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Effect of Different Natural Feeds Containing Calcium and Phosphorus on The Growth Rate of Sand Lobster (*Panulirus Homarus*) In Floating NET Cages

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ABSTRACT

The purpose of this study is to determine the effect of different natural feeds containing calcium and phosphorus on the growth rate of sand lobster (Panulirus homarus) in floating net cages in Pangandaran Regency. This study used a complete randomized design (RAL) with four treatments and 4 replicates. The treatment given is anchovies (A), shrimp (B), barnacles (C), and golden snails (D) given to sand lobsters for 60 days. The parameters observed in this study included survival, daily growth rate (LPH), feeding efficiency (EPP), specific growth rate based on weight, specific growth rate based on length, and water quality. The results showed that different natural feeds containing calcium and phosphorus showed an increase in all growth parameters. The type of feed that produced the best growth was anchovy feeding with an LPH value of 1.92%, survival of 100%, EPP of 12.65%, specific growth rate based on weight of 116.62 g, specific growth rate based on length of 6.30 cm and water quality range during the study, namely temperature ranging from 27.1 – 29.0 °C, acidity degree (pH) ranging from 7.74 – 8, salinity ranging from 34 – 35 ppt and dissolved oxygen (DO) ranging from 7.05 – 8.70 mg/L.

Keywords : Sand lobster, growth rate, calcium, phosphorus, natural feed

INTRODUCTION

Lobster is one of the leading commodities in export fisheries carried out by the government in implementing the concept of the blue economy (Santoso, 2023). Based on Indonesian Statistics for 2014-2019, there is an increase in lobster exports of around 3.54% in one year (Rostika *et al*. 2023). Most lobster farming businesses in Indonesia still use seeds caught from nature (Priyambodo *et al.* 2020). According to KKP statistics in 2020, the total lobster production in Indonesia in the capture fisheries sector is 9,959.25 tons, while the total production of cultivated lobsters is only 206.7 tons. Based on this, it shows that lobster production in Indonesia is still dominated by catches, which is 99.3%. So that lobster cultivation is very important to do because the lobster catch will decrease along with the increase in market demand (Sudewi *et al.* 2018).

In lobster farming, one of the things that needs to be considered is feed, because feed is the main source of energy for lobsters to grow and develop. Lobsters also have cannibalism, which is the nature of preying on each other between species of the same kind in the population which can occur when lobsters undergo molting or molting of their skin (Trisnasari *et al*. 2020). The lobster will emit a distinctive aroma that makes other lobsters to prey on it. For this reason, feed with the right amount, type and nutritional content is needed to suppress the occurrence of cannibalism.

The content of calcium and phosphorus is one of the elements that has the main function in the formation of hard tissues such as bones, exoskeleton and skeleton (Zainuddin 2012). The calcium content serves as the main ingredient in the skin hardening

process after molting (Rosmawati *et al*. 2019). In addition, the phosphorus content can also support the moulting process in lobsters in energy formation (Indriswari 2021). The calcium content required in feed to meet the growth needs of lobsters is a maximum of 3% (Anggaini *et al*. 2018). Meanwhile, the phosphorus content requirement of shrimp yuwana is 1.2% (Tacon (1986) *deep* Rostika *et al*. 2010).

Generally, the feed given in lobster rearing still relies on rucah fish (Nugaha *et al*. 2019). The use of rucah fish as feed results in low value *Feed Conversioan Ratio* (FCR) and have inconsistent nutritional content caused by varying fish species (Isriani *et al.* 2022). The calcium content in rucah fish is also relatively low, ranging from 23.6 mg to 96.1 mg (Jeyasanta & Patterson 2014). Rucah fish can also affect the water quality at the cultivation site due to feed waste that is not used by lobsters (Junaidi & Hamzah 2014). Artificial feeding in lobster farming also has a disadvantage, namely requiring high costs (Jayadi *et al*. 2023). Feeding artificial feed without natural feed can produce lower growth compared to the addition of natural feed. So that natural feed in lobster rearing needs to be done because natural feed is also a food ingredient that is commonly eaten by lobsters obtained from nature (Rosmawati *et al.* 2019). According to Purnamaningtyas & Nurfiani (2017) mentioned that in nature sand lobsters eat 49.80% mollusks, 44.5%, crustaceans, 3.66% detritus and 1.81% fish.

Novelty of the research lies in its focus on the effects of natural feed containing calcium and phosphorus on the growth parameters of sand lobsters in floating net cages. This study aims to identify the optimal type of natural feed that enhances the growth of sand lobsters, addressing the current reliance on inconsistent and nutritionally variable rucah fish. By emphasizing natural feeds that align with the lobsters' dietary habits in the wild, this research could lead to improved feed conversion ratios, better growth outcomes, and reduced cannibalism, thereby advancing sustainable lobster aquaculture practices.

Based on these problems, research is needed on the effect of natural feed containing calcium and phosphorus on the growth parameters of sand lobsters in floating net cages. So it is expected to produce the optimal type of natural feed in the growth of sand lobsters. Therefore, research on the provision of natural feeds containing calcium and phosphorus is different.

RESEARCH METHOD

This research was carried out on floating net cages on the East Coast, Pangandaran Regency for 60 days in the month September 2023 – November 2023. The tools used during the study were M cage (96 cm x 89 cm), buoys, digital scales, millimeter blocks, DO meters, pH meters, refractometers, stationery, styrofoam, cameras, mines, and containers. The materials used are sand lobster as test animals, anchovies, shrimp, barnacles and golden snails as treatment feed.

The method used in this study is an experimental method with a complete randomized design (RAL) consisting of 4 treatments and 4 replicates. The treatment tested was different natural feeding, namely:

- Treatment A: The use of natural anchovy feed
- Treatment B: Use of natural feed for shrimp
- Treatment C : Use of natural barnacle feed
- Treatment D: Use of natural feed for golden snails

Container Preparation

The maintenance container used is an M cage with a size of 96 cm x 89 cm as many as 4 pieces. The cage is cleaned and dried first, then sewn because of maintenance after previous use. Cages and buoys are tied using mines at a depth of 5 meters.

Lobster Maintenance

During the lobster rearing period, feeding is carried out every day with a frequency of feeding 1 time a day and the amount of test feed given is 20% of the weight of the fish for one day. The survival of lobsters is observed by looking at the number of lobsters that die every day. Then every 10 days, sampling activities are carried out which aim to measure the weight gain and length increase of lobsters so that the growth rate and feed efficiency can be observed. Water quality parameters are also measured as supporting data to determine the feasibility of water quality during maintenance.

Observation Parameters

Survival

According to Effendie (2002), the survival value can be calculated using the following formula:

$$SR = \frac{N_t}{N_0} \times 100\%$$

Information:

SR = Fish survival (%)
Nt = Number of test fish individuals at the end of rearing (tail)
N0 = Number of test fish individuals at the beginning of rearing (tail)

Daily Growth Rate (LPH)

The calculation of the daily growth rate uses the formula put forward by Effendie (1997) as follows:

$$G = \frac{lnWt - lnWo}{t} X\ 100\%$$

Information:

G = Daily growth rate (%)
Wt = Average weight of fish at the end of rearing (tail)
Wo = Average weight of fish at the beginning of rearing (tail)
t = Length of maintenance time (days)

Feeding Efficiency (EPP)

The efficiency of feed utilization is calculated through the formula according to NRC (1993) deep Iskandar and Elrifadah (2015) as follows:

$$\text{EPP} = \text{x } 100\%\frac{\text{Wt}-\text{W0}}{\text{F}}$$

Information:

EPP = Feeding Efficiency (%)
F = Number of feeds given during the study (g)
Wt = Average weight of seeds at the end of the study (g)
Wo = Average weight of seeds at the beginning of the study (g)

Weight Growth Rate

Fish growth parameters are calculated using the formula absolute weight growth rate (Effendie 1997):

$$\text{Wm} = \text{Wt} - \text{Wo}$$

Information:

Wm = Absolute weight growth rate (g)
Wt = Average weight of seeds at the end of the study (g)

Wo = Average weight of seeds at the beginning of the study (g)

Long Growth Rate

The rate of absolute length increase is calculated using the formula (Mulqan *et al.* 2017):

$$Pm = Lt - Lo$$

Information:

Pm = Absolute length growth rate (cm)

Lt = Average length of seeds at the end of the study (cm)

Lo = Length Average seeds at the beginning of the study (cm)

Water Quality Parameters

The water quality parameters measured in this study were temperature, acidity (pH), salinity and dissolved oxygen (DO) using a pH meter, DO meter, and refractometer. In the measurement of water quality parameters refer to the standard SNI 8116:2015 namely temperature 27 – 32 °C, acidity degree (pH) 8 – 8.5, salinity 34 – 36 ppt and dissolved oxygen (DO) >5 mg/L.

Data Analysis

Growth data was analyzed using variance fingerprint analysis with F test at 5% test interval to determine the effect of each treatment. Then to see the significant difference between the treatments, it was followed by the Duncan double distance test with a confidence level of 95%. Water quality data was analyzed descriptively through observational studies with supporting data and related literature.

RESULT AND DISCUSSION

Survival

Survival or can be called *survival rate* (SR) is the number of organisms that are still alive at the end of the study from the number of test fish stocked at the beginning of the study (Iskandar & Elrifadah 2015). Based on the results of the 60-day study, it was obtained that the survival value of sand lobsters between treatments was 100% (Figure 1). The high survival value can occur due to several factors such as the nature of the lobster itself, sufficient feed, suitable cultivation containers and good water quality parameters that affect the survival of sand lobsters. This is in accordance with the statement Timumun *et al*. (2022) that the survival of lobsters can be influenced by internal factors, namely the nature of cannibalism and external factors, namely the environment, such as water and feed quality parameters.

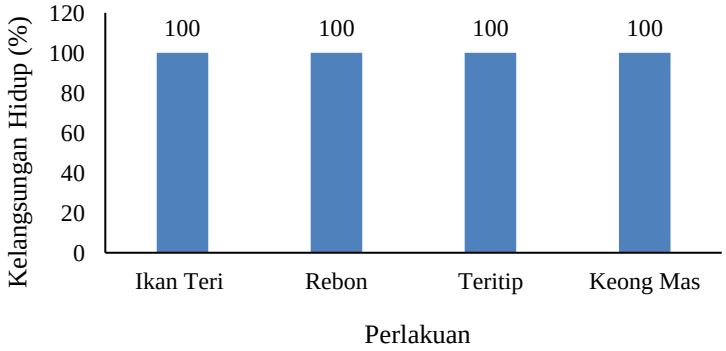

Figure 1. Sand Lobster Survival

Feeding is one of the factors that can determine the high or low survival value of organisms. Natural feeding differed during the study as it was thought to be well utilized

by lobsters for their survival. The calcium and phosphorus content contained in the feed can increase the survival value by up to 100% in the entire treatment. However, different natural feeding of sand lobsters did not give real different results, so it was considered not to have much effect on the survival of sand lobsters. This is in accordance with research Suriadi & Agus (2017) which gets a 100% survival value in the enlargement of batik lobsters by feeding anchovies, squid and sea worms. In research Nugaha *et al*. (2019) said that feeding anchovies can provide a survival value of 83% - 97.2% in sand lobsters. In addition, in the research Cleft *et al.* (2016) Getting Survival Pearl lobster is 80% preserved in a running water system for 60 days. Another study on the application of golden snails to sand lobster rearing resulted in a survival value of 100% (Anggaini *et al*. 2018).

Daily Growth Rate (LPH)

Daily growth rate (LPH) is a percentage of daily growth calculated based on the weight of the test organism during the study (Balqis & Isma 2021). The growth rate can be affected by several factors such as the nature of cannibalism, the environment and the feed of lobsters (Timumun *et al*. 2022). According to Trijoko & Nurcholis (2018) Lobsters really need enough nutrients and energy for food reserves and the formation of new shells during the molting process.

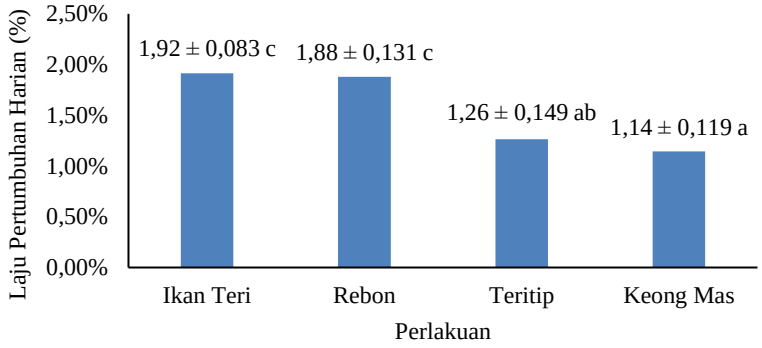

Figure 2. Daily Growth Rate of Sand Lobster

Based on the results of observations of the enlargement of sand lobsters with different natural feeding for 60 days, it was found that the growth rate value was in the range of 1.14% to 1.92%. The highest daily growth rate value was found in treatment A which was 1.92%, then treatment B was 1.88%, treatment C was 1.26%, and the lowest daily growth rate value was in treatment D of 1.14%. After an analysis test using Anova, it was found that different natural feeding could produce a real difference in the daily growth rate of sand lobster so that it was continued with the Duncan test at a 95% confidence interval.

In this study, treatment A produced the highest growth rate value of 1.92%. The high value can be caused because the content contained in anchovies is very complete such as protein content (16 g), energy (77 kcal), and minerals, especially calcium (500 mg) and phosphorus (500 mg). The need for mineral content in lobsters is very important because there is a deposition of calcium carbonate ($CaCO_3$) in the exoskeleton after the calcification process which can cause hardening in the post-molting and maintenance phases (Shahroom *et al.* 2023).

The provision of different natural feeds containing calcium and phosphorus in this study is suspected to be able to be used well by sand lobsters. This can be shown by the value of a higher daily growth rate compared to the study Main *et al*. (2023) That is, it

produces the value of the daily growth rate of sand lobster in the range of 0.90% to 1.74% with fish and crustacean feeding. In addition, in the research Saputra *et al*. (2022) The daily growth rate of sand lobsters obtained was in the range of 1.6% to 1.12% with the application of mangrove snails. Other research is Cleft *et al*. (2016) which obtained a daily growth rate of 0.096% to 0.125% on sand lobster enlargement for 60 days.

Feeding Efficiency (EPP)

The efficiency of feeding is the result of the comparison between the value of body weight gain and the amount of feed given during the study. Feeding in accordance with the nutritional needs of an organism can increase the value of feeding efficiency (Nofyan 2005; Centyana *et al.* 2014). The average efficiency of feeding sand lobsters during the 60-day study can be seen in Figure 3.

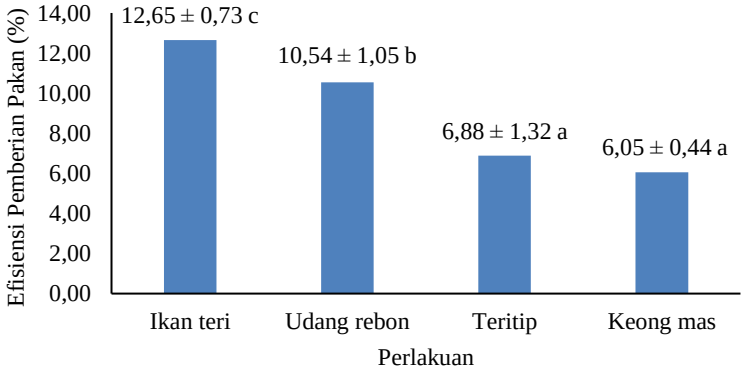

Figure 3. Sand Lobster Feeding Efficiency

The results of the observation of sand lobster obtained the value of feeding efficiency in the range of 6.05% to 12.65%. The highest feeding efficiency value was found in treatment A which was 12.65%, then treatment B was 10.54%, treatment C was 6.88%, and the smallest feeding efficiency value was in treatment D of 6.05%. The results of statistical analysis using Anova showed that different natural feeding was suspected to have a real effect on improving feed efficiency between treatments, so it was followed by the Duncan double distance test with a 95% confidence interval. Based on the Duncan test, it was found that treatment A was significantly different from treatment B, C and D. The high treatment of treatment A is suspected that the feeding of anchovies can be used well by lobsters because it contains quite complete nutrients, especially minerals such as calcium (500 mg) and phosphorus (500 mg) so that it can meet the growth needs of sand lobsters. The results of this study are not much different from the research Main *et al*. (2023) in the enlargement of sand lobster, which is 15.42%. One of the factors that affects this is the water quality parameters, because the two studies are in the same location. In research Nuance *et al*. (2018) Feeding fish can increase feed efficiency in betutu fish rearing by 22.26%.

Specific Growth Rate By Weight

The weight growth rate is the comparison between the difference in the total weight of the organism at the beginning of maintenance and the amount of weight at the end of maintenance. The higher the value produced, the faster the organism will carry out the weight growth rate (Salamah & Zulpikar 2020).

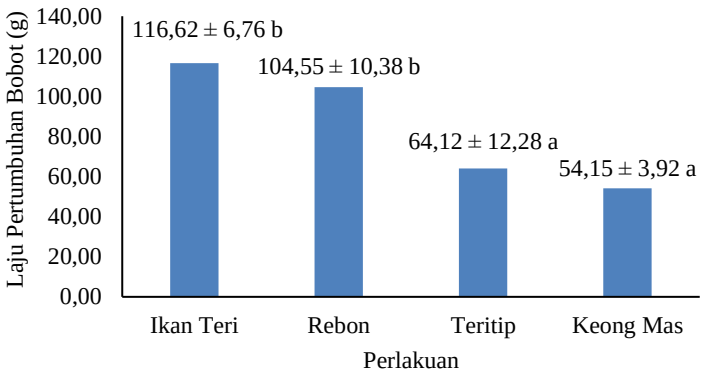

Figure 4. Specific Growth Rate By Weight

Based on the observation results in the enlargement of sand lobsters, a specific growth rate based on weight was obtained in all treatments, which was between 54.15 g to 116.63 g. The value of the specific growth rate based on the highest weight was found in treatment A, which was 116.63 g, followed by treatment B at 104.55 g, treatment C at 64.13 g, and the specific growth rate value based on the smallest weight was found in treatment D, which was 54.15 g. The difference in the value of the weight growth rate can be caused by the difference in the amount of feed nutrients contained in each treatment. Furthermore, it was continued with the Duncan test which resulted that treatment A was not significantly different from treatment B and was significantly different from treatment C and D. This happened because the content contained in treatment A and B was quite complete. Weight growth in treatment B has a lower value compared to treatment A, so it can be said that anchovy feeding is an efficient type of feed for the growth of sand lobsters. In accordance with research Sumiati *et al*. (2023) It was stated that the feeding of anchovies in the enlargement of sand lobsters produced the highest weight growth, which was 85.27 g. Moreover Isriani *et al*. (2022) It was also mentioned that feeding sand lobsters using anchovies resulted in an absolute weight growth of 76.23 g. So it can be said that the growth rate of sand lobster weight in this study is very high compared to previous research.

Specific Growth Rate Based on Length

The growth rate of length is the calculation of the difference between the length of an organism starting from the tip of the head to the tip of the tail at the end of the study and the length of the body at the beginning of the study. Growth is the process of increasing the length and weight of an organism as seen from the change in length and weight in units of time (Thenu & Tinglioy 2021). Based on the observation results in the enlargement of sand lobsters, a specific growth rate based on length in all treatments was obtained, which was between 3.60 cm to 6.30 cm. The value of the specific growth rate based on the highest length was found in treatment A which was 6.30 cm, followed by treatment B of 5.68 cm, treatment C of 4.45 cm, and the value of specific growth rate based on the lowest length was found in treatment D which was 3.60 cm.

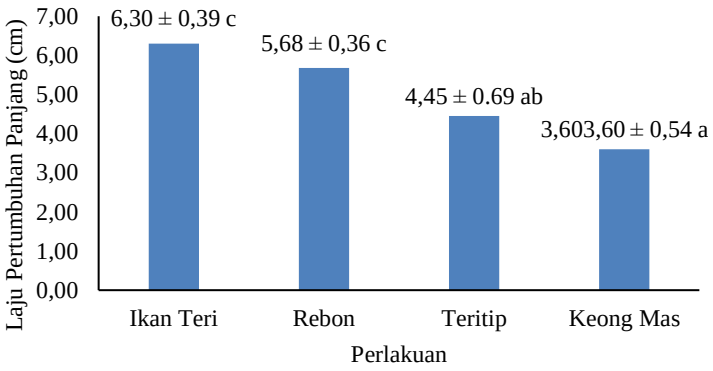

Figure 5. Specific Growth Rate Based on Length

After the Duncan test, the specific growth rate values based on the length of treatment A (6.30 cm) and B (5.68 cm) were not significantly different. However, the highest length growth rate is found in treatment A so that anchovies are a suitable type of feed for the long growth of sand lobsters. This is in accordance with the researcher's Sumiati *et al*. (2023) which stated that the feeding of anchovies in the enlargement of sand lobsters produced the highest length growth value of 4.03 cm. According to Suriadi & Agus (2017) mentioned that the use of different types of feed has different nutritional content, so it can affect the final growth value. According to Isriani *et al*. (2022) suggest the use of anchovy feed in lobster cultivation, as it can have a significant effect on growth.

During the study, a specific growth rate value was obtained based on the lowest length, namely in treatment D. The low value is suspected because the feed provided is not optimally utilized by lobsters. This can happen due to improper feeding techniques such as separating the shell from the golden snail meat.

Water Quality

Water quality is one of the factors that can affect the growth and survival rate in lobster rearing (Rosmawati et al. 2019). In carrying out aquaculture, it is very important to manage water quality, because water is a medium for live aquaculture organisms (Aquarista *et al*. 2012). The water quality parameters observed in this study, namely temperature, acidity (pH), salinity and dissolved oxygen (DO) can be seen in Table 1.

Table 1. Water Quality Parameters in Floating Net Cages

Parameters	Result	Quality Standards (SNI 8116:2015)
Temperature	27.1 – 29.0 °C	27 – 32 °C
Degree of acidity (pH)	7,74 – 8	8 – 8,5
Salinity	34 – 35 ppt	34 – 36 ppt
Dissolved oxygen (DO)	7.05 – 8.70 mg/L	>5 mg/L

Temperature is a very important factor for the life of organisms in the waters. Temperature can affect the metabolic activity of aquatic organisms (Hamuna *et al*. 2018; Main *et al*. 2023). During sand lobster rearing, the water temperature ranges from 27.1 – 29,0 °C. This value is still included in the optimal temperature according to quality standards SNI 8116:2015 for lobster cultivation at KJA.

Acidity (pH) is a parameter used to express the acidity or alkalinity of a water (Hariyadi *et al*. 2020). In this study, the pH value was found to be in the range of 7.74-8 which showed that the value was lower than the quality standard for lobster rearing. This value is still insufficient to meet the quality standards according to SNI 8116:2015. However, based on the quality standards set by the Government in 2021 The pH value in

this study is in the range in accordance with the quality standards of marine life, which is 7-8.5. Strengthened by research Kordi (2011) said that the optimal pH value for marine life is 7.6-8.7.

Salinity is one of the parameters that shows the level of salinity or dissolved salt content in seawater (Hasrianti & Nurasia 2016). Based on observations during the study, the salinity value was in the range of 34-35 ppt. This value is included in the optimal salinity value for seawater lobster enlargement that has been determined by SNI 8116:2015.

Dissolved oxygen or *Dissolved Oxygen* (DO) is one of the water quality parameters that is very beneficial for the survival of marine life. Observations of dissolved oxygen during lobster rearing are in the range 7,05 – 8.70 mg/L. This value is still appropriate for the survival of sand lobsters. This is in accordance with the requirements of water quality standards for the maintenance of sand lobsters according to SNI 8116:2015 which is >5 mg/L.

CONCLUSION

The results of the study of natural feeding containing calcium and phosphorus have a significant influence on the growth of sand lobsters such as daily growth rate, feeding efficiency, specific growth rate based on weight, and specific growth rate based on length. The type of feed that produces the best growth is anchovy feeding. Meanwhile, different natural feeding has no real effect on the survival of sand lobsters. The water parameters on the East Coast of Pangandaran are in quite good condition and in accordance with quality standards.

REFERENCES

Anggraini, Witari, Abidin, Zaenal, & Waspodo, Saptono. (2018). Pengaruh Pemberian Pakan Keong Mas Terhadap Pertumbuhan Dan Kelangsungan Hidup Lobster Pasir (Panulirus Homarus). *Jurnal Perikanan Unram*, *8*(2), 20–29. Https://Doi.Org/10.29303/Jp.V8i2.114

Aquarista, F., Iskandar, & Subhan, U. (2012). Pemberian Probiotik Dengan Zeolit Pembawa Pada Budidaya Ikan Lele Dumbo (Clarias Gariepinus). *Jurnal Perikanan Dan Kelautan*, *3*(4), 133–140.

Balqis, Raudhatul, & Isma, Muhammad Fauzan. (2021). Kinerja Lama Pemuasaan Terhadap Pertumbuhan Dan Kelangsungan Hidup Benih Ikan Nila (Oreochromis Niloticus) Long-Standing Performance Of Tilapia Seed Growth And Survival Rate Of Oreochromis Niloticu. *Jurnal Ilmiah Samudra Akuatika*, *4*(2), 45–53.

Centyana, E., Cahyoko, Y., & Agustono. (2014). Substitusi Tepung Kedelai Dengan Tepung Biji Koro Pedang (Canavalia Ensiformis) Terhadap Pertumbuhan, Survival Rate Dan Efisiensi Pakan Ikan Nila Merah. *Jurnal Ilmiah Perikanan Dan Kelautan*, *6*(1), 7–14.

Effendie, M. I. (1997). *Biologi Perikanan (Bagian I: Studi Natural History)*. Bogor: Ipb Press.

Effendie, M. I. (2002). *Biologi Perikanan*. Yogyakarta: Yayasan Pustaka Nusantara.

Hariyadi, Kamil, M., & Ananda, P. (2020). Sistem Pengecekan Ph Air Otomatis Menggunakan Sensor Ph Probe Berbasis Arduino Pada Sumur Bor. *Rang Teknik Journal*, *3*(2), 340–346.

Hasrianti, & Nurasia. (2016). Analisis Warna, Suhu, Ph Dan Salinitas Air Sumur Bor Di Kota Palopo. *Prosiding Seminar Nasional*, *02*(1), 747–753.

Indriswari, P. (2021). *Aplikasi Pakan Formulasi Berbasis Protein Nabati Dan Probiotik Hoc® Pada Pendederan Lobster Pasir, Panulirus Homarus (Linnaeus, 1758)*. Bandar Lampung.

Iskandar, Rina, & Elrifadah. (2015). Pertumbuhan Dan Efisiensi Pakan Ikan Nila (Oreochromis Niloticus) Yang Diberi Pakan Buatan Berbasis Kiambang. *Jurnal Ziraa'ah*, *40*(1), 18–24.

Isriani, Afni, Liliyanti, Mita Ayu, & Kalih, Lalu Achmad Tan Tilar Wangsajati Sukmaring. (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. Https://Doi.Org/10.29303/Abdiinsani.V9i1.477

Jayadi, Harlina, Wahyuti, Tang, B., & Nursyahran. (2023). Edukasi, Pembimbingan Dan Pelatihan Pembuatan Pakan Buatan Pada Pembudidaya Lobster Air Tawar Di Desa Pacellekang, Kecamatan Patallasang, Gowa, Sulawesi Selatan. *Jurnal Abdi Insani*, *10*(4), 2587–2594.

Jeyasanta, K. I., & Patterson, J. (2014). Nutritive Evaluation Of Trash Fishes In Tuticorin (India). *World Journal Of Fish And Marine Sciences*, *6*(3), 275–288. Https://Doi.Org/10.5829/Idosi.Wjfms.2014.06.03.8521

Junaidi, M., & Hamzah, M. S. (2014). Kualitas Perairan Dan Dampaknya Terhadap Pertumbuhan Dan Sintasan Udang Karang Yang Dipelihara Dalam Keramba Jaring Apung Di Teluk Ekas, Provinsi Nusa Tenggara Barat. *Jurnal Ilmu Dan Teknologi Kelautan Tropis*, *6*(2), 345–354.

Kordi, G. (2011). *Budidaya 22 Komoditas Laut Untuk Konsumsi Lokal Dan Ekspor*. Yogyakarta: Lily Publisher.

National Research Council, Nrc. (1993). *Nutrient Requirement Of Fish*. Washington Dc:

National Academic Press.

Nofyan, E. (2005). Pengaruh Pemberian Pakan Dari Sumber Nabati Dan Hewani Terhadap Berbagai Aspek Fisiologi Ikan Gurami (Osphronemus Gouramy). *Jurnal Ikhtiologi Indonesia*, *5*(1), 1–3.

Nuansa, Fajar, Afdhal El Rahimi, Sayyid, & Siska Mellisa. (2018). Pemberian Pakan Alami Yang Berbeda Terhadap Pertumbuhan Benih Ikan Betutu (Oxyeleotris Marmorat) Different Given Natural Food Growth Of Fish Seed Growth (Oxyeleotris Marmorat). *Jurnal Ilmiah Mahasiswa Kelautan Dan Perikanan Unsyiah*, *3*(2), 45–54.

Nugraha, M. D., Setyowati, D. N., & Waspodo, S. (2019). Pemberian Pakan Ikan Rucah Dengan Dosis Yang Berbeda Terhadap Performa Pertumbuhan Lobster Pasir (Panulirus Homarus). *Jurnal Perikanan Unram*, *9*(2), 153–159. Https://Doi.Org/10.29303/Jp.V9i2.161

Pemerintah Republik Indonesia. (2021). *Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 Tentang Tentang Penyelenggaraan Perlindungan Dan Pengelolaan Lingkungan Hidup.*

Priyambodo, B., Jones, C. M., & Sammut, J. (2020). Assessment Of The Lobster Puerulus (Panulirus Homarus And Panulirus Ornatus,Decapoda: Palinuridae) Resource Of Indonesia And Its Potential Forsustainable Harvest For Aquaculture. In *Aquacultur*.

Purnamaningtyas, Sri Endah, & Nurfiani, Amula. (2017). Kebiasaan Makan Beberapa Spiny Lobster Di Teluk Gerupuk Dan Teluk Bumbang, Nusa Tenggara Barat. *Akuatika Indonesia*, *2*(2), 155. Https://Doi.Org/10.24198/Jaki.V2i2.23421

Rosmawati, Mulyana, & Rafi, Muhammad Azmi. (2019). Pertumbuhan Dan Kelangsungan Hidup Benih Lobster Air Tawar (Cherax Quadricarinatus) Yang Diberi Pakan Buatan Berbahan Baku Tepung Keong Mas (Pomacea Sp.). *Jurnal Mina Sains*, *5*(1). Https://Doi.Org/10.30997/Jms.V5i1.1771

Rostika, R, Haetami, K., & Pratiwy, F. M. (2023). Teori Dan Praktik Budidaya Lobster Pasir (Panulirus Homarus) Terkini Untuk Calon Dan Pembudidaya Lobster Di Kabupaten Pangandaran. *Jurnal Berdaya*, *2*(2), 60. Https://Doi.Org/10.24198/Job.V2i2.41780

Rostika, Rita, Insan, Irsyaphiani, & Subakti, Aji. (2010). Peran Kalsium Pakan Terhadap Pertumbuhan Yuwana Lobster Air Tawar Red Claw (Cherax Quadricarinatus). *Prosiding Forum Inovasi Teknologi Akuakultur*, 795–801.

Salamah, & Zulpikar. (2020). Pemberian Pakan Probiotik Pada Pakan Komersil Dengan Protein Yang Berbeda Terhadap Kinerja. *Aquatic Science Jurnal*, 21–27.

Santoso, R. (2023). Hilirisasi Sektor Perikanan Dan Kelautan Dengan Memberdayakan Koperasi Nelayan. *Pusat Penelitian Badan Keahlian Sekretariat Jenderal Dpr Ri*.

Saputra, Boby Aldo, Setyawan, Agus, Supono, Brite, Margie, & Adiputra, Trinoegraha Yudha. (2022). Culture Performances Of Spiny Lobster (Panulirus Homarus) With Optimum Feeding Rate. *Jurnal Rekayasa Dan Teknologi Budidaya Perairan*, *10*(2), 74–80.

Shahroom, Ahmad, Shapawi, Rossita, Mustafa, Saleem, Halid, Nur Fatihah Abd, Estim, Abentin, & Tuzan, Audrey Daning. (2023). Effects Of Eggshell And Seashell Powder As Natural Dietary Calcium Supplements On Growth, Molting Frequency, And Carapace Calcium Composition Of Juvenile Red Claw Crayfish, Cherax Quadricarinatus. *Peerj*, *11*. Https://Doi.Org/10.7717/Peerj.15449

Sni 8116:2015. (2015). Produksi Lobster Pasir (Panulirus Homarus, Linn 1758) Di Karamba Jaring Apung (Kja). *Standar Nasional Indonesia*.

Sudewi, Widiastuti, Z., Slamet, B., & Mahardika, K. (2018). Investigasi Penyakit Pada Pembesaran Lobster Pasir Panulirus Homarus Di Karamba Jaring Apung (Lombok, Pegametan Dan Pangandaran). *Jurnal Ilmu Dan Teknologi Kelautan Tropis*, *10*(1), 111–122.

Sumbing, Mv, Al-Azad, S., Estim, A., & Mustafa, S. (2016). Growth Performance Of Spiny Lobster Panulirus Ornatus In Land-Based Integrated Multi-Trophic Aquaculture (Imta) System. *Transactions On Science And Technology*, *3*(1–2), 143–149.

Sumiati, Junaidi, Muhammad, & Scabra, Andre Rachmat. (2023). The Effect Of Moist Feeding With Different Dosages Of Probiotic On The Growth Of Sand Lobster (Panulirus Homarus) In Floating Cages. *Jurnal Biologi Tropis*, *23*(1), 503–511.

Suriadi, La S., & Agus, Kurnia. (2017). Pengaruh Jenis Pakan Segar Terhadap Pertumbuhan Biomassa Calon Induk Lobster Batik (Panulirus Longipes) The Effect Of Fresh Feed On The Growth Of Broodstock Candidate Of Longipe Spiny Lobster (Panulirus Longipes). *Media Akuatika*, *2*(2), 360–367.

Thenu, Johanna L., & Tinglioy, Lexon H. J. (2021). Laju Pertumbuhan, Kelangsungan Hidup Dan Komposisi Kimia Ikan Nila (Oreochromis Niloticus) Hasil Rekayasa Dari Air Tawar Ke Air Laut. *Inasua: Jurnal Teknologi Hasil Perikanan*, *1*(1), 40–50. Https://Doi.Org/10.30598/Jinasua.2021.1.1.40

Timumun, Maspa, Mangitung, Septina F., Tahya, Akbar Marzuki, & Safir, Muhammad. (2022). Perbandingan Pertumbuhan Lobster (Cherax Quadricarinatus) Yang Diberi Pakan Buatan Basah Dan Kering. *Jurnal Agrokompleks Tolis*, *2*(3), 61–66.

Trijoko, T., & Nurcholis, Heri Aji. (2018). Pengaruh Molting Terhadap Struktur Dan Perkembangan Cangkang Pada Lobster Hijau Pasir (Panulirus Homarus L., 1758). *Jurnal Kelautan: Indonesian Journal Of Marine Science And Technology*, *11*(2), 167. Https://Doi.Org/10.21107/Jk.V11i2.3797

Trisnasari, Vania, Subandiyono, .Subandiyono, & Hastuti, Sri. (2020). Pengaruh Triptofan Dalam Pakan Buatan Terhadap Tingkat Kanibalisme Dan Pertumbuhan Lobster Air Tawar (Cherax Quadricarinatus). *Sains Akuakultur Tropis*, *4*(1), 19–30. Https://Doi.Org/10.14710/Sat.V4i1.6064

Utama, Mochhamad Ikhsan Cahya, Rostika, Rita, . Iskandar, Herawati, Titin, Hatami, Kiki, & Grandiosa, Roffi. (2023). Analysis Of Different Depth And Types Of Feed On The Growth Of Spiny Lobster (Panulirus Homarus) Using The Vietnamese Cage Method In Pantai Timur, Kabupaten Pangandaran. *Asian Journal Of Fisheries And Aquatic Research*, *21*(2), 55–64. Https://Doi.Org/10.9734/Ajfar/2023/V21i2538

Zainuddin, Zainuddin. (2012). Effect Of Calcium – Phosphorous With Different Ratio On Nutrient Retension And Changes The Chemical Composition Of Tiger Shrimp Juvenile (Penaeus Monodon Fabr.). *Jurnal Ilmu Dan Teknologi Kelautan Tropis*, *4*(2), 208–216. Https://Doi.Org/10.29244/Jitkt.V4i2.7783