การศึกษาระยะเวลาและอัตราการฟักไข่ของปลาดุกแอฟริกา (*Clarias gariepinus*) ด้วยความหนาแน่นของไข่ที่แตกต่างกัน

Study of Hatching Period and Rate of African Catfish (*Clarias gariepinus*) with Different Egg Densities

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บทคัดย่อ

จุดประสงค์ของการศึกษาในครั้งนี้เพื่อทดสอบผลของความหนาแน่นของไข่ปลาดุกแอฟริกา (*Clarias garipienus*) ต่อระยะเวลาฟักและอัตราการฟักไข่ การศึกษาครั้งนี้ได้ทดลอง ณ วิทยาลัยเกษตรและเทคโนโลยีนราธิวาส ระหว่างวันที่ 1-5 เมษายน พ.ศ. 2568 จำนวนน้ำหนักไข่ปลาดุกที่ใช้ในการทดลองครั้งนี้ คือ 5 (T1) 10 (T2) และ 20 (T3) กรัม โดยแต่ละชุดการทดลองมี 3 ซ้ำ โดยไข่ปลาจะถูกนำมาผสมกับน้ำเชื้อปลาดุกจำนวน 0.5 มิลลิลิตร ทุกชุดการทดลอง จากนั้น ไข่ที่ได้รับการผสมจะถูกนำไปวางในตู้ปลาที่มีการให้อากาศอย่างเหมาะสมต่อการฟักไข่ตลอดการทดลอง ผลของการทดลองพบว่าระยะเวลาในการฟักออกเป็นตัวของปลาดุกอยู่ระหว่าง (23.30-23.50 ชั่วโมง) ซึ่งไม่มีความแตกต่างทางสถิติ ($P>0.05$) สำหรับอัตราการฟักนั้นพบว่า ชุดการทดลองที่ 3 (T3) มีอัตราการฟักสูงที่สุดคือ 88.54±0.39 % ซึ่งแตกต่างอย่างมีนัยสำคัญ ($P<0.05$) จากชุดการทดลองอื่น ๆ (T1 71.99±0.62% และ T2 83.11±1.56 %) สรุปได้ว่า ในการฟักไข่ของปลาดุกแอฟริกานั้น ยิ่งมีน้ำหนักไข่มากขึ้น อัตราการฟักของไข่จะเพิ่มขึ้นตามไปด้วย

คำสำคัญ: ปลาดุกแอฟริกา อัตราการฟัก ระยะเวลาการฟัก ชีววิทยาระบบสืบพันธุ์

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Abstract

This study aims to investigate the effects of different egg densities on the hatching period and rate of African catfish (*Clarias gariepinus*) eggs. The experiment was conducted at Narathiwat College of Agriculture and Technology during 1^{st}-5^{th} April, 2025. African catfish eggs were used in quantities of 5 (T1), 10 (T2) and 20 (T3) g with 3 replicates, mixed with 0.5 cc of male African catfish sperm then incubated in aquariums with mild aeration throughout experimental period. The results showed that the incubation period was not significantly different among treatments (23.30-23.50 hrs). From the hatching rate point of view, T3 treatment showed the highest hatch rate (88.54$\pm$0.39 %) which was significantly different from other treatments, T1 (71.99$\pm$0.62%) and T2 (83.11$\pm$1.56%). In conclusion, it was found that the highest egg weight of African catfish resulted in a significantly highest hatching rate.
Keywords: African catfish, hatching rate, egg incubation, reproductive biology

Introduction

Aquaculture has been fast-growing industry in recent years owing to its economic importance, essential protein resources and environmental sustainability (Pomeroy et al., 2014). Fish farming has been the main portion in both production and exportation, involving over a million individuals operating in this business worldwide (Oyinlola et al., 2018). According to Araujo *et al.* (2022), total fish production globally was assumed to be 177.8 million tons with production from fisheries and aquaculture were 90.3 and 87.5 million tons respectively. The latest authors pointed out further that freshwater fish played a major role in this sector. African catfish (*Clarias gariepinus*) is a commercial catfish species in Thailand and other countries in Southeast Asia owing to its well-adaptability to deteriorated water quality, fast growing, great resistance to pathogens and relatively simple culture techniques (Patta et al., 2024; Julius et al., 2025).

C. gariepinus has been introduced to Thailand in late the 80s to early 90s and since then become main economic species instead of walking catfish, *C. batrachus* and broadhead catfish, *C. macrocephalus* (Wattanutchariya & Panayotou, 1981; Low et al., 2021). Even though African catfish culture techniques are well-documented and established but there has been paucity of research development since the 2000s and also several aspects of *C. gariepinus* need to be improved such as reproductive biology, larval rearing and seedstock improvement to sustain this fish according to the United Nation's Sustainable Development Goals (SDGs). A better understanding on the reproductive point of view would develop breeding program, shorten time management, and increase yield production (Julius et al., 2025). According to Barasa and Ouma (2024), the constraint of African catfish breeding is the quality of larval production and high mortality occurring during the hatching period. Egg density is another unnoticed factor that is crucially important to larval quality, hatching rate, and hatching period. Moreover, catfish egg is adhesion egg which means the eggs adhere to substrate and clump in one particular area caused low hatching and larval growth rates (Azizah et al., 2019). Therefore, it is very important to determine the optimal density of catfish seed production. There has been scarce information related to these topics for catfish (Ferosekhan et al., 2021). The present study objective is to determine the effect of egg density on hatching period and hatching rate of African *C. gariepinus* to fulfill fundamental reproductive biology data on this species.

Materials and methods

Location and broodstock acquisition and preparation

A study of the difference of egg density on hatch period and rate was conducted at Narathiwat College of Agriculture and Technology (NCAT), Narathiwat, Thailand during 1st-5th April, 2025. Two males and females African catfish broodstock (body weight ranged from 600-800 g) were purchased from the local market then transferred to the freshwater hatchery, NCAT for acclimatization and quarantine for 3 days. During the acclimatization period, the broodstock were not fed and water quality was controlled following Otoh et al. (2024); temperature 26-28 ^{o}C, dissolved oxygen > 5 ppm and pH 7.2-7.8 by using YSI 556. In order to obtain egg used in the experiment, female broodstock were weighed for hormone usage calculation then the specimens were injected with Suprefact *E* with domperidone at the concentration of 1 ml and domperidone 5 mg per 1 kg fish weight, respectively. For male broodstock, no injection was administered and milt acquisition were obtained from dissecting and squeezing the testis (figure 1).

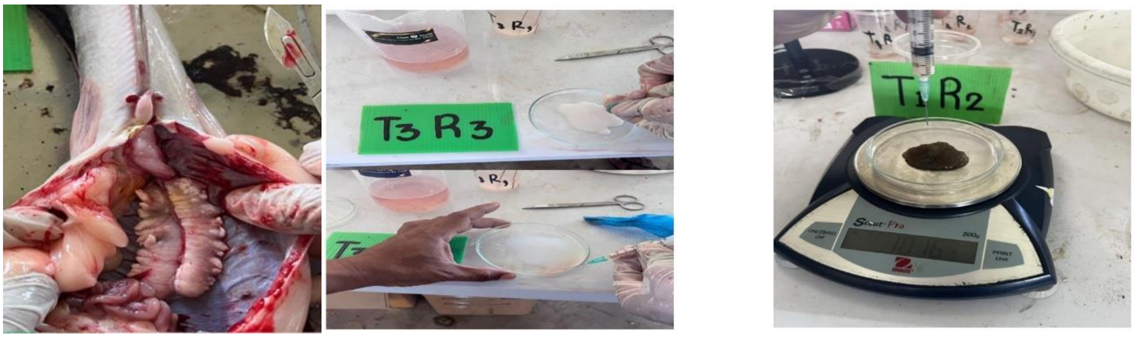

Figure 1 male African catfish testis and milt preparation

Experimental Design

In this study there were 3 treatments of different egg weights namely; T1 5g, T2 10g, and T3 20g, with 3 replicates. After injection 12 hours, female broodstock with swollen belly were squeezed at the abdomen to release eggs into a glass tray, and weighed according to the treatment. Coincidentally, male broodstock were dissected to obtain milt then squeezed into a glass. Then 0.5 ml of milt was injected using 1 ml syringe per treatment. Eggs and milt were mixed altogether by using chicken a feather in the glass then placed on a frame of blue net attached to PVC pipe as substrate in an aquarium glass size 60 x 40 x 30 cm (Length x width x depth) to observe the hatching period and hatching rate. Water quality parameters were monitored according to Otoh et al. (2024); temperature 26-28 ^{o}C, dissolved oxygen > 5 ppm and pH 7.2-7.8 by using YSI 556. Hatching period was started immediately after placing the egg in the aquarium until the first larva hatched from the egg, and hatching rate was assessed by the formula according to Julius et al. (2025).

$$\text{Hatching rate (\%)} = \frac{\text{Number of newly-hatched larvae}}{\text{Number of eggs in each replication}} * 100$$

Data Analysis

Hatching period and hatching rate data were analyzed by using One-way ANOVA to determine the significance level. Data were analyzed for variance (F test) at 95 % confidence level. If the analysis of variance was found to be significantly different ($P<0.05$), Duncan's multiple region test was operated to determine differences between treatments.

Results and Discussions

The present study obtained the results that there was an effect of egg weight on hatching rate (Table 1). There was no significant difference in hatching period on African catfish, *Clarius gariepinus* among treatments. Hatching period of present study (23.30-23.50 hr) are considered to be less than Borode et al. (2002) and Julius et al. (2025) which were 19.20 and 21.00 hr, respectively. It could imply that there were other parameters affected on hatching period such as environmental factor i.e. temperature, salinity and dissolved oxygen. Phelps et al. (2007); Hayimad et al. (2022) indicated that environmental parameter in particular temperature would affect the ovulation of broodstock, delay embryonic development or even prolong incubation period. The latest authors emphasized further that the fluctuation of temperature could cause disturbance and stress in molecular level of aquatic animals. It could be assumed that the fluctuation of temperature probably played significant role on prolong hatching period of African catfish in this study.

Table 1 Hatching period and hatching rate and standard deviation of African catfish (*Clarias gariepinus*) eggs

Parameter	5g (TR1)	10g (TR2)	20g (TR3)
Incubation period (h)	23.50$\pm$0.28^a	23.30$\pm$0.19^a	23.30$\pm$0.22^a
Number of eggs	1,404.60$\pm$15.17	3,254.30$\pm$32.29	7,042.60$\pm$41.59
Number of larvae	1,011.17$\pm$15.17	2,704.65$\pm$32.29	6,235.52$\pm$41.59
Hatching rate (%)	71.99$\pm$0.62^a	83.11$\pm$1.56^b	88.54$\pm$0.39^c

The total number of hatched larvae was determined 24 hours after the egg started hatching by counting newly-hatched larvae. Unfertilized eggs that turned whitish were collected and siphoned out. The hatching rate of *C. gariepinus* egg was significantly different between treatments. The results showed that treatment 3, was the highest hatching rate (88.54+0.39%) which was significant difference (P<0.05) from other treatments. Hatching rates of the present study in all treatments were higher than Kucska et al. (2022) which temperature lower in the experiment lower than (25$\pm$1 ^{O}C) the present study and Maradun et al. (2018) studies were around 55.1-66.7 % and 78.67 % respectively. The present study result on hatching rate was not inconsistent with Azizah et al. (2019) study which lower stocking density of catfish egg produced higher hatching rate, namely at standard water quality parameters the hatching rate at the lower egg density (60 g) was 91.3$\pm$0.42 % while at the higher density (70 g) was 80.8±0.68 %. The latest authors reported that egg stocking density significantly affected to hatching rate because the embryo needs spaces for movement, exchange oxygen and develop to next phase. It could be implied that the density of the present study too low and have too much space consequently adversely affected to the hatch rate. Hatching rate of African catfish was varied from 11.2-92.3% depending on various factors such as water temperature, dissolved oxygen level and pH (Kucharczyk et al., 2020). From the present study observation, egg stocking density also affected the hatch rate of African catfish egg so that optimum egg stocking density needs to be investigated deeper in order to boost hatchery production of African catfish.

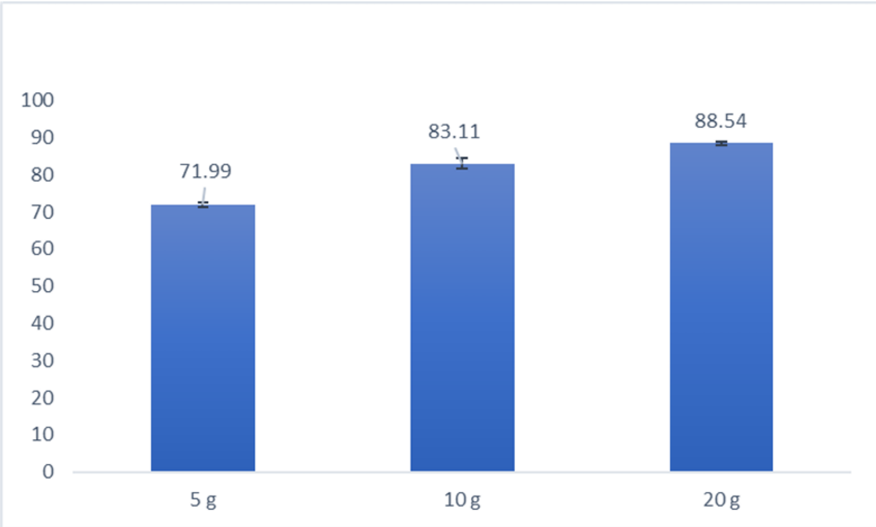

Figure 2 Hatching rate with standard deviation of African catfish, *Clarias gariepinus* with different egg weights

The rate of hatching or hatchability is normally influenced by yolk nutrients in the egg which are spent during embryonic development (Ferosekhan et al., 2021). In present study, all of the broodstock were unfed throughout the acclimatization period, which means the changes in the hatching rate among different egg weight treatments may not be directly affected by the parental diet. However, according to Ferosekhan et al. (2021), there is a high possibility of reduced endogenous nutrient flow to egg. This action is primarily regulated by 17-β estradiol and to a lesser extent by testosterone (Lubzens et al., 2010). The ability to synthesize these steroid sex hormones declines in maternal animals, resulting in insufficient production or synthesis of vitellogenin and phosvitin during ageing (Blythe et al., 1994; Lu et al., 1979). This might be a reason for the lower hatching rate witnessed in the present study if compared to Azizah et al. (2019) study.

Conclusion

A study of hatching period and hatching rate of African catfish (*Clarias gariepinus*) with different egg weights showed no difference in hatching period among treatments but there were significant differences in hatching rate. From the study, during egg incubation, temperature was monitored to avoid temperature fluctuation during the hatching period. During broodstock acclimatized period, the specimens need to be fed ad libitum to avoid poor larval quality and hatchability. Nonetheless, present study indicated that there must be more research related to egg weight such as higher egg weight treatment and egg weight with suitable milt concentration.

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