 hours, P2: 28.02 hours, P3:23.13 hours, P4: 21.03 hours, P5: 20.12 hours. The best treatment for hatching rate, normality and survival rate were P2 treatment, 86.33%, 100% and 97.3%, respectively. Based on the results acquired, incubation temperature at 28 ± 0.5°C produced the best hatching rate, normality, and survival rate.

***Keywords**:* hatching performance; egg incubation; Snakehead fish; water temperature

Introduction

Snakehead culture has been develop in several aspect regarding larvae system. War *et al*., (2011) used different live feeds to enhances larvae survival rate. Hartini *et al*., (2013) combined probiotics media related with water quality, able to increase survival and growth of fries. Substitution of *Artemia* sp. with golden snail (Pomacea canaliculata) and earthworm (Lumbricus rubellus) also made attention to feed snakehead larvae on growth and protein retention (Kurnia *et al*., 2013). More over, water quality in particular pH recieved attention to survival and protein retention (Nisa *et al*., 2013). The influences of the variety of stocking density to survival and growth of snakehead fish fry and the survival and growth of snakehead fish on various modifications of swamp water pH on substrate soil (Astria *et al*., 2013).

Related to reproduction for snakehead, several studies were done likes Zultamin *et al*., (2014) used human chorionic gonadotropin hormone to stimulation of snakehead gonads. Induced breeding applied to snake head brood stocks with different doses of synthetic gonadotropin hormone stimulation (Saputra *et al*., 2015), fish pituitary extract (Sakuro *et al*., 2016).

Eggs incubation of snake head not complete revealed due to limited information. Muslim and Yonarta (2017) used oxygen supplied and duration to incubated eggs of snake head. Water temperature is limited factor that affect the egg incubation and hatching rate is water temperature. Slow and past the hatching period should be controlled by the high or low incubation temperature. Temperature is the main environmental factor governing the development of fish eggs (Nwosu and Holzlohner, 2000; Sapkale *et al*., 2011). However, too high temperatures can disrupt enzyme activity resulting in hardening of the chorion and inhibiting the hatching process (Mukti *et al*., 2009).

The best temperature range during the incubation for hatching of fish eggs depends on the species of fish. The best incubation

temperature for Pagrus major eggs is 12.7 to 29.7°C (Apostolos and Kitajima, 1994), Oreochromis karongae between 25 and 29°C (Valeta *et al*., 2013), Plectropoma laevis at 30°C (Andriyanto et at, 2013), Anabas testudineus at 28 °C (Putri *et al*., 2013), Lutjanus johnii at 30°C (Sugiarto *et al*., 2015), Hexagrammos otakii 12–16°C (Fawen *et al*., 2015), Lates calcarifer at 30°C (Thépot and Jerry, 2015). The results of that studies showed, temperature can affect of hatching egg fish. However, no information optimum temperature for incubation snakehead fish egg is available yet.

The aim of this study was to evaluate the effect of water temperature on incubation period, hatching rate, normality and survival rate of larvae snakehead fish *Channa striata* .

Materials and Methods

This research was an experimental research using completely random design with 5 treatments of incubation temperature: P1 (26 ± 0.5°C), P2 (28 ± 0.5°C), P3 (30 ± 0.5°C), P4 (32 ± 0.5°C), P5 (34 ± 0.5°C) and 3 repetitions, which was conducted at the Fish Breeding Unit "Batanghari Sembilan", Indralaya, South Sumatera, Indonesia. Research container was aquaria (30 x 30 x 30 cm^3) which is filled 5 liters of water. Water temperature was maintened at the levels of treatments by installing an electric heater with thermostat in each aquaria.

Wild broodstocks was used in this research. Eggs were obtained from semi-naturally spawning of one male broodstock (weight of 200 $g.fish^{-1}$) and one female broodstock (weight of 400 $g.fish^{-1}$). Spawning was semi-naturally by stimulating using syntetic gonadotrophine (® ovaprim) at a dose of 0.4 $ml.kg^{-1}$ fish (Saputra *et al*., 2015) with sex ratio of 1:1 (male:female) (Amornsakun *et al*., 2011). The spawning done in a styrofoam/container (70 x 40 x 30 cm^3). Floating eggs (fertilized eggs) were used for the experiment. Selected eggs were then distributed incubated into each aquaria with density of 20 eggs/liter or 100 eggs/aquaria.

The process of removing the eggs into each aquaria was done using a plastic bag. The eggs in the plastic bag are acclimatized for 5 minutes in the aquaria for each treatment. After acclimatization, the eggs are removed from the plastic bag and release into the aquaria.

The temperature of the water in the aquaria is monitored every 30 minutes to keep the water temperature in accordance with the treatment. If the water temperature in the aquaria increases or decreases so that it is not in accordance with the temperature of the treatment, then it is rearranged by using an electric heater and thermostat. The observation of normalities of larvae included morphology of head, body and tail was done the end of experiment.

All data were statistically analysed using one-way analysis of variance (ANOVA) and multiple comparisons among treatment means were made with the Duncan Multiple Range Test (DMRT). Results were considered statistically significant at the level of $P<0.05$.

Results

Incubation temperature gave significant effects in the incubation period, hatching rate, normality, and survival rate of the larvae produced ($P<0.05$). The data acquired during the incubation period, hatching rate, normality, and survival rate of the larvae was shown in Table 1.

Tabel 1. Hatching rate, incubation period, normality, and survival rate of snakehead fish larva

Parameters	Water Temperature Treatment				
	(26 ± 0.5°C)	(28 ± 0.5°C)	(30 ± 0.5°C)	(32 ± 0.5°C)	(34 ± 0.5°C)
Hatching rate (%)	69.33[a]	86,33[c]	82.00[c]	79.33[bc]	70.00[ab]
Incubation period (hour)	30.01[e]	28.02[d]	23.13[c]	21.03[b]	20.12[a]
Normality of larva (%)	98.51 [c]	100 [c]	100 [c]	92.46 [b]	87.59 [a]
Survival rate of larva (%)	85.49[b]	97.03[c]	91.49 [ab]	82.71 [a]	82.20 [a]
Water quality :					
pH (unit)	4.17-5.09	4.17-5.12	4.17-5.21	4.17-5.24	4.17-5.32
DO ($mg.L^{-1}$)	3.11-3.19	3.05-3.74	3.28-3.61	3.04-3.49	3.24-3.51

Discussion

Incubation temperature showed a significant effect on hatching performances of snakehead fish eggs. The results show that the highest hatching rate of snakehead fish egg is found in P2 (28±0.5°C) treatment, i.e. 86.33%. However, that hatching rate value is not significantly different with the hatching rate value in P3 (30±0.5°C) treatment and P4 (32±0.5°C) treatment, i.e. 82.00% and 79.33%, respectively. Lower hatching rate was found in low (P1) (26±0.5°C) and high (P5) (34±0.5°C) incubation temperature, i.e. 69.33% and 70.00%, respectively. High hatching rate in P2 (28±0.5°C) treatment is suspected that the incubation temperature at P2 (28±0.5°C) treatment used is the optimal temperature in the incubation of the snakehead fish egg, resulting in the best hatching percentage compared to other treatments.

The P1 (26±0.5°C) resulted in a low hatching percentage of 69.33%. The low hatching rate on P1 (26±0.5°C) has suspected that the incubation temperature is not tolerable and causes a slow embryonic development process, so the embryo is incapable of growth completely, causing the eggs to be damaged by fungus and death.

Based on the analysis of variance (Table 1), different incubation temperature showed a significant effect on the hatching period of snakehead fish egg. The results show that the fastest hatching period is P5 (34±0.5°C) treatment, which was 20.12 hours. The treatments of P1 (26±0.5°C), P2 (28±0.5°C), P3 (30±0.5°C), P4 (32±0.5°C) were significantly. The eggs incubated at high temperature hatch faster than that lower temperature. In high temperature metabolic processes occur more rapidly causing the development of embryos in the shell more active than low temperature, thus accelerating the hatching process. The temperature of incubation media will stimulate the embryo metabolism process, so that embryo development in higher incubation media will be faster (Andriyanto *et al*., 2013).

In this study the embryonic development of snakehead fish was not observed because of limited equipment. According to Marimuthu and Haniffah (2007), embryonic development of Channa striatus that incubated at 29±1°C is as follows: 15 – 20 min after spawning (2 cell stage), 30 – 50 min (16 cell stage), 1.30 – 2.0 hr (morula), 5.00 – 6.00 hr (blastula), 8.00 – 9.00 hr (gastrula), 9.00 – 9.30 hr (post gastrula), 9.30 – 10.00 hr (early neurula), 10.30 – 11.00 hr (neurula somite), 13.00 – 14.00 hr (late neurula), 15.00 – 16.00 hr (10 myotome), 17.00 – 18.00 hr (15 myotome), 20.00 hr (22 myotome), 22.00 hr (pre hatched embryo), 23.30 – 24.0 hr (hatching).

The newly hatched larvae were transparent and faintly brown in color. The hatchlings had unpigmented eyes and devoid of distinct mouth and fins. Since the head was very small, it was not distinctly separated from the yolksac. There was a functional heart and the blood circulation was noticed but the blood was unpigmented. The head and the yolksac together appeared as a bulb like structure when viewed from the above. The larvae floated passively on the water surface and occasionally swam upside down in inclined manner (Marimuthu and Haniffah, 2007).

The abnormal larvae occur due to the imperfect embryo development so that the hatching larvae are less ready to face the environment. The high temperatures can cause premature larvae so that the resulting larvae are less prepared for their environment (Woynarovich and Horvath, 1980). The results show that the abnormal larvae is found in P1 (26±0.5°C) treatment, i.e 1.49%, P4 (32±0.5°C) treatment, i.e 7.54%, P5 (34±0.5°C) treatment, i.e 12.41%, whereas in P2 (28±0.5°C) and P3 (30±0.5°C) were not found. It is suspected that the causes of deformities larvae are incubation temperature. The temperature can cause disruption of embryo development if not suitable (Johnston, 1993; Davidsen, 2012).

The highest of larvae day-0 until da-3 survival rate was found in P2 treatment (97.3%). Lower larvae survival rate at high incubation temperature (P5) (34±0.5°C) is caused by high water temperature during incubation that lead to premature hatch, and this larvae can not survive. In addition, high temperatures (P5) (34±0.5°C) can affect the larva metabolism so that the absorption of egg yolk faster than low temperatures.

Water being the life line of aquatic animals has significant effects practically on all life aspects of fish through its various parameters like, water temperature, pH, etc. (Sapkale *et al*., 2011). Water quality parameters measured in this study include pH and dissolved oxygen (DO). The pH range in this study: 4.17-5.09 (P1), 4.17-5.12 (P2), 4.17-5.21 (P3), 4.17-5.24 (P4), and 4.17-5.32 (P5). Based on the results of this study, the pH range from 4.17 to 5.53 is still within the tolerance for hatching and rearing of snakehead fish larva (Nisa *et al*., 2013).

Adequate levels of dissolved oxygen (DO) are essential to the survival of most aquatic organisms, no exception of fish. The range of dissolved oxygen in this study: 3.11-3.19 mg.L^{-1} (P1), 3.05-3.74 mg.L^{-1} (P2), 3.28-3.61 mg.L^{-1} (P3), 3.04-3.49 mg.L^{-1} (P4), and 3.24-3.51 mg.L^{-1} (P5). Based on the results of this study, the dissolved oxygen concentration in the incubation media during treatment still supports for hatching of egg and rearing of snakehead fish larvae.

Conclusion

Temperature is closely correlated with incubation period, hatching rate, normality and survival rate of snakehead fish larvae. Based on incubation period, hatching rate, larvae normality results, the best temperature for snakehead fish eggs incubation is 28 ± 0.5°C.

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