TIK-33 THE SPAWNING RATE OF SNAKEHEAD FISH (CHANNA STRIATA, BLOCH 1793) WITH NATURAL AND SEMI-NATURAL METHODS

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THE SPAWNING RATE OF SNAKEHEAD FISH (CHANNA STRIATA, BLOCH 1793) WITH NATURAL AND SEMI-NATURAL METHODS

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ABSTRACT
The Snakehead fish (*Channa striata*) is one of the important catches in Indonesia. This is because snakehead fish contains high protein and albumin so that it has high economic value. Due to those factors, the population of snakehead fish is starting to decrease because of overfishing in the wild. One way that can be taken to increase the population of snakehead in nature is to develop these fish in a cultivated environment. Activities to increase the population of snakeheads fish can be carried out through hatcheries, which can be started by spawning the snakehead fish. The purpose of this study was to determine the spawning rate of snakehead fish naturally and semi-naturally. The treatments included semi-natural treatment in the form of oodev hormone at a dose of 1.5 ml/kg, hCG hormone at a dose of 0.2 ml/kg, ovaprim hormone at a dose of 0.2 ml/kg and natural treatment without hormone injection was used as a control. The results showed that the spawning rate of snakehead fish in the control treatment was very low, while the semi-natural treatment had the same value, namely 33%, both in the treatment of oodev, hCG and ovaprim hormone. Even so, the most effectively used of hormone stimulation for snakehead fish was the hormone ovaprim. This was supported by research data in the form of latency time, fertilization rate and hatching rate which were better than hCG and oodev.

KEY WORDS
Snakehead fish, effectiveness, latency time, fertilization rate, hatching rate.

Snakehead (*Channa striata* Bloch 1793) is one of the most important catches in the Indonesian fishery due to its high economic value, high protein and albumin content. This is why snakeheads are often eaten and used as wound dressing. The abundance of snakeheads (*Channa striata* Bloch 1793) influences the decline of the wild snakehead population. Makmur (2003) The decline of snakehead populations in the wild is caused by seasonal spawning of snakeheads due to the increase in gonadotropin and steroid hormones, as well as environmental factors during sexual maturation, so that snakehead production is still difficult throughout the year. Therefore, it is necessary to do spawn activities for snakehead fish to meet the many needs in the community. The breeding of snakehead fish from seeds to fries can be done to overcome the population decline in the wild. Activities to increase the population of snakehead fish can be carried out through hatcheries, which can be started by spawning the snakehead fish.

Snakehead fish spawning can occur naturally and semi-naturally. According to the Mandiangin Freshwater Aquaculture Center (2014), natural spawning activities include male and female broodstock selection, broodstock mixing, spawning processes and eggs. Breadstick selection was observed by observing the visual characteristics of male and female parents with mature gonads, after which the selected breadcrumbs were collected in containers. The mixing is done by placing the parents in each spawning tank, as much as a pair of males and females. Snakehead Fish farming activities can be done by upgrading snakehead fish spawning technology. Sakuro et al., (2016) manipulation of the spawning environment and hormonal stimulation are part of the snakehead fish spawning technology.

The ingredients used for hormonal stimulation are human chorionic gonadotropin (hCG), Oodev, and Ovaprim. Several studies on synthetic gonadotropin hormones, the previous study by Saputra et al., (2015), where the results of this study show that the dose of human chorionic gonadotropin (hCG) used in spawning was 0.2 ml/kg *Channa striata* fish. Ath-Thar et al., (2017) that based on them research the hormone Oodev can increase the gonadal maturation stage of snakehead fish at a narrow dose of 1.5 ml/kg, based on the results of research by Augusta and Pernando (2019), it was found that the semi-native spawning of snakehead fish closely spawning stimulation can be seen with the hormone ovaprim dose of 0.2 ml/kg. For these three studies, as well as the research, it is necessary to determine the prevention of the use of the three hormonal stimulation, as well as the efficiency of the use of hormonal stimulation, accelerate the storage of snake heads, so that can increase the population of snakeheads in the world, especially in Kalimantan community.

METHODS OF RESEARCH

The study was conducted from November 26 to December 26, 2021 at the Wet Laboratory of the Faculty of Fisheries and Marine Affairs, Lambung Mangkurat University.

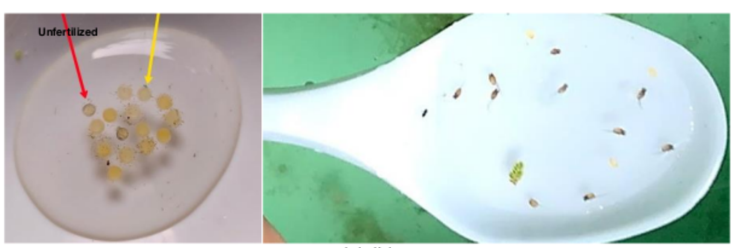
The tools used are scuba diver, aquarium size 17x11x11 cm, scoop, hose, label paper, ruler, digital scale, syringe, spoon, knife, box, pH meter, DO meter and thermometer. The materials used were 12 pairs of snakeheads (range 250-300 grams/head), synthetic gonadotropin hormone, Oodev hormone, Ovaprim hormone, maggot, water hyacinth and *Pistia stratiotes*.

The investigation procedure includes tank preparation, rescue preparation, natural and near natural spawning, observation and measurement of water quality. In the first week, the adaptation process of the test fish in the test tank and matching fish was carried out as shown in Figure 1.

(a) (b)

Figure 1 – Snakehead fish parent matching process, a) when mixed and b) a pair with matching bread

In the second to third week, the natural and semi-natural spawning of snakehead fish is carried out. Observations and data collection were carried out during the fourth week. Data collection includes latency, number of eggs, fertilized eggs, oviposition and water quality. This is as shown in Figure 2.



(a) (b)

Figure 2 – Collecting data, a) the process of counting fertilized and unfertilized eggs and b) larvae calculation process

The design used in this study was a completely randomized design (CRD) with 4 different treatments with 3 replications, namely:

- Control: Spawning naturally;
- Treatment A: Semi-natural spawning using the hormone Oodev with the treatment dose is 1.5 ml/kg fish;
- Treatment B: Semi-natural spawning using synthetic gonadotropin hormone with the treatment dose is 0.2 ml/kg fish;
- Treatment C: Semi-natural spawning using the hormone Ovaprim with the treatment dose is 0.2 ml/kg fish.

Figure 3 – Treatment Placement

The normality test was performed using the Liliefors method (Nasoetion and Barizi, 1985), this test is useful to test the normality of the data from the research results. In addition, the uniformity test used the Barlett method (Sudjana, 1992). If the data are declared as anomalous and homogeneous, the data should be transformed before further analysis is performed. Once the above conditions are met, the variance analysis can be performed. According to Habafiah (2000), if the data need further testing, further testing depends on the diversity coefficient (DC) and a simple regression test.

RESULTS AND DISCUSSION

The results of weighing and body length of all snakehead fish used can be seen in Table 1.

Table 1 – Weigh and Body Length of Fish

Pond	Weigh (g)		Body Length (cm)	
	Female	Male	Female	Male
K1	240±10.41	180±8.14	31±1	29±1
K2	260±10.41	193±8.14	32±1	30±1
K3	255±10.41	178±8.14	30±1	28±1
A1	680±233	190±17.3	42±5.291	29±0.577
A2	260±233	190±17.3	32±5.291	30±0.577
A3	295±233	220±17.3	34±5.291	30±0.577
B1	265±250	200±116.8	32±7.234	29±4.041
B2	240±250	186±116.8	31±7.234	29±4.041
B3	685±250	395±116.8	44±7.234	36±4.041
C1	485±93	200±25	33±1.527	30±1
C2	375±93	150±25	31±1.527	28±1
C3	300±93	175±25	34±1.527	29±1
Mean	362±165.2	205±62.2	34±4.46	30±2.09

Source: Primary Data, 2021.

Based on Table 1, the weight and body length of the snakehead (*Channa striata* Bloch 1793) used in this research had a mean weight of 362±165.2 g for females and 205±62.2 g for males. The body length of the female broodstock is 34±4.46 cm and the body length of the male broodstock is 30±2.09 cm.

The broodstock weight should be taken during the laying process, as determining the number of successfully laid eggs is judged by the broodstock weight, in addition to the broodstock weight it is also useful for 'broodstock determination'. The dose to be injected meets the needs of the broodstock body while stimulating spawning. Meninda (2020) says that weighing should be done first, this is useful to determine the dose of hormone to be injected into the fish.

The results of body weight and body length measurements of snakeheads in this research ranged from an average of 362±165.2 g for females and 205±62.2 g for males. Female broodstock body length is 34±4.46 cm and male broodstock body length is 30±2.09 cm, can produce an average number of 5,854 eggs. This result is more than the results of Augusta and Pernando research (2019) that female parental weight is between 214.5-410.2 g, males 227.2-391.3 g, total number of fertilized eggs from the natural lactation process was in the range of 1,837 eggs, as well as from the results of Adipu and Rovik research (2018) that the body length of snakehead fish varies between 30-35 cm/head, the number of eggs produced is in the range of 4,180 eggs. The difference between the results of the study and the results of existing studies shows that the body weight and body length of the broodstock affect the number of eggs produced during the spawning season, consistent with Sukendi (2001), that body weight and body size is the length affects of the egg count from fish species.

Based on field observations, the behavior of snakeheads (*Channa striata* Bloch 1793) was observed during the matchmaking process. The packaged male corkfish tends to be closer to the female parent more often, even when the male parent is separated from the female parent, the female parent shelters directly into the male parent, or the male parent escapes from the disruption to the female. Become a parent again and vice versa. The matchmaking process can be seen in Figure 1.

Based on Figure 1, fish are kept in culverts with a stocking density of 1 fish/pond in the process of fish adaptation in the wet laboratory. This is useful for natural spawning prevention measures that are not consistent with the study design. After 7 days of breeding per individual fish, the fish were then phased in, the brood weight was measured and the brood body length was measured. Matching is done by placing 1 male and 4 females in 1 tank. After a pair (1:1) snakehead fish is found, the fish are put together and the research design can be carried out. Snakehead spawning occurred at a 1:1 ratio, in agreement with the Mandiangin Freshwater Aquaculture Center (2014) reporting that each pair of broodstock was used naturally and semi-naturally in snakehead spawning male broodstock to 1 female broodstock.

The behavior of matched fish is characterized in that if they don't match, fish will go through the union process for storage, while the spawning process will not work as it should. As stated by Kusmini et al., (2015), spawning behavior is characterized by the male parent moving closer to and around the female parent as a sign of ovulation. When spawning, the male parent bends the body towards the female parent. Then the female parent releases eggs, followed by the male parent releasing sperm to fertilize the eggs. The results of the field observations are consistent with existing explanations that the matched fish can complete the mating process to spawn, while the spawning process does not work properly if they are not matched.

Opportunities and occurrences of natural and semi-natural spawning in this research can be seen in Table 2.

Table 2 – Opportunities and Occurrences of Spawn

Opportunities and Occurrences	A			B			C			K		
	1	2	3	1	2	3	1	2	3	1	2	3
Spawn		O		O				O				
Not Spawn	O		O		O	O	O		O	O	O	O

Source: Primary Data, 2021.

Based on Table 2, the overall probability and occurrence calculation was only carried out on the treatment data that successfully spawned, namely semi-natural treatment. The calculations are as follows:

$$\text{Opportunity} = \frac{\text{Total Spawn}}{\text{Total Treatment}}$$

Where: Opportunity is attempt in spawning; Total Spawn is a number of treatments that successfully spawn; Total Treatment is a number of treatments tested.

$$\text{Occurrences} = \text{Oppurnity x } 100\%$$

Where: Occurrences is index of opportunities that occur; Opportunity is attempt in spawning.

This calculation refers to the literature of Han (2016) where spawning success (%) = (number of spawn loaves / total breeding stock per treatment) x 100. Based on the calculations performed is the probability that this semi-natural spawning will occur. 3/9 and the incidence is 33%. Thus, the efficiency of the use of additional hormones in the form of Ovaprim, hCG and Oodev hormones in the natural spawning of snakehead fish is 33%.

The calculation of probabilities and events as performed was tested in the research by Putra et al., (2019) on star pomfret, where the spawning index when using Ovaprim hormone was 100%, chorullone hCG hormone was 100% was, Wofa - FH hormone was 75% and Polaris hCG hormone was 50%. Compared to the spawning index from the research by Putra et al., (2019), the probabilities and events in snakehead spawning are of course quite small, the value difference of this index is presumably influenced by the spawning success rate and the spawning interval as suggested by Peter et al. (1988) reports that the criteria for assessing the efficiency of hormone uptake are the high and low conserving success rates and the time interval between the last injection and expansion.

Treatment unsuccessful and successful when adjusted to data in the field was caused by multiple factors such as degree of sexual maturity and quality. This is in line with the opinion of Idrus (2016) that the level of sexual maturity and the quality of the eggs produced are the cause of successful spawning in fish. A quality determines whether the eggs can be released for the mother to spawn without problems.

The data on the degree of gonad maturity of the snakehead used in this study can be seen in Table 3. The spawning female parent's gonadic maturity is Level IV and the male spawning broodstock gonadic maturity is Level III.

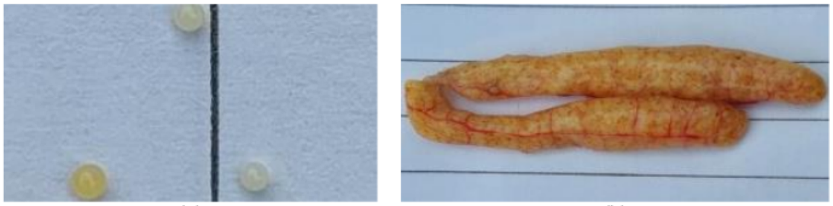
Table 3 – Gonad Maturity Level

Treatment	TKG	
	Female	Male
K1	II	III
K2	II	III
K3	II	III
A1	II	III
A2	IV	III
A3	II	III
B1	IV	III
B2	II	III
B3	II	III
C1	II	III
C2	IV	III
C3	II	III

Source: Primary Data, 2021.

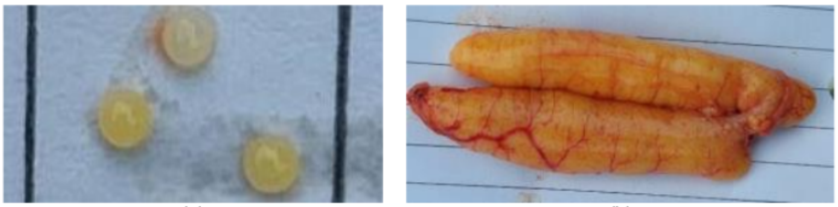
Gonadal Maturity of Snakehead Fish (*Channa striata* Bloch 1793) in this research refers to the Kesteven literature where female TKG II eggs are characterized by red and white powdery eggs, female TKG IV characterized by red-orange eggs are and can be distinguished by color, and TKG III males are generally white and oblong. The TKG capable of inducing spawning is at levels III and IV; this is supported by data on latency, number of eggs, rate and speed of fertilization. Observation of gonad maturation level was done by snakehead fish surgery.

Based on the results of this study, the snakehead was found to spawn at the stage III-IV level of sexual maturity, which is consistent with the Mandiangin Freshwater Fish Cultivation Fisheries Center (2014) statement that the farmed fish (*Channa striata* Bloch 1793) is ready to natural and semi-natural spawning are mostly in the range of TKG III-V.



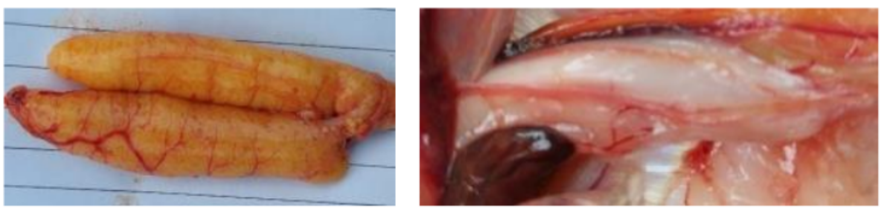
(a) (b)

Figure 4 – Gonad Maturity Level of Female Snakehead Fish at Level II, a) separated eggs and b) whole gonads



(a) (b)

Figure 5 – Gonad Maturity Level of Female Snakehead Fish at Level IV, a) separated eggs and b) whole gonads



(a) (b)

Figure 6 – Differences in Gonad Maturity Levels of Snakehead Fish, a) Female and b) Male

The latent timing of spawning in this study is shown in Table 4. Treatments that speed up spawning are Treatment C (Ovaprim hormone) followed by Treatment A (Oodev hormone), Treatment B (hCG hormone) and control.

Table 4 – Spawning Latent Time

Pond	Injection Time	Ovulation Time	Latent Time
A	11-12-2021, 17.28 WITA	18-12-2021, 06.15 WITA	6 day 13 hour 15 minute
B	11-12-2021, 18.02 WITA	19-12-2021, 16.17 WITA	7 day 22 hour 15 minute
C	11-12-2021, 18.26 WITA	14-12-2021, 05.36 WITA	2 day 10 hour 10 minute
K	11-12-2021	-	Nothing spawn

Source: Primary Data, 2021.

Treatments that accelerate the onset of semi-natural spawning are C (Ovaprim hormone) with a latency of 2 days 10 hours 10 minutes, followed by A (Oodev hormone) with a latency of 6 days 13 hours 15 minutes, B (hCG hormone) with a latency period of 7 days 22 hours 15 minutes, and the control did not spawn.

The rapid latency in Treatment C was believed to be due to the optimal dose of Ovaprim hormone to be used, which allowed the female parent to release more pheromone activity prior to ovulation. According to Zairin et al. (2005) the increase in neurophysical hormones is due to a pheromone response in the body which, when a certain level is reached, causes the female parents to release eggs more quickly.

The latency generated in this study is quite long compared to the results of the study by

Saputra *et al.,* (2015) where the latency varies by a few hours, in the range of 23 to 27 hours. It is believed that this difference is influenced by the function of hormonal stimulation used in the maturation process of the gonads for spawning. This is in line with the opinion of Zutamin *et al.* (2014) that the content in the dose of the hormone injected into the snakehead fish can affect the speed of spawning of snakehead fish.

Data on the number of eggs from the spawning day of the cork broodstock in this study can be seen in Table 5. Most eggs were produced in treatment B (hCG hormone), followed by treatment A (Oodev hormone), treatment C (Ovaprim hormone) and control.

Table 5 – Number of Eggs

Repeat	Treatment (granule)			
	A (Oodev)	B (hCG)	C (Ovaprim)	Control
I	0	6692	0	0
II	5572	0	5297	0
III	0	0	0	0
Total	5572	6692	5297	0

Source: Primary Data, 2021.

Based on Table 5, the results of Liliefor's normality test on the number of snakehead eggs showed that the data is normally distributed with the value of Lmax (0.746) > Ltable 5% (0.27) and 1% (0.31) were, H1 was accepted and H0 was rejected. The Bartlett test of homogeneity on the number of snakehead eggs showed that the data variance was homogeneous, with X2 counting (30.325) > X2 table 5% (5.991) and 1% (4.605), accepting H1 and rejecting H0. Based on the results of analysis of variance (Anova), the calculated treatment F-data (2.968) were found to be < of F-table 5% (5.14) and < F-table 1% (10.92), thereby H0 is accepted and H1 was rejected, proving that there was no significant effect between treatments.

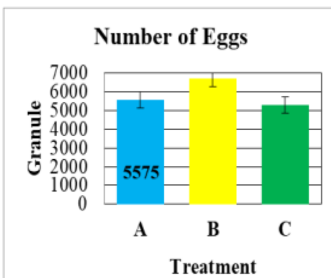


Figure 7 – Graph of Number of Snakehead Fish Spawning Eggs

Based on Figure 7 above, the treatment that could produce the largest number of eggs is treatment B (hCG hormone) with 6,692 eggs, the second treatment A (Oodev hormone) with 5,575 eggs, and the third treatment C (Ovaprim hormone) with a total of 5,297 eggs. The number of eggs produced is thought to be influenced by the spawning environment and the weight of the fish, particularly the weight of the male fish. In treatment B, the weight of the spawning fish went from 265±0.25 g (females) to 200±116.8 g (males) and the weight of the fish was 260±233 g (females) in 190±17.3 g (Male) and C 375±93 g (female) and 150±25 g (male).

The effect of fish weight on the results of this study is consistent with Harianti (2013) that for a given size or weight of fish, the number of eggs increases during the fish and then again due to response to the improvement in nutrition due to sexual maturity decreases distance between spawning cycles.

The number of eggs produced in this study was better than in the research by Saputra *et al.*, (2015) who found 2,874-3,616 eggs in a weight range of 160-170 g female and male corkfish injected with hCG hormone. While Ath-thar *et al.,* (2017) stated that the traces with Oodev injection were in the range of parental weights 255-219 g, the number of eggs produced ranged from 1,250-5,000 eggs, in Augusta and Pernando (2019) Fed stated that the number of fertilized eggs from the results of the spawning process using Ovaprim was 1,837 eggs and the weight of female brood ranged from 214.5-410.2 g males 227.2-391.3 g.

The data on the fertilization rate from snakehead deposits in this research are presented in Table 6. Most fertilized rates were produced in Treatment C (Ovaprim hormone), followed by Treatment B (hCG hormone), Treatment A (Oodev hormone) and control.

Table 6 – Fertilization Rate

Pond	Fertilized (granule)	Unfertilized (butir)	Fertilization Rate (%)
A	813	4762	14,59
B	3894	2798	58,18
C	4626	671	87,33
Control	0	0	0

Source: Primary Data, 2021.

The results of the Liliefor's normality test on the number of snakehead eggs show that the data are usually distributed with the value of Lmax (0.712) > Ltable 5% (0.27) and 1% (0.31), so H1 is accepted and H0 rejected. The Bartlett test of homogeneity on the number of snakehead eggs shows that the data variance is homogeneous, counting X2 (32.542) > X2 table 5% (5.991) and 1% (4.605), thus accepting H1 and rejecting H0. Based on the results of analysis of variance (Anova), it was obtained that the calculated F-data for treatment (2.459) < F-table 5% (5.14) and < F-table 1% (10.92) were H0 accepted and H1 was rejected, proving that there was no significant effect between treatments. The graph of the fertilization rate of snakehead fish eggs is shown in Figure 8.

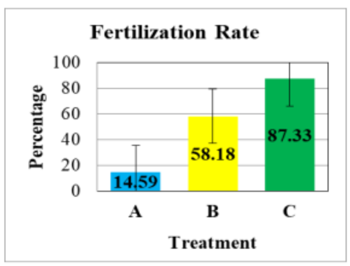


Figure 8 – The Graph of the Fertilization Rate of Snakehead Fish

Based on Figure 8, the optimal treatment in terms of ovulation degree is treatment C (Ovaprim hormone) with a percentage of 87.33%, the second B (hCG hormone) with a percentage of 58.18% and the third A (Oodev hormone) with a rate of 14.59%.

Based on analysis of variance, it could be shown that the use of different hormonal stimuli in the fertilization of snakehead fish did not differ significantly, but compared to the results of other studies, there were significant differences. The fertilization rate in this study is different from the results of Muslim research (2017) that fertilized oocytes with Ovaprim stimulation can reach the range of 96.31-97.75%, while the results of this study are 87.33%, research results by Haniffa et. al., (2000) stated that the survival of snakeheads with hCG in the degree of fertilization ranged from 60-68% compared to the results of this study which was 58.18% and the results of research by Dwantara and Rahmia. (2017) argue that the fertilization rate with the hormone Oodev reaches the range of 54.31-79.59%. This differs from the results of this study, which is 14.59%. This is probably due to the high dose in the test fish, which led to a decrease in sperm volume during lactation. As reported by Muhammad et al., (2003), a high dose has a negative effect on the work of the gonads, so the lower the fertilization rate, the lower the sperm volume and the higher the sperm concentration for ovulation.

Data on the hatching rate of snakehead fish spawning in this research can be seen in Table 7. The highest score was obtained in Treatment C (Ovaprim hormone), followed by Treatment B (hCG hormone), Treatment A (Oodev hormone) and a control.

Table 7 – Hatching Rate

Pond	Sample of eggs (granule)	Hatch of eggs (granule)	Hatching Rate (%)	Hatching Time
A	100	17	17	29 Hour
B	100	59	59	27 Hour
C	100	90	90	24 Hour
K	0	0	0	0

Source: Primary Data, 2021.

Based on Table 7, the results of the Liliefor's normality test on the number of snakehead eggs show that the data are normally distributed with the value of Lmax (0.716) > Ltable 5% (0.27) and 1% (0.31), so H1 is accepted and H0 rejected. The Bartlett test of homogeneity on the number of snakehead eggs shows that the variance of the data with X2 (16.127) > X2-table 5% (5.991) and 1% (4.605) is homogeneous, thus accepting H1 and rejecting H0. Based on the results of analysis of variance (Anova), it was obtained that the calculated F-data for treatment (2.446) were < the F table (5%) and < the F-table (1%), so H0 was accepted and H1 was rejected, treatment shows no significant effect, calculation result data. The graph of the hatching rate of snakehead fish is shown in Figure 9.

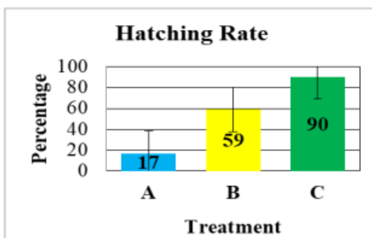


Figure 9 – The Graph of the Hatching Rate of Snakehead Fish

Based on Figure 9, the optimal treatment for hatching rate of eggs is treatment C with 90% percentage (Ovaprim hormone), the second is treatment B with 59% percentage (hCG hormone), and treatment A (Oodev Hormone) at a rate of 17% percentage. The Hatching rate in this research differed from the research of Cahyati et al., (2021) who found that the use of the hormone ovaprim in spawned snakehead fish resulted in an 82.67% hatching rate, which is different compared to other die results of this study of 90%, the results of Yakoob and Ali (1992) research revealed that the percentage of eggs hatched with the hCG.

Hormone reached the range of 53.2-56.4%, while the results of this study 59% deceive, Dewantara and Rahmatia (2017) argued that the hatching rate with Oodev hormone was in the range of 60.72- 89.72%. This differs from the results of this research which is 17%. The success of fertilization and ovulation depends on the time of ejaculation (spawning) and the sperm's ability to compete for fertilization of the egg. Muhammad *et al.,* (2005) noted that eggs that do not develop after fertilization and changes in the physiological capacities of eggs during embryogenesis are other factors that can cause low hatch rates. Satyono (2009) also notes that the male egg's sperm has a major impact on the final rate, meaning that not all fertilized eggs become larvae. Aryani et al., (2010) state that water temperature, pH and oxygen, and microbiology are external factors that determine the extent of the eruption.

The water quality data in this study can be seen in Table 8. The water quality during this study is still consistent with snakehead fish living standards.

Table 8 – The Water Quality

The Water Quality	Perlakuan				Quality Standards	Note
	Control	A	B	C		
	27,53	27,13	27,26	26,83		Outset
Temperature	0	27,70	27,70	26,90	26-30°C (Bijaksana, 2011)	Spawn
	27,53	27,46	27,43	27,00		Close
	3.52	3,22	3,17	3,20		Outset
DO	0	3,46	3,18	3,19	1,88 - 3,5 mg.L^{-1} (Almaniar, 2011)	Spawn
	3,52	3,28	3,19	3,21		Close
	6,15	6,11	6,17	6,07		Outset
pH	0	6,29	6,18	6,14	4-9 (Saputra *et al.*, 2015)	Spawn
	6,24	6,14	6,20	6,10		Close

Source: Primary Data, 2021.

Based on Table 8 above, the water quality for all treatments had an initial mean temperature of 27.2, 27.4 at spawning and 27.3 at the end. The initial DO average was 3.28 while the saving was 3.26 and the ending was 3.30. The mean initial pH was 6.13 while the spawn was 6.2 and the final pH was 6.17.

The results of the first average temperature measurement are between 27.2°C, during spawning it was around 27.4°C and at the end it was around 27.3°C. If the temperature in the media is below the norm, it will affect the appetite of the fish and release bacteria that will hinder the survival of the fish. This is consistent with the opinion of Kordi *et al*. (2005) who found that fish live at temperatures below 24°C, but fish appetites decrease and that this condition is good for bacteria in the water.

The results of pH measurements of all observations made in this research were the initial pH mean of 6.13, at the time of spawning 6.2 and at the end 6.17. Range from 6.5 to 7.1. This range is still within the normal range as reported by Hanafie *et al*. (2007) state that a good pH is a good pH for all fish species whose natural marsh environment has a pH 5-8. According to Amoaah (2011), although fish are generally susceptible to changes in water pH, fish can still survive in acidic and alkaline waters. Saputra *et al.,* (2015) pH 4-9 is the optimal range for freshwater fish hatcheries. If the pH is below the optimal range, fish growth will be disrupted and fish are very sensitive to bacteria and parasites.

The results of measuring the water quality parameters of dissolved oxygen during the initial study were 3.28 mg/L^{-1}, at spawning 3.26 mg/L^{-1}and the final mean was 3.30 mg/L^{-1}. From the results of the dissolved oxygen parameter measurement, the obtained data value is still above the standard minimum dissolved oxygen value, which is in agreement with the opinion of Hidayat *et al*. (2013) that deoxygenated water covers the area of the sage than 2 mg/L^{-1} can still produce fish in live cork, and dissolved oxygen was still relatively adequate in this study compared to the results of the study by Almaniar (2011), in which oxygen ranged from 1.88 - 3.5 mg/L^{-1} was dissolved.

CONCLUSION

The opportunity and occurrence of snakehead fish natural spawning in this research did not spawn, while semi-natural spawning had an opportunity 3/9 with occurrence of 33%. The use of hormonal stimulation used effectively in snakehead fish is the Ovaprim hormone, this is supported by latency, fertilization rate and hatch rate data which are better than hCG hormone and Odev hormone data.

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TIK-33 THE SPAWNING RATE OF SNAKEHEAD FISH (CHANNA STRIATA, BLOCH 1793) WITH NATURAL AND SEMI-NATURAL METHODS

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