Journal of Engineering Science and Technology
20th EURECA 2023 Special Issue October (2024) 122 - 128

PRODUCTION PERFORMANCE OF SCALLOPED SPINY LOBSTER PUERULUS (*PANULIRUS HOMARUS*) RAISED AT DIFFERENT CALCIUM DOSES

DUDI LESMANA[1,*], EDDY SUPRIYONO[2], WIDANARNI WIDANARNI[2], KUKUH NIRMALA[2], DEDI JUSADI[2], ASEP BAYU DANI NANDIYANTO[3], YUDI WAHYUDIN[1], ABDULLAH BAHARUN[1]

[1]Universitas Djuanda, Bogor, Indonesia
[2]IPB University, Bogor, Indonesia
[3]Universitas Pendidikan Indonesia, Indonesia
*Corresponding Author: Email: dlesmana20@gmail.com

Abstract

Lack of macrominerals like calcium, which affects moulting failure, decreasing water quality (low alkalinity and pH), delayed development, and death, are issues that arise in the lobster culture environment. Calcium needs to be added to the maintenance media to solve the issue. It is a novelty in research that the use of the proper dose of calcium in maintenance media is physiologically able to resolve these issues of environmental change, moulting, and growth. This study employed a fully randomized design with several calcium dosages, including 0, 20, 40, and 60 mg/L $CaCO_3$. The administration of various calcium significantly changed the absolute weight, for example, is affected by variations in calcium content ($P<0.05$). For the media to work at its best in terms of output, the ideal dose of calcium carbonate addition is 38.42 mg/L.

Keywords: $CaCO_3$, Environmental change, Panulirus homarus, Production performance

1. Introduction

The One of the most popular fisheries products in the world with significant commercial value is spiny lobster. Both domestic and foreign markets for lobster have high pricing. After tuna, squid, and shrimp, lobster will be the fourth-largest catch in the world in 2020 [1]. Scalloped lobster is the type of lobster with the third-largest availability in nature, behind ornate lobster and rock lobster, in Indonesia, a country with strong lobster potential [2]. The availability of lobster will be impacted by excessive natural lobster catching operations; hence cultivation activities must be done.

While there have been attempts to cultivate lobster in Indonesia, no significant progress has been made. Lack of macrominerals like calcium, which affects moulting failure, decreasing water quality (low alkalinity and pH), delayed growth, and death, is one of the issues encountered in lobster farming. Because marine organisms can't store much calcium, they must mostly get it from the sea [3]. Nearly all biological processes, including growth and development, inflammation, immunological response, and cell death, are known to involve Ca^{2+} [4]. Therefore, the lobster's capacity to survive will depend on its availability. Because significant amounts of calcium must collect from the environment to create shells, crustaceans have far more active calcium metabolism than other invertebrates [3]. Due to the fact that crustaceans routinely release their skeleton to expand their bodies, their usage of calcium is rated as being very high. Shi et al. [5] found that because calcium is widely absorbed and utilised during moulting, a crucial process for crustacean growth, there is a decreased availability of macro-minerals like calcium.

Low levels of alkalinity can also prevent lobsters from growing and moulting. The calcium uptake mechanism is impeded at pH levels below 5.75, and the intermoulting duration lengthens [6]. In aquaculture systems, managing environmental factors like mineral availability and ideal alkalinity effectively is crucial since it can have an impact on physiological processes, water chemistry, and the development of cultured organisms [7]. Calcium can be taken through food sources and the environment, although environmental calcium plays a much larger role in the process of hardening crustacean shells [3]. Bicarbonate and pH, in addition to calcium, can have an impact on the environment's mineralization [8, 9]. Calcium carbonate can be added to the solution to enhance the alkalinity, which serves as a pH buffer [10]. Stress brought on by low pH levels might hinder crustacean growth and survival [11].

The survival rate of lobster with an initial weight of 58.08 g that was raised at an alkalinity range of 200 mg/L $CaCO_3$ was able to grow by 86.67%, according to research on the effects of calcium addition and variations in alkalinity [12]. The individual compartment system allowed for the lobsters to be raised to reach an alkalinity range of 32.1 to 241.3 mg/L $CaCO_3$ [13]. According to research, alkalinity of 160 mg/L $CaCO_3$ increased the longevity of lobsters by 96.67% (weighing 51.22 g) [14].

There has not been any research done yet on the effects of adding calcite ($CaCO_3$) as a mineral source to boost puerulus development and improve water quality in the lobster puerulus rearing water. Therefore, the purpose of this study was to determine how different doses of calcite added to rearing water affected growth performance and water quality of scalloped lobster puerulus.

2. Materials and methods

2.1. Rearing and calcium determination

We used four treatments, namely control (without calcium administration), and calcium administration at 20, 40 and 60 mg/L $CaCO_3$. Each treatment was repeated for 4 treatments. The puerulus used in this study measured had an average of ± 0.22 g. They were obtained from fisherman from Lampung and Sukabumi District. The lobster was acclimatized for a week in an aquarium before being administered with the diet treatment. They were then reared for 40 days in 16 units of 60 x 40 x 40 cm3 (96 L) with a stocking density of 15 lobster/aquarium and is equipped with protein skimmer. To determination of the initial doses of treatments, we used four administrations at 0-100 mg/L and for observations of alkalinity and pH were carried out for 48 hours. The data obtained were tabulated using the Microsoft Excel 2013 program. Data Quantitatively analysed using Analysis of Variance (ANOVA) on intervals 95% confidence if there is a difference will be tested further with the Tukey test using Minitab 2020.

2.2. Production performance

The following production performance parameters were measured: weight gain, survival rate, specific growth rate and feed conversion ratio. All lobster from each treatment were measured at the beginning and at the final culture period. Growth performance was evaluated using the formula for survival rate (%) = 100 × final number of lobster/initial number of lobster, specific growth rate (%/day) = 100 × (ln final weight–ln initial weight)/total of the rearing period, and feed conversion ratio = total diet consumed/body weight gain [15].

3. Result and Discussion

3.1. Result

3.1.1. Production performance

The lobster puerulus that had been fed for 40 days and had been given a calcium dose of 40 mg/L had the highest absolute weight values (P 0.05). (Table 1). When 40 mg/L of calcium was added, growth performance tended to be better than control.

Table 1. Test model specifications and test conditions.

Parameter	$CaCO_3$ Doses (mg/L)			
	0	20	40	60
BM (g)	0.33 ±0.01b	0.61 ± 0,07a	0.64 ± 0.08a	0.60 ± 0.10a
SGR(%hari-1)	2.34 ± 0.13	2.38 ± 0,17	2.40 ± 0.07	2.28 ± 0.02
SR (%)	44.44 ± 0,29	46.67 ± 0,98	62.22 ±0.64	48.89 ± 1.04
BM (g)	0.33 ±0.01b	0.61 ± 0,07a	0.64 ± 0.08a	0.60 ± 0.10a

Note: The numbers on the same line followed by the same letter are not significantly different at the 5% test level (Tukey test). ;absolute weight (BM); specific grow rate (SGR), survival rate (SR).

3.1.2. Determination of optimum dosage of Calcium Carbonate

The optimal dose of calcium carbonate can then be calculated using the regression equation that is derived from the results of the quadratic response pattern that emerges from the observation of a variable. According to the quadratic formula for absolute weight growth, $y = -0.0002x^2 + 0.0168x + 0.3412$, 38.42 mg/L of calcium carbonate should be added to the media at the optimal rate as shown in Fig. 1.

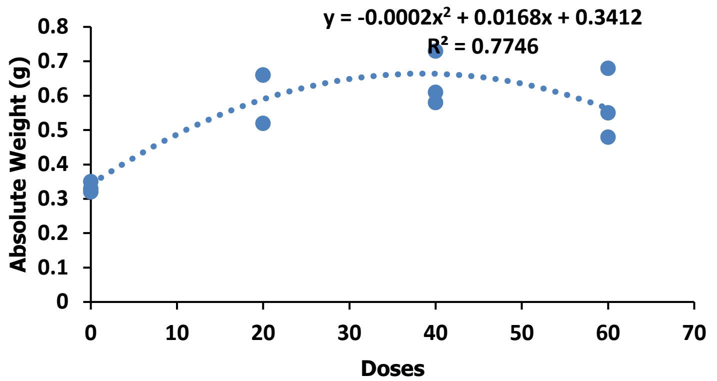

Fig. 1. Investigated shapes of projectiles (Geometry and dimensions).

3.1.3. Water quality

In general, the temperature, salinity, pH, dissolved oxygen, ammonia, nitrite, and nitrate parameters of Panulirus homarus with comparatively diverse doses of calcium are in conjunction with one another. Table 2 provides an overview of the study's environmental factors.

Table 2. Water quality of Panulirus homarus cultivated with different doses of calcium.

Parameter	$CaCO_3$ Doses (mg/L)			
	0	**20**	**40**	**60**
Alkalinity	59.36-147.40	70.67-152.60	63.60-137.40	67.84-166.40
pH	6.96-8.62	7.00-8.60	7.02-8.60	7.16-8.58
NH_3 (mg/L)	0.00-0.08	0.00-0.05	0.00-0.04	0.00-0.03
NO_2 (mg/L)	0.04-0.68	0.05-0.67	0.05-0.61	0.04-0.65
NO_3 (mg/L)	0.38-3.13	0.17-3.33	0.39-2.42	0.38-2.36
Temperature (ºC)	28.08-29.26	28.24-29.30	28.12-29.26	28.50-29.42
DO (mg/L)	4.96-6.00	4.84-5.84	4.84-5.96	4.90-5.96
Salinity (g/L)	30-35	30-35	30-35	30-35

3.2. Discussion

The primary factor in determining whether aquaculture production is successful is the production of aquaculture biota [16]. Growth is the length and weight gain brought on by the transformation of energy into body biomass. According to Solanki et al. [17], both internal and extrinsic influences have an impact on lobster growth. Physiological conditions or genetic makeup are examples of internal elements that influence growth, whereas the aquatic habitat and diet are examples of external factors. Additionally, crustacean growth is marked by recurrent moulting.

Overall, all treatments significantly increased lobster puerulus production performance (Table 1). This is evident from the absolute weight growth (BM) value for treatment 40, which was higher than that of the other treatments throughout the research.

According to the study's findings, puerulus kept at a calcium level of 40 mg/L was able to improve production performance when compared to other treatments. The optimal dose of calcium carbonate added to the media is 38.42 mg/L according to the quadratic equation derived for the absolute weight growth, which is given by $y = -0.0002x^2 + 0.0168x + 0.3412$.

The study's findings indicated that a rise in alkalinity was accompanied by an increase in pH (Table 2). The pH value is impacted by CO2 concentrations in addition to alkalinity. Conversely, a higher pH value is associated with a lower CO2 concentration, and vice versa [10]. In crustaceans, the calcification process is disrupted by the low pH value [9]. Ammonia levels, for example, are still within tolerance ranges for lobsters. The maximum ammonia tolerance level for lobster is less than 0.1 mg/L, according to Mojjada et al. [18]. Nitrate (NO_3) and nitrite (NO_2) concentrations varied during the study period. This demonstrates how Nitrosomonas bacteria, which turn ammonia into nitrite, and Nitrobacter bacteria, which turn nitrite into nitrate, carry out the nitrification process.

The findings of this study show that even after the addition of a protein skimmer, the nitrite and nitrate levels remain below the tolerance limits for lobster production. According to Estrella [19], lobsters can withstand nitrite concentrations of less than 5 mg/L and nitrate concentrations of less than 100 mg/L. The study's temperature, DO, and salinity parameters are suitable for lobster farming. According to Jones [20], lobster rearing requires temperatures between 25 and 31 degrees Celsius, DO concentrations greater than 3.5 mg/L [18], and salinities between 25 and 35 g/L [21].

4. Conclusion

Some concluding of this research is given below:

- The addition of a calcium dose of 40 mg/L can produce performance. The highest growth was absolute weight growth of 0.64 ± 0.08 g and survival rate was 62.22 ± 0.64 %.
- According to the quadratic equation, 38.42 mg/L of calcium carbonate addition is the ideal amount to add to the media in order to achieve the best production results. c speeds are analysed in this paper.

In order to improve the production performance of lobster puerulus where all biological processes, including growth and development running optimally, additional research on the usage of the ideal dose of calcium carbonate is suggested.

Acknowledgement

We would like to thank LPDP, Ministry of Finance of the Republic of Indonesia, which has funded research through the 2016 BUDI – DN (Indonesian Lecturer Excellence Scholarship – Domestic Scholarship) scholarship.

Funding

This work was funded by the Ministry of Finance, Republic of Indonesia. No.160430077803.

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