

Accelerating the gonad maturity time of puyu (*Anabas testudineus*) by feeding with earthworms (*Lumbricus rubellus*)

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Abstract. Puyu (*Anabas testudineus*) is a freshwater fish that has high economic value and is consumed by many people. The increasing demand for puyu has made fishermen to capture too many in the wild and caused the wild populations to decline. Therefore, conservation is needed so that the puyu population in nature does not become extinct. In this study, puyu were fed earthworms at 5% of their body weight with the aim of evaluating the acceleration of gonad maturity compared to that in nature. The experiment in this study used a completely randomized design (CRD) with 5 treatments: P0 giving earthworms once a day, P1 = 2 times a day, P2 = 3 times a day, P3 = 4 times a day, and P4 = 5 times a day and each treatment was given 3 repetitions. The parameters observed were the time to achieve gonad maturity level (GML), gonad maturity index, fecundity, egg diameter and water quality. The results of the study showed that the higher the frequency of giving earthworms, respectively 5 times a day, provided the faster GML IV of puyu on the 45th day (66.66%), increased the GMI (4.85%), fecundity was of 6070 eggs⁻¹, and diameter of eggs was of 0.83 mm. These results indicate that the frequency of giving earthworms can accelerate gonad maturity and improve the quality of egg puyu fish.

Key Words: egg diameter, fecundity, frequency.

Introduction. Puyu fish (*Anabas testudineus*) is found throughout Asian countries, and spawning in nature usually occurs seasonally and only once a year, at the beginning of the rainy season, the end of September or from October to November (Ahmad & Fauzi 2010). Puyu is a freshwater fish that has a high selling value, especially in Indonesia which had a production of 588,393 tons in 2020 (KKP 2020). The availability of puyu seeds is a major problem for fish farmers, and to increase the production of puyu seeds requires solutions to speed up the reproductive cycle and quality, especially gonad maturity and improving egg quality.

One way this can be done is by providing quality feed and in sufficient quantities. According to Pujianti et al (2014), feed has a huge influence on gonad maturity, both male and female fish. Therefore, choosing the right feed plays a very important role in the gonad maturation process of the fish.

Food that has potential in the gonad maturation process of puyu is earthworms (*Lumbricus rubellus*), and earthworms are easy to obtain (Nuraini & Tanjung 2017), cheap and have high nutrition (Purba et al 2021). The protein content of earthworms is 64-76%, and fat is 7-10% (Susanti & Mayudin 2012), so earthworms have the potential to be used to accelerate the gonad maturity of brood fish (Purba et al 2021). This research was carried out with the aim of accelerating the maturity time of the gonads of puyu that were given earthworms with different frequencies.

Material and Method

Location and research design. This study was carried out at the Fish Seed Center of the Faculty of Agriculture (Faperta), Islamic University of Riau (UIR), Pekanbaru, Riau, Indonesia, and took place from March to August 2022. This research used a Completely

Randomized Design (CRD) with 4 treatments and 3 replications. The treatment used was to give earthworms as much as 5% per feeding of the puyu fish's body weight with the following frequency:

- Treatment 0: frequency 1 times a day
- Treatment 1: frequency 2 times a day
- Treatment 2: frequency 3 times a day
- Treatment 3: frequency 4 times a day
- Treatment 4: frequency 5 times a day

A total of 150 female puyu fish, aged 4 to 5 months, with immature gonads were obtained from Teratak Buluh village fishermen's catches from the wild, Siak Hulu sub-district, Kampar district, Riau, Indonesia. Sex differentiation was performed through morphological examination, while age was estimated based on the fish's size and weight. The fish were taken to the experimental site (Faperta UIR Fish Seed Center) and adapted to the nursery pond for 15 days. The feed test was carried out in a 1×1×1 m net cages (hapa), totaling 15 units with a water level of 0.8 m. A total of 10 female puyu fish were stocked in each cage and fed 5% of their body weight with a frequency according to the specified treatment. The research was conducted for 60 days.

During the experiment, water quality parameters were measured at three stages: the beginning, middle, and end of the trial. Temperature and pH were measured using a pH tester (H198108, Romania), and dissolved oxygen (DO) was measured using a DO meter (Lutron PDO-519, Taiwan).

Statistical analysis. Data on gonad maturity index, fecundity and egg diameter of puyu were processed using Microsoft Office Excel (version 2016). Next, the data was tested using ANOVA; if there is a significant difference ($p < 0.05$), then we proceeded with Duncan's analysis. If the results show no significant differences ($p > 0.05$), then the data is analyzed descriptively. The ANOVA test was carried out using IMB SPPS Statistics version 25.

Results and Discussion

Time to reach the level of gonad maturity. The speed of reaching the level of gonad maturity is calculated from the number at the start of rearing until the puyu (*Anabas testudineus*) reaches gonad maturity IV (GML IV). From Table 1, it shows that the more often earthworms are given, the faster the gonad maturation. This is because the more frequent feeding of earthworms can fulfill nutritional needs for energy, so that the rest can be used for maturation of gonads.

Table 1
The gonad maturity level (GML) of puyu (*Anabas testudineus*) fed with earthworms for 60 days

Treatments	GML	Number of gonadally mature fish (day)										Total (fish)
		0		15		30		45		60		
		fish	%	fish	%	fish	%	fish	%	fish	%	
P0	I	-	-	-	-	2	33.3	3	50.0	1	16.6	-
	II	-	-	-	-	2	33.3	2	33.3	4	66.6	
	III	-	-	-	-	-	-	-	-	-	-	
	IV	-	-	-	-	-	-	-	-	-	-	
P1	I	-	-	-	-	2	33.3	1	16.6	4	66.6	-
	II	-	-	-	-	3	50.0	2	33.3	3	50.0	
	III	-	-	-	-	-	-	2	33.3	1	16.6	
	IV	-	-	-	-	-	-	-	-	-	-	
P2	I	-	-	2	33.3	1	16.6	2	33.3	-	-	2
	II	-	-	-	-	3	50.0	1	16.6	2	33.3	
	III	-	-	-	-	-	-	3	50.0	3	50.0	
	IV	-	-	-	-	-	-	-	-	2	33.3	
P3	I	-	-	3	50.0	2	33.3	-	-	-	-	7

	II	-	-	-	-	3	50.0	2	33.3	-	-
	III	-	-	-	-	2	33.3	2	33.3	3	50.0
	IV	-	-	-	-	-	-	3	50.0	4	66.6
P4	I	-	-	5	83.3	2	33.3	-	-	-	-
	II	-	-	-	-	2	33.3	2	33.3	-	-
	III	-	-	-	-	3	50.0	2	33.3	3	50.0
	IV	-	-	-	-	-	-	4	66.6	5	83.3

Gonad maturity index (GMI). The results showed that different frequencies of earthworm administration had an effect ($p < 0.05$) on the gonad maturity index of puyu (Figure 1). The gonad maturity index value is obtained from the comparison of gonad weight with the fish's body weight, so that the faster the fish reaches GML IV, the more gonad development will increase and the GMI value will increase (Sukendi et al 2013). The gonad maturity index value is related to the quality of the feed consumed by the fish, the better the quality of the feed, the higher the GMI value. Mukti et al (2023) reported that the increase in GMI values, fecundity and egg diameter was caused by oocyte development.

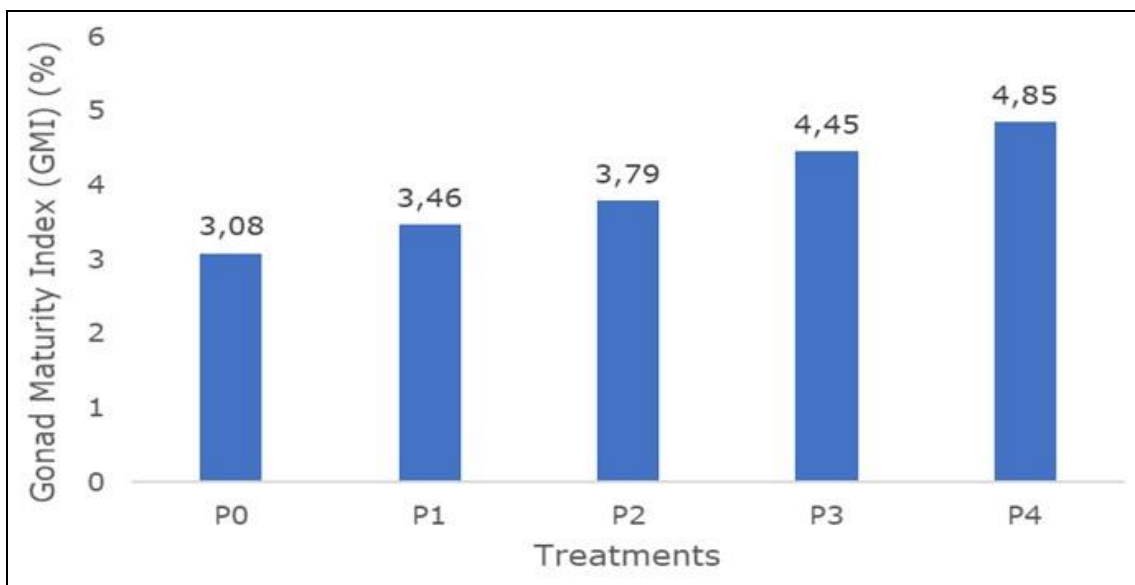


Figure 1. Gonad maturity index of puyu (*Anabas testudineus*) fed with earthworms for 60 days.

Fecundity. The frequency of giving earthworms to fish affects the fecundity of puyu eggs ($p < 0.05$) (Figure 2). Giving earthworms 5 times a day showed the highest fecundity value compared to other treatments, namely 6,070 eggs. The factor that determines egg fecundity is feed quality (Esa et al 2023). The increase in egg fecundity in each treatment is influenced by the quality of the brood fish and feed nutrition, as well as the efficiency of their utilization. Apart from that, according to Muchlisin (2014), fecundity is also influenced by the length and weight of the fish, the longer and heavier the fish, the more likely the number of eggs it has.

Prostaglandin activity is also thought to play a role in the formation of eggs. The more vitellogenin is carried to the gonads, the more eggs are formed in the gonads (Tang & Affandi 2004). The feed that can influence vitellogenesis is feed that contains protein, fat, vitamins E and C, and minerals that suit the fish's needs (Sinjal et al 2014). Fat functions as a source of energy and essential fatty acids. Usually, fat is used as a building block for the structure of fat granules and egg yolk granules (Yulfiperius et al 2003). According to Effendie (2002), differences in fecundity of species of the same size are caused by different protein and fat contents.

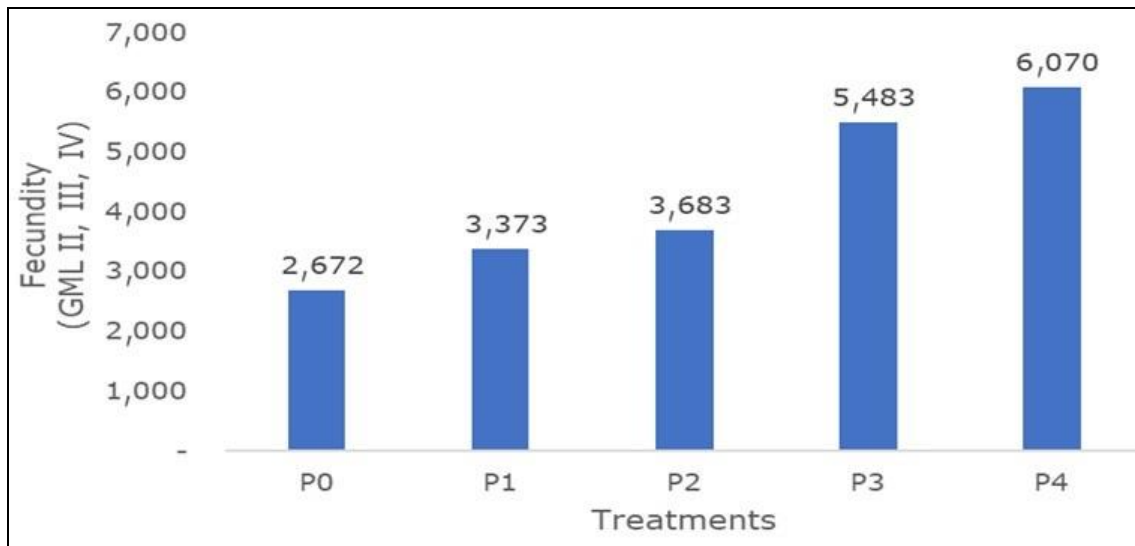


Figure 2. Fecundity of puyu (*Anabas testudineus*) fed with earthworms for 60 days.

Egg diameter. Egg diameter is the diameter or length of an egg. Figure 3 shows that giving earthworms with different frequencies affects the diameter of puyu eggs ($p < 0.05$). The size of the egg diameter is caused by the nutritional content in the egg. Sinjal (2014) stated that the nutritional content in fish feed is one of the determining factors in supporting the success of parents in reaching gonad maturity and oocyte development, especially at the beginning of egg development.

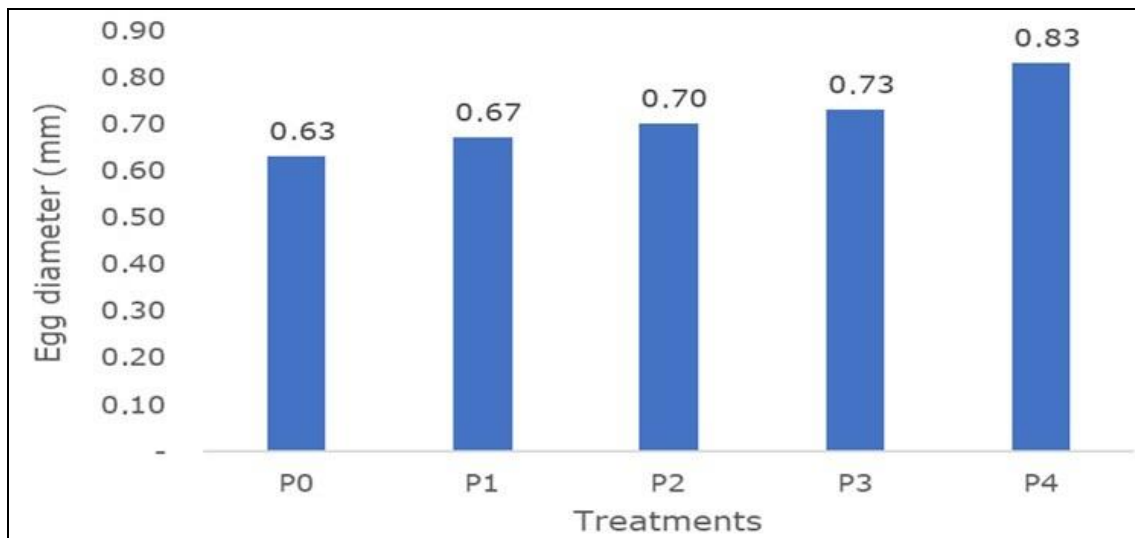


Figure 3. Egg diameter of puyu (*Anabas testudineus*) fed with earthworm for 60 days.

Water quality. The water temperature of the puyu fish rearing media during the experiment ranged between 24-32°C. This temperature range is quite good for rearing brood fish, according to what Effendie (2002) said, the temperature range of 24-33°C is the optimum temperature and does not reduce the fish's appetite. According to Maniagasi et al (2013) temperature variations are usually influenced by several factors, such as the level of light intensity on the surface of waters, weather conditions, clouds and the mixing process. Then the pH during the experiment ranged from 6 to 7. Syafriadiman et al (2005) reported that the ideal pH for aquatic biota is in the range of 5-8. According to Syamiazi et al (2015), the pH obtained during maintenance is quite favorable for most aquatic biota which are sensitive to changes in pH. Dissolved oxygen levels during the experiment were still relatively good for puyu, namely in the range of 4-5 mg L⁻¹, this is supported by Sari et al (2015) who stated that dissolved oxygen in the range of 3.38 to 5.06 mg L⁻¹ is ideal for puyu fish activity.

Conclusions. The results of this study show that the frequency of giving earthworms can accelerate gonad maturation and increase the quantity (fecundity) and quality of eggs (egg diameter) in puyu. This research is useful for accelerating the production of gonad mature female fish, and it is hoped that it can contribute to the production of puyu fish seeds.

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Conflict of interest. The authors declare that there is no conflict of interest.

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