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Calcium-Rich Natural Feed and Its Effect on Average Daily Gain, Survival Rate, and Histopathology of Hepatopancreas and Intestine in Green Lobster (Panulirus homarus)

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Abstract

Research High-Calcium Natural Feed on Average Daily Gain, Survival Rate and Histopathogical Hepatopancreas and Intestine of Green Lobster (Panulirus Homarus) few have done so, even though this is important to observe and know. The aim is to find the food habit of green lobster, so that this information can be known to stake holders and can be a consideration when cultivating. The research was conducted from August 2024 to November 2024 at Padjadjaran University Marine Station in Pangandaran Regency. Aquaculture research has been conducted with 4 treatments namely A (80% anchovy feeding), B (100% anchovy feeding), C (80% rebon feeding) and D (100% anchovy feeding), repeated 3 times. Parameters observed were Average Daily Gain (ADG), Survival Rate (SR), histopathological hepatopancreas and lobster intestine. ADG and SR were reported quantitatively, while histopaptologic was reported descriptively. This study was conducted using a completely randomized design (CRD) and the results showed that lobsters fed with 100% anchovy feed (D) showed a high ADG of 1.63. which was different from lobsters fed with 80% anchovy feed (A), lobsters fed with 80% rebon feed (C) and 100% (D). This Calcium-rich feed gives a high SR and is equally good at 96% in treatments A, B, C and D. Histopathology of the hepatopancreas shows a healthy lobster condition

Keywords: ADG, green lobster, gastrointestinal health, survival rate, weight gain.

INTRODUCTION

Indonesia is the second largest lobster producer with a total production of 556 tons under Vietnam with a production of 1,100 tons and above Singapore with 58 tons and Sri Lanka with 19 tons. Lobster production from Indonesia still comes from fishing compared to production from aquaculture (Jones et al., 2019). To meet the increasing demand for lobster, the role of aquaculture is very necessary in meeting consumer needs, where currently there are problems of decreasing lobster populations in nature and habitat destruction. Experimental and commercial scale lobster farming activities have started in a number of countries such as Japan, Australia, India, New Zealand, and Vietnam. Some of these countries have used submersible cage systems equipped with various designs and materials (Cardia et al., 2017).

Lobster is a type of shelled animal that performs molting which plays a very important role in lobster growth. The molting is also followed by weight gain and body volume growth which is

characterized by an increase in the total weight value of the lobster and the carapace length value itself (Nelson, 2020). According to Scabra et al. (2023) lobster growth can be optimal if the calcium and phosphorus minerals that enter the body can be fulfilled from food and the environment. In lobsters and shrimp as crustacean animals, calcium acts as the main ingredient in the hardening process of the exoskeleton after the molting phase. Because one of the main elements that make up the shell in lobsters is calcium carbonate (CaCO3). One of the causes of failure in hardening the lobster shell is that the lobster does not succeed in absorbing calcium into the body / gastrolization.

According to Rivaie et al. (2023) stated that lobsters prefer natural food over frozen food. In addition, natural food is considered more effective because the nutrients contained in the feed have not been reduced due to processing (Al Huda et al., 2024) stated that lobsters fed diets that did not contain natural (fresh) feed showed lower growth rates than lobsters fed natural feed. This suggests that incorporating live organisms into the feed can increase lobster growth because the natural feed contains high attractants that can increase feeding response in crustaceans.

According to Purnamaningtyas & Nurfiani (2017) sand lobster is an organism that utilizes fish 1.81%, mollusca 49.80%, detritus 3.66% and crustaceans 44.5% as its food. Some natural foods that can be a substitute for raw fish containing calcium and phosphorus in lobsters from the mollusca, crustacean and gastropod groups are rebon shrimp (Acetes sp.), gold snails (Pomacea canaliculata), barnacles (Cirripedia) and anchovies (Stolephorus sp.) (Kunzmann et al., 2023). The characteristic of rebon shrimp is a small body without the fourth and fifth pereiopod pairs. The length is only about 1-4 cm with translucent color, black eyes, and red spots on the uropod (Figure 1).

A B

Figure 1. Rebon shrimp (A) and anchovies (B)

Currently, natural feeds that contain high Calcium and Phosphorus and provide the best Daily Growth Rate and the highest Lobster Survival Rate are anchovies and rebon, but have not been observed in more depth regarding Average Daily Gain and Survival Rate. Also needed is information on the histopathological condition of lobster hepatopancreas and intestine observed under a microscope (Ross et al., 2019).

Anchovy protein is composed of several kinds of essential amino acids, which are amino acids that cannot be formed in the body, but must come from food (Kari et al., 2022). The most prominent essential amino acids in anchovies are isoleucine, leucine, lysine and valine. In addition to containing essential amino acids, anchovies are also rich in non-essential amino acids. The prominent non-essential amino acids in anchovies are glutamic acid and aspartic acid. Other significant nutritional contributions from anchovies are minerals, calcium, phosphorus and iron. The nutritional values contained in 100 g of anchovy are energy 81 kcal, protein 16 g, water 79 g, calcium 500 mg, phosphorus 500 mg, iron 1 mg, vitamin A 60 SI, vitamin 4 BI, carbohydrate 7 g, fat 1.2 g.

Anchovies contain protein, calcium, vitamins and a number of other nutrients that are very beneficial for health and intelligence (Liu & Ralston, 2021). Anchovy protein contains several essential amino acids, which are amino acids that cannot be formed in the body, but must come from food. The most prominent essential amino acids in anchovies are isoleucine, leucine, lysine and valine. In addition to containing essential amino acids, anchovies are also rich in non-essential amino acids. The prominent non-essential amino acids in anchovies are glutamic acid and aspartic acid. The complete chemical composition of fresh anchovy is as follows: 77 kcal energy, 16 grams protein, 1 gram fat, 500 grams calcium, 500 mg phosphorus, 1 milligram iron, 47 vitamin A, 0.05 vitamin B, 60% water.

They also contain large amounts of selenium, a mineral that plays a role in heart health, thyroid, immunity, and bone health. Anchovies are also a good source of the minerals iron and calcium. Iron is necessary for the body to transport oxygen from the lungs, while calcium is important for strong bones. Anchovies are also a source of the minerals iron and calcium. Iron is necessary for the body to transport oxygen from the lungs, while calcium is essential for strong bones, rich in omega-3 fatty acids (Badoni et al., 2021). In fact, they are also considered oily or fatty fish, just like salmon, tuna, sardines and mackerel.

The nutritional content of anchovy feed is 70% protein content, 5.30% fat content and 7.60% carbohydrates. Anchovies have many vitamins and minerals that are beneficial for health, these strongly flavored fish are high in vitamin B3 or niacin, a vitamin that helps convert food into energy. They also contain large amounts of selenium, a mineral that plays a role in heart health, thyroid, immunity, and bone health.

One alternative feed that can be used for feed ingredients is rebon shrimp. Rebon shrimp is easy to obtain because it is widely traded by the community at a relatively cheap price, the results of research by Sholicin, et. al. (2020), also showed the addition of dried rebon shrimp gave an effect on fish growth.

All food eaten will enter the stomach/stomach, then into the midgut, foregut and hind gut, before finally exiting through the anus. In general, the role of the heaptopancreas is as a storage bag and initial digestion, here the feed size reduction has begun, as well as chemical digestion which is characterized by the presence of digestive juices and enzymes (Rønnestad & Morais,

2020). Feed that was originally complex in structure and molecules has been simplified, and is ready to be absorbed.

Furthermore, the digested food enters the foregut, midgut, and hindgut, here the biological digestion process occurs which is characterized by the presence of microorganisms that help the digestion process. Then there is a process of absorption of molecules that have been digested into simpler molecules into blood vessels by "active transport" to be disseminated to body cells. Indigestible food is taken to the anus for excretion.

Undigested feed is generally complex material that is difficult to break down physically, chemically and biologically, usually carbohydrate/fiber groups. What do lobsters prefer to eat in nature? Based on the analysis of the stomach contents of lobsters from nature, it can be seen that the 'prey' in nature are zooplankton, krill, filter feeders, fish larvae that contain a lot of protein, minerals and enzymes. If we cultivate lobsters, we should feed them chopped fish, small shrimp, squid and crushed shellfish in a fresh state, as much as 10 percent of the weight of the lobster per day (Gökoğlu & Gökoğlu, 2021).

Lobsters will attack each other if they are not given enough and fresh food. Therefore, lobsters need to be given fresh food in the right amount and at the right time, in addition, lobster cultivation containers need to be added with shelters to hide. Knowing the best type of natural food for juvenile size lobsters is anchovy (Stolephorus sp) or rebon (Acetes sp) with various doses in order to produce good growth and survival rates.

This study aims to fill these gaps by providing a comprehensive examination of how specific natural feeds like anchovy and rebon affect not only lobster growth and survival but also their internal histopathological conditions, setting it apart from existing research that has primarily focused on broader feed composition without detailed biological insights.

RESEARCH METHODS

The research design used a completely randomized design (CRD) to test combinations of calcium and phosphorus-rich feed types. The tools used in the research activities were: KJA cage size M, boat, digital scales (0.1 gram), thermometer, scissors, freezer, nets, refractometer, pH meter, DO kit, bucket, brush, rag, pot, basket, gloves, seser, weight, and plastic rope size 1 cm. The materials used in the research activities were: Green Lobster (Panulirus homarus) measuring between 40 grams - 50 grams, anchovies, rebon, salt, ice cubes, white sand, newsprint, and water.

The research was conducted in [location], and the study took place over a period of 4 months, from [start date] to [end date]. The preparation stage of lobster cultivation began with the procurement of KJA and its equipment, installation of the KJA, and sinking of the KJA. After the KJA was ready, the next step was the maintenance of juwana-sized lobsters, with 25 lobsters per cage. Natural food (anchovy and rebon) was also procured. Lobsters were cultivated for 2 months, with measurements taken every 10 days, including observations of feed and feeding habits. Water quality measurements in the KJA were recorded at the beginning and end of the activity. Differences in the response of the lobsters were analyzed using the F statistical test. If a significant difference was found, Duncan's further test was conducted (Gora et al., 2018).

RESULT AND DISCUSSION

Body weight gain of lobsters fed different types of natural food

Natural feeding has been done where the lobster response is as follows:

Table 1. Lobster weight (grams) in response to feeding various types of natural food at various doses for 40

Treatment	A/80% anchovy feed	B/100% anchovy feed	C / 80% rebon feed	A/100% anchovy feed
T0	64	64	64	64
T 1	85,2	87,9	87,5	86,6
T 2	99,7	102,5	101,8	103,1
T 3	116,4	122,3	117,1	121,3
T 4	125,1	125,4	124,5	129,1
Delta	61,1	61,4	60,5	65,1
ADG	1,53	1,53	1,51	1,63*

Note: asterisks behind the numbers indicate significant differences

Based on the data in Table 1, it appears that the ADG of the lobsters after 4 x 10 days is significantly different. From the table above, it can be seen that every time the weight is measured, there is a significant increase, which means that the ADG is also increasing, but the best is the lobster that is given anchovy feed as much as 100% of the dose, which is 1.63%. this shows that the natural feed given is able to convert into lobster meat.

A good and profitable lobster aquaculture development is one that produces lobster production with a good survival rate and growth rate. Lobster farmers in Lombok, Lobster Survival Rate ranges from 40-50% (Purnamaningtyas & Nurfiani, 2017) personal communication. The biggest challenge at this time is in addition to feed rich in Calcium and Phosphorus in accordance with food and feeding habits, but it is difficult to do because lobsters are cultivated in cages that are 5 meters below sea level.

Based on data obtained from previous research (Kunzmann et al., 2023), it can be seen that the good parameters are lobsters fed with anchovy and rebon feed, as shown in Figure 4.

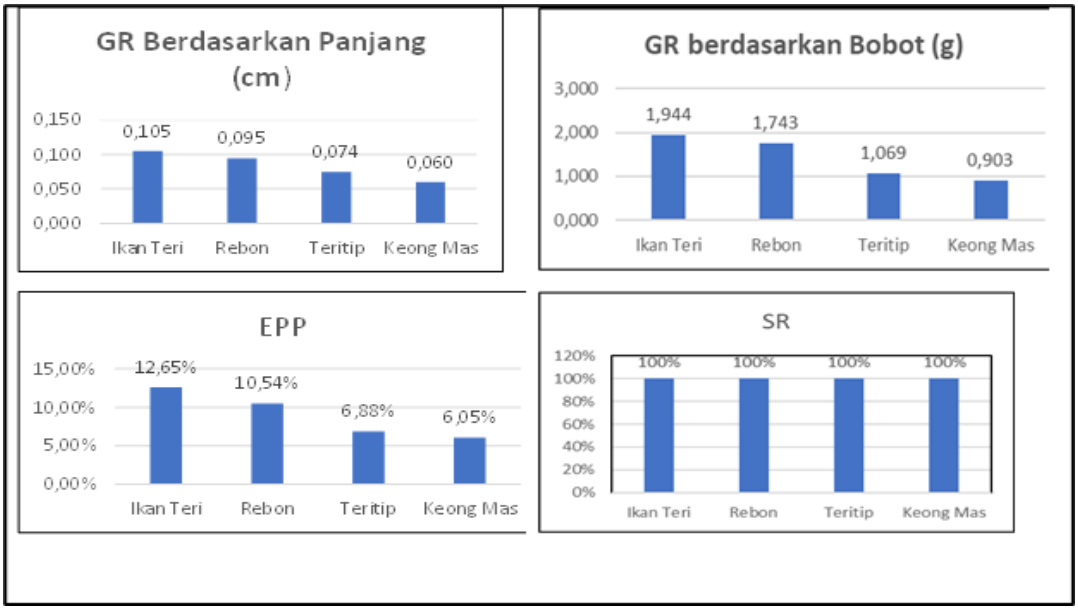

Figure 2. Growth Rate based on Length and Weight, Feed Efficiency and Survival Rate of 75 gram Initial Size Lobster fed with natural food rich in Calcium and Phosphorus (anchovy, rebon, barnacles and gold snail).
Source: Rostika et al (2023)

In general based on Figure 4, it can be seen that anchovy and rebon natural food provide the best parameters on growth rate and feeding efficiency of green lobster, compared to barnacles and gold snails. Anchovy protein is composed of several kinds of essential amino acids, the most prominent essential amino acids are isoleucine, leucine, lysine and valine (Ahmad et al., 2018). The nutritional values contained in 100 g of anchovies are energy 77 kcal, protein 16 g, calcium 500 mg, phosphorus 500 mg, and iron 1 mg. Dried rebon shrimp contains about 59.4 grams of protein per 100 grams. In addition to protein, rebon shrimp also contains various minerals, such as calcium, phosphorus, and iron. The following are some of the health benefits of prawns, namely helping to maintain the density and strength of the reinforcement system, helping to maintain muscle health, helping to strengthen the immune system, helping growth and development, Survival rate of lobster with 4 treatments is as good as 96% (Table 2).

Table 2. Lobster Survival Rate Data with 4 treatments (%)

Treatment	A/80% anchovy feed	B/100% anchovy feed	C / 80% rebon feed	A/100% anchovy feed
Initial (T0)	25	25	25	25
Total (T30)	24	24	24	24
%	96	96	96	96

Based on data in the field, the SR of lobsters after 40 days of rearing is 92%. This shows high SR data, compared to data in other places, with an average of 50%. This is due to the natural

diet of anchovies and rebon which are rich in Calcium minerals which play a role in increasing lobster immunity. The availability of food and shelter is important for lobster survival. In the absence of these, lobsters can become more cannibalized, which can lead to many deaths in the rearing tanks. The low survival rate is 40-50% (Cokrowati et al. 2012).

Gastrointestinal Condition of Lobsters

Lobsters are opportunistic eaters and generally feed on fresh food, but they are also known to be cannibals. In this study, both anchovy and rebon were preferred as natural food. They are most active at night, and their feeding behavior usually includes looking at food, grasping food with their claws and feet, breaking food into small pieces with their claws, moving food to their mouth with their jaws. Food that enters the mouth will be digested in the hepatopancreas first, and that is where absorption occurs, and then the food juice is circulated to all cells in the body (McGaw & Curtis, 2024).

The rest of the food will be discharged out through the anus down the intestine, the role of the intestine in shrimp and lobster is more or less the same drngan colon in fish. Images of the hepatopancreas and intestines of lobster fed with rebon and anchovy are in Figures 5 and 6.

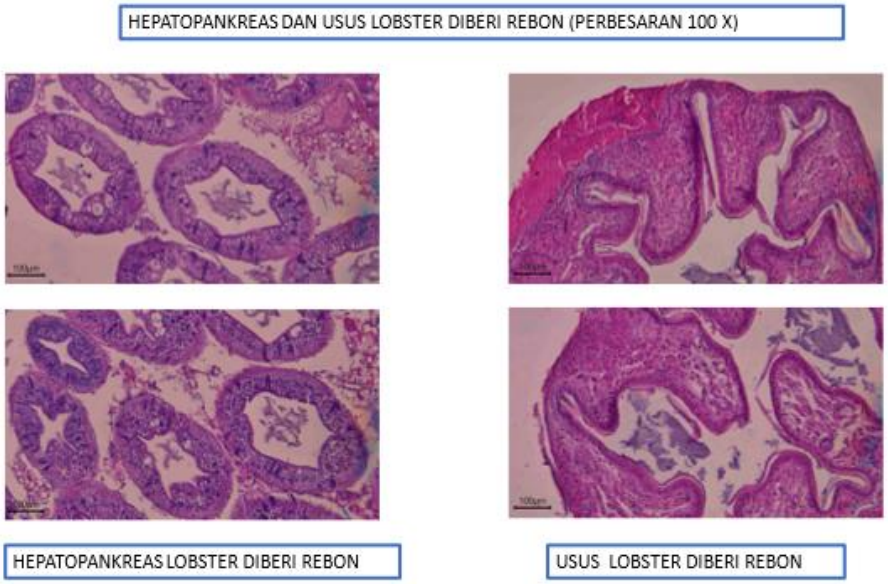

Figure 3. Hepatopancreas and Intestines of Lobsters Fed with Rebon Feed

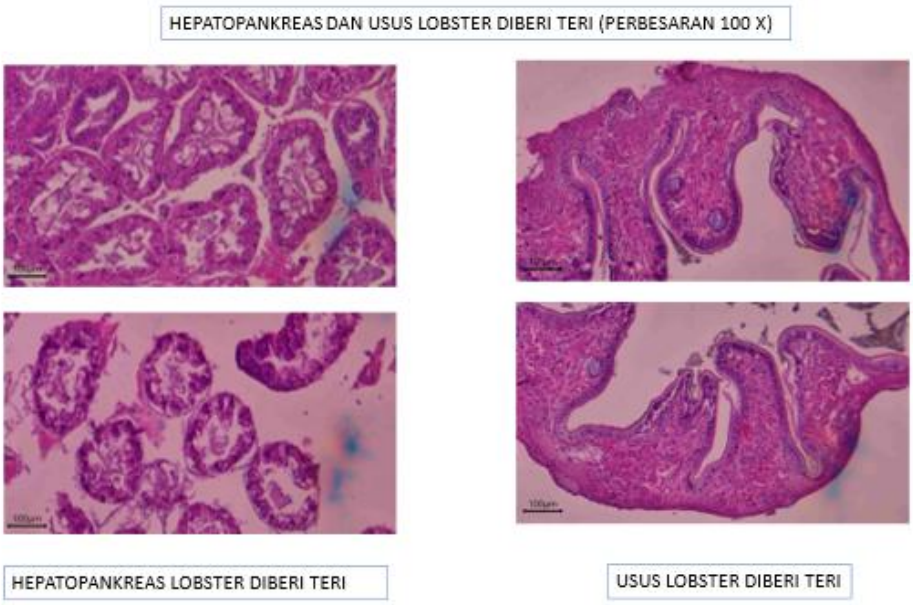

Figure 4. Hepatopancreas and intestines of anchovy-fed lobsters

CONCLUSION

Lobster breeding using natural feed that is high in Calcium and Phosphorus as much as 100% is the right dose. There was a significant weight gain and Average Daily Gain in treatment D, namely giving rebon shrimp with a delta weight of 65.1gram and 1.63. Survival rate is as good as 96% between treatments. The hepatopancreas and intestines of lobsters fed anchovy and lobster showed the health of the lobster's gastrointestinal tract. The observed feed habit of lobster is that lobster is a nocturnal eater with feeding habits and likes both types of natural food (anchovy and lobster).

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