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GROWTH AND GASTROINTESTINAL CONDITIONS OF GREEN LOBSTER (PANULIRUS HOMARUS) WITH DIFFERENT NATURAL FEEDING, WHICH ARE RAISED IN A LONGLINE SUBMERGED CAGE SYSTEM ON THE EAST COAST OF PANGANDARAN REGENCY

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Abstract

The purpose of this study was to test what type of natural feed provides growth and physiological conditions of the green lobster gut. One important factor to support the development of aquaculture is appropriate feed to support growth. Efforts can be made in optimizing the growth of sand lobsters through feeding that contains calcium and in natural feed consistently. This study consisted of 4 treatments of natural feed types rich in Calcium and Posfor, namely anchovies, rebon shrimp, gold snails and barnacles. The purpose of this study was to observe different types of natural feed that can increase lobster survival (SR), weight growth rate, intestinal histological features and hepatopancreas in green lobsters and water quality at the study site. The highest survival rate in this study was found in the treatment of rebon shrimp and gold snails of 96%. While the highest growth rate parameter is the treatment of anchovy feed of 113.9 ± 30.7020. Furthermore, the highest intestinal histological condition is the treatment of anchovy feed, namely the area of villi of 1857,667 (µm2) and the number of villi in the intestine in green lobster 1857,667.

keywords: green lobster, calcium-phosphorus, natural feed, growth, intestinal hytologic conditions

INTRODUCTION

Green lobster (*Panulrirus homarus*) is one of the crustacean animal commodities in Indonesia with high economic value both in the domestic and international markets (Pratiwi et al., 2016; Rostika et al., 2023). In 2018 Indonesia became the second largest lobster producer with a total production of 556 tons below Vietnam. However, lobster production in Indonesia still comes from fishing compared to production from cultivation (Budiyanto, 2021).

In lobsters as *crustaceans*, calcium and phosphorus play an important role in growth, namely as the main ingredients in the process of hardening the *exoskeleton* after the molting phase (Kunkel et al., 2012). According to (Zaidy & Hadie, 2009) The required calcium requirement in the hardening phase of the lobster skin is a maximum of 2.5% and a minimum phosphorus of 1.2%. However, the needs of calcium and phosphorus cannot be met from within the body (hemolymph) and the environment because it is only able to meet 10% and 0.34% of the needs so that both minerals must be contained in the feed (Hadie et al., 2010).

In nature, lobsters utilize various organisms such as fish 1.81%, mollusks 49.80%, detritus 3.66% and *crustaceans* 44.5% as feed (Purnamaningtyas & Nurfiani, 2017). The use of trash fish as lobster feed has a negative impact on the environment (Irvin & Shanks, 2015b; Junaidi, 2016), low feed conversion rate (Irvin & Shanks, 2015b; Jones, 2010) and formulation Low calcium and phosphorus range from 4.15 – 49.52% (Susi, 2013; Talat et al., 2005). In addition, the use of artificial feed on lobsters will become waste in the cultivation media, if the formulation is not right (Niode et al., 2017). Research (Irvin & Shanks, 2015a) Natural feed is more optimal in increasing growth because it contains attractants that can increase feed response in crustaceans.

Some natural foods that can be a substitute for trash fish that contain high calcium and phosphorus in lobsters from the molluscs, *crustaceans* and gastropods are rebon shrimp (*Acetes* sp.), gold snails (*Pomacea canaliculata*), barnacles (*Cirripedia*). The three feeds have high calcium and phosphorus content respectively as in 757% and 292% rebon shrimp (Direktorat Gizi, 1992), keong mas 129,18 % dan 60,52 % (Putri et al., 2019), and barnacles (*Cirripedia*) by 727 % (Rahmaningtyas et al., 2017). This study aims to determine the best type of natural feed and its effect in increasing survival and growth rate as well as the physiological condition of lobsters (Panulirus homarus).

METHODS

This research will be conducted from November to December 2023. Lobster rearing is carried out in Floating Net Cages (KJA) Faculty of Fisheries and Marine Sciences, Padjadjaran University, in East Coast Waters, Pangandaran Regency, West Java.

The test animals used in this study were juvenile green lobsters with initial weights ranging from 70-90 g; length 13-16 cm. Green lobster is obtained from the results of catching in nature by fishermen of Pangandaran Regency.

The feed used consists of 4 types, namely anchovies (*Stolephorus* sp.), rebon shrimp (*Acetes* sp.), gold snails (*Pomacea canaliculata*), barnacles (*Cirripedia*). Feed is given in the afternoon in the amount of 20% by weight of biomass. Data collection was carried out for 60 days by measuring the length and weight of lobsters every 10 days until the end of rearing. Measurements of lobster body length and weight are carried out by taking 5 heads at each treatment. Body length

measurements are carried out using millimeter blocks with an accuracy of 1 mm while weight measurements use digital scales with an accuracy of 0.1 g. Water quality data collection includes parameters of brightness, current velocity, temperature, dissolved oxygen, pH and salinity. Measurements were taken at the beginning and end of the study in the morning and evening.

Test lobsters were kept on a cube-shaped *L-shaped submerged cage* with a length of 272 cm, a width of 250 cm, and a height of 135 cm. The material on the cage frame is made of square-shaped High Destiny Polyethyline (HDPE) poles. Cages already tied to buoys are sunk at a depth of 5 m.

The study was designed using a complete randomized design (RAL) consisting of 4 treatments and each was given 5 individual repeats. The parameters used consist of *survival rate (*SR), weight growth rate, intestinal histology and water quality. Analysis of water quality and gastrointestinal conditions was analyzed descriptively. Performance parameters are statistically analyzed through the fingerprint analysis test (ANOVA). If the treatment had an effect, Duncan's follow-up test was carried out at a 95% confidence level. The survival rate is calculated based on the formula proposed by Huisman (1987), namely:

$$SR = \frac{Nt}{No} x100\%$$

Information:

SR = Survival (%)

Nt = Number of fish at the end of the study (tail)

No = Number of fish in the study awaal (tail)

Weight growth is calculated using the equation proposed by Effendie (1997), namely:

Wm = Wt – Wo

Information:

Wm = Growth rate (g)

Wt = Average weight of seeds at the end of the study (g)

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

The histological examination is calculated using a formula according to Iji *et al.* (2001) as follows.

$$LV = \frac{b + c}{c} \times a$$

Information:

LV = vili surface area (μm^2)

a = vili height (μm)

b = apical width vili (μm)

c = basal width vili (μm)

Making histological preparations of sand lobster intestines was carried out at the Biological Laboratory of FMIPA Universitas Padjadjaran.

RESULTS AND DISCUSSION

Survival Rate

At the end of the rearing period, survival data were obtained on 60% of all green lobsters. The highest survival value was found in treatment A (gold snail feed) and C (rebon shrimp feed) of 96% and the lowest in treatment D with anchovy feeding of 72% (Figure 1).

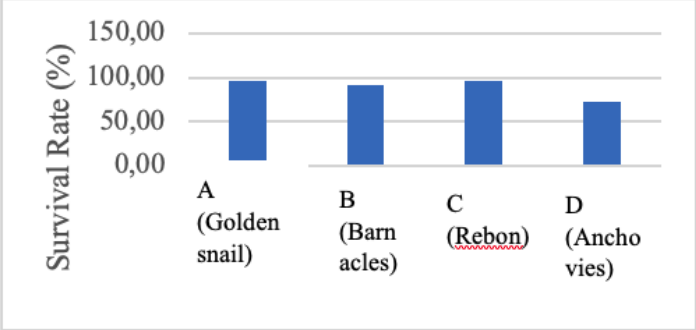


Figure 1. Green Lobster survival rate

The high survival rate is due to the amount and frequency of feed given precisely to prevent mutual prey among lobsters and is supported by optimal water quality in accordance with its natural habitat. This is in accordance with opinion Rihardi *et al.* (2013) which states that the high survival is due to the timing and amount of feeding and the condition of water quality during maintenance is stable and does not become a limiting factor on lobster survival rates. In addition, it is suspected that the treatment of A, B and C comes from natural feed that has a shell so that the calcium and phosphorus content in the shell is able to minimize the occurrence of cannibalism and maintain survival in lobsters. This is in accordance with Suptijah, (2012) that calcium derived from *crustacean shells* can make receptors quickly enter so that they can be directly utilized by the body properly.

Predation activity that occurs in lobsters is characteristic of aggressiveness between individuals in one container that shows dominance (Safir et al., 2023). Increased cannibalism in lobsters occurs during molting, because the lobster's body is soft and it is of particular interest to the alleged distinctive aroma released during molting that attracts other individuals for predation (Handayani & Syahputra, 2018). Calcium plays an important role in speeding up lobster time in the exoskeleton hardening process to avoid predation during molting.

Weight Gain

Growth measurements showed that during the 60 days of observation there was an increase in the average weight gain of green lobsters. the increase had different effects between treatments

(P>0.05). The highest average increase was found in treatment D with feeding using anchovies, which was 1.90% (Figure 2).

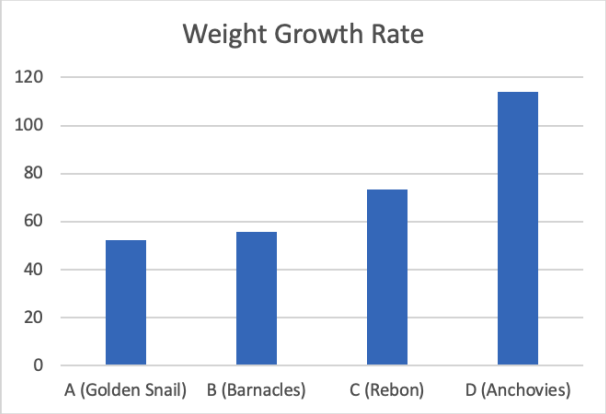


Figure 2. Sand lobster growth rate graph

The high increase in D treatment is thought to be because anchovies can meet the needs of calcium and phosphorus to stimulate or stimulate lobster growth. As according to (Nurfaidah & Agustono, 2021) Calcium plays a significant role in the molting process as gastroliths that will be absorbed by lobsters to harden the shell again after the motling process. A more frequent molting frequency will provide a better accretion rate (Safir et al., 2023). So the more often the lobster molts, the faster its growth will be (Handayani & Syahputra, 2018). According (Kurniasih, 2008) that crustaceans that obtain adequate nutritional content will experience faster molting because the energy stored in food will be metabolized and used directly for growth and maintenance. As it is known that molting plays an important role in the life cycle of lobsters. This is because the success of molting will determine the growth of lobsters (Hakim, 2009).

Gain is directly proportional to growth and closely related to body weight. High weight growth in D treatment can be achieved due to the availability of calcium which affects growth in sand lobsters because in the hardening phase of the shell after molting lobsters and curstaceans require calcium in the process. The content of calcium and phosphorus in anchovies is 757 mg / 100 g and 292 mg / 100 g (Direktorat Gizi, 1992) More contributions were able to produce the highest growth in individual weight of sand lobsters in this study.

Weight growth is an indicator of physiological cell development, especially in crustaceans Weight growth is influenced by various factors until molting takes place (Tahya et al., 2016). Growth characteristics in crustaceans are different from fish. This is due to molting events in its life cycle (Saputra & Indaryanto, 2019). Growth in lobsters occurs very rapidly during the postmolt phase. In the postmolt phase, growth occurs optimally due to the absorption of various materials from the environment and various mineral needs, especially calcium and phosphorus from feed to restore the strength of the carapace (Safir et al., 2023). The ability of lobsters to metabolize before molting is very influential on the success of significant growth. This is important because

the failure of lobsters to collect energy can cause death (mortality) during the ecdysis phase (Kunkel et al., 2012).

Histology of the Intestine and Hepatopancreas

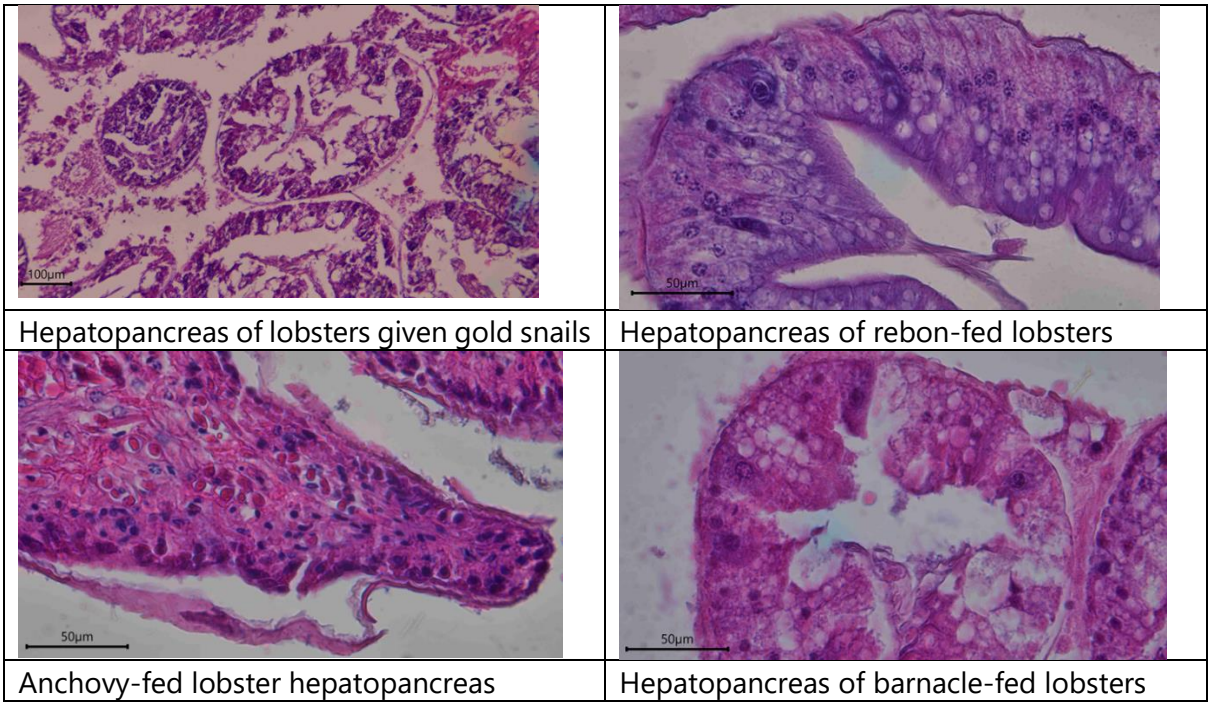
Lobsters have a different gastrointestinal tract from the gastrointestinal tract of fish. The process of breakdown and absorption of feed nutrients occurs in the hepatopancreas. The gastrointestinal tract in lobsters consists of the mouth, stomach, hepatopancreas and intestines. The hepatopancreas acts as the front intestine, while the intestinal part of the lobster resembles the nature of the back intestine (Rostika, 2023). The results showed that the area of lobster villi ranged from 505,908 – 1857,667 (µm2) while the number of villi ranged from 10,200 – 15,000.

Table 1. Calculation of Number and Area of Lobster Villi

Treatment	Total of Villies	Broad Vili (μm^2)
A	10.200	505.908
B	8.400	441.290
C	14.600	1631.468
D	15.000	1857.667

The digestive tract will become healthier which then the development of intestinal villi will be increases, so that digestibility and absorption of nutrients increase, especially protein and calcium (Purwati et al., 2005).

The largest villi surface area is found in treatment D with anchovy feeding, which is 1857.6679 μm^2. This is thought to be because anchovies provide high nutritional contributions such as protein, minerals, and other nutrients. It is supported by (Purwati et al., 2005) that the digestive tract will become healthier which then the development of intestinal villi will increase, so that the digestibility and absorption of nutrients increase especially protein and calcium, histological images of the hepatopancreas are in Figure 3.



Hepatopancreas of lobsters given gold snails	Hepatopancreas of rebon-fed lobsters
Anchovy-fed lobster hepatopancreas	Hepatopancreas of barnacle-fed lobsters

Figure 3. The histology of the hepatopancreas is found in.

Based on the results of research conducted by Haetami et al., (2022) Regarding the morphometrics of intestinal villi and goldfish weight gain, it is found that increasing the width, length and depth of the crypta in the villi can increase the area of nutrient absorption which will affect growth. Monitoring the gastrointestinal tract is important to assess digestive performance because the intestine is an organ that plays an important role in the process of absorption and digestion of nutrients from food (Rašković et al., 2009). Intestinal performance is closely related to the growth of sand lobsters.

The area of villi is related to the process of absorption of nutrients, the larger the size of the villi, the more nutrients absorbed by the body which will affect the development of organs in the body. Meanwhile, the length of the villi also serves to absorb nutrients through certain cells transported by a network of capillaries and lymphatic vessels which are then flowed by the blood to be distributed to cells throughout the body (Siagian, 2016).

Water Quality

Water quality observations were used as supporting parameters that could support the life of sand lobsters in the study. Water quality observations used as supporting parameters during the study were brightness, current speed, temperature, *dissolved oxyden* (DO), acidity (pH) and salinity. The measurement results show that water quality still meets the quality standards for sand lobster maintenance (Table 2).

Table 1. Water Quality Measurement Results

Parameter	Measurement Results	Baku Mutu
Brightness (m)	3,1	>3**
Current speed (cm/det)	19,5	20-40**
Temperature (°C)	27 – 29	27 – 32*
DO (mg/l)	6,4 – 8,8	>5*
pH	7 – 8	8-8,5*
Salinitas (ppt)	34 – 35	34-36*

*Standard according to SNI 8116:2015

**Standard according to Affan (2011); Radiarta *et al.* (2015); Prasetya & Hasidu, (2022)

The brightness value obtained on the coast of the East Coast of Pangandaran is 3.1 m. Based on this, the suitability of lobster cultivation land in the KJA system has a very suitable brightness of >3 m, while the category is quite suitable ranging from 2-3 m (Affan, 2011; Radiarta et al., 2015). The brightness parameter relates to the number of particles floating or suspended in the water column. The more particles that enter the waters, the condition of the waters will be more turbid.

The current speed measured on the East Coast of Pangandaran obtained a value of 19.5 cm / sec. Currents that are too strong will endanger the growth and construction of KJA, while currents that are too low are not suitable for cultivation activities (Adipu et al., 2014). The suitability value of lobster cultivation land with the KJA system ranges from 20-40 cm / sec (Prasetya & Hasidu, 2022). Current circulation plays a very important role in cultivation in KJA. Currents that are too weak are not able to decompose food waste in maintenance containers, so it will result in buildup and become toxic to cultivated biota (Louhenapessy et al., 2023).

The temperature value found during the study produced a value of 27-29 °C which shows that the coastal waters of the East Coast of Pangandaran are very suitable for lobster cultivation with the KJA system. The acquisition of temperature values during the study was not much different from the 2023 study on the hatchability of lobster eggs which produced the best egg hatchability of 91.5% with a temperature value of 29 °C (Faris et al., 2023). If there is a temperature fluctuation, the lobster will have an impact on the inhibition of growth and molting process (Handayani & Wardhana, 2022).

The acquisition of *dissolve oxygen* (DO) values in this study ranged from 6.4 – 8.8 mg / l. based on seawater quality standards for KJA system cultivation, the corresponding DO parameters > 5 mg / l. Thus, the *dissolved oxygen* (DO) value in this study is very suitable for lobster growth. *Dissolved oxygen* (DO) can decrease in a body of water which will have an impact on growth, metabolic performance and molting, and can cause a decrease in the immune system of lobsters so that resistance to disease also decreases (Setyowati et al., 2013).

The degree of acidity or pH is a measure of the concentration of hydrogen ions that indicates the alkaline and acidic nature of waters. The pH value obtained during the study ranged from 7 - 8. The value is appropriate and slightly lower than seawater quality standards. Based on PP 22 of 2021, the quality of pH in waters during the study was still within the quality standard limits for marine biota, namely 7 – 8.5.

The measurement results at the time of the study showed salinity values ranging from 34 - 35 ppt. Based on the standard value of water quality, the value obtained is appropriate for lobster growth. These results are supported by research (Amali & Sari, 2020) That the salinity range between 36-42 has a significant effect on the life pass rate of sand lobsters which is 97%. Salinity is very important for the survival of marine life. A decrease in salinity value will change the dynamics and composition of organisms, so that every marine life has a tolerance limit for salinity (Rahman & Mansyur, 2016).

CONCLUSION

The highest value in the survival rate of green lobster is the treatment of rebon shrimp and gold snails by 96%. However, for growth rate and physiological conditions of the intestine and hepatopancreas, green lobster is best in giving anchovies treatment compared to other treatments. This can be seen from the data obtained, namely growth rate, length growth 4.9, feeding efficiency 10.16%. While the treatment that provides.

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