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Use of Mixed Feeds for Inducing Gonad Maturation of G4 Transgenic Mutiara Catfish Broodstock Indoor Hatchery

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ABSTRACT

This research aims to determine the optimal dose of boiled mackerel tuna mixture on HI-PRO VITE 781 feed on gonadal maturity index and feed conversion ratio of transgenic mutiara catfish G4 in indoor hatchery maintenance at optimal temperature. This research was conducted at the Hatchery of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran. The method used was an experimental method with a completely randomized design (CRD) method with four treatments, namely the difference in the dose of boiled mackerel tuna administration in commercial feed and three replications. The treatment in this study was the administration of boiled mackerel tuna doses of 3.5%, 2.5%, 1.5% in mixed feeds to G4 transgenic mutiara catfish and tested on non-transgenic mutiara catfish with a percentage of 3.5% female weight biomass and then added an 30 g HI-PRO-VITE 781 with two times feeding frequency. The research parameters included gonad maturity index and feed conversion ratio. The results showed that feeding a mixture of boiled mackerel tuna and HI-PRO-VITE 781 had a significant effect on the gonadal maturity index and feed conversion ratio. Feeding boiled mackerel tuna at 1.5% was the best treatment with a gonadal maturity index of 47.16% for females and 4.98% for males and a feed conversion value of 1.19 for 56 days of rearing.

Keywords: gonadosomatic index, feed conversion ratio, transgenic, indoor

1. INTRODUCTION

Transgenic mutiara catfish is a pearl catfish that has inserted the *CgGH* (*Clarias gariepinus* Growth Hormone) gene into the mutiara catfish genome by applying gene transfer through sperm electroporation to improve the growth quality of the fish. Fish with a fast growth rate can cause gonadal maturation to be faster than normal fish. Providing quality feed has a major effect on gonadal maturity, this occurs because the basic ingredients in the formation of egg cells and sperm cells come from the results of the metabolism of the feed given, especially female fish.

Gonad fertility of fish as a producer of sperm and eggs is the main key in assessing the reproductive ability of transgenic fish, therefore it is necessary to know the gonado somatic index to obtain G4 transgenic mutiara catfish parent candidates as superior catfish broodstock.

Boiled mackerel tuna contains a fairly high protein (35.8%) with a complete essential amino acid content needed for the growth of fish gonads. Feeding a mixture of pellets (protein 33%) and boiled mackerel tuna crumbs gave mutiara catfish a high daily growth rate of $4.89 \pm 0.35\%$ and the best feed conversion ratio was 0.58 ± 0.04 which is expected to accelerate gonad maturation [1-11]

2. MATERIALS AND METHODS

The research was carried out from August to October 2022 at the hatchery unit of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran (Figure 1).



Figure 1. Indoor Hatchery

The materials used in this study were 18 pairs of G4 transgenic mutiara catfish and 6 pairs of non-transgenic mutiara catfish (control) as well as HI-PROVITE 781 and boiled mackerel tuna as feed. The study was conducted using an experimental method with a completely randomized design (CRD) consisting of four treatments and three replications. The treatment used is as follows:

- ✓ Treatment A: boiled tuna (3.5% brood biomass of G4 transgenic pearl catfish)
- ✓ Treatment B: boiled tuna (2.5% brood biomass of G4 transgenic pearl catfish)
- ✓ Treatment C: boiled tuna (1.5% brood biomass of G4 transgenic pearl catfish)
- ✓ Treatment D: boiled tuna (3.5% brood biomass of non-transgenic pearl catfish)

The frequency of feeding is two times a day at 09.00 and 16.00 WIB. Boiled mackerel tuna feed was given according to the treatment plus 30 g of HI-PROVITE 781 feed for each treatment. Total water change every three days. The temperature during the research was in the range of 28 – 30 °C.

Monitoring of fish growth (weight and length) and fish gonad growth is carried out every week. Weighing the weight of the fish using a digital scale with an accuracy of 0.01 g and measuring length using a ruler with an accuracy of 0.5 mm. The parameters observed were the *Gonado Somatic Index* (GSI) and *Feed Conversion Ratio* (FCR).

2. 1. Observation Parameters

2. 1. 1. Gonad Maturity Index

The level of gonadal maturity or gonado somatic index (GSI) was analyzed using the GSI formula [8].

$$\text{GSI} = \text{GW}/\text{BW} \times 100\%$$

Description :

GSI = Gonado Somatic index (%)

GW = Gonadal weight (g) (weight after maturation – weight before maturation)

BW = Broodstock fish body weight (g) (weight after maturation)

The gonad weight is obtained from the calculation of the weight after maturation minus the weight before maturation. This is done because the broodfish is not killed to take the gonads because it is for spawning and further research.

2. 1. 2. Feed Conversion Ratio

Feed conversion ratio (FCR) is a value that indicates how much feed is needed to produce one kilogram of fish meat. Feed conversion is calculated by formula as follows:

$$\text{FCR} = = \frac{F}{Wt - W0}$$

Description :

Wt = total final weight of fish (g)

Wo = total initial weight of fish (g)

F = total amount of feed given (g)

2. 1. 3. Data Analysis

Parameter analysis of GSI and FCR values uses analysis of variance (ANOVA). If between treatments had a significant effect, then proceed with the Duncan Multiple Range Test (DMRT) with a 95% confidence level using SigmaPlot 12.3 software.

3. RESULT AND DISCUSSION

3. 1. Female Gonado Somatic Index

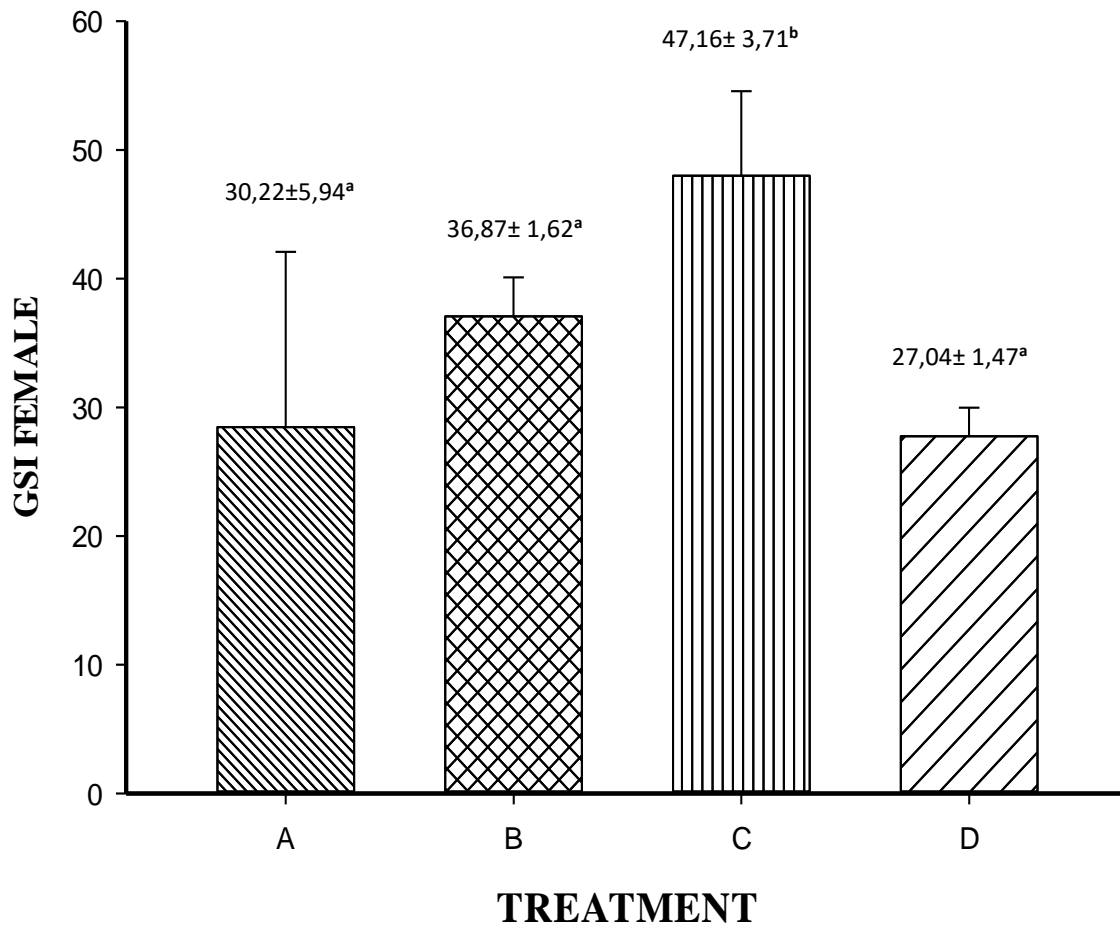


Figure 2. Female Gonado Somatic Index

The gonado somatic index (GSI) is a quantitative index that displays a sexual state of fish resulting from a ratio of gonads and fish body weight and is used as a parameter for fish spawning. The gonadal maturity index is related to the gonadal maturity level, the faster the fish reaches TKG IV, the higher the gonadal maturity index value.

The results of statistical tests of analysis of variance (ANOVA) showed that boiled cob feed had an effect on the gonadal maturity index. The highest gonado somatic index value was in treatment C, i.e. transgenic pearl catfish with 1.5% boiled cob feeding treatment of 47.16, followed by treatment B (2.5%) of 36.87%, then treatment A (3, 5%) of 30.22, % indicates that a high GSI value only requires a little boiled mackerel tuna (Figure 2).

The difference in the value of the gonadal maturity index between the transgenic mutiara catfish in treatment A and the non-transgenic mutiara catfish in treatment D despite being given the same feed and the same dosage because the non-transgenic mutiara catfish did not contain exogenous GH, the compensation for the gonad maturity index value was higher. low. The essential function of exogenous GH is to increase protein synthesis thereby stimulating growth, including the growth of oocytes or spermatocytes which has implications for increasing the GSI value of transgenic male and female fish. Over-expression of GH inserts (exogenous GH) induces proliferation (multiplication) of oocytes and as a consequence the number of eggs in the ovary increases which causes an increase in GSI as shown from the results of a study on gonad weight measurements of G2 transgenic catfish.

Based on the research results, the average value of the gonadal maturity index increased as the percentage of boiled cob feed decreased, with the average value of the gonadal maturity index for females ranging from 27.04% to 47.16%. Gonad weight is directly proportional to the value of the gonado somatic index, meaning that the greater the gonad weight, the greater the gonado somatic index value. The gonad weights of female fish treated C after maturation were on average higher than the other treatments, indicating that the percentage of boiled mackerel tuna 1.5% induced an increase in GSI values compared to 2.5% and 3.5%. Given the high protein of boiled mackerel tuna (35.8%), only a little extra boiled cobs (1.5%) is needed to meet the needs of essential amino acids needed for gonadal growth.



Figure 3. Female broodstock of transgenic mutiara catfish

The gonadal maturity index of 1.5% feeding was greater than that of boiled mackerel tuna feeding 2.5% and 3.5%, presumably due to excess protein so that the excess was removed, this disposal required energy. Excessive feed protein is only partially absorbed and used for growth or repair of damaged cells, the excess will be excreted which causes increased energy requirements for protein catabolism, one of the results of which nitrogen is excreted in the form of ammonia which is excreted through the kidneys. The catabolic process uses protein energy so that protein for gonadal growth is reduced and the GSI value decreases. The readiness of brood fish to spawn or release eggs is not only seen from the gonadal maturity index, but seen from its morphological characteristics (Figure 3). The characteristics of a female fish ready to spawn are its belly enlarged towards the anus and when touched it feels soft, the genital opening is reddish if the stomach is massaged slowly releasing yellowish eggs.

3. 2. Male Gonado Somatic Index

The results of the observations showed that the provision of a mixture of boiled mackerel tuna feed with different ratios was able to increase the value of the gonadal maturity index. The results of data analysis carried out after rearing resulted in the highest gonadal maturity index of 4.98% in G4 transgenic mutiara catfish treatment C by feeding boiled mackerel tuna 1.5% and 30 g commercial feed. While the lowest value was in treatment D, namely non-transgenic mutiara catfish with 3.5% boiled mackerel tuna feed and 30 g commercial feed (Figure 4).

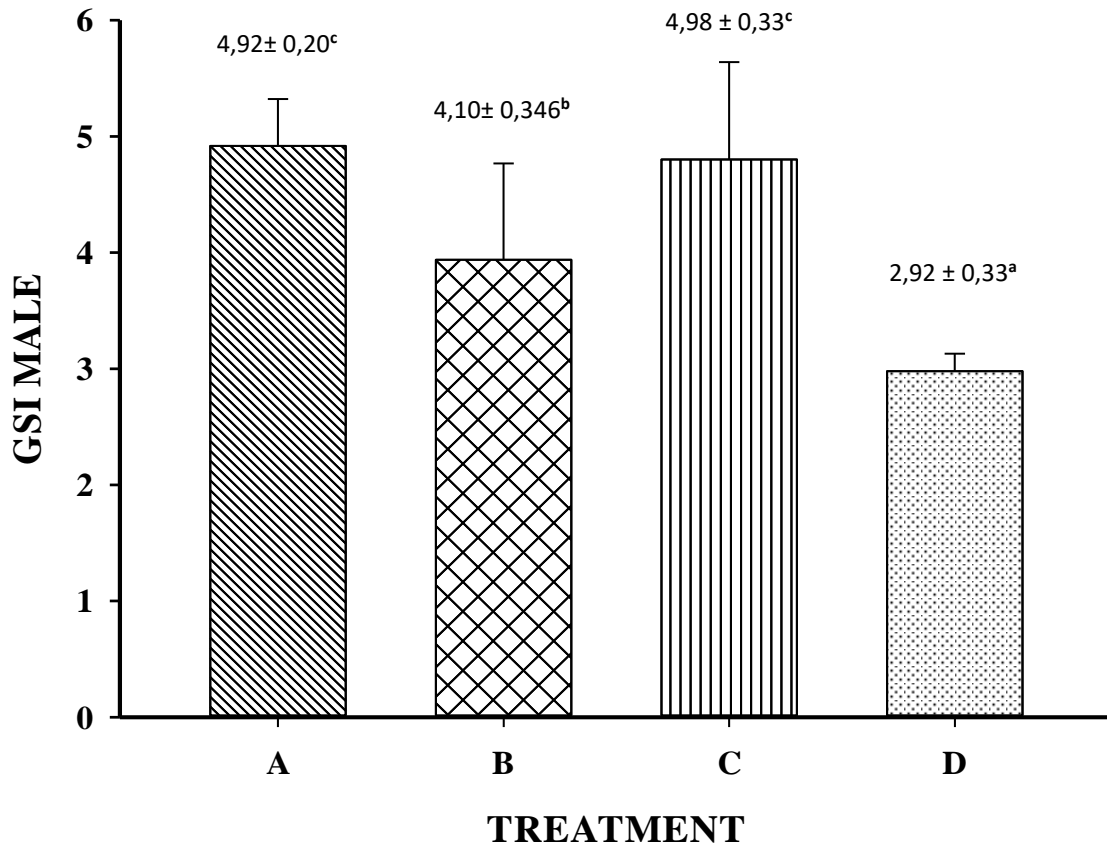


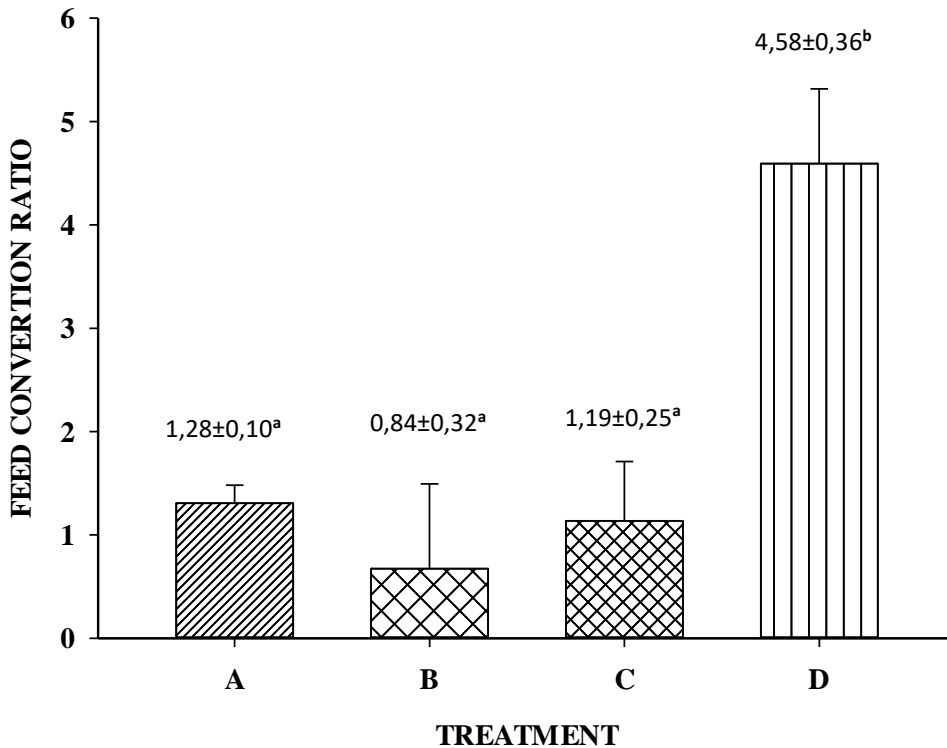
Figure 4. Male Gonado Somatic Index

The results of this research show that the gonadal maturity index is 2.92% -4.98%. The gonadal maturity index value for male mutiara catfish was 0.22% -1.47%. Male catfish (Figure 5) with mature gonads have a smaller head proportion, duller chest skin color with protruding genitals and extending backwards and reddish genitals, aggressive movements and upright dorsal fins when the fish is held.



Figure 5. Male broodstock of transgenic mutiara catfish

3. 3. Feed Conversion Ratio



Figur 6. Feed Conversion Ratio

Feed Conversion Ratio (FCR) is the ratio of the amount of feed eaten to the weight of the fish at the end of maintenance. FCR is an indicator to ensure the effectiveness of feed and shows the extent to which feed is efficiently used by fish. The smaller the value of the feed conversion ratio means the efficiency level of feed utilization is better, conversely if the value of the feed conversion ratio is large, the efficiency level of utilization is not good.

The results of statistical analysis of variance (ANOVA) with 95% confidence showed that the value of the feed conversion ratio of transgenic mutiara catfish and non-transgenic mutiara catfish fed boiled mackerel fish with different levels showed a significant effect on the feed conversion ratio. The results of the Duncan test showed that treatment A (3.5%) was not significantly different from treatment B (2.5%) and treatment C (1.5%) but significantly different from treatment D (3.5%). Feeding a different mixture for each treatment showed that the lowest FCR value for treatment B (2.5%) was 0.84 (Figure 6). The results of this study showed that the feeding of G4 transgenic mutiara catfish with boiled cob crumbs had a good feed ratio, considering that the feed conversion ratio value below 2 was classified as efficient. Feeding a different mixture for each treatment showed that the lowest FCR value for treatment B (2.5%) was 0.84 (Figure 6).

4. CONCLUSIONS

Optimum mixed feed dose for gonadal maturity index of G4 transgenic mutiara catfish in indoor rearing was 1.5% (treatment C) the highest gonadal maturity index value was 47.16% in females and 4.98% in males and treatment B (2.5%) for the feed conversion ratio with a value of $0.84 \pm 0.32\%$.

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