The Effect of Feeding Different Enriched Squid Oil Time of *Nereis* sp. on Growth and Survival of *Vannamei* Shrimp (*Littopenaeus vannamei* Boone, 1931) Post Larvae

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**Abstrak**

Brilly Elfayuga Rhesanda, Sarjito, Seto Windarto, Vivi Endar Herawati. The Effect of Feeding Different Enriched Squid Oil Time of *Nereis* sp. on Growth and Survival of *Vannamei* Shrimp (*Littopenaeus vannamei* Boone, 1931) Post Larvae. 2022. White leg shrimp (*L. vannamei*) is one of aquaculture commodity that has high economic value both in the domestic and global markets. White leg shrimp in the post larval stage are generally stocked in ponds and given artificial feed. Along with the development of information and cultivation technology, artificial feed is less effective for shrimp feed because its nutritional content is not in accordance with the needs of shrimp. In addition, to obtain raw materials for artificial feed for shrimp farming, we still rely on imports. The increasing value of imported feed will have an impact on increasing cultivation costs, so an alternative must be sought to replace quality imported feed that has high protein value. The use of live feed can be a solution for shrimp feed, one of which is *Nereis* sp. worms. *Nereis* sp. has been used as a live feed needed for the continuity of nauplii production in shrimp hatcheries. Optimizing the growth of vanname shrimp can use the addition of enrichment on *Nereis* sp., namely using squid oil. The purpose of this study was to determine the effect of adding sea worms (*Nereis* sp.) enriched with squid oil on the growth and survival of white leg shrimp (*L. vannamei*) Post Larvae 15; and knowing the best soaking times of addition of *Nereis* sp. with squid oil on the growth and survival of white leg shrimp (*L. vannamei*) post larve 15. This study used an experimental method and used analysis of variance’s test with a completely randomized design (CRD) of 4 treatments and 3 replications. Treatment of the length of time for soaking *Nereis* sp. into squid oil, namely A (0 hour), B (1 hour), C (2 hours), and D (3 hours). The data observed include Relative Growth Rate (RGR), Total Feed Consumption (TKP), Feed Utilization Efficiency (EPP), Protein Efficiency Ratio (PER), and Survival Rate (SR). The addition of squid oil to the feed of *Nereis* sp. had a significant effect (P>0.05) on the growth and survival rate of *vanamei* shrimp post larvae. Treatment D with 3 hours of soaking times into squid oil was the best treatment with a growth value of RGR (9.91±0.61%/day); TKP (61.28±0.10 g); EPP (5.82±0.38%); PER (12.33±0.17%); dan SR (95.56±1.93%).

**Key words :** enrichment, *L. vannamei*, *Nereis* sp., soaking times, squid oil.

**Introduction**

White leg shrimp (*L. vannamei*) is one of potential shrimp, because white leg shrimp is one of the leading products of the aquaculture product. According to KKP (2015), white leg shrimp contributed the largest number to the export value of aquaculture products, which was 43.86% of the total export value of aquaculture products in 2015. According to Kaligis (2015), the advantages of white leg shrimp are among others, easy to cultivate and stable cultivation production because white leg shrimp is relatively resistant to disease. White leg shrimp when the post larval stage are generally stocked in ponds are fed with artificial feed in the form of powder. According to the research of Mansyur et al., (2011), using a semi-intensive method fed artificial feed has a feed efficiency result of 72.42% - 83.57%. Provision of artificial feed during the rearing period is considered to be...
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insufficient to meet the needs of white leg shrimp post larval stage. In addition, artificial feed for shrimp farming still relies on imported feed (Awaludin et al., 2020). The increasing value of imported feed will have an impact on the increasing cost of cultivation, so it is necessary to look for alternatives to quality imported feed that has high protein value. According to Pasaribu et al., (2017), feed is a very important factor in white leg shrimp cultivation because it absorbs 60-70% of the total production cost. According to the research of Febrianti et al., (2019), artificial feed used for white leg shrimp post larvae stadia containing tuna fish meal and maggot flour has a nutritional content of 23.25% protein, 10.85% fat, and 8.39% water. As an alternative to artificial feeding, live feed nereis worms is given to white leg shrimp. According to Herawati et al., (2020) that Nereis sp. has the potential to be developed into live feed for tiger prawns and white leg shrimp.

Research conducted by Herawati et al., (2020) showed that Nereis sp. contains 33.19% protein and 19.98% fat. To complement and increase the nutritional content of Nereis sp. as shrimp feed, enrichment is needed, according to Wijana (2006), which states that white leg shrimp in the post larval stage requires protein in the feed ranging from 30-50% to support growth and survival. The results of the study by Hermawan et al., (2015), an increase in the percentage of the content of Nereis sp. as much as 30% in shrimp feed can increase growth and uptake of shrimp feed. The process of enriching live feeds to increase the nutritional content of live feeds is often carried out using ingredients that contain high levels of essential fatty acids, one of the essential fatty acid providers that is good for enrichment is squid oil.

According to Hermawan et al., (2015), Nereis sp. in fresh form of chopped or in the form of flour mixed in making pellets is very good for increasing shrimp growth. Larvae need proper and balanced nutritional value for good survival and growth. The correlation between feed nutrition and larval nutritional needs is shown by the content of essential fatty acids (n-3 HUFA), especially EPA (Eicosa Pentanoid Acid) and DHA (Docosa Hexanoid Acid). Nutrient enrichment for nereis can generally use squid oil which contains EPA and DHA. According to Khasani (2013) squid oil contains 13.4% - 17.4% EPA fatty acids and 12.8% - 15.6% DHA. EPA and DHA belong to the HUFA group which have an important role in supporting the survival of crustacean larvae (Sorgeloos et al., 2001) and the normal functioning of metabolism (Gonzales and Velasquez., 2002). According to Respati et al., (2021) HUFA contains attractants that can increase the palatability or ability of feed to be consumed by cultivars, so that HUFA can increase the value of feed consumption levels and growth rates. According to Craig and Helfrich (2002), unsaturated fatty acids (HUFA) cannot be produced in the body and must be obtained from feed, then with the help of enzymes converted into long hydrocarbon chains. The formation of double bonds forming HUFA, EPA and DHA is very important for metabolic functions and components in cell membranes. This is confirmed by Ibeas et al. (2000), which states that marine cultivars do not have the enzyme system found in freshwater cultivars, so marine cultivars are in dire need of
n-3 and n-6 long chain HUFAs from feed for optimal growth. Santoso (2006) argues that sufficient EPA and DHA content is a source of essential fatty acids for shrimp, so it can maintain survival and accelerate growth. Ratri (2020) explained that deficiency of EPA and DHA as well as fatty acids and amino acids also affects the growth and weight of biomass. The increase in nutrition in the feed was done by immersing nereis using squid oil. Squid oil which has been absorbed by Nereis sp. has content such as protein and fat that will be digested by shrimp for energy needs and growth. According to Monoroig and Kabeya (2018), who state that marine worms are capable of biosynthesis from the feed given especially to the EPA and DHA contained in the feed.

The result of research conducted by Yuwono et al., (2001), who used Nereis sp. as post larval feed for 20 tiger prawns, given in the form of chopped worms in a fresh condition. The basis of treatment in this study refers to the study of Murueta et al. (2002), namely the use of squid as a feed protein supplement for the growth of white leg shrimp. In this study, squid oil was used as an enrichment for Nereis sp. by soaking to support the growth of white leg shrimp post larvae. To find out the best enrichment results, then modify it by giving the length of time for enrichment. The basis for giving the length of enrichment time was taken from the study of Yunus et al., (1996), it’s given treatment soaking times 0 hours, 2 hours, 4 hours, 6 hours and 8 hours. 2 hours of soaking times with a survival rate 74.08%. So in this study the modification of the soaking time was taken, namely 0, 1, 2, 3 hours. The concentration of squid oil in enrichment is 30 ml/3 L of water, this concentration refers to the research of Mufidah et al., (2009), using live feed Daphnia sp. which was enriched using 10 ml/L of viterina water resulted in the highest growth of 1.885%/day.

**Material and Methods**

The test animal used in this study was the white leg shrimp (*L. vannamei*) larvae from the CV. RIZ Samudera, Marine Science Techno Park (MSTP) Jepara. The white leg shrimp larvae used were stage 15 post larvae which were fed by Nereis sp. enriched with squid oil with different soaking times. There were 30 shrimps/container. The length of rearing the white leg shrimp larvae is for 30 days. The container size used in the study was 60 L volume as much 12 containers using a non-recirculating system for 30 days of maintenance. White leg shrimp (*L. vannamei*) larvae at the beginning and end of the past rearing period were measured absolute weight growth using analytical scales with an accuracy of 0.001 and absolute length growth was measured using millimeter blocks. This is done to determine the growth in absolute relative growth rate and absolute survival during the maintenance period.

The materials used in this study were squid oil, Nereis sp., stage 15 white leg shrimp larvae. Weight Nereis sp. as much as 4,000 grams then washed with filtered sea water. There are 4 treatments in this study, which is 4 containers each container by 1000 grams Nereis sp., then prepare squid oil according to the needs of 120 ml each were given 30 ml oil/container.
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The use of squid oil then mixed well. Save the containers filled with *Nereis* sp. and enrichment materials according to the required enrichment time, namely 0, 1, 2, and 3 hours.

The container used in this study is made from sturdy plastic that located indoors. The containers that will be used previously are cleaned by brushing and flushing with water first. The rearing media used was seawater with a salinity of 29 ppt, because the salinity for rearing white leg shrimp ranged from 29-34 ppt (SNI 7311:2009). The water source comes from the sea water of Marine Science Techno Park (MSTP) Jepara, Central Java which has previously been accommodated, filtered and then sterilized using chlorine at a dose of 10 g/ton, then neutralized using sodium thiosulfate at a dose of 50% of chlorine (SNI 7311: 2009). The containers that have been cleaned and dry are set 4 x 3 positions. The installed container is then given aeration, where the aeration is placed in each container that has been provided in the aeration pipes. The container size used in the study was 25 cm (w) x 43 cm (l) x 30 cm (h).

The experimental design used in this study was a completely randomized design (CRD). This study used 4 treatments and each treatment was repeated 3 times, the arrangement of the treatments was as follows:
- **Treatment A**: *Nereis* sp. without enriched with squid oil
- **Treatment B**: *Nereis* sp. enriched with squid oil for 1 hour
- **Treatment C**: *Nereis* sp. enriched with squid oil for 2 hour
- **Treatment D**: *Nereis* sp. enriched with squid oil for 3 hour

Determination of the density dose of live feed given to white leg shrimp (*L. vannamei*) larvae was carried out based on a preliminary test that was carried out before the study was carried out. Fill each containers with sea water that treatment until 5 L, stocked vannamei shrimp 30/container. Feed 4 times a day, at 07.00, 14.00, 18.00 and 21.00 using *Nereis* sp. by chopping it first according to the mouth opening of the white leg shrimp larvae, according to KKP which is 200-300 microns. Cover the each container using net. The net keeps the shrimp from jumping out of the container. To determine how many doses of feed needed, it is necessary to calculate 20% of the mass of white leg shrimp biomass. According to Utomo et al., (2005) the amount of feed given depends on the achievement of fish weight and number of fish. The results of this preliminary test are then used as a consideration in determining the dosage of live feed used at the time of treatments.

The data displayed includes data on the relative growth rate (RGR), feed utilization efficiency (EPP), protein efficiency ratio (PER), survival (SR), grazing rate (TKP) and water quality.

**Relative Growth Rate (RGR)**

According to De Silva dan Anderson (1995), the daily growth rate can be calculated using the following formula:

\[
RGR = \frac{W_t - W_0}{W_0 x t} \times 100\%
\]

**Note:**
- **RGR**: Absolute relative growth rate (%/day)
- **Wt**: Final weight of fish (g)
- **W0**: Fish initial weight (g)

**Live Feed Utilization Rate (Grazing Rate)**

AQUACULTURA INDONESIANA
An International Journal of Indonesian Aquaculture Society (www.aquasiana.org)
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Grazing rate shows the amount of live feed eaten by white leg shrimp larvae during the rearing period. The grazing rate can be calculated by knowing the amount of initial feed given and the remaining feed during maintenance by comparing the amount of feed given with the remaining amount of live feed on the maintenance media. According to Weatherly (1972), total feed consumption can be calculated using the following formula:

\[ TKP = F2 - F1 \]

Note:
TKP : Total feed consumption (g)
F2 : Final weight of feed (g)
F1 : Feed initial weight (g)

**Feed Utilization Efficiency (EPP)**

According to Zonneveld et al., (1991), feed utilization efficiency can be calculated using the following formula:

\[ \text{EPP} = \frac{Wt - W0}{F} \times 100\% \]

Note: 
EPP : Feed utilization efficiency (%)
Wt : Final weight of fish (g)
W0 : Fish initial weight (g)
F : Amount of feed consumed (g)

**Protein Efficiency Ratio (PER)**

According to Tacon (1993), the protein efficiency ratio can be calculated using the following formula:

\[ \text{PER} = \frac{Wt - W0}{Pi} \times 100\% \]

Note:
PER : Protein efficiency ratio (%)
Wt : Final weight of fish (g)

\[ \text{Survival Rate (SR)} \]

According to Effendie (1997), the survival rate can be calculated using the following formula:

\[ \text{SR} = \frac{Nt}{N0} \times 100\% \]

Note:
SR : Survival Rate (%)
Nt : Amount of individuals at the end of the study
N0 : Amount of individuals at the start of the study

**Water Quality**

Water quality measurements include salinity measured using a refractometer; dissolved oxygen (DO), acidity (pH) and temperature were measured using a Water Quality Checker (WQC). The use of WQC for water quality measurements is carried out by inserting the instrument into the culture media water and seeing the value of each measured parameter, after completion the WQC measurement is calibrated with plain water and dried with a dry cloth before storage.

The data obtained were analyzed using Analysis of Variance (ANOVA) which first carried out the normality test, homogeneity test and additivity test to determine that the data were normal, homogeneous and additive. If it is known that there is a significant (P <0.05) or very real (P <0.01) effect, then proceed with the
Duncan Multiple Area Test to determine the difference in the mean between treatments and determine the best treatment. Water quality data were analyzed descriptively.

**Result**

**Relative Growth Rate (RGR)**

Based on the data on the relative growth rate of white leg shrimp larvae (*L. vannamei*) during 30 days the study a histogram can be made which is presented in Figure 1.

![Figure 1](image)

**Figure 1.** The relative growth rate histogram of the white leg shrimp (*L. vannamei*) larvae during 30 days the study.

The highest relative growth rate histogram showed the highest value in treatment (D) *Nereis* sp. enriched with squid oil for 3 hours, which is 9.91%: while the lowest absolute relative growth rate in treatment (A) *Nereis* sp. without enriched with squid oil, which is 5.15%. Analysis of variance (ANOVA) showed a significant effect (P<0.05) on relative growth rate. Furthermore, to find out the difference in the mean value between treatments, the Duncan test was carried out, the results are presented in Table 1.

Table 1. The results of Duncan’s test on relative growth rate of white leg shrimp (*L. vannamei*) during 30 days study.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Middle value</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>9.91</td>
<td>D</td>
</tr>
<tr>
<td>C</td>
<td>7.50</td>
<td>*2.41 C</td>
</tr>
<tr>
<td>B</td>
<td>5.98</td>
<td>**3.93 *1.52 B</td>
</tr>
<tr>
<td>A</td>
<td>5.15</td>
<td>**4.76 *2.35 *0.83 A</td>
</tr>
</tbody>
</table>

Note : (**) shows significantly different results; (*) shows aren’t significantly different results.

Based on the results of Duncan's test (Table 1), the relative growth value of white leg shrimp larvae showed that treatment D gave a significant difference to treatment B and treatment A, but had no effect on treatment C. Duncan's test results from treatment C did not make a difference with treatment B and treatment A. The results of the Duncan test for treatment B did not give any difference with treatment A, D and C. So that the treatment of *Nereis* sp. enriched with squid oil for 3 hours (D) was significantly better than *Nereis* sp. without squid oil enrichment (A) on the daily growth rate of white leg shrimp larvae.

**Live Feed Utilization Rate (Grazing Rate)**

Based on the live feed utilization rate (Grazing Rate) data of white leg shrimp larvae (*L. vannamei*) during the 30 days study a histogram can be made which is presented in Figure 2.
The grazing rate histogram showed the highest value in treatment (D) Nereis sp. enriched with squid oil for 3 hours, which is 61.28 g; while the lowest grazing rate in treatment (A) Nereis sp. without enriched with squid oil, which is 58.18 g. Analysis of variance (ANOVA) showed a significant effect (P<0.05) on absolute relative growth rate. Furthermore, to find out the difference in the mean value between treatments, the Duncan test was carried out, the results are presented in Table 2.

Table 2. The results of Duncan’s test on grazing rate of white leg shrimp (L. vannamei) during 30 days study.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Midle value</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>61.28</td>
<td>D</td>
</tr>
<tr>
<td>C</td>
<td>60.25</td>
<td>**1.03</td>
</tr>
<tr>
<td>B</td>
<td>59.25</td>
<td>**2.03</td>
</tr>
<tr>
<td>A</td>
<td>58.18</td>
<td>**3.10</td>
</tr>
</tbody>
</table>

Note: (***) shows significantly different results; (*) shows aren’t significantly different results.

Based on the results of Duncan's test (Table 2) the grazing rate of white leg shrimp showed that treatment D gave a significant difference to treatment C, treatment B and treatment A. Duncan's test results from treatment C gave a significant difference to treatment B and treatment. A. The results of Duncan's test treatment B gave a significant difference with treatment A, but had no effect on treatments D and C. So that the treatment of Nereis sp. enriched with squid oil for 3 hours (D) was significantly better than Nereis sp. without squid oil enrichment (A) on total grazing rate of white leg shrimp larvae.

Feed Utilization Efficiency (EPP)

Based on the feed utilization efficiency (EPP) data of white leg shrimp larvae (L. vannamei) during the 30 days study a histogram can be made which is presented in Figure 3.
hours, which is 5.82%; while the lowest feed utilization efficiency in treatment (A) Nereis sp. without enriched with squid oil, which is 3.38%.

Analysis of variance (ANOVA) showed a significant effect (P<0.05) on feed utilization efficiency. Furthermore, to find out the difference in the mean value between treatments, the Duncan test was carried out, the results are presented in Table 3.

Table 3. The results of Duncan’s test on feed utilization efficiency of white leg shrimp (L. vannamei) during 30 days study.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Midle value</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>5.82</td>
<td>D</td>
</tr>
<tr>
<td>C</td>
<td>4.81</td>
<td>**1.01</td>
</tr>
<tr>
<td>B</td>
<td>3.94</td>
<td>**1.88</td>
</tr>
<tr>
<td>A</td>
<td>3.38</td>
<td>**2.44</td>
</tr>
</tbody>
</table>

Note : (**)) shows significantly different results; (*) shows aren’t significantly different results

Based on the results of Duncan’s test (Table 4), the feed utilization efficiency showed that treatment D gave a significant difference to treatment C, B and A. The results of Duncan's test treatment C gave a significant difference to treatment B and A. The results of Duncan’s test treatment B did not give any difference with treatments A, D and C. So that the treatment of Nereis sp. enriched with squid oil for 3 hours (D) was significantly better than Nereis sp. without squid oil enrichment (A) on the efficiency of feed utilization of white leg shrimp larvae.

**Protein Efficiency Ratio (PER)**

Based on the protein efficiency ratio (PER) data of white leg shrimp larvae (L. vannamei) during the 30 days study a histogram can be made which is presented in Figure 4.

The highest protein efficiency ratio (PER) value, namely 12.33%, occurred in the feeding treatment (D) Nereis sp. enriched with squid oil for 3 hours, while the lowest protein efficiency ratio was 7.97% in treatment (A) Nereis sp. without enriched with squid oil. The results of analysis of variance (ANOVA) showed a significant effect (P<0.05). Furthermore, to find out the difference in the mean value between treatments, the Duncan test was carried out, the results are presented in Table 4.

Table 4. The results of Duncan’s test on protein efficiency rate of white leg shrimp (L. vannamei) during 30 days study.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Midle value</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>12.33</td>
<td>D</td>
</tr>
<tr>
<td>C</td>
<td>10.38</td>
<td>**1.95</td>
</tr>
<tr>
<td>B</td>
<td>8.56</td>
<td>**3.77</td>
</tr>
<tr>
<td>A</td>
<td>7.97</td>
<td>**4.36</td>
</tr>
</tbody>
</table>

Note : (**)) shows significantly different results; (*) shows aren’t significantly different results
Based on the results of Duncan’s test (Table 4) the value of protein efficiency ratio in white leg shrimp larvae showed that treatment D gave a significant difference to treatment C, treatment B and A. The results of Duncan's test treatment C gave a significant difference to treatment B and A. The results of Duncan's test in treatment B did not give any difference with treatments A, D and C. So that the treatment of Nereis sp. enriched with squid oil for 3 hours (D) was significantly better than Nereis sp. without enrichment of squid oil (A) to protein efficiency ratio of white leg shrimp.

**Survival Rate (SR)**

Based on the survival rate (SR) vannamei shrimp (L. vannamei) larvae during the 30 days study a histogram can be made which is presented in Figure 5.

![Survival Rate Histogram](image)

**Figure 5.** Histogram of Survival Rate of white leg shrimp (L. vannamei) larvae during 30 days study.

The survival rate histogram shows that the highest survival rate value of 95,56% found in the feeding treatment (D) Nereis sp. enriched with squid oil for 3 hours, while the lowest survival rate value was 86,67% in the feeding treatment (C) Nereis sp. enriched with squid oil for 2 hours. The results of analysis of variance (ANOVA) showed a significant effect (P<0.05). Furthermore, to find out the difference in the mean value between treatments, the Duncan test was carried out, the results are presented in Table 5.

Table 5. The results of Duncan’s test on survival rate of white leg shrimp (L. vannamei) during 30 days study.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Middle value</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>95,56</td>
<td>*D</td>
</tr>
<tr>
<td>A</td>
<td>94,44</td>
<td>*A</td>
</tr>
<tr>
<td>B</td>
<td>91,11</td>
<td>**B</td>
</tr>
<tr>
<td>C</td>
<td>86,67</td>
<td>**C</td>
</tr>
</tbody>
</table>

Note : (***) shows significantly different results; (*) shows aren’t significantly different results.

Based on the results of Duncan's test (Table 5) the survival rate of white leg shrimp larvae showed that treatment D gave a significant difference to treatment C, but did not make a difference to treatment B and A. Duncan test results from treatment A gave a significant difference with treatment C but did not give a difference with treatment B. The results of the Duncan test for treatment B did not give a difference with treatment C, D and A. So that the treatment of Nereis sp. enriched with squid oil for 3 hours (D) was significantly better than the other treatments on the survival rate of white leg shrimp larvae.
Water Quality

Based on the research that has been done, it is obtained the value of water quality as supporting data including dissolved oxygen (DO), salinity, degree of acidity or power of hydrogen (pH), temperature and ammonia of which the results are presented in Table 6.

Table 6. The results of water quality measurements on post larvae of white leg shrimp (L. vannamei) for 30 days of rearing.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Eligibility by source</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO (mg/L)</td>
<td>27.2 – 30.3</td>
<td>&gt;5c</td>
</tr>
<tr>
<td>Salinity (ppt)</td>
<td>32 – 33</td>
<td>20-40a</td>
</tr>
<tr>
<td>pH</td>
<td>7.2 – 7.6</td>
<td>6.0 – 9.0d</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>27.2 – 30.3</td>
<td>29 – 32b</td>
</tr>
<tr>
<td>Ammonia (mg/L)</td>
<td>0.023-0.19</td>
<td>&gt;0,1e</td>
</tr>
</tbody>
</table>

Note: Adiyana et al., 2015 (a)
Nuntung, 2018 (b)
Bahri et al, 2020 (c)
Mateka et al., 2015 (d)
Pantjara et al., (2015) (e)

Discussion

Absolute Growth

Based on the study that the soaking time of Nereis sp. using squid oil had a significant effect on the growth and survival of white leg shrimp larvae in terms of the results of the measurable variables. This is related to the length of time absorption of nutrients from squid oil in Nereis sp. The soaking time of Nereis sp. with this squid oil to get the maximum nutritional content. According to Rahmadhani et al., (2017), live feed enrichment is an activity that is often carried out by cultivators to increase nutrient levels in feed for a certain length of time. Nereis sp. has a habit of eating that is a filter feeder, so that nereis is able to absorb nutrients in the form of protein and fat from squid oil which is used as an enrichment material. According to Crawford et al., (2006) in Pamungkas (2009), the eating habits of polychaeta marine worms are deposit feeders, predators and filter feeders. Polychaeta have sensors in the head as a complementary tool for eating (Baker et al., 2014).

Based on study by Remyakumari et al, (2018) the protein contained in squid contains unsaturated fatty acids such as aspartic acid, lysine, glutamic acid, leucine, serine, arginine, cystine, histidine and tryptophan. According to Bangkit et al., (2016), squid oil contains 9% EPA and DHA and 31% unsaturated fatty acid content. EPA and DHA belong to the HUFA group which have an important role in supporting the survival of crustacean larvae (Sorgeloos et al., 2001) and the normal functioning of metabolism (Gonzales and
Velasquez., 2002). Beside that, squid oil contains attractants so that the shrimp larvae that are kept are more interested in the feed and can increase the growth of the larvae. As study by Yudiarto et al., (2012) regarding the addition of squid oil attractant to feed, in this study it was found that giving squid oil as an attractant was able to increase fat retention, protein retention and energy retention of fish fry during the study period. The provision of fatty acids in an amount that is in accordance with the needs of shrimp plays an important role in stimulating the body's resistance of white leg shrimp so that it activates the immune function that affects its ease of adapting to its environment and resistance to disease attacks, so as to increase survival and growth (Prastyanti et al., 2017).

One of the growths that occur in white leg shrimp larvae can be known through the growth rate of relative growth rate, Nereis sp. which was enriched with squid oil for 3 hours (D) gave the highest yield of 9.91%/day and in Nereis sp. without enrichment treatment (A) gave the lowest yield of 5.15%/day. The initial stocking weight of 15 post larvae white leg shrimp was 0.04-0.05 g/tail and the final weight of post larvae of 45 white leg shrimp after 30 days of rearing was 0.10-0.16 g/tail, the initial weight was multiplied by the initial number stocking was 30 shrimps and the final weight multiplied by the number of live shrimp. The addition of this weight is related to the nutritional content of the feed and the absorption of squid oil by the nereis worm, at the time of enrichment of 3 hours squid oil is the best time for enrichment so that during this enrichment the nutrients from squid oil can be maximally absorbed by the nereis. The effect of the length of enrichment time is considered to be able to absorb the attractants contained in squid oil, so that the grazing rate in the squid oil enrichment treatment for 3 hours (D) was also high, namely 61.28 g for 30 days of rearing. Another factor that affects the daily growth rate is the provision of feed that is adjusted to the density of the cultivar in each cultivation container, this will prevent cannibalism caused by competition for feed. According to Novriadi et al., (2020) that for feed intake, the amount given increases along with the amount of stocking density used. When compared with salmon oil as a live feed enrichment ingredient, which contains about 25% fatty acids and 75% unsaturated fatty acids (Maulana et al., 2014) and squid oil extracted from squid has a relative percentage of n-3 fatty acids. which is quite high, namely 41% because squid is a class of molluscs with a fairly high fat content and most of the lipids are in the form of phospholipids (Wahyudin, 2005). The study of Maulana (2016), showed that enrichment of live food nutrients for artemia using salmon oil applied to crustaceans resulted in a 77.50% survival rate. While the live food of Nereis sp. In this study, the highest survival rate was nereis which enriched squid oil for 3 hours, which was 95.56%. Riyanti et al., (2020) added that adequate feed consumption and adequate nutrient content in the feed can have a significant effect on the growth of the average weight and length of individual post-vaname shrimp larvae and the survival of the cultivar. This is also reinforced by Rasidi and Patria (2012), who state...
that the relative growth rate is the rate of growth over time.

The value of the level of grazing rate of each white leg shrimp was different for each treatment. According to Riyanti et al., (2020), the more protein that can be retained in the body and the less protein that is catabolized into energy, the greater the growth value. Provision of feed that is in accordance with the needs of white leg shrimp larvae will support its growth. Determination of the dose of feed given by the *ad libitum* method as much as 20% of the white leg shrimp biomass (SNI 7331:2009), where there is an additional dose of feed per weight sampling, which is 30 days divided by 4 sampling times, then the weight is calculated and there is an increase shrimp biomass weight so that there is an increase in the dose. Then the feeding of all treatments every day for 30 days was added up to become the total feed given (F1) and every day the remaining feed was calculated (F2) to be able to find out the amount of feed consumed (F). Based on study of Antunes et al., (2018), the use of appropriate feed can keep the culture media in balance and maintain the level of cultivar weight gain while controlling feed intake. A high rate of feed consumption will result in a high growth rate. In addition, the level of feed consumption will be followed by the efficiency of the use of white leg shrimp feed. The feed utilization efficiency results correlated with shrimp biomass weight obtained from Wt (final weight x number of live shrimp) – W0 (initial weight of rearing x 30 shrimp) from all replicate treatments for 30 days of rearing divided by feed consumed (F) obtained from TKP is F1 (total initial feed) – F2 (total remaining feed) then multiplied by 100%. Based on the data obtained, the highest feed utilization efficiency value was in the treatment of *Nereis* sp. which was enriched with squid oil for 3 hours (D) and the lowest value was treated with *Nereis* sp. which did not carry out the squid oil enrichment process (A). The high level of feed utilization efficiency in the treatment of *Nereis* sp. Enrichment for 3 hours (D) showed that this feed was good for white leg shrimp larvae to digest. This is reinforced by Putri et al., (2020), the higher the digestibility of protein in white leg shrimp, the greater the protein that can be utilized for growth.

The value of feed utilization efficiency shows the optimization of white leg shrimp in consuming the given feed. Good feeding management will increase the growth and survival of white leg shrimp larvae. This is in accordance with the opinion of Susilowati (2014) which states that a fast growth rate is highly dependent on food efficiency and also low osmotic activity. *Nereis* worms by being treated with different lengths of enrichment time with squid oil, can transfer nutrients, especially amino acids and protein which are needed for energy sources and shrimp growth. The enrichment time of 3 hours gave the highest results, so that during the enrichment time, the nutritional content in squid oil was able to be absorbed by the *Nereis* sp. optimally. This is reinforced by Perdana et al., (2021) which states that the levels of essential fatty acids obtained from the feed can be used efficiently by shrimp larvae for physiological processes of the body such as fat transport. The longer the enrichment process, the higher the protein and fatty acids
contained in the *Nereis* sp., in addition, the longer the enrichment process can increase the attractant content of the *Nereis* sp. This affects the protein efficiency ratio. According to Riyanti *et al.* (2020), the greater the feed efficiency value, the more efficient the use of feed in the fish’s body. High and low utilization efficiency is influenced by the nutrient source and the amount of each component of the feed nutrient source (Herawati *et al.*, 2020b).

The value of protein efficiency ratio indicates the amount of protein utilized by white leg shrimp. Based on the results obtained, the value of the protein efficiency ratio in the treatment of *Nereis* sp. which was not enriched with squid oil (A) which was 7.97% was the lowest of all treatments, the treatment of *Nereis* sp. which was enriched with squid oil for 1 hour (B) was 8.56%, the treatment of *Nereis* sp. which was enriched with squid oil for 2 hours (C) was 10.38% and the treatment of *Nereis* sp. which was enriched with squid oil for 3 hours (D), which was 12.33%, was the highest of all treatments. According to Riyanti *et al.*, (2020), a good source of protein for white eg shrimp larvae in growth at an early stage which requires about 55% protein. The growth factor is very likely to affect the amount of feed consumption, the amount of feed consumption increases along with the increase in the value of shrimp growth. This is reinforced by Lee and Kyeong (2018), that differences in the quantity or quality of protein, the ratio of protein in the feed, and the type of species affect the final result of the protein consumed.

Live feed enrichment *Nereis* sp. with squid oil produced the highest protein in treatment D feed, namely *Nereis* sp. with a long soaking time of 3 hours, while the live feed of *Nereis* sp. which produced the lowest protein in feed A, namely feed *Nereis* sp. without squid oil enrichment. This is presumably because squid oil contains high protein, so that enrichment produces feed with high protein as well. This is in accordance with the opinion of Shahkar *et al.*, (2014), the difference in the amount of protein in the feed, the quality of the protein in the protein ratio in the feed will affect the energy produced and if the protein is low it will have an inconsistent impact on crustacean growth.

**Survival Rate (SR)**

One of the parameters to determine the success or failure of a cultivation can be seen from the level of survival rate. The results of observations on the survival parameters of white leg shrimp larvae during the study showed that the results had a significant effect (P<0.05). The survival rate for *Nereis* sp. without enriched with squid oil (control) was 94.44%, *Nereis* sp. enriched with squid oil for 1 hour was 91.11%, *Nereis* sp. enriched with squid oil for 2 hours was 86.67% it was the lowest SR and the *Nereis* sp. enriched with squid oil for 3 hours, was 95.56%, is the highest SR. According to Respati *et al.*, (2021), survival rate can be influenced by several factors, including water quality, maintenance media, and feed. According to Pratama *et al.*, (2017) good water quality will cause physiological processes in the shrimp body to run well, thus supporting the growth and survival
rate of shrimp. The water quality maintained in the rearing media will support the success of cultivation, another factor is the nutritional content of the feed consumed. Unavailability of feed will cause the death of white leg shrimp. According to Prawira et al., (2014) its caused by the growing stages and growth of shrimp so it takes feed more. Another opinion according to Lestari et al., (2018) mortality that often occurs in hatchery shrimp larvae is due to feed nutrition, rearing management, quality of naupli and poor environmental conditions. According to Susilowati et al., (2014) growth and survival rate will determine the production of white vaname shrimp biomass, water quality especially oxygen supply is very important for white vaname shrimp production.

**Water Quality**

Observation of water quality during the maintenance period is very important. The observed water quality includes dissolved oxygen (DO), salinity, degree of acidity or power of hydrogen (pH), temperature and ammonia. The results obtained during the rearing period showed optimal results for rearing white leg shrimp larvae. According to Asnawi et al., (2018), water quality is an environmental factor that plays an important role in the success of aquaculture business, so that its management must comply with optimal standards to support the growth and survival of test organisms.

Dissolved oxygen levels during the maintenance period were 5.4 – 6.8 mg/L. According to Adiyana et al., (2015), the recommendation of dissolved oxygen concentration for shrimp culture is >5 mg/L. The temperature range during the rearing period is 27.2 – 30.3 °C, the temperature range is still quite feasible for the maintenance of white leg shrimp. According to Nuntung et al., (2018), the water quality parameters for rearing white leg shrimp include a temperature of 29-32 °C. Changes in temperature are influenced by the location of the cultivation container, whether it receives direct sunlight or not, so that temperature changes from day to day are not too conspicuous or fluctuating. Degree of acidity or power of hydrogen (pH) measured during the maintenance period ranged from 7.2 to 7.6. The pH range is still suitable for white leg shrimp hatchery activities and supports the growth and survival of larvae. In cultivation media that has alkaline water, the pH value is still within the limits of 6.0 – 9.0 for estuary and marine ecosystems (Mateka et al., 2015). During the research period, the measured salinity was 32 – 33 ppt. According to Bahri et al., (2020), that vannamei shrimp prefers salinity that is not too high, which is optimum at 20-40 ppt salinity. These results are still in accordance with the feasibility for vaname shrimp culture.

Measurement of ammonia levels is needed to control water quality during the rearing period, measurement of ammonia levels is carried out twice, at the beginning of rearing and at the end of rearing. The results obtained that ammonia levels during the rearing period were in the range of 0.023-0.19 mg/l. These results indicate that the water ammonia level in the rearing of white leg shrimp larvae exceeds the feasibility threshold, resulting in stress white leg shrimp larvae and even death., according to Pantjara et al., (2015) safe ammonia levels for shrimp survival rates are less than 0.1 mg/L.
High concentrations of ammonia can cause stunted shrimp growth, can increase the content of nitrite which is toxic in the waters. To maintain ideal water quality, it is necessary to do daily siphoning. Siphoning is done with the help of a small hose that is placed at the bottom of the pond to suck up shrimp manure (Wulandari et al., 2015). The purpose of siphoning is to suck up the remaining sediment of feed and shrimp feces so that they do not break down into toxic substances.

Conclusions

The conclusions that can be obtained from this research are as follows:
1. Live feed of Nereis sp. affect the growth and survival of white leg shrimp (L. vannamei) larvae; and
2. The best result in this study was the treatment of Nereis sp. which was enriched with squid oil for 3 hours showed a significant effect (P<0.05) on the values of relative growth rate, grazing rate, feed utilization efficiency, protein efficiency ratio, and survival rate, which were respectively 9.91±0.64%/day; 61.28±0.10 g; 5.82±0.38%; 12.33±0.80%; and 95.56±1.93%.

Suggestions

Based on the research that has been done, the advice given is that it is necessary to do further research on white leg shrimp (L. vannamei) culture by being given live feed of Nereis sp. which was enriched using squid oil with an increased immersion time to determine the nutritional content of Nereis sp. the best.

Acknowledgement:

The authors would like to thank all of the CV. RIZ Samudera and Marine Science Techno Park (MSTP) Jepara, the Vannamei Shrimp (L. vannamei) Research Team and all those who have helped from the preparation of the research, the implementation of the research until the completion of this article.

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