Asian redtail catfish (*Hemibagrus nemurus*) larvae response to commercial feed enriched with fish oil derived from *Pangasius* waste

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Abstract. Asian redtail catfish (*Hemibagrus nemurus*) is a freshwater commodity that has been cultivated and has high economic value. Feed is one of the important factors in cultivation. Larvae favor good quality feed and will increase their growth. Feed enrichment with fish oil will improve palatability and stimulate growth. One method to improve feed quality is to enrich it with fish oil derived from *Pangasius* processing waste. The purpose of the study was to determine the response and growth of Asian redtail catfish larvae to feed that had been enriched with oil derived from Pangasius processing waste at different doses. The treatments used were P1 = commercial feed without enrichment, P2 = feed enrichment with 8% fish oil, P3 = feed enrichment with 10% fish oil, P4 = feed enrichment with 12% fish oil, and P5 = feed enrichment with 14% fish oil, which was reared with a stocking density of 5 fish/L. The results showed that feed enrichment with oil derived from *Pangasius* processing waste influenced the feeding response of the Asian redtail catfish larvae with the best treatments P3 and P4 with a value of 9.0, while the best growth and survival was P3 (0.87 ± 0.00 and 82.33 ± 2.08). In conclusion, feed enrichment with a 10% dose gives the best response and effect on the growth of Asian redtail catfish larvae.

1. Introduction

Asian redtail catfish (*Hemibagrus nemurus*) is a freshwater fish commodity that has important economic value, and has the potential to be cultivated. The current price of Asian redtail catfish ranges from Rp 60.000 to 120.000/kg [1]. Many people favored this fish because it has thick meat and delicious taste, making the demand of this [2]. The production of Asian redtail catfish from the aquaculture only is around 27 – 30% of the total production during 2017 – 2021 and the amount of production is largely determined by the larvae production for enlargement cultivation activities [3].

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In larval rearing of Asian redtail catfish, the best feed is silk worm [4]. The problem is that the availability of silk worms in nature is still limited, especially during the rainy season [1].To overcome this problem, it is necessary to find alternative foods to feed the larvae.

One approach to produce quality foods with high survival rates is through feed enrichment using fish oil. Feed enhancements with the addition of commercial fish oil to improve the growth and survivability of post larvae in fish have been carried out in *Hemibagrus wyckioides*, *Ompok bimaculatus*, and *Hemibagrus nemurus* [5-7]. However, commercial fish oil has a relatively expensive price [8-10] and limited availability [11-12].

Fish oil is becoming the most important source of fish feed ingredients worldwide [13-15]. Fat is one of the most important nutrients for fish and acts as a provider of essential fatty acids and as a source of energy. It also minimizes the use of protein and reduces nitrogen emissions to the environment [15].

One of the potential sources of fat that can be used in the absence of competition with humans is the waste belly fat (mesenteric) of *Pangasius* fish. The fish oil that is produced from processing *Pangasius* mesenteric waste contains types of fatty acids that belong to the monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) groups [16]. Furthermore, the fish oil extracted from the remaining mesenteric processing of catfish contains palmitic acid 34.19%, oleic 35.85%, and PUFA as much as 12.35%, in the form of linoleic, linolenic, EPA, and DHA fatty acids [17].

Fatty acids play an essential role in the growth and the development of fish larvae, fatty acids provide the necessary energy, assist in the absorption of nutrients, and certain fatty acids, such as omega-3 fatty acids (EPA and DHA) play an important role in the development of the larval nervous system of Asian redtail catfish, increasing endurance, to support growth. The enrichment of catfish waste oil in commercial feed also has a high level of palatability, so fish can quickly respond to feed that stimulates their sense of smell due to the chemoreceptor mechanism, this is one of the main factors that affect the growth rate of fish.

However, the response and growth of Asian redtail catfish larvae to feed enriched with *Pangasius* mesenteric waste oil is not yet known. So this study was conducted to determine the response and growth of Asian redtail catfish larvae to feed enriched with *Pangasius* mesenteric waste oil.

2. Materials and Methods

This research was conducted between January and June 2024 at the Fish Hatchery and Breeding Laboratory, Faculty of Fisheries and Marine Sciences, Riau University. The feed enrichment treatment in this study follows the dosage used by [6], where the application of cod liver oil and vegetable oil at an optimal level of 8% yielded the best growth performance in butter catfish (*Ompok bimaculatus*) larvae. The design used in this study was a completely randomized design (CRD), with five treatments and three replications, as follows:

- P1 = commercial feed pf 0 not enriched with *Pangasius* mesenteric waste oil
- P2 = commercial feed pf 0 enriched with *Pangasius* mesenteric waste oil 8%
- P3 = commercial feed pf 0 enriched with *Pangasius* mesenteric waste oil 10%
- P4 = commercial feed pf 0 enriched with *Pangasius* mesenteric waste oil 12%
- P5 = commercial feed pf 0 enriched with *Pangasius* mesenteric waste oil 14%

Asian redtail catfish larvae that used were five days old with a size of 0.5 ± 0.00 cm that came from the artificial spawning of a pair of Asian redtail catfish brood stock that were stimulated using sGnRH + antidopamine at a dose of 0.5 ml/kg body weight of the female and 0.3 ml / kg body weight of the male. Larval rearing was conducted in a 30x30x30 cm^3

aquarium with a water volume of 15 L with a stocking density of 5 fish/L [18]

Pangasius mesenteric waste oil is made by collecting fish belly fat waste obtained from traditional markets, then cleaning it using tissue to remove blood and dirt. Then the *Pangasius* mesenteric fat is tightened until smooth using a knife, then weighed as much as 100 g to be oven for 60 minutes at 60ºC, after melting into oil, filtering the pulp to ~~get~~ retrieve the clean oil. *Pangasius* mesenteric waste oil is added to commercial feed (pf 0) according to the treatment dose, as shown in Figure 1.

(a) (b)

Fig. 1. (a) *Pangasius* mesenteric waste oil, (b) mixtures of feed with *Pangasius* mesenteric waste oil

The mixed feed is stored in plastic and refrigerated to avoid oxidation. The exposure of fish oil to oxygen can result in deterioration of quality, odor and fragrance [19] the feed that will be fed is first removed from the refrigerator and allowed to settle to room temperature and then is fed to the Asian redtail catfish larvae. The feeding method is ad satiation with a duration of four times a day. The results of the proximate test of feed that has been enriched with *Pangasius* mesenteric waste oil are presented in Table 1.

Table 1. Proximate test result

Treatment	Moisture	Ash	Crude protein	Crude Fat	Karbohidrat	
					Crude fiber	NFE
Feed P1	10.22	13.17	38.72	7.38	2.88	28.08
Feed P2	9.18	11.84	34.17	13.41	1.16	30.24
Feed P3	8.70	11.46	33.28	16.69	1.66	28.21
Feed P4	8.34	11.25	32.10	17.34	1.62	29.35
Feed P5	7.92	10.94	31.63	19.09	1.14	29.28

Based on the results of the proximate test, it is shown that the fat level in the food increases with the addition of *Pangasius* fish mesenteric oil waste, while the other elements are relatively decreased.

The parameters measured during this study were larval response to feed, growth performance absolute weight (g), absolute length (cm), specific growth rate (%/day) and larval survival (%). The assessment of feed response was done by scoring [1]

Table 2. Scoring fish larvae response to feed

Observation	**1**	**3**	**5**
Larvae attraction to food	Larvae are slow (>2 minutes) to swim to the bottom to retrieve collect food	Larvae are fast (between 30 seconds - 2 minutes) swimming to the bottom to collect food	Larvae immediately (<30 seconds) swim to the bottom to collect food
The way larvae take food	Larvae are slow (>30 seconds) to collect food	Larvae are quite fast (10-30 seconds) in collecting food	Larvae are very fast (no pause) in food
Feed residue	Feed remains at the bottom	a small amount of feed remains	No feed remains at the bottom of the medium."

Data on larval response to the feed were analyzed descriptively, while growth and survival performance parameters were tabulated and statistically analyzed using SPSS version 22.

3. Result and Discussion

The results of this research can be seen from the response data of Asian redtail catfish larvae to the feed given, such as the score of how the larvae collect the feed, the attractiveness of the larvae to the feed and the remaining feed. (Table 3)

Table 3. Response of Asian redtail catfish larvae to feed enriched with *Pangasius* mesenteric oil waste

Feed response	**P1**	**P2**	**P3**	**P4**	**P5**
Larvae attraction to feed	1	3	3	3	3
How the larvae collect food	1	1	3	3	1
Feed residue	1	3	3	3	1
Score	3	7	9	9	5

Based on the larval response to feed, it can be seen that between treatments P3 and P4 have the highest and same score, followed by treatments P2, P5, and P1. Based on the value of larval attractiveness to feed, the treatment enriched with *Pangasius* mesenteric waste oil provides an increase in larval attractiveness to feed, and this is different from treatment P1 (without the addition of mesenteric oil). Furthermore, for the response value of how the larvae take the feed, it can be seen that the P3 and P4 treatments are very good compared to the other treatments, where the P3 and P4 treatments immediately consume the feed given, while in the other treatments the larvae show a slower response compared to the P3 and P4 treatments. However, for the residual feed response, treatments P2, P3, and P4 were better, with relatively little residual feed compared to P1 and P5. Based on these response values, it can be seen that feeding enriched with mesenteric waste oil provides a good response value when compared with no enriched mesenteric waste oil. The study of larvae response to feed by comparing silk worm feed, fermented paste feed, and unfermented feed, found that fermented paste feed gave the highest response with a value of 2.76% [1].

The addition of *Pangasius* mesenteric waste oil to feed can increase the palatability of fish to feed, thus affecting the fish response to the feed given. Some researchers have revealed that enrichment of fish feed using fish oil can improve feed quality [20] and feed palatability [21-22]. Furthermore, feed enrichment using *Pangasius* fish mesenteric waste oil can also increase the eye function in fish larvae, resulting in different larvae responses to feed. Because feeding fats with a greater number of C atoms (long chain) can improve retinal function and reduce cardiometabolic risk [7].

According to the evaluation of growth performance, treatment P3 showed the best results in growth and survival. This treatment produced absolute weight growth of 0.87±0.00, absolute length of 4.33±0.01, specific growth rate of 15.60±0,02 and survival of 82.33±2.08 ($p<0.05$), when compared to other treatments (Table 4).

Table 4. Growth performance and survival of Asian redtail catfish larvae on feed enriched with *Pangasius* mesenteric waste oil

Treatment	Absolute weight growth (g)	Absolute length growth (cm)	Specific growth rate (%/day)	Survival rate (%)
P1	0.61±0,01^{b}	3.61±0,03^{b}	14.71±0,04^{b}	68.66±0,57^{ab}
P2	0.72±0,01^{c}	3.79±0,01^{c}	15.12±0,03^{c}	71.33±2,08^{b}
P3	0.87±0,00^{e}	4.33±0,01^{e}	15.60±0,02^{e}	82.33±2,08^{d}
P4	0.78±0,00^{d}	4.06±0,01^{d}	15.34±0,02^{d}	78.66±1,52^{c}
P5	0.57±0,01^{a}	3.50±0,02^{a}	14.55±0,05^{a}	65.66±2,08^{a}

The dose of oil in the feed is very important to maintain the growth and health of the fish. In this study, the growth rate and feed utilization increased with the addition of fish oil dose, however, if you look at the P5 treatment, it has the lowest weight and length growth value. This has a positive correlation with the response of Asian redtail catfish larvae to feed, although P5 has a higher response value than P1, but the growth is the lowest, besides that between treatments P3 and P4 have the same value of larval response to feed, but the growth performance and survival are different. Increasing the dose of fish oil in the feed will increase the growth of juvenile fish *Hemibagrus wyckioides* until it reaches the optimal level 10,5%, fish larvae *Ompok bimaculatus* as per 8.0% and Asian redtail catfish (*Hemibagrus nemurus*) by using EPA dan DHA with dosage 6300 mg/kg feed [5-7]. The only source of fish oil used by the researcher was commercial fish oil.

The improvement in growth performance in Asian redtail catfish larvae fed a diet enriched with *Pangasius* mesenteric waste oil is inseparable from the increase in ingredients that play a role in growth. *Pangasius* fish mesenteric oil has a fatty acid composition in the form of palmitic acid of 26.22%, linolenic fatty acid 0.83%, linoleic acid 19.97%, EPA 0.18% and DHA 0.77% [16]. Furthermore, fish oil extracted from *Pangasius* mesenteric waste contains palmitic acid 4.38%, oleic 36.00%, PUFA 9.53%, MUFA 63.65%, EPA 0.13%, DHA 0.14%, linoleic 0.08%, and linolenic 7.53% [17]. The fish larvae can utilize the feed well if it is supported by the appropriate amount of fat requirements for growth, so that most of the protein can be utilized to support growth, while the fat content can be used as a source of energy, therefore, optimal growth occurs [5]. In treatment P5, larvae growth was slowed due to excessive fat content in the feed. This was indicated by the decreased response of the fish larvae to the feed given and the low survival rate. The enrichment of feed with catfish mesenteric oil waste in treatment P5 caused a decrease in water quality, mainly characterized by low oxygen level in the water, which decreased to 3.6-4.1 mg/L. This was indicated by the behavior of the fish larvae, which often rose to the surface to take in oxygen. During rearing interval, the water in the container was in muddy brown color, and there were many oily bubbles on the surface. *Pangasius* waste oil added to the feed is a source of essential fatty acids that cannot be synthesized by the body, so it needs to be added to the larval feed. This is also supported by [23] which states that essential fatty acids are one of the components that can affect larval growth.

4. Conclusions

The enrichment of commercial feed (PF0) with *Pangasius* mesenteric waste oil in the rearing of Asian redtail catfish larvae had a positive impact on larval response to feed as well as growth and survival. The best dose found in this study was commercial feed enriched with 10% *Pangasius* mesenteric waste oil. This study provides valuable information on the utilization of *Pangasius* mesenteric waste as a source of fish oil for enrichment of commercial feed in larval rearing of Asian redtail catfish.

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