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PASTA FEED ENRICHMENT FERMENTED WITH MESENTERIC PARTS OF PANGASIUS ON THE GROWTH AND SURVIVAL OF ASIAN REDTAIL CATFISH (*Hemibagrus nemurus*) LARVAE

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ABSTRACT

Pasta feed is an alternative replacement feed naturally occurring in cultivating Asian redtail catfish (*Hemibagrus nemurus*) larvae. However, pasta feed is not yet able to completely replace the *Tubifex* sp, and enrichment feed pasta with oils from mesenteric waste catfish is expected to improve the performance of pasta feed. This research aimed to determine the effect of enriching fermented pasta feed with waste oil from the mesenteric parts of catfish on the growth and survival of Asian redtail catfish larvae. This research used an experimental method with the design used, a Completely Randomized Design (CRD), one factor, and five treatments with three replications. This research was carried out from March to April 2024 at the Fish Hatchery and Breeding Laboratory, Fisheries and Marine Science Faculty, Universitas Riau. The research results show the influence of enrichment of fermented pasta feed with pangasius mesenteric fish oil on the growth and survival of Asian redtail catfish larvae. Given larvae feed fermented paste + fish oil from pangasius mesenteric waste 12 % produce growth and survival highest with an absolute weight of 1.63 g, absolute length of 5.33 cm, specific growth rate of 14.73%/day, survival of 84.44%, type A cannibalism index of 13.77%, and normal mortality of 1.77%. Water quality parameters such as water temperature range from 27-28.9 °C, pH ranges from 5-7, and DO ranges from 5.1-8.1 mg/L.

Keywords: Pasta feed, Fish oil, Fermented, *Pangasius* sp, *Hemibagrus nemurus*

1. INTRODUCTION

Asian redtail catfish (*Hemibagrus nemurus*) is one of the freshwater fish native to Indonesia. It has high economic value and is widely kept in Kalimantan, Java, and Sumatra, especially Riau[1]. The Asian redtail catfish cultivation business has grown rapidly, and the continuous availability of fish seeds in quantity and good quality is an absolute requirement to increase production. One of the supporting factors for its success is the availability of sufficient feed in terms of both quality and quantity. The best food for post-larvae of asian redtail catfish is *Tubifex* sp. However, the supply of *Tubifex* sp has so far relied more on catches from nature, so it is very dependent on the season. During the rainy season, *Tubifex* sp experiences a shortage. This causes the hatching of Asian redtail catfish to be hampered[2].

One alternative that can be done is giving Asian redtail catfish larvae artificial feed in the form of paste. However, at the larval stage, the digestive system and digestive enzymatic functions of Asian redtail catfish larvae are still straightforward and have not developed completely. This limits the larvae's ability to digest artificial food. One way to increase the digestibility of catfish larvae on artificial feed is to ferment artificial feed using EM-4 probiotics and add fish oil derived from catfish mesenteric

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waste. This waste has not been used as a source of fish oil for feed enrichment.

Catfish mesenteric fat is located in the stomach. It contains nutrients in the form of polyunsaturated fatty acids and polyunsaturated fatty acids (PUFA), including linoleic acid, linolenic acid, EPA, and DHA, which are essential fatty acids[3]. Fatty acids play an important role in the growth and development of fish larvae, providing the required energy and assisting in the absorption of nutrients. Fermentation techniques using Effective Microorganism-4 (EM4) in feed can increase protein in raw fish raw materials converted from carbohydrates and fats[4].

Research on the enrichment of fermented pasta feed with oil from the mesenteric waste of catfish on the growth and survival of fish, especially Asian redtail catfish larvae, has not yet been carried out. Based on this background, research on the enrichment of fermented pasta feed with fish oil from the mesenteric waste of catfish on the growth and survival of fish, especially Asian redtail catfish, needs to be carried out. This research aimed to determine the effect of enriching fermented pasta feed with waste oil from the mesenteric parts of catfish on the growth and survival of Asian redtail catfish larvae.

2. RESEARCH METHOD

Time and Place

The research was carried out for 40 days, from 20 March 2024 to 28 April 2024, at the Faculty of Fisheries and Marine's Fish Hatchery and Breeding Laboratory at the Universitas Riau.

Method

The method used in this research was an experimental method, with the design used is a completely randomized design (CRD), with one factor and five treatments with three replications, thus requiring 15 experimental units. The following are some of the treatments that will be carried out in this research:

P1 : Fermented pasta feed
P2 : Fermented pasta feed + fish oil from catfish mesenteric waste 10%
P3 : Fermented pasta feed + fish oil from catfish mesenteric waste 12%
P4 : Fermented pasta feed + fish oil from catfish mesenteric waste 14%
P5 : *Tubifex* sp.

Parameters Measured

The parameters measured during this research were larvae response to feed, absolute weight growth (g), absolute length growth (cm), specific growth rate (%/day), survival rate (%)[5-6], cannibalism index, and water quality measurements.

Data Analysis

Data on absolute weight growth, absolute length growth, specific growth rate, and larval survival calculated during the research are presented in tables and graphs, and the resulting data were analyzed statistically using the SP version 23 application. An ANOVA test was carried out to determine the effect of enriching fermented pasta feed with fish oil from catfish waste on the growth and survival of Asian redtail catfish larvae. If the test results show the treatment's effect on the measured parameters, further tests are carried out using the Student Newman-Keuls range test[7]. Water quality parameter data is tabulated into tables and analyzed descriptively.

3. RESULT AND DISCUSSION

Larvae Response to Feed

Based on Table 1, treatment P1 (and treatment P2, the response of Asian redtail catfish larvae to feed was quite aggressive, and the feed given had little leftover. This is because the fermented pasta feed is enough to attract the larvae to consume it. After all, the fermentation process provides an aroma and taste of the feed that is attractive to the Asian redtail catfish larvae. This process was revealed by Noviana[8], where the feeding process starts from the level of appetite consumption, then continues with responding to stimuli, determining the location, type of feed, catching the feed, and the taste of the feed according to the fish's wishes, then the feed will be consumed. In treatment P3, the larval response to feed was very aggressive, even though little food was left. Feeding fish oil from the mesenteric waste of catfish at the smell produced by the oil. In addition, feed that is given probiotics is more flavorful than feed that is not. This dose can make the larvae more attracted to it. The aroma of the food can stimulate fish larvae to approach and consume the food provided[8].

Table 1. Larvae' response to feed

Treatment	How Larvae Take Feed	Attraction of Larvae	Leftover Feed
P1 (Fermented Pasta Feed)	3	3	3
P2(FPF+10% Fish Oil)	3	3	1
P3 (FPF+12% Fish Oil)	5	5	3
P4 (FPF+14% Fish Oil)	3	1	1
P5 (*Tubifex* sp)	5	5	5

Information: *value 5: the way the larvae take food, the attraction to the food is very aggressive, and the food given is not left. *value 3: the way the larva takes food, the attraction to the food is aggressive, and the food given has little left. *value 1: the way the larva takes the food, the attraction to the food is not aggressive, and the food given always has some left

Treatment P4 was based on observations of the larval response to the feed, namely that it was quite aggressive and there was little food left in the container. If you pay attention, giving a higher dose of oil causes a reduction in the preference of the asian redtail catfish larvae for food, thereby causing the fish to reduce their aggressiveness towards the food provided. The results of observations on the response of asian redtail catfish larvae to food showed that the food given influenced the response of fish larvae.

In the P5 treatment, the reaction of the Asian redtail catfish larvae to food was very aggressive, and the food given always ended up being left. This is because the *Tubifex* sp, apart from having a distinctive smell, has a brighter colour and also moves, so the Asian redtail catfish larvae are more attracted to them.

Growth Rate of Asian Redtail Larvae

Table 2 shows that the absolute weight growth of Asian redtail catfish larvae ranges from 1.51 to 2.96 g, absolute length growth ranges from 4.55 to 5.87 cm, specific growth rate ranges from 13.87 to 15.54%/day and significantly different between treatments (P<0,05). In terms of the ability to replace the role of *Tubifex* sp, 50.67-55.07% for weight growth and 77.51-90.80% for length growth. The value of weight growth is relatively lower, but length growth is relatively better compared to the results of previous research.

Heltonika et al.[6] revealed that the ability of fermented pasta feed to replace weight growth was 69%, while non-fermented pasta was only 47% when compared to *Tubifex* sp. Likewise, the ability to compensate for the increase in length was 71% in the fermented pasta treatment, whereas it was only 56% in the non-fermented pasta treatment.

The results of measuring the absolute weight growth of asian redtail catfish larvae were highest in treatment P5, namely 2.96 g, followed by treatment P3 with a value of 1.63 g, treatment P1 with a value of 1.55 g, treatment P4 with a value1, 51 g and the lowest was in treatment P2 with a value of 1.50 g (Table 2).

Furthermore, based on the Analysis of Variation test (ANOVA) showed that the treatments were significantly different (P<0.05), where the treatment of giving *Tubifex* sp (P5) was significantly different for the absolute weight growth of Asian redtail catfish larvae when compared with other treatments. In contrast, if seen based on the data, the provision of mesenteric oil did not have a significant effect on the weight growth of catfish larvae in P1, P2, P3, and P4 (fermented pasta feed + fish oil from catfish mesenteric waste 14%). The growth pattern of the average weight of Asian redtail catfish larvae is presented in Figure 1.

Table 2. Average absolute weight growth (g), absolute length growth (cm), specific growth rate (%) Asian redtail catfish larvae

Treatment	Absolute weight (g)	Absolute length (cm)	SGR (%/day)	PAW (%)	PAL (%)
P1 (Fermented pasta)	1,52 ±0,02^{a}	4,70±0,01^{a}	13,89±0,03^{a}	51,35	80,07
P2 (FPF+10% fish oil)	1,50 ±0,01^{a}	4,58±0,06^{a}	13,87±0,03^{a}	50,67	78,02
P3 (FPF+12% fish oil)	1,63 ±0,01^{a}	5,33±0,12^{b}	14,73±0,18^{b}	55,07	90,80
P4 (FPF+14% fish oil)	1,51 ±0,10^{a}	4,55±0,22^{a}	13,88±0,17^{a}	51,01	77,51
P5 (*Tubifex* sp)	2,96 ±0,17^{b}	5,87±0,34^{c}	15,54±0,14^{c}	100	100

Information: The average value followed by the same letter in the column indicates that it is not significantly different. PAW (percentage of ability to replace pasta feed to *Tubifex* sp in absolute weight), PAL (percentage of ability to replace pasta feed to *Tubifex* sp in absolute length

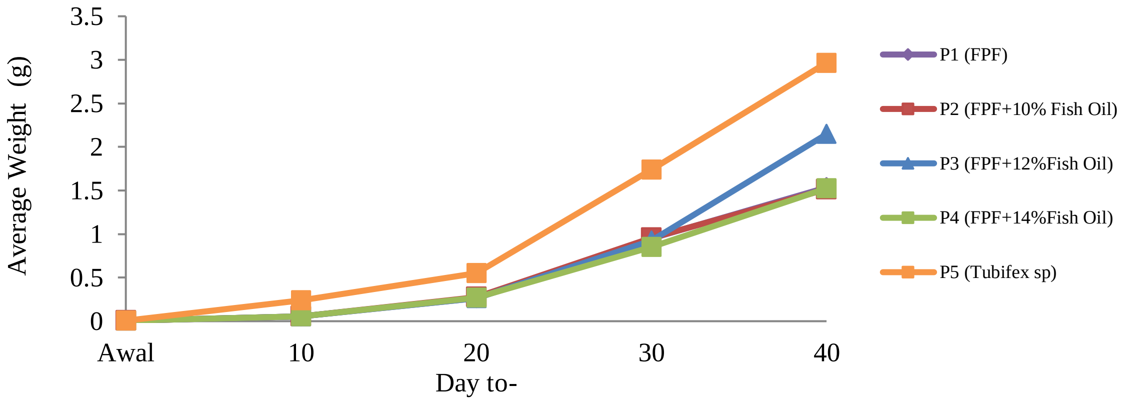

Figure 1. Average weight growth of Asian redtail catfish larvae

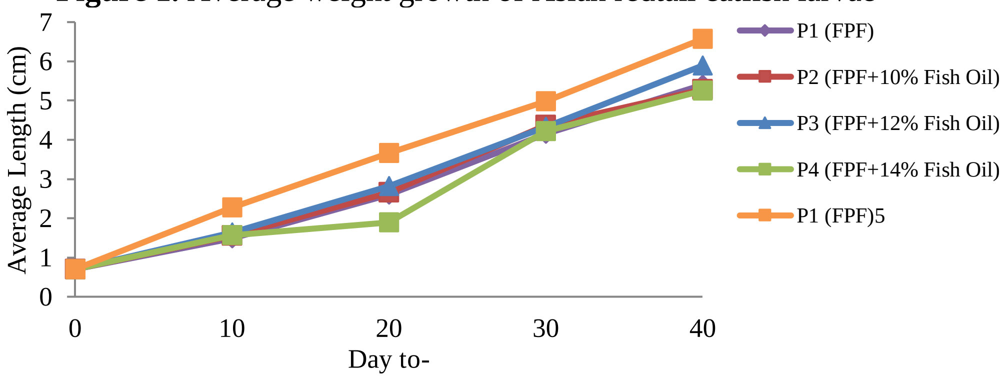

Figure 2. Average length growth of Asian redtail catfish larvae

The average weight growth of Asian redtail catfish larvae from the start of rearing until the 10 days was no significant difference in growth, which was almost the same in each treatment. This is because the asian redtail catfish larvae are still in the organ formation phase, so the food obtained is focused on being used for the morphological development process[9]. In the larval phase from 1 to 12 days of age, the digestive tract of the Asian redtail catfish larvae has not yet formed perfectly and Digestive enzymes are still in small quantities, so they are not able to digest food properly.

On the 20-day and 30 days, the pattern was the same as on the 10th day, but on the 40-day, it was seen that P5 was still the best treatment, but in the P3 treatment, it could have better weight growth compared to weight growth in treatments P1, P2, and P4. The development of larvae in treatments P1, P2, P3, and P4 was not able to increase significantly from the 10th day to the 30th day. It is suspected that the larval response to the feed was less aggressive, as seen from the small amount of food left in the rearing container, while P5 average weight growth increased compared to other treatments.

Meanwhile, on days 31-40, the highest increase occurred in treatment P3, namely 2.14 g, followed by treatments P1, P2, and P4. The appropriate addition of fish oil from the mesenteric waste of catfish to fermented pasta feed can improve feed performance by increasing the growth of Asian redtail catfish larvae.

The fatty acids contained in the waste oil from the mesenteric part of catfish influence the growth and development of fish larvae, provide the energy needed and help in the absorption of nutrients. Fish oil from the mesenteric waste of catfish is thought to increase larval growth because fish oil, apart from being used as a fat source, also functions as an attractant. Feed treated with optimal catfish mesenteric oil also functions as an attractant in the form of attractant aroma and taste in the feed so that it can stimulate fish to approach and consume the feed provided.

Fermenting pasta feed using probiotics containing yeast (*Saccharomyces* sp) is also thought to add aroma to the feed, thereby attracting fish with the aroma caused by yeast so that the appetite of the fish larvae for pasta feed increases the response of the larvae. Fish taking food become more aggressive, thus influencing weight growth; in accordance with the statement of Saruksuk[10], the addition of probiotics containing yeast will add aroma to pasta feed.

Based on Table 2. the Analysis of Variation test (ANOVA) enrichment of fermented pasta feed with waste oil from the mesenteric part of catfish was significantly different ($p<0.05$) on the absolute length growth of asian redtail catfish larvae.

Based on Figure 2, we can see the growth pattern of the average length of asian redtail catfish larvae in treatments P1, P2, P3, and P4, resulting in average length growth that is not very different, but statistically, it is significantly different. While P5 showed the highest increase in length from day 11-40, the best maintenance days were P5 treatment. This is because *Tubifex* sp, apart from having a distinctive aroma, has brighter colors and also moves, so the larvae Asian redtail catfish are more attracted to *Tubifex* sp than artificial food. Budianto et al.[11] *Tubifex* sp is a natural food that is very popular with fish that live in freshwater because these *Tubifex* sp have a high nutritional content, namely 57% protein value, 13.30% fat and 2.04% carbohydrates, so they are suitable for fish growth.

On days 11-30 of treatment, P1, P2, P3, and P4 had a similar pattern to the 10th day. However, in treatment P4, on day 20, the growth was slower than in the other treatments. This is thought to be because giving too much oil can affect length growth. This is due to changes in feed intake behaviour. If we look at the data on the response to feed, it can be seen that in P4, there has been a decrease in the response to feed (Table 1). Stefani[12] revealed that increasing the dose of waste oil from the mesenteric part of catfish by 14% resulted in a decrease in length growth rate, and the lowest length growth was 3.50 cm.

The highest treatment on days 31-40 was P3, and the average length increased. This is thought to be the pasta feed given to asian redtail catfish larvae plus probiotics containing yeast, which can increase the aroma of the pasta feed can stimulate the response of the asian redtail catfish larvae to become aggressive in approaching and consuming the feed provided.

Specific Growth Rate

The specific growth rate of asian redtail catfish larvae was highest in treatment P5, namely 15.54%/day, followed by treatment P3 with a value of 14.73%/day, treatment P1 with a value of 13.90, treatment P4 with a value of 13, 88%/day and the lowest was in treatment P2 with a value of 13.87%/day.

In treatment P3, because the larvae's response to feeding was very aggressive, the larvae consumed more feed. The more feed the larvae consumed, the more nutrients absorbed could support the growth of Asian redtail catfish larvae. Energy is used for basic metabolism, movement, production of sexual organs, and replacement of damaged cells, and excess is used for growth.

Based on research by Noor & Pakaya[13], artificial feed given by an EM4 fermenter can influence the specific growth rate of gourami fish. This shows that giving EM4 fermenters in artificial feed can increase the growth rate of fish. Fermentation of feed can reduce the crude fiber of feed, making it easier for fish to absorb feed and quickly absorb it by the body so that the growth rate increases[14]. The daily growth rate of larvae is closely related to the availability of protein and fat found in feed and is needed for growth. The fatty acid content EPA and DHA in catfish oil consumed by asian redtail catfish larvae is able to produce energy which larvae can utilize to support. As Susanti et al.[15] argue, the fat content provided can be used as an energy source for fish for growth and reproduction.

Treatment P2 showed the lowest daily growth rate. This is thought to be because the dose of fish oil given could not provide sufficient fat requirements for the growth of asian redtail catfish larvae. Fat is an energy supply component. Absolutely the biggest with daily activities ranging from swimming, looking for food, and avoiding enemies, metabolism, growth, and body endurance require energy. Fat contains fatty acids, and generally, fish cannot make it, so it must be eaten in food.

Survival Rate

The effect of enriching fermented pasta feed with waste oil from the mesenteric parts of catfish on the survival of asian redtail catfish larvae (Table 3).

Table 3. Cannibalism index and survival of Asian redtail catfish larvae

Treatment	Type A	Type B	M N
P1 (Fermented pasta feed)	21.77±10.0[ab]	0±0.00	8.44 ±3.35[a]
P2 (FPF+10% fish oil)	26.22 ±6.0[ab]	0±0.00	6.22 ±0.77 [a]
P3 (FPF+12% fish oil)	13.77±2.03 [ab]	0±0.00	1.77±2.03 [a]
P4 (FPF+14% fish oil)	16.00±2.67 [ab]	0±0.00	16.44±5.04[b]
P5 (*Tubifex* sp)	8.89 ±2.77 [a]	0±0.00	1.33±1.33 [a]

Information: The mean value in the same column followed by the same letter indicates not significantly different (P>0.05)

Based on the results of the Analysis of Variance test (ANOVA), enrichment of fermented pasta feed with waste oil from the mesenteric parts of catfish had a significantly different effect on the survival rate of asian redtail catfish larvae, where the survival rate was influenced by the incidence of cannibalism and normal larval death (P<0.05).

Based on Table 3, it can be seen that there are two causes of death of Asian redtail catfish larvae; the first is due to cannibal behaviour, where the highest incidence is in P2, then followed by P1, P4, P3, and P5. Suppose it is related to the response to food. In that case, there is a correlation between this cannibal behaviour and the completeness of nutrition in Asian redtail catfish larvae, where at the lowest P5, the food given always runs out. Meanwhile, treatment P2 showed the highest death of Asian redtail catfish larvae in type cannibalism, with a value of 26.22%. This is thought to have increased the level of cannibalism due to feeding with a dose of fish oil from waste from the mesenteric part of catfish, which is low and insufficient for the energy needs of Asian redtail catfish larvae.

The aroma of the feed given is less prominent because the dose of fish oil used is small, so the response of the larvae to the feed provided is moderate. According to Heltonika et al.[5], there are three groups of factors that influence cannibalism, namely interspecific factors (parental care for larvae and fish food), endogenous intraspecific factors (nutritional status, size differences, genetic relationships, group behaviour, level of response, and same-sex recognition) and factors exogenous intraspecific (stocking density, protection, light, and disturbance). The second factor of larval death is caused by normal death; in P4, this incident is the highest. This is closely related to the decrease in water quality caused by excessive fish oil administration and can cause the death of Asian redtail catfish larvae.

Treatment P4 showed the highest normal mortality with a value of 16.44%. This was because excessive doses of fish oil made the water in the rearing container brown (murky). Consequently, the larvae had difficulty seeing excessive food and aromas. The larvae's response to food is not too aggressive, as Stefani[12] believes Larvae do not like excessive smells, which slow down growth and cause death. The survival value of the P3 treatment was 84.44%.

This was because the probiotics added to the pasta feed eaten by Asian redtail catfish larvae contained *Lactobacillus* sp, which can secrete enzymes that can convert complex molecules into simple molecules so that Asian redtail catfish larvae whose digestive system and digestive enzymatic functions are still straightforward and have not yet developed perfectly, can digest and absorb the pasta feed given to the maximum so that the larvae can survive. The addition of fish oil from the waste of the mesenteric part of catfish affects increasing the survival of fish larvae because the fat content in fish oil from the waste of the mesenteric part of catfish as an energy source can increase the growth and survival of larvae. This is supported by the statement of Prastyanti et al.[16] that the essential fatty acid EPA is required for survival, and DHA is necessary for growth.

Faziel et al.[17], the survival rate is the percentage of fish alive at the end of the rearing period. Survival is a significant factor determining the success of harvesting and raising fish. The results from Table 3 show that the survival rate of larvae during the 40 days of this study is classified as good, ranging from 67.55%-88.44%. According to Najib[18], a survival rate of >50% is considered good, a survival rate of 30-50 Medium %, and survival of less than 30% is not good.

Water Quality

These parameter measurements were carried out 3 times during the research, namely at the beginning, middle, and end of the study; measurements of temperature, pH, and DO of the research container were carried out in the morning. The range of water quality values during the study can be seen in Table 4.

Table 4. Water quality parameters

Treatment	Temperature (^{0}C)	pH	DO (mg/L)
P1 (Fermented pasta feed)	27,3 – 28,5	5,5 – 6,3	5,2 – 6,1
P2 (FPF+10% fish oil)	27,3 – 28,9	5,4 – 6,2	5,2 – 6,1
P3 (FPF+12% fish oil)	27,5 – 28,9	5,7 – 6,3	5,5 – 6,5
P4 (FPF+14% fish oil)	27,0 – 28,9	5,0 – 6,1	5,1 – 6,0
P5 (*Tubifex* sp)	27,0 – 28,0	6,5 – 7,0	6,3 – 8,1

Based on Table 4, feeding fermented pasta with fish oil from the mesenteric waste of catfish to Asian redtail catfish larvae can affect the water quality in the rearing container, such as in treatment P4 dose High levels of oil cause the water quality to be poor because during the maintenance period, the water becomes brown (murky), and the surface of the water is more oil.

Water quality parameters are still within the optimum range and can support the growth and survival of Asian redtail catfish larvae with temperatures ranging from 27–28.9, pH ranges from 5-7, and DO

5.1–8.1 mg/L. Water quality, especially temperature, is an essential factor that influences the success of cultivation. Temperature can affect dissolved oxygen levels in the environment, affecting fish breathing.

The results of temperature measurements during the research ranged from 27 – 28.9. This temperature value was relatively stable and was still within the optimal temperature range for the growth of Asian redtail catfish larvae so that they could grow well. This is to research by Cahyaruni et al.[19], the temperature during larval maintenance ranges from 25-28°C, which research has supported well.

The pH during the study ranged from 5-7, where this value is included in the range that is quite good for the growth of Asian redtail catfish larvae. This is to the statement of Sinaga et al.[20], which shows that the results of pH measurements during the maintenance process range from 5.9 to 7.2. Furthermore, according to Sukendar et al.[21], a suitable pH for growing Asian redtail catfish fry is around 6–7. Based on the results obtained, it can be said that the water quality during the rearing process of Asian redtail catfish larvae is in the optimal range.

The results of dissolved oxygen measurements when rearing asian redtail catfish are between 5.1–8.1 mg/L. This value is considered ideal due to the provision of aeration in each maintenance aquarium. Providing aeration functions as an oxygen supplier; this dissolved oxygen value is suitable for the growth of Asian redtail catfish. According to Suhenda et al.[22], this is the statement that good dissolved oxygen for Asian redtail catfish cultivation is around 3-8 mg/L. Kordi[23] states that the optimum dissolved oxygen value for Asian redtail catfish cultivation is 3-7 mg/L.

4. CONCLUSION

Based on the research results, it was found that enrichment of fermented pasta feed with waste oil from the mesenteric parts of catfish had a significant effect ($P<0.05$) on the growth and survival of Asian redtail catfish larvae. The best treatment in research on enriching fermented pasta feed with waste oil from the mesenteric part of catfish on the growth and survival of Asian redtail catfish larvae results in an absolute weight growth of 1.63 g, absolute length 5.33 cm, specific growth rate 14.73%/day, survival 84.44%, type a cannibalism index 13.77%, normal death 1.77%, based on the survival rate, it can be seen that the dominant cause of death is due to cannibals, and the higher the administration of fish oil from the mesenteric waste of catfish can cause normal mortality to increase and water quality parameters during the study were temperature range 27–28.9°C, pH ranges from 5-7 and DO 5.1–8.1 mg/L.

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