Growth Performance of Scalloped Spiny Lobster (*Panulirus homarus*) Given Artificial Feed Based on Chicken Eggs Hatching Waste

Natasya Cahya Okta[1], Fariq Azhar[1], Andre Rachmat Scabra[1], Abdul Syukur[2], Muhammad Amin[3], Faturrahman[4,*]

[1]Aquaculture Study Program, Department of Fisheries and Marine Sciences, University of Mataram
[2]Biology Education Study Program, FKIP, University of Mataram
Jl. Majapahit No.62, Selaparang, Mataram, Nusa Tenggara Barat 83115 Indonesia
[3]Aquaculture Study Program, Faculty of Fisheries and Marine Sciences, Airlangga University
Jl. Mulyorejo, Mulyorejo, Surabaya, Jawa Timur 60115 Indonesia
[4]Biology Study Program, Faculty of Mathematics and Natural Sciences, University of Mataram
Jl. Majapahit No.62, Selaparang, Mataram, Nusa Tenggara Barat 83115 Indonesia
Email: fatur@unram.ac.id

Abstract

The availability of cheap and high nutritional value artificial feed is a prerequisite for the sustainability of lobster cultivation. In this study, the lobster feed formula was made based on chicken egg hatching waste and maggot flour. The purpose of this study was to determine the performance of scalloped spiny lobsters with artificial feed treatment P1 (70% fish meal + 0% hatching waste), P2 treatment (50% fishmeal + 20% hatching waste), P3 treatment (30% fishmeal + 40% hatching waste), and P4 treatment (10% fishmeal + 60% hatchery waste). This study used lobster seedlings with a size of 1.5 - 3.5 cm which were kept for 60 days. Lobster performance is measured based on body weight, body length, growth rate, feed conversion, molting and lobster dilution rate. The data were analyzed descriptively by presenting mean, standard deviation, and statistical analysis using Duncan's advanced test. The results of the lobster performance study based on absolute length and weight in the P1 treatment were obtained 1.22±0.05 and 1.03±0.21; on P2 treatment obtained 1.31±0.16 and 1.16±0.09; P3 treatment obtained 1.37±0.37 and 1.47±0.13; and P4 treatment obtained 0.82±0.18 and 0.9±0.22. The calculation of the specific growth rate in the P1 treatment was obtained 0.56±0.09, the P2 treatment was obtained 0.69±0.21, the P3 treatment was obtained 0.73±0.16, and the P4 treatment was obtained 0.56±0.24. The ratio of feed conversion and lobster dilution shows a tendency to decrease as the concentration of chicken hatching waste increases. The growth performance of scalloped spiny lobsters fed with chicken egg hatching waste-based feed is quite good up to a concentration of 40% and if more than that will reduce the growth performance of lobsters.

Keywords: spiny lobster, chicken hatchery waste, growth, artificial feed

INTRODUCTION

Scalloped spiny lobster (*Panulirus homarus*) is one of Indonesia's marine fishery commodities which can be found especially in the waters of the Indian Ocean. Scalloped spiny lobster is a potential type of lobster because it has high economic value (Asvin *et al*., 2019). Market consumption demand continues to increase based on data from the Central Statistics Agency (BPS) recorded lobster seeds exported in 2019 which was 1,633,220 kg or worth US$ 33,189,390 and in 2020 increased to 2,150,420 kg or worth US$ 76,106,250 (KKP, 2020). The increasing demand has resulted in the increasingly expensive price of lobster fry (puerulus) resulting in high lobster fry fishing. The price of scalloped spiny lobster clear seeds in 2014 for a size of 2-3 cm ranged from Rp. 14,000/head - Rp. 20,000/head (Witomo and Nurlaili, 2015), while in 2018 the price of lobster fry increased to Rp. 18,000/head - Rp. 26,000/head. The high selling value makes the exploitation of lobsters in nature very intensive and if not balanced with conservation will threaten the extinction of lobster resources (Adhiatma, 2019).

Efforts that can be made for the preservation of lobster resources and long-term stock sustainability are by cultivating lobsters. One of the factors that determine the success of lobster farming to support growth and survival is feed. Quality feed that is easily digested, complete nutritional content and does not contain harmful substances (Yunaidi *et al*., 2019). In addition, the nutritional content in the feed must also be considered, including proteins, carbohydrates, fats,

*) Corresponding author

Diterima/Received : 08-03-2023, Disetujui/Accepted : 08-05-2023
DOI: https://doi.org/10.14710/jkt.v26i2.17609

minerals and vitamins. The nutritional content is very important for fish as a source of energy and grow (Taufiq *et al*., 2016).

Currently, feeding lobsters still relies on fresh trash fish, one of which is the type of green anchovies (terijo). Terijo fish contains 64.33% protein, 1.14% carbohydrates, 7.40% fat, and 4.15% Ca (Susi, 2013). However, the provision of fresh trash fish has disadvantages, namely it rots quickly, is easily damaged, the price is expensive and its availability in certain seasons (Suharyanto, 2012). Ridwanudin *et al.* (2018) states that the weakness of giving trash fish also affects the low feed conversion ratio, so that the number of trash fish needed for growth is getting more and more.

The lobster cultivation area in East Lombok is 2,195 hectares. Meanwhile, the potential land area for lobster cultivation is 731.84 hectares, the area of land that has been utilized is 16.06 hectares, the percentage of new land concentration reaches 2.2 percent. Its development areas are in Srewe Bay, Jukung Bay and Ekas Bay. The number of cultivators and Floating Net Cages (KJA) located in the Jerowaru and Keruak Districts, so far as many as 147 KJA. With the number of members reaching 1,809 people and the number of KJA (plots/holes) 8,438. The number of KJA in each area includes KJA Teluk Jukung 6,069 holes, Ekas Bay Area 2,313 holes and Sriwe Bay area 56 holes. Lobster farming in this region relies entirely on feed from trash fish which is difficult to obtain and their availability is not continuous. For this reason, the presence of artificial feed whose raw materials are not competitive with human needs is urgently needed.

Some materials that have high enough nutrition and are not competitive with human needs and can be used as raw material for lobster feed are chicken egg hatching waste. The nutrients in chicken egg hatching waste are very high, including crude protein, crude fat, ash, metabolic energy and minerals (Mehdipour *et al*., 2009; Inderaswari & Ari, 2017; Orrico *et al*., 2020). It is further explained that the mineral content in the shell of chicken eggs is Ca can reach 37.30%; magnesium 0.38%; phosphorus (P) 0.35%; carbonate 58% and manganese 7%. In this study, a study of the growth performance of scalloped spiny lobsters given artificial feed containing chicken egg hatching waste of different levels was carried out.

MATERIAL AND METHOD

This study was conducted using an experimental method using a Complete Randomized Design (RAL). The treatment aimed to determine the effect of adding a combination of chicken egg hatching waste flour with different doses on feed with four treatments and three replication so that a total of 12 experimental units were obtained as follows:

P1= (chicken egg hatching waste flour 0%), P2= (chicken egg hatching waste flour 20%), P3= (chicken egg hatching waste flour 40%), and P4 = (chicken egg hatching waste flour 60%)

Artificial feed formulations of scalloped spiny lobster look in Table 1.

Research Procedure

Feed Preparation and Production: The first step is to make chicken egg hatching waste flour. First of all, the waste of hatching chicken eggs is cleaned of shells, dead embryos, dead DOC, blood spots and other impurities. Furthermore, this waste is steamed for 25 minutes, cooled and than blended to form small particles. After that, the blended waste is roasted using medium heat until golden brown. Furthermore, grinding is done to form chicken egg hatching waste flour. The ready-made chicken egg hatchery waste flour is subjected to a proximate analysis before it is formulated into pellet feed.

The pellet feed is made as follows: all ingredients (egg hatching waste flour, corn flour, agar powder, fish oil, vitamin mix, and mineral mix) are weighed according to the composition of raw materials in Table 1. After all the ingredients are weighed, they are manually mixed starting with the smallest amount of ingredients, then gradually adding the larger ones to ensure that all the ingredients are evenly mixed. To make it more homogeneous, the feed mixture is mixed using a mixer (PICO Mixer MX 500 brand). The next step is the making of the dough by slowly adding clean water to the feed mixture while stirring slowly using the mixer until the dough is smooth. The smooth dough is steamed for 10 minutes and then cooled. The final step is the feed molding, which is done using a feed molding tool with a size of 1 cm in length and 3 mm in diameter, which is suitable for the lobster's mouth size of 1 cm (Anggraini et al., 2018). After that, the feed is placed in plastic and stored in a cool, dry place away from direct sunlight. A total of 5 kg of pellet feed is produced for a 60-day rearing period. After that, the feed is put into a plastic and then stored in a cool room temperature, not damp and not exposed to direct sunlight.

Container preparation: The container used in this study is a plastic container with a length of 55 cm, width of 38 cm, and height of 34.5 cm, with a volume of 52 L each. Twelve containers were used, and each was filled with 46 L of water. Before use, the containers were thoroughly washed with seawater until there was no plastic smell. Then, the containers were soaked in seawater for approximately 3 days. After that, the lobsters were ready to be transferred into the containers.

Lobster Preparation: Each container is filled with 20 scalloped spiny lobsters per m2 with a size of 1.5 - 3.5 cm. The lobster seedlings were obtained from fishermen of Teluk Awang, Mertak Village, Pujut District, Central Lombok Regency. Before the rearing process of all lobster samples are carried out preliminary weight and length measurements.

Lobster Rearing: The lobster were reared for 60 days. During the rearing period, feeding, siphoning, weighing, and measuring water quality were conducted. Artificial feed was provided twice a day at 08.00 am and 06.00 pm (Achmad *et al*., 2021). Length and weight measurements of scalloped spiny lobsters were taken every 15 days by measuring all the lobsters in each rearing container. Siphoning was performed every 2 days to remove any remaining feed or feces to prevent accumulation and decay in the rearing media. Water quality measurements were taken every 15 days.

Table 1. Artificial feed formulations for spiny lobster

No.	Raw Materials	Proportion (%)			
		P1	P2	P3	P4
1	Cob fish meal	70.00	50.00	30.00	10.00
2	Cornstarch	5.00	5.00	5.00	5.00
3	Chicken egg hatching waste	0.00	20.00	40.00	60.00
4	Maggot flour	15.00	15.00	15.00	15.00
5	Agar powder	3.00	3.00	3.00	3.00
6	Tapioca flour	2.00	2.00	2.00	2.00
7	CMC	2.00	2.00	2.00	2.00
8	Fish Oil	1.00	1.00	1.00	1.00
9	Vita-Min Mix	1.00	1.00	1.00	1.00
10	Progol	1.00	1.00	1.00	1.00
	Total	100.00	100.00	100.00	100.00
	Proximate Analysis	P1	P2	P3	P4
	Protein	52,0%	46,8%	41,6%	36,4%
	Lipid	8,13%	12,74%	17,36%	21,98%
	Carbohydrates	3,85%	3,85%	3,85%	3,85%
	Ash	1,97%	6,81%	11,64%	16,84%
	Calorie	-	559,048	1103,69%	1677,14%
	Crude fiber	-	0,184%	0,36%	0,55%

Research Variable

The variable tested in this study are Absolute Weight Growth, Absolute Length Growth, Survival Rate (SR), Specific Growth Rate (SGR), and Feed Conversion Rate (FCR). Water quality parameters are carried out every 15 days to measure temperature, pH, salinity and dissolved oxygen (DO). *Absolute Weight Growth.* Growth is calculated according to the formula (Effendie, 1979):

$$W = Wt - Wo$$

Absolute Length Growth. The calculation of absolute length is carried out using the formula (Effendie, 1979):

$$L = Lt - Lo$$

Lobster growth during the study was calculated using a specific growth rate formula (SGR) as follows (Effendie, 1979; Putra *et al*., 2019):

$$SGR(\%) = 100\,x\,\frac{(lnWt - lnWo)}{t}$$

Feed conversion ratio (FCR) calculated by using formulas (Dhewantara, 2021):

$$FCR = \frac{f}{Wt + Wd - Wo}$$

Survival rate of Lobster observed and calculated using formula ((Solanki *et al*., 2012):

$$SR(\%) = \frac{Nt}{No}x\,100$$

Molting frequency. The calculation of molting frequency is done by counting the number of sand lobster populations that undergo complete molting during the 60-day rearing (Hakim, 2009).

Note: *Wt, Wd* and *Wo* = the lobster's weights at the final, the dead and the initial of the feeding experiment (g); *Lt* and *Lo* = the lobster's lengths at the final and the initial of the feeding experiment (cm). *t* is the experimental period (days); *f* amount of feed (g)and *Nt* and *No* = the number of lobsters at the final and initial of the experiment.

Data Analysis

The data were analyzed using Analysis of Variance (ANOVA) at a confidence level of 95%. If the statistical analysis results show a different effect, then a further Duncan test is carried out. Meanwhile, for proximate analysis and water quality parameters, they were analyzed descriptively.

RESULTS AND DISCUSSION

Generally, the results showed that the addition of chicken egg hatching waste to the feed of scalloped spiny lobsters with different compositions had a significantly different effect on their growth, which refers to an increase in size, weight, and length over time. Green *et al*. (2014) state that lobster growth is influenced by both internal and external factors. Internal factors that affect growth include heredity, sex, age, parasites, and disease, while external factors include food, temperature, salinity, and water oxygen. More specifically, the following section explains the effect of adding chicken egg hatching waste on the growth performance of scalloped spiny lobsters The results of observing the growth of spiny lobsters after being raised for 60 days showed that there were differences in the absolute weight growth of spiny lobsters that were given feed treatments containing different concentrations of chicken egg hatching waste (Figure 1).

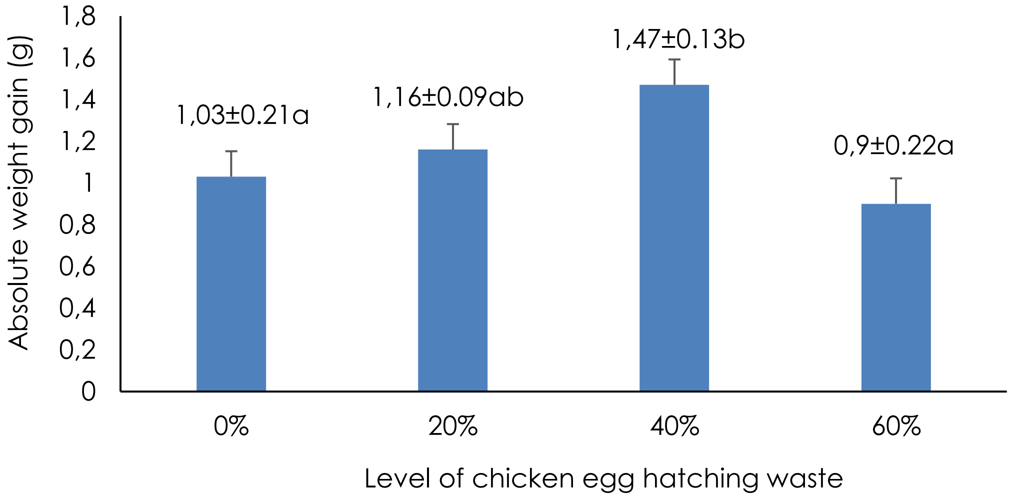

Figure 1. Absolute Weight Growth of Scalloped spiny Lobsters raised for 60 days

Figure 1 shows that the P3 treatment gave the highest average absolute weight growth of scalloped spiny lobster with a value of 1.47 g followed successively by the P2 treatment of 1.16 g, P1 of 1.03 g, and the lowest absolute weight value was found in the P4 treatment of 0.9 g. The results of the analysis of variance showed that the addition of chicken egg hatching waste to lobster feed had a significant effect on the growth of spiny lobsters. Therefore, a Duncan's post-hoc test was conducted to determine the best treatment. The results of the Duncan's test showed that treatment P3 was significantly different from treatments P1 and P4, but not significantly different from treatment P2. After that, there was no significant difference between treatments P2, P1, and P4. Based on the results obtained, it was found that treatment P3 (with the addition of 40% chicken egg hatching waste to lobster feed) was the best treatment.

The results of the study show that adding chicken egg hatching waste to lobster feed can increase the absolute weight growth of spiny lobsters (*Panulirus homarus*). The addition of chicken egg hatching waste to lobster feed (treatments P2 and P3) resulted in a tendency of increased absolute weight growth compared to the treatment without chicken egg hatching waste (Treatment P1). The increased absolute weight growth in treatments other than P1 were caused by the fact that the chicken egg hatching waste added to the lobster feed contains animal protein which is almost equivalent to meat meal. Additionally, chicken egg hatching waste is an excellent source of protein and is easily digested by the animal body.

Based on research cited from Nugroho *et al*. (2016) and Nurmaslakhah *et al*. (2017), the utilization of 40% chicken egg hatching waste in feed formulation is considered optimal due to its nutritional value being almost equivalent to meat meal. Furthermore, the use of chicken egg hatching waste as feed is considered more beneficial compared to using soybean meal or fish meal. Therefore, it is recommended to use chicken egg hatching waste in feed formulation within the range of 30-50%. Treatment P3 has the best absolute weight growth due to the fact that the use of chicken egg hatching waste in feed formulation provides sufficient nutrition for livestock growth. This indicates that the utilization of chicken egg hatching waste as feed can be a good alternative in developing sustainable and environmentally friendly aquaculture industry.

On the contrary, a decrease in absolute weight gain of lobsters occurred in treatment P4 (60% chicken egg hatching waste in the feed). This can be attributed to the significant decrease in protein content of the feed due to the use of 60% chicken egg hatching waste, where treatment P4 only contained 10% fish meal and 16% maggot meal. Proximate analysis results showed that the protein content of feed formula P4 was 36.4% and the fat content was 21.98% (Table 1). This protein content is considered far from optimal to meet the growth requirements of lobsters. Protein is the most important aspect of nutrition that should be available in sufficient amounts in feed to meet the nutritional requirements of the cultured biota, as the availability of sufficient nutrients in feed will affect the growth of the cultured biota. Conklin *et al*. (1983) cited in Makasangkil *et al.* (2017) stated that there was a decrease in body weight of coral lobsters if the protein content in their diet was less than 60%.

In the P4 treatment, the fat content of the feed was very high. High levels of feed fat can reduce feed consumption because fat is digested more slowly than carbohydrates and protein. Thus, if the feed contains high levels of fat, digestion will be disrupted and can cause animals to feel full longer, so they will be less interested in eating. In addition, high levels of feed fat can also cause a decrease in feed quality because it can affect the availability of nutrients. Therefore, the use of feed containing a balanced fat content is very important to maintain optimal health and growth in animals.

Absolute Length Growth

The results of the observation of the absolute length growth of scalloped spiny lobster after conducting research for 60 days showed that there was a difference in the absolute length of scalloped spiny lobster that were given feed treatments containing different concentrations of chicken egg hatching waste (Figure 2).

In general, the data in Figure 4 shows that the addition of 20 to 40% egg hatching waste can increase the absolute length growth of spiny lobsters. Even in treatment P3, the sand lobster shows the highest absolute length growth rate. This result is consistent with the measurement of absolute weight growth rate in spiny lobsters. The analysis of variance indicates that the addition of egg hatching waste to the sand lobster feed produces a significant difference in the length growth of the sand lobster. Therefore, a Duncan test was conducted to determine the best treatment. The post-hoc test showed that treatment P3 was significantly different from treatment P4 but not significantly different from treatment P2 and P1. After that, P2, P1, and P4 were not significantly different.

The use of chicken egg hatching waste in feed affects the absolute growth of lobsters because besides its high protein content, the sufficient availability of calcium in the feed containing egg hatching waste will also affect the growth of sand lobsters. Calcium is needed by

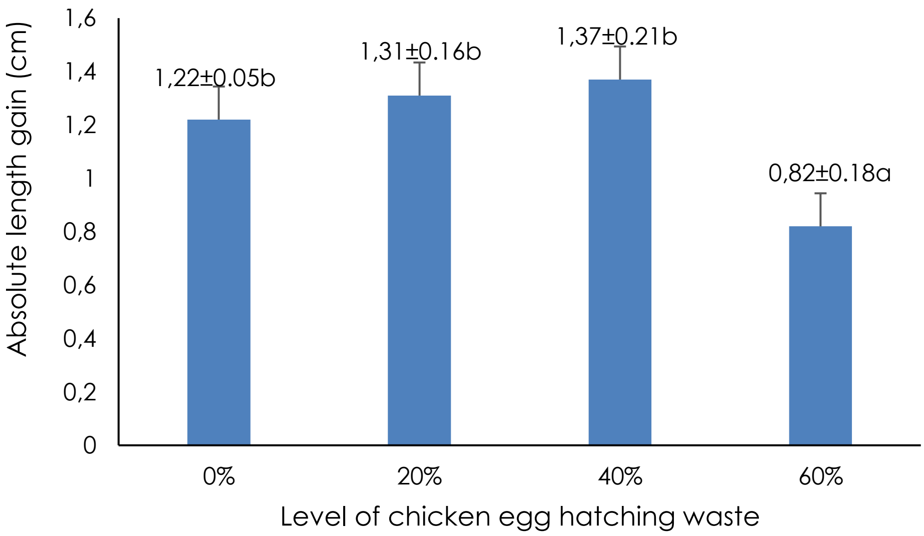

Figure 2. Absolute Length Growth of Scalloped spiny Lobsters raised for 60 days

sand lobsters and other crustaceans in the process of hardening their shells after moulting. This is supported by Yulihartini *et al*. (2016) who stated that calcium is useful in the formation and hardening of the new skin of shrimp. Adequate availability of calcium will make the moulting process of shrimp run smoothly and quickly. The faster the moulting recovery process of shrimp, the better their growth. Lobster growth can occur optimally if the calcium that enters their body meets the required concentration. The calcium absorbed by lobsters can come from food, water, and the cannibalism or predation of shed shells (Hakim, 2009). That is why, according to Kholis *et al*. (2021), length growth is more dominant than weight gain in lobsters' growth. Lobster growth is influenced by several factors such as gender, food availability especially calcium, competition and predation, age, and water quality.

Specific Growth Rate (SGR)

The results of observations of scalloped spiny lobster growth after 60 days of maintenance showed that there were differences in the specific growth rate of scalloped spiny lobsters that were given feed treatments containing different concentrations of chicken egg hatching waste (Figure 3). Figure 5 shows that the highest specific growth rate of sand lobsters is found in treatment P3 with a value of 0.73%, followed by P2 at 0.69%. Meanwhile, the specific growth rate in treatment P1 is equally low as treatment P4 at 0.56%. The analysis of variance results indicate that the addition of chicken egg hatching waste to lobster feed does not have a significant effect on the growth of sand lobsters.

The results of statistical analysis of the specific growth rate of sand lobsters after a 60-day maintenance process indicate no significant differences among the treatments, indicating that the use of chicken egg hatching waste can be substituted for fishmeal in lobster feed. This means that this substitution can support the nutritional requirements for lobster growth. In addition, the combination of protein sources between fishmeal and chicken egg hatching waste in a certain dosage provides good growth for sand lobsters. This is consistent with Ridwanudin *et al*. (2018) that the combination of different protein sources in sand lobster feed allows for the fulfillment of nutrient intake such as amino acids or fatty acids that can support the growth of sand lobsters.

The ability of chicken egg hatching waste to substitute fish meal in lobster feed can be understood because eggs are a source of animal protein that has high nutritional value. The proximate analysis of chicken egg hatching waste flour showed that it contains 36.24% protein and 29.59% fat. According to Wulandari dan Arief (2022), eggs contain high-quality protein because they have a complete essential amino acid composition and have a high biological value of 100%. Additionally, according to Sidiq (2014), eggs contain a complete range of vitamins, including vitamin A, vitamin B, niacin, thiamine, riboflavin, vitamin E, and vitamin D.

Feed Conversion Ratio (FCR)

The results of the calculation of the feed conversion ratio of scalloped spiny lobsters under different treatments of chicken egg hatching waste flour after 60 days of rearing showed differences (Figure 4). Figure 4 shows that the lowest average value of feed conversion ratio was found in treatment P4 with a value of 3.04, followed by P3 at 4.01, P2 at 5.06, and the highest feed conversion ratio value was found in treatment P1 at 9.1. The analysis of variance results showed that the addition of chicken egg hatching waste to sand lobster feed had a significant effect on the feed conversion ratio value. The Duncan test results showed that treatment P4 was significantly different from treatment P1, but not significantly different from treatments P3 and P2.

The feed conversion ratio (FCR) is the ratio of the amount of feed eaten to lobster meat produced from the use of feed. The smaller the feed conversion value, the better the utilization of feed given to scalloped spiny lobsters raised and vice versa. The results showed that the lowest feed conversion value (FCR) was found in the P4 treatment with a value of 3.04 and the highest feed conversion value in the P1 treatment was 9.1. This suggests that feeding chicken egg hatching waste at different doses has a significant influence on the value of the feed conversion ratio.

The differences in FCR values among each treatment are possible due to several factors, including 1) the high fat content of the feed, especially in treatment P4 (21.98%), which resulted in a decrease in feed consumption, and 2) the different number of lobsters in each treatment due to the cannibalistic behavior of lobsters. The death of lobsters due to cannibalism affects the energy source obtained by lobsters not only from the feed but also from the energy gained by consuming their peers, which causes an increase in additional energy for lobsters. This condition is in line with the opinion of Adiyana (2017), who stated that the cannibalism that occurs in the treatment may result in lower FCR of the lobsters in that treatment. The use of energy derived not from feed but obtained from consuming peers is suspected to be an additional energy source that supports growth. FCR values from this study showed values that were the differ as the results of Slamet *et al*., (2020) research, namely the FCR values of lobsters fed artificial feed ranged from 3.0-3.20.

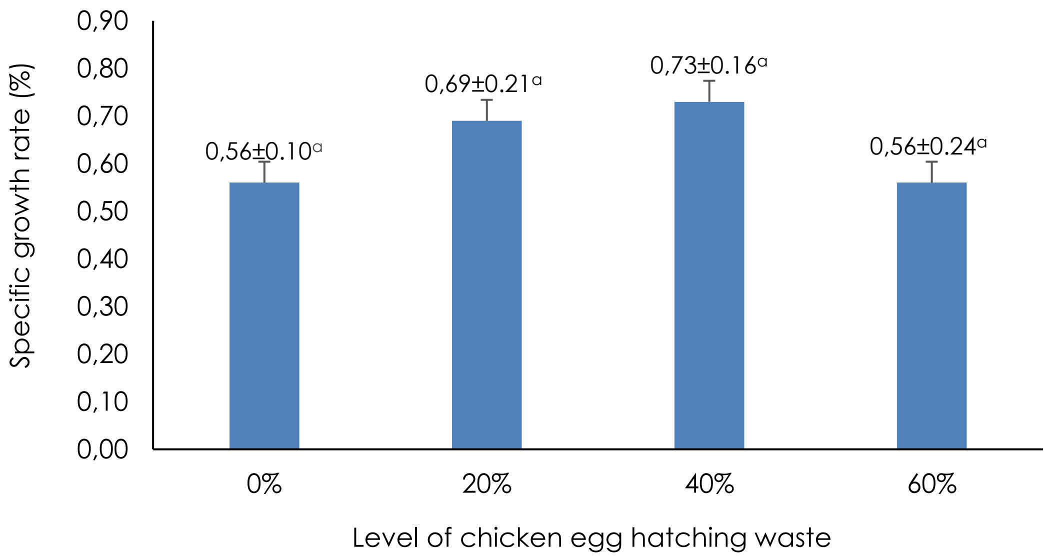

Figure 3. Specific Growth (SGR) of Scalloped spiny Lobsters raised for 60 days

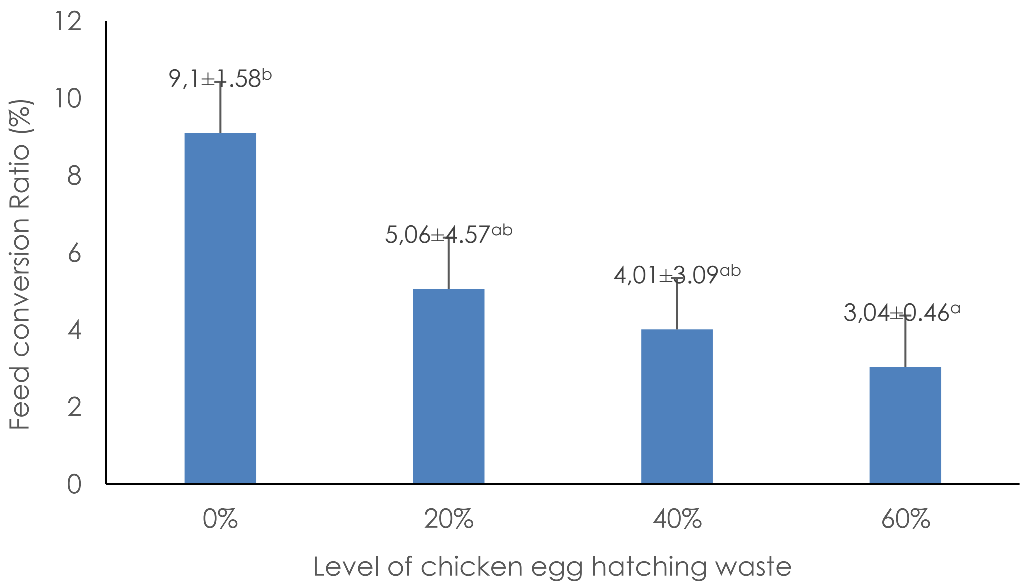

Figure 4. Feed Conversion Rate (FCR) of scalloped spiny lobsters raised for 60 days

Molting Frequency

The molting frequency is the number of molting events that occur in scalloped spiny lobsters during the study. Molting is one of the growth parameters of sand lobsters. The results of the observation of the precursor lobster molting value after 60 days of rearing showed that there were differences in molting precursence values that were given feed treatments containing different concentrations of chicken egg hatching waste (Figure 5).

Figure 8 shows that the lowest molting frequency value is found in treatment P1 with a value of 9 individuals, followed by P3 with 13 individuals, P4 with 14 individuals, and the highest molting frequency value is found in treatment P2 with a value of 15 individuals. The more lobsters undergo molting, the more growth occurs in the lobsters, but the greater the likelihood of cannibalism. The results of the variance analysis indicate that the addition of chicken egg hatching waste to sand lobster feed does not have a significant effect on the molting percentage of sand lobster feed.

Molting is a change of skin in lobsters where lobsters experience growth and increase in body weight. The ability to molt is very necessary for scalloped spiny lobsters to grow and increase in size. Lobsters molting must have enough energy to replace their old skin with new skin. The energy obtained from the food eaten, without sufficient energy, the scalloped spiny lobster will fail to molt and can result in death. Lobster yang mati saat molting di duga mengalami penyerangan dari lobster yang lain. When the lobster molts, quite a lot of energy is released and it tends to make the lobster weak and also the lobster shell is still very soft when it is finished molting (Hakim, 2009). Lobster shells that have just finished molting require 1-2 weeks to harden without disturbance from the sea or from within. If the lobster experiences a threat, the lobster will become stressed and die. According to Prastowo *et al*., (2021) that scalloped spiny lobsters that change their shells need conditions and atmosphere that support them, without any disturbances, either from sound, vibration or the sound of human stomping around the rearing container.

In this study, the highest molting frequency occurred in treatment P2 with 15 molts, then treatment P4 with 14 molts, treatment P3 with 13 molts and the lowest molt was found in treatment P1 with 9 molts. According to Lesmana and Mumpuni (2021) that the lobster undergoes molting during its lifetime so that growth will be able to occur. Molting activity in lobsters serves to stimulate growth as well as repairing damaged parts of the lobster's body such as broken legs or anten so that the lobster's body is normal again.

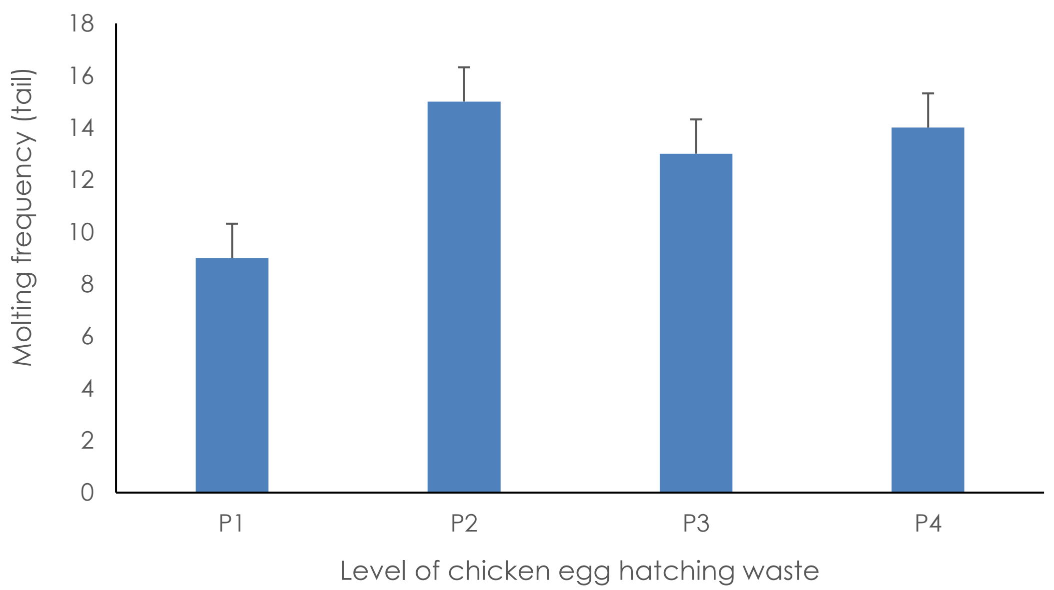

Figure 5. The molting frequency of scalloped spiny lobsters raised for 60 days

The activity of molting depends on the availability of calcium. It is known that egg-hatching waste from chickens contains high levels of minerals, including calcium. Yuwanta (2010) stated that the nutrient content in the hatching waste includes crude protein 36.24%, crude fat 29.59%, crude fiber 0.92%, ash 25.16%, metabolic energy 2795.24 Kcal/kg, calcium 10.73%, and phosphorus 0.69%. Furthermore, it is explained that the Ca content can reach 37.30%; magnesium 0.38%; phosphorus (P) 0.35%; carbonate 58%, and manganese 7% if the chicken egg-hatching waste is not separated from its shells. Thus, it can be said that the calcium content in the chicken egg-hatching waste is sufficient to meet the needs of the reared lobsters to accelerate the hardening of the lobster shell after molting

Survival Rate (SR)

The results of the analysis of the survival rate value of scalloped spiny lobsters after 60 days of maintenance period showed that there were differences in SR values in various treatments in the maintenance media (Figure 6). Figure 6 shows that the highest average live survival value of scalloped spiny lobster was found in the P1 treatment with a value of 100%, followed successively by the P2 treatment of 75%, P3 of 67% and the lowest survival value was found in the P4 treatment with a value of 58%. In general, the percentage of survival rate in this study was higher than that of Slamet *et al*., (2020), which ranged from 16.7% -39% for 120 days of lobster rearing. The results of the analysis of variance showed that the results of adding chicken egg hatching waste to granulated lobster feed had a real effect on the survival of scalloped spiny lobter. After that, Duncan's further test was carried out to find out the best treatment, the test results showed that the P1 treatment was significantly different from the P4 treatment but did not differ markedly from the P2 and P3 treatment.

The survival rate (SR) of scalloped spiny lobsters in each treatment has an average percentage of the total number of scalloped spiny lobsters that survived from the beginning of stocking until the end of the study. Based on the research results, the highest SR value was found in treatment P1 with a value of 100%, and the lowest SR value was found in treatment P4 with a value of 58%. This shows that the provision of chicken egg hatching waste significantly affects the decrease in the survival rate of lobsters. It is apparent that the higher the level of chicken egg hatching waste, the lower the survival rate of lobsters. The decrease in the survival rate of lobsters is suspected to be related to the frequency of molting, which can trigger cannibalism. According to Cokrowati *et al*. (2012), the survival rate will decrease in lobsters that molt frequently due to the risk of cannibalism from other lobsters, leaving them with no adequate shelter and being easily attacked, while the food supply should still be available. Furthermore, the increased mortality of lobsters fed with chicken egg hatching waste is suspected to occur because their appetite is reduced due to the high fat content in the food. Appetite is a stimulus perceived by organisms to consume food, and if an organism lacks sufficient food or nutrition, its growth may be inhibited, and it may face health problems or even die.

Water quality

Before the study took place, researchers had confirmed that the conditions of the aquaculture water were at the normal threshold for lobster cultivation. Observation of water quality parameters which include values of the temperature range, pH, DO and salinity. The results of 60 days of water quality adjustment are presented in Table 2.

In general, it can be seen from Table 2 that after 60 days of scalloped spiny lobster rearing period, it shows that the range of water quality parameter values is still within the feasibility limit of scalloped spiny lobster rearing. Temperature is a very important parameter because it can affect other parameters, for example the higher the temperature, the lower the dissolved oxygen level. During the research process, the temperature value obtained was still the optimal range for scalloped spiny lobsters in all treatments, which is between 29-30^{o}C. According to Adiyana (2015;

2017) the optimum temperature range for marine life is 24-32°C, so that overall temperature conditions during maintenance are still within the optimum temperature range for lobster cultivation. This is in line with the opinion of Junaidi *et al*., (2018) that the temperature of 31,06°C in this research is still classified as good for lobster cultivation.

The pH level during the study had a minimum value of 7.5 and a maximum value of 8.1. The water's pH value is influenced by CO2 concentration during the day due to photosynthesis, causing a decrease in CO2 concentration and an increase in water pH. Conversely, during the night, all organisms in the water release CO2 from respiration, causing the water pH to decrease (Supriatna *et al*. 2020). However, the pH value range in this study is still within the optimal range for lobster

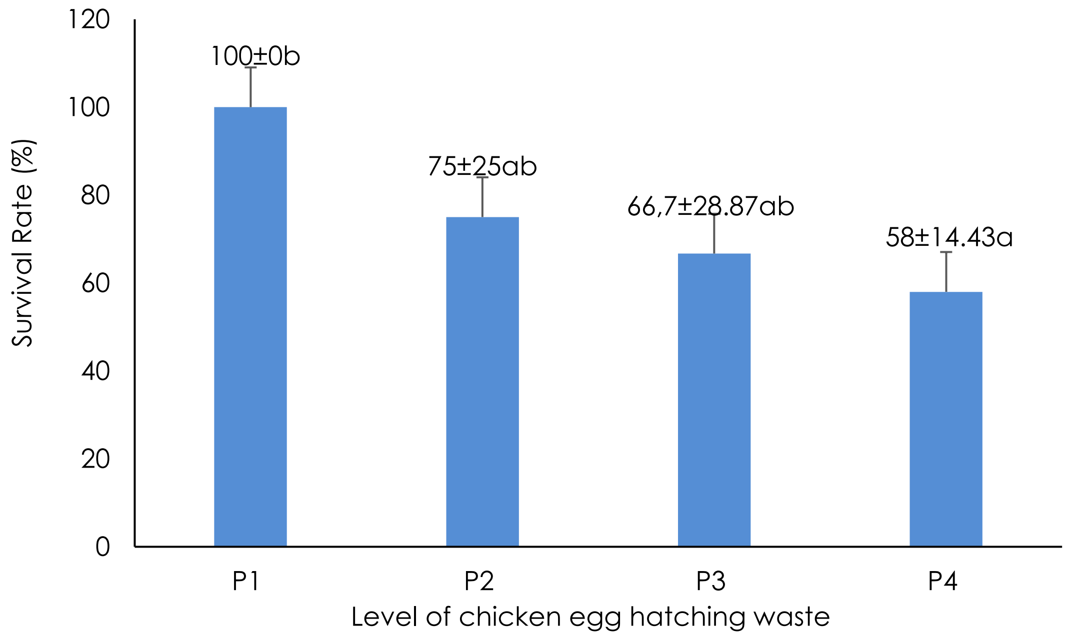

Figure 6. Survival Rate (SR) of Scalloped spiny Lobsters raised for 60 days

Table 2. The value of the water quality parameters of lobster farming for 60 days of rearing

Parameters	Treatment	Range Value	Eligibility Library
Temperature (°C)	P1	29 - 30	27-32°C (Jurnal Sains Teknologi dan Lingkungan 2018)
	P2	29 - 30	
	P3	29 - 30	
	P4	29 - 30	
pH (mg/l)	P1	7.5 - 8.0	7,19-8,22 (Jurnal Mina Sains ISSN 2407-9030)
	P2	7.5 - 8.1	
	P3	7.5 - 8.1	
	P4	7.5 - 8.1	
DO (mg/l)	P1	4.5 - 4.9	4.6-6.3 (Jurnal Ilmu dan Teknologi Kelautan Tropis 2022)
	P2	4.5 - 4.9	
	P3	4.5 - 4.8	
	P4	4.5 - 4.9	
Salinity (ppt)	P1	33 - 34	32-36 ppt (Jurnal Kelautan Nasional 2015)
	P2	33 - 34	
	P3	33 - 34	
	P4	33 - 34	

cultivation. According to Prama *et al*. (2022), the recommended pH value for lobster cultivation is within the range of 6.5-9, while the optimal pH for marine biota is within the range of 7.5-8.5. If the pH value increases beyond the optimal range, it can be harmful to the cultured biota as it may cause stress and death.

The next parameter that is highly required for the growth and survival of lobsters in lobster breeding media is the dissolved oxygen (DO) level. The range of dissolved oxygen during the breeding process is 4.5-4.9 mg/L. This level of dissolved oxygen is still within the optimal range for sand lobsters. According to Yoga *et al*. (2020), the DO level in the breeding media for sand lobster larvae ranges from 5.51-5.96 ppm. However, Prama and Kurniaji (2022) stated that the range of 4.6-6.3 is still within the tolerance limits for the growth and survival of sand lobster larvae. This is also reinforced by Phillips & Kittaka's (2000) statement that the minimum dissolved oxygen concentration that can be used for lobster farming is 40-80 saturation or equivalent to 2.7-5.4 mg/L. Furthermore, Boyd & Tucker (1998) mentioned that the recommended dissolved oxygen for lobster farming is (>5 mg/L), while the optimum dissolved oxygen content in marine organisms is 5-6 grams/L.

Salinity is the level of salt content and saltiness in water, soil or other liquids. suitability of salinity is very important for the growth of lobsters (Vidya & Joseph, 2012). The salinity content during the scalloped spiny lobster rearing process has the lowest salinity value of 33 ppt and the highest range of values is 34 ppt. The salinity level from the results of this study is still within optimal limits for scalloped spiny lobster cultivation. The high and low values of salinity in waters are caused by rising water temperatures and other factors such as continuous rain which change the salinity of waters. According to Lestari *et al*., (2018) that the salinity in the waters required by sea lobsters for growth ranges from 28-32 ppt.

CONCLUSION

The results of this research can be concluded that the addition of chicken egg hatching waste to the scalloped spiny lobster artificial feed has a significant effect on the growth, molting, and survival of lobsters. The best dosage of chicken egg hatching waste mixed with lobster artificial feed is 40% (treatment P3). It is recommended that the use of chicken egg hatching waste flour as a substitute for fish flour in lobster artificial feed should be in the range of 20-40% because at this concentration, the growth is quite good, the frequency of molting is quite high, and the relative survival is still within the tolerance limits.

REFERENCES

Achmad, M., Widarma, I.G.S., Fadilah, M.N., Ramadhan, R., & Putri, A. (2021). Efek penambahan cangkang telur pada pakan bentuk mikro (Microbound Diet) terhadap pertumbuhan spesifik dan survival rate Lobster Panulirus sp. *Journal of fisheries and Marine Science,* 5(1), 41–50.

Adhiatma, F. (2019). Efektivitas (RPOA) Regional of Action Dalam Penanggulangan IUU Fishing Studi Kasus : Penyulundapan Ilegal Benih Lobster Indonesia ke Vietnam. *Journal of International Relations*, 5(4), 780-788.

Adiyana, K. (2017). Kinerja Produksi Pendederan Juvenil Lobster Pasir (*Panulirus homarus*). *Jurnal Media Akuakultur, 12*(2), 75–83.

Adiyana, K., Supriyono, E., & Pamungkas, A. (2015). Evaluasi Penggunaan Sistem Jaring Terhadap Respons Produksi Pendederan Juvenil Lobster Pasir *(Panulirus homarus)* Menggunakan Teknologi Resirkulasi. *Jurnal Kelautan Nasional,* 10(3), 139–150.

Anggraini, W., Abidin, Z., & Waspodo, S. (2018). Pengaruh Pemberian Pakan Keong Mas Terhadap Pertumbuhan Dan Kelangsungan Hidup Lobster Pasir (*Panulirus homarus*). *Jurnal Perikanan Unram,* 8(2), 20–29. doi: 10.29303/jp.v8i2.114

Asvin, R.M., Restu, I.W. & Ekawaty, R. (2019). Komposisi Jenis dan Ukuran Lobster (Panulirus sp.) Hasil Tangkapan di Pantai Yeh Gangga Kabupaten Tabanan dan Pantai Canggu Kabupaten Badung Provinsi Bali. *Current Trends in Aquatic Science,* 2(1), 108-114

Boyd, C.E. & Tucker, C.S. 1998. Pond aquaculture water quality management. New York (US): Springer Science + Business Media. 700 p.

Cokrowati, N., Utami, P., & Sarifin (2012).Perbedaan Padat Tebar Terhadap Pertumbuhan Dan Kelangsungan Hidup Post Peurulus Lobster Pasir *(Panulirus homarus)* Pada Bak Terkontrol. *Jurnal Kelautan,* 5(2), 156–167.

Dhewantara, Y.L., Rahmatia, F., & Nainggolan, A. (2021). Studi Perbandingan Shelter Terhadap Respon Pasca Produksi Larva Lobster Pasir (*Panulirus homarus*) Pada Kontainer Sistem Resirkulasi. *Jurnal Akuakultur Rawa Indonesia,* 9(2), 163-172.

Effendie, M.I. 1979. Fisheries Biology Nusantara Library Foundation Bogor 112p [in Indonesian]

Hakim, R.H. (2009). Penambahan Kalsium Pada Pakan Untuk Meningkatkan Frekuensi Molting Lobster Air Tawar (Cherax Quadricarinatus). *Gamma,* V(1), 72–78.

Isriani, A., Liliyanti, M. A., & Sukmaring, L.A.T.T.W. (2022). Analisis Kandungan Protein Pada Lobster Pasir *(Panulirus Homarus)* yang Dibudidayakan Di Dusun Telong-Elong Kabupaten Lombok Timur. *Jurnal Abdi Insani,* 9(1), 178–187.

Indreswari, R., & Adi, R. (2017). Aplikasi Tepung Limbah Penetasan Dalam Ransum Untuk Meningkatkan Produktivitas Itik Lokal. *Jurnal Semar*, 5(2), 9–25.

Junaidi, M., Nurliah, N., & Azhar, F. (2018). Kondisi Kualitas Perairan untuk Mendukung Budidaya Lobster di Kabupaten Lombok Utara, Provinsi Nusa Tenggara Barat. *Jurnal Sains Teknologi & Lingkungan,* 4(2), 108–119. doi: 10.29303/jstl.v4i2.92.

Kementerian Kelautan Perikanan. (2020). Data Ekspor-Impor. Kementerian Kelautan Perikanan. Jakarta.

Kholis, M. N., & Novita, M.Z. (2021). Hubungan Panjang Bobot Dan Mortalitas Lobster Pasir (*Panulirus homarus* LINNAEUS 1785) Di Perairan Kota Bengkulu. *Journal of Fisheries and Marine Research,* 5(3), 539-546.

Lestari, D.P., Nurliah, A.A.D., & Larasati, C.E. (2018). Parameter Kualitas Air Dalam Mendukung Kegiatan Budidaya di Kawasan Teluk Jor, Kabupaten Lombok Timur. *Prosiding Konferensi Nasional Pengabdian Kepada Masyarakat dan Corporate Social Responsibility*, *1*, 723–730.

Lesmana, D., & Mumpuni, F.S. (2021). Tingkah Laku Lobster Pasir (*Panulirus homarus)* Yang Dipelihara Pada Shelter Berbeda. *Jurnal Mina Sains,* 7(2), 62–68.

Mehdipour M., Shargh, M.S., Dastar, B., & Hassani, S. 2009. Effects of different levels of hatchery waste on the performance, carcass, and Tibia ash and some blood parameters in broier chickc. *Pakistan Journal of Biological Sciences*, 12, 1272-1276

Nugroho, A. A., Sumarsih, S., & Sulistiyanto, B. (2016). Kandungan Total Bakteri dan Total Fungi Pada Pellet Limbah Penetasan yang Dibuat dengan Penambahan Bentonit. *Jurnal Agriper,* 16(2), 69–75. doi: 10.17969/agripet.v16i2.3192.

Nurmaslakhah, A., Rachmawati, D., & Suminto. (2017). Pemanfaatan Tepung Telur Ayam Afkir Dalam Pakan Buatan Yang Berprobiotik Terhadap Efisiensi Pemanfaatan Pakan, Pertumbuhan dan Kelulushidupan Lele Dumbo. *Journal of Aquaculture Management and Technology*, 6(4), 49–57.

Nugraha, M.D., Dewi, N.S., & Saptono, W. (2019). Pemberian Pakan Ikan Rucah Dengan Dosis Yang Berbeda Terhadap Performa Pertumbuhan Lobster Pasir (*Panulirus Homarus*). *Jurnal Perikanan,* 9(2), 153–159. doi : 10.29303/jp.v9i2.161

Orrico A.M.A., Schwingel A.W., de Mendoca Costa, M.S.S., Junior, M.A.P.O., Borquis R.R.A., de Oliveira, J.D., Leite, B.K.V., Garcia R.G., & da Silva Vilela, R.N., 2020. Characterization and valuing of hatchery waste from the broiler chicken productive chain. *Waste management*, vol 105 (15): 520-530. doi: 10.1016/j.wasman.2020.02.029

Phillips, B.F. & Kittaka J. 2000. Spinny Lobster: Fisheries and Culture. Osney Mead (GB): Blackwell Science. 556-585 pp.

Prama, E. A., Kurniaji, A. (2022). Performa Pertumbuhan Dan Kualitas Air Pada Pendederan Lobster Pasir *(Panulirus homarus)* Yang Dipelihara Dengan Sistem Resirkulasi. *Jurnal Ilmu dan Teknologi Kelautan Tropis,* 14(3), 259–272.

Prastowo, B.W., Manja, M.B., & Betutu, Senggagau. (2021). Comparison Of Grow-Out Methods Of Scalloped spiny Lobster (*Panulirus homarus)* With Recirculation Aquaculture System (RAS) and Flow-Through (FT): Studi of Biological Activities. *E-Jurnal Rekayasa Dan Teknologi Budidaya*

Perairan, 10(1), 1-14. doi: 10.23960/jrtbp.v10i1.p1-14

Putra D.F., Armaya,L, Rahimi, S.A.E., Othman, N. 2019 BIOTROPIA, 26(2): 136-142

Ridwanudin, A., Fahmi, V., & Pratama, S. (2018). Pertumbuhan Lobster Pasir (*Panulirus homarus*) dengan Pemberian Pakan Moist. *Jurnal Oseanologi dan Limnologi di Indonesia*, 2(21), 95–103. doi: 10.14203/oldi.2018.v3i2.165

Sidiq. (2014). Uji kadar protein organoleptik pada telur ayam leghorn stelah disuntikan dengan ekstrak black garlic. Fakultas Keguruan Dan Ilmu Pendidikan. Universitas Muhamadiyah. Surakarta.

Slamet B., Rusdi I., Wiri A., & Haryanti. (2020). Post puerulus of scalloped spiny lobster, *Panulirus homarus* (Linnaeus 1758) rearing in floating net cage with different artificial diet. *IOP Conference Series: Earth and Environmental Science,* 521(1), p.012005. doi: 10.1088/1755-1315/521/1/012005

Solanki, Y., Jetani, K.L., Khan, S.I., Kotiya, A.S.,Makawana, N.P., and Rather, M.A. 2012. Effect of stocking density on growth and survival rate of spiny lobster (Panulirus polyphagus) in cage culture system. International Journa of Aquatic Science, 3(1), 3-14.

Suharyanto. (2012). Pengaruh Pemberian Kombinasi Pakan Ikan Rucah dan Pakan Buatan (Pelet) Terhadap Pertumbuhan dan Laju Sintasan Rajungan (*Portunus pelagicus*). *Majalah Ilmiah Biologi BIOSFERA : A Scientific Journa*l, 29(2), 93-101.

Supriatna, Mahmudi, M., Musa, M., & Kusriani. (2020). Hubungan pH dengan Parameter Kualitas Air pada Tambak Intensif Udang Vannamei (*Litopenaeus vannamei*). *Journal of Fisheries and Marine Research,* 4 (3), 368-374

Susi, D. (2013). Pakan Itik Pedaging dan Petelur. Penebar Swadaya. Jakarta.

Taufiq, T., Firdaus, F., & Arisa, I.I. (2016). Pertumbuhan Benih Ikan Bawal Air Tawar (*Colossoma macropomum*) Pada Pemberian Pakan Alami Yang Berbeda. *Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah*, 1(3), 355-365.

Vidya, K., & Joseph, S. (2012). Pengaruh Salinitas Terhadap Pertumbuhan dan Kelangsungan Hidup Lobster Muda India, *Panulirus homarus* (Linnaeus). *Jurnal Ikan India, 59*(1), 113–118.

Witomo, C.M. & Nurlaili. (2015). Strategi Keberlanjutan Pengelolaan Bibit Lobster Di Perairan Lombok. *Jurnal Kebijakan Sosial Ekonomi Kelautan dan Perikanan*, 5(1), 11-18.

Wulandari, Z. & Arief, I.I. (2022). Review: Egg Powder: Nutritional Value, Functional Properties and Benefits. *Jurnal Ilmu Produksi dan Teknologi Hasil Peternakan*, 10(2), 62-68

Yoga, I.G., Giri, V., Gde, P., Julyantoro, S., Putu, N., & Wijayanti, P. (2020). Optimasi Dosis Formalin sebagai Desinfektan dalam Media Pemeliharaan terhadap Kelangsungan Hidup dan Pertumbuhan Larva Lobster Pasir (*Panulirus homarus*). *Jurnal Current Trends in Aquatic Science,* 3(1), 106-112.

Yulihartini, W., Rusliadi, & Hamdan, A. (2016). Pengaruh Penambahan Calsium Hidrosida Ca (Oh)2 Terhadap Moulting, Pertumbuhan dan Kelulushidupan Udang Vannamei (*Litopenaeus vanna*mei). [Skripsi]. Riau. Fakultas Perikanan dan Kelautan Universitas Riau

Yunaidi, Rahmanta, A.P., & Wibowo A. (2019). Aplikasi pakan pelet buatan untuk peningkatan produktivitas budidaya ikan air tawar di desa Jerukagung Srumbung Magelang. *Jurnal Pemberdayaan: Publikasi Hasil Pengabdian kepada Masyarakat*, 3(1), 45-54. doi: 10.12928/jp.v3i1.621