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Alternative supplementary biochemical food for growing up the freshwater lobster (*Cherax quadricarinatus*)

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Abstract. *Priyono E, Astirin OP, Setyono P. 2009. Alternative supplementary biochemical food for growing up the freshwater lobster* (Cherax quadricarinatus). *Nusantara Bioscience 1: 123-130.* This research denotes to know the influence of biochemical composition to the rapid grow of freshwater lobster on the stadium of postlarva (PL) of 60 within three months. This research used the complete random planning dealing with 4 treatments and each treatment would get 3 times cycle. The treatments cover, group K tested animal was treated with 100% mill food containing 30% of protein. Group A is given with food and biochemical food containing 13,34% of protein. Group B is treated with mill food which is mixed with biochemical food containing 10,7% of protein. While group C was tested by treating them with mill food and biochemical food containing 13,58%. After all the above mentioned would be set up within 3:1 comparison. The variable of this research was the length of the abdomen, cephalothorax, total length, and the wet weight. The data analysis is using ANOVA system on 95% power test completed by of SPSS version 13. The result of the research shows that mentioned treatments give us the same influence toward the growth of freshwater lobster. The composition of biochemical food with the containing protein around 10,7%,13.34%, and 13,38% has given the same effect to the lobster growth on postlarva 60 levels. There is a strong correlation between abdomen and cephalothorax and between the total length and the lobsters weight.

Keywords: *Cherax quadricarinatus*, supplementary food, water quality.

Abstrak. *Priyono E, Astirin OP, Setyono P. 2009. Alternatif penambahan suplemen hayati untuk meningkatkan pertumbuhan udang lobster air tawar* (Cherax quadricarinatus). *Nusantara Bioscience 1: 123-130.* Penelitian ini bertujuan untuk mengetahui pengaruh pemberian suplemen hayati sehingga dapat meningkatkan pertumbuhan lobster air tawar pada stadia post larva (PL) 60 pada masa pertumbuhan 3 bulan. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan 4 macam perlakuan, masing-masing dengan 3 kali ulangan. Perlakuan yang diberikan meliputi, kelompok K hewan uji diberikan pakan pabrik 100% dengan kadar protein 30%, kelompok A hewan uji diberikan pakan pabrik ditambah suplemen hayati dengan kadar protein 13,34%, kelompok B hewan uji diberikan pakan pabrik dicampur dengan suplemen hayati kadar protein 10,7%, sedangkan kelompok C hewan uji diberikan pakan pabrik ditambah suplemen hayati dengan kadar protein 13,58% masing-masing dengan perbandingan 3:1. Variabel yang diamati adalah panjang cephalothorax, abdomen, panjang total, dan bobot basah. Analisis data dengan menggunakan ANAVA taraf uji 95% dengan bantuan SPSS versi 13. Hasil penelitian menunjukkan bahwa perlakuan yang diberikan berpengaruh sama terhadap petumbuhan lobster air tawar. Komposisi suplemen hayati dengan kadar protein antara 10,7%, 13,34%, dan 13,58% memberikan pengaruh yang sama terhadap pertumbuhan lobster stadia post larva 60. Terdapat korelasi yang sangat erat antara cephalothorax dengan abdomen, dan antara panjang total dan berat lobster .

Kata kunci: *Cherax quadricarinatus,* suplemen hayati, kualitas air.

INTRODUCTION

The presence of freshwater crayfish in Indonesia has not been much known to the public, even there are some people who think that lobster species can only be obtained from the catch at sea and cannot be cultivated. Freshwater crayfish has long been grown in Queensland, Australia, and the United States, while in Indonesia only started in 1991, and still is limited done by some breeders due to the limited number of parent who must be imported from Australia. Freshwater crayfish consists of 500 species from families *Astacidae*, *Cambaridae* and *Paraticidae* whose habitat are in lakes, rivers, wetlands and irrigation channels (Sukmajaya and Suharjo 2003). Currently, the dominant species cultivated is *Cherax* spp., while the most popular species is *Cherax quadricarinatus* (Red Claw). *C. quadricarinatus* is a freshwater crayfish from Australia, found in rivers, swamps and lakes in the north coast of Australia, and northeastern Queensland. In Indonesia, this population is found in Papua (Bahtiar 2006). This species is much cultivated in Indonesia because it has high resistance to parasites, high adaptability and rapid growth compared with most other lobster species, which can grow to 50 cm with a weight between 300-600 g, meat content of 30% on average abdominal and the claws of 5-10% (Wiyanto and Hartono, 2007; Showalter 2006). Shrimp life consists of several stages including; stage nauplii from 0.32 to 0.58 mm size, stage zoea 1.05 to 3.30 mm, 3.50 to 4.80 mm are respectively Mysis stage and *postlarva stage* (PL). In this stage, it is shaped like an adult shrimp lobster so that the body can be distinguished between cephalothorax and abdominal (Haliman and Adijaya 2005).

Freshwater crayfish has similar characteristics with the sea water lobster, but the difference is in the maintaining. Freshwater crayfish also has an export opportunity in various countries (Petasik 2005). Lobster market share is not limited in the country but also found abroad. Export lobster cultivation tends to increase every year. In 1990, lobster exports to the Netherlands reached 745.132 tons or 89.59% of total exports of lobster in Indonesia (826 tones) In 1995, Indonesian exports reached 182 065 tones of lobster per year, 2% of total exports (3641.3 tones). Total exports of cultivated lobster reached 94,511 tons/year (Alexander 2006a, b).

Development of the freshwater crayfish is not separated from the high market demand, especially export markets either alive or frozen. Basically the main purpose is for the consumption of lobster, but lately begun to be exploited as ornamental lobsters. Cultivation of freshwater crayfish has become the best solution for the current business or for side business, given the current economic condition is uncertain, and the lobster market is always waiting for the supply of fresh water from the farmers every day both local consumption and export. In addition to the conditions that are very supportive, biological food source for the lobster is quite abundant. Some examples are the vegetables that are categorized as biological feed, such as: kale, spinach, bean sprouts, green beans, and cabbage. These types of feed that are categorized as tubers are cassava, sweet potatoes, and white yams. The type of feed that are categorized as meat is snail, snail carp, fish, chicken. With biological feed, the lobster can grow rapidly (Bahtiar 2006).

Freshwater crayfish maintenance is easy. It is very easy to obtain their food and the price is cheap. Starting from 1-month ranchers have gotten the sale of seeds. The average age of harvested of 1, 2, 3, 4 and 5 months depending on which program the farmers want. Everything is profitable only difference in profit and the initial capital only. Freshwater lobster eats everything. Lobsters eat all the kind of food. Feed is one of the most important parts of cultivation. Availability of food in sufficient quantities needed to support the success in the cultivation of freshwater grows out. Types of artificial feed or feed supplement that farmers use in freshwater aquaculture grow out are usually various kinds. The feed mill is quite expensive, for it is necessary to minimize the use of feed mills so as to reduce the operational cost of cultivation. Hence the need for additional research on the use of feed (biological) which have economic value and are available in the hope for improving the cultivation of freshwater crayfish to its maximum. To lobster, food is very important, because food occupies 40-50% of the total production cost that must be replaced (Lim 2006).

Some studies on artificial food ingredient use 4 ingredients in terms of fiber, protein, and fat. Bran contains 12.5 g/100 g protein, 4.9 g/100 g fat, and 18.3 g/100 g fiber. Fish meal contains 55 g/100 g protein, 6 g fat, and 2.4 g/100 g fiber. Bean cake contains 37.7 g/100 g protein 11.5 g/100 g fat, and 13.2 g/100 g fiber. Wheat flour contains 12.2 g/100 g protein 1.5 g/100 g fat, 2.7 g/100 g fiber (Mujiman 2004). According to Priscilla (2007) lobster feed contain 87.79% dry matter, fat 5.72%, 1.81% crude fiber, ash 2.79%, which effects on lobster growth rate.

Biological feed is more easily obtained in sufficient quantities, sustained and more durable. At least for one season of maintenance, the nutritional content can be adjusted according to the needs, shapes, and sizes that can be tailored to the needs of lobster. Durability in water can be adjusted with lobster eating habits, smell and taste can be set so it will look attractive and desirable. This kind of food is more available and cheaper than the food from manufacturers that are very often and sometimes difficult to obtain.

The purposes of this study are: (i) to know the difference of crayfish growth stages postlarvae (PL) 60 plants fed only with feed supplement mixed with various kinds of plant. (ii) To determine the optimum composition of biological supplement to the growth of freshwater postlarva stage crayfish (PL) 60.

MATERIALS AND METHODS

Material

Test animals. This study used test animals from species of freshwater crayfish *Cherax quadricarinatus*, PL60, size; long 2 inches (5.08 cm).

Biological food. Big pink earthworms *Allobophora caliginosa* species are from the local yard (in the vicinity of the bin), while carrots and green bean sprouts purchased at market Sukoharjo. Feed was given taste, about one-third of weight (ad *libitum*) was given 1 time a day, i.e. at 3.00 pm. The food is given in the afternoon because the lobster belongs to nocturnal animals and actively foraging substrate waters at night.

Experimental design

The experimental design used was Completely Randomized Design (CRD) which is an experiment that gives restriction to the allocation of treatment of the material or test area with basic assumptions. The size of the test animals is considered homogeneous, as well as tools, materials, media, and environment maintenance. The method is based on experiment conducted research methods to investigate the possibility of a causal relationship with how to use one or more condition treatment to one or more experimental groups (Srigandono 1989). The study was conducted using 4 treatments with repetition 3 times. The most notable treatment is the provision of supplementary food.

(i) K: control group with 100% of the feed mill, with 30% protein content.
(ii) A: group A with providing supplemental biological protein content 13.3%, mixed with the feed mill.
(iii) B: group B with biological supplementation 10.7% protein content mixed with the feed mill.
(iv) C: group C with biological supplementation 13.5% protein content mixed with the feed mill.

This treatment is given to know the composition of biological supplements best to influence the growth of lobsters PL 60.

Procedures

The procedure includes the preparation of this research study, the implementation of the core research and measurement of water quality include pH, temperature and dissolved oxygen.

Preparation. Activities of preparatory phase of this study are as follows: (i) Preparation of equipment and materials to be used. (ii) Preparing test animals which 60 PL of lobster seed length of 2 inches (5.08 cm) with the same age. (iii) Preparation of test media that is used to prepare water originating in the bin into a bath of aerated settling maintenance and 24 hours later measured the temperature, pH and Dissolved Oxygen.

Implementation. Tested animals were put in the maintenance container that had been filled with water taps which had been accommodated for 24 hours, chlorine content was decreased and the temperature was set to room temperature, as high as 15 cm and aerated to increase the supply of natural oxygen container cultivation. Lobsters fed for 8 weeks with record growth (cephalothorax length, abdominal length, total length and weight of crayfish) were performed every 2 weeks, which it is expected that within 2 weeks the lobsters have reached measurable growth. The daily activities were carried out according to treatment of each feeding at 3.00 pm. Penyifonan has done as much as 30% of the volume of water every day and replaced with water from reservoir. The weekly events container cleaning and maintenance was done as well as measuring its growth every 2 weeks. Eligibility and allocation of water quality referred to PP. 82 year 2001 concerning the management of water quality and water pollution control.

Observation / data collection. The data observed were growth cephalothorax length, abdominal length, total length and weight of lobster. Growth cephalothorax average length, abdominal length, and total length was measured using the formula length growth Effendi (1997):

$$L = Lt - Lo$$

L = length of individual average growth (cm)
Lo = The mean length of individual baseline (cm)
Lt = The mean length of individual end of the study (cm)

Calculation of average individual weight was calculated using the formula Stickney (1979):

$$W = Wt - Wo$$

W = average weight of biomass growth (g)
Wo = average weight of test animals at the beginning of the study (g)
Wt = Average weight of test animals at the end of the study (g)

Data analysis

Analysis of data is with data normality test which is used to find out that the data obtained from a normal distribution, then the next stage is to test the homogeneity. The objective is to find out that the data will be tested come from a homogeneous population. After the data otherwise acting normal and homogeneous test next stage of analysis of variance (ANOVA) followed by Duncan multiple range tests (DMRT) at 5% significance level to find out the real differences among the treatments.

RESULTS AND DISCUSSION

Maintenance of environmental factors

Media environment maintenance is very influential on the test animals. Water quality plays a role for lobster, remembering that organisms have a certain tolerance limit to environmental factors in which the organisms are located (Ward 1987; Handy 1992). Water quality effects on lobster growth. Water quality parameters that must be controlled during the process of research are the degree of acidity (pH), Dissolved oxygen (DO) and temperature. The measurement results of water quality during the maintenance process are shown in Table 1. This table shows that there is no significant difference between the time of observation (January, February, and March). It is expected that with this evidence, then the things that affect the growth of the lobster is really from the treatment given. These water quality parameters included in Class I under Government Regulations (*Peraturan Pemerintah*) No. 82/2001 (Table 2), whose allocation can be used for drinking water, and others that require the designation of water quality in common with the use of these.

Table 1. Water quality data on maintenance period.

Parameter	Units	Observation time		
		January Average ± SD	February Average ± SD	March Average ± SD
pH	-	7,579 ± 0,083	7,410 ± 0,051	7,060 ± 0,379
Suhu (t)	^{0}C	25,425 ± 0,154	25,292 ± 0,211	25,342 ± 0,090
DO	mg/L	8,089 ± 0,068	8,124 ± 0,062	8,021 ± 0,168

Table 2. Quality parameters under Government Regulations (*Peraturan Pemerintah*) No. 82/2001

Parameter	Units	Class			
		I	II	III	IV
Physics					
Temperature	^{0}C	-	-	-	-
Organic chemistry					
pH *)		6-9	6-9	6-9	5-9
DO **)	mg/L	6	4	3	0

Note: * pH (acidity), when the naturally outside that range will be determined based on the state of nature. ** DO (dissolved oxygen), a minimum number

The degree of acidity (pH)

Average pH value for maintenance is stable, the average ranged from 7.06 (March 2008) to 7.57 (January 2008) the situation is quite qualified in the maintenance of *C. quadricarinatus.* Optimum pH between 7.5 to 8.5 in the maintenance of lobster (Alfrianto 1990), 7.2 to 8.5 (Bahtiar 2006), 7-8 (Wiyanto and Hartono 2007). The observation of pH during maintenance can be seen in Figure 1, where the pH did not change significantly. Rapid change in pH will result in lobsters becoming stressed, the condition of the body will be weak, it can even result in death. The pH 4-5 is the deadly levels of acidity, no reproduction, whether for reproductive the pH is 7-9, while pH 11 is deadly levels of alkalinity (Cholik et al. 1986). PH value becomes the parameter directly related to CO2 and ammonia. Changes in pH occur if there is accumulation of CO2 respiration, so the pH will be low (Ghufron 1997). The higher the density of lobsters, the higher the concentration of CO2 in water will be, but lobsters can still tolerate the levels of CO2. Possible increased levels of CO2 in the water can be reduced by the replacement of water by 30% of overall volume. The existence of other toxic gases that allow the disruption of lobster growth is ammonia gas. Ideally, the ammonia content is less than 0.01 ppm (Boyd and Lithkopper 1982).

Based on statistical analysis as listed in Table 1, it is known that the pH did not significantly affect lobsters growth because during the measurement the pH value is tolerable for lobster.

Dissolved oxygen (DO)

DO levels greatly affect the metabolism of lobster, respiration always needs oxygen necessary to the survival of lobster. Another thing to note is the accumulation of food residue and dirt from the lobster that will also reduce oxygen levels, because in order to digest the food scraps and manure needs oxygen. This results in decreased levels of dissolved oxygen in maintenance media. Oxygen dissolved in water is needed for respiration of the lobsters ranged from 4-8 mg/L, if the oxygen requirement is fulfilled, it will be better for lobster growth, so that its activities would be good also because microbes decompose the remaining feed and feces.

Average value of DO during maintenance shows digit range between 8.02 to 8.12 mg / L. This indicates that the value is stable (does not show a high fluctuation). DO optimal for maintenance of lobsters is between 4-8 mg / L (Alfrianto and Eviliawaty 1990), at least 3 mg / L (Bahtiar 2006), 3-7 mg / L (Singh 2003). DO observations during maintenance can be seen in Figure 1.

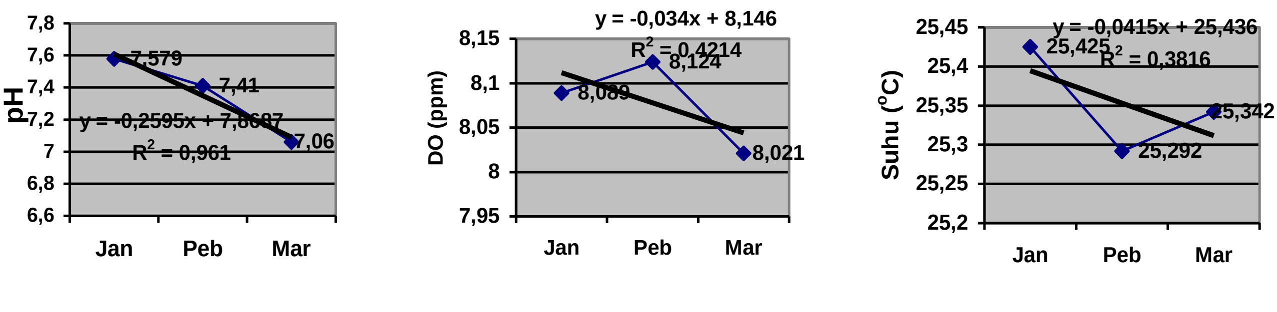
From the statistical tests as listed in Table 2, between DO with lobster growth there was a low correlation proved the value of "r" ($0.2 \leq r \leq 0.4$) that during the maintenance in dissolved oxygen it did not affect the growth of lobsters. Results of measurements carried out showed that DO in the range of 8.12 mg/L, so the situation was quite ideal for the life of lobster and did not affect its life.

Most organisms use oxygen in process of decay. This process can take place due to the activity of bacteria that describes organic materials such as food remains and lobsters feces (Alfrianto 2006). Problems of this kind if not treated quickly will occur resulting in decrease of accumulation of dissolved oxygen (DO).

Temperature

Water temperature is an environmental factor affecting the rate of metabolism. Changes in body temperature will follow changes in water temperature, so if there is a decrease in environmental temperature there will lower the lobster's body temperature that will decrease the rate of metabolism. The situation is even worse if the lower ambient temperature conditions can cause lobster to die.

If the ambient temperature increases, the lobster temperature will increase as well, so the metabolic rate also increases. If the increase in temperature continues to rise it will reach critical temperature where lobster will experience death from *hypoxia* (Afrianto and Eviliawaty 2005). An increase in water temperature, generally will result in increasing the biological activity and will result in increased need for oxygen in waters, in other words, the increase in temperature water will decrease the level of solubility of oxygen, and it will reduce the ability of aquatic organisms in utilizing the available oxygen for the survival of biological processes in water (Asdak 2004).



A B C

Figure 1. Relations with the observation time: A. pH, B. DO, C. temperature. Note: **pH**: y shows regression equations, determinant coefficient R2 expressed in the figure showing the large R2: 0.961 means that if the pH factor for maintenance can contribute to the influence of 96.1%. This happens because during the measurement between the months of January and February the average pH did not show a high deviation (0.083 and 0.051), but in March the pH has decreased resulting in a higher deviation (0.379) so that this will result in R2 will be higher. Similarly, although the decline was still within the optimum value. **DO**: y indicates the regression equation, the determinant coefficient R2 states shown in the figure of R2: 0.4214 means for maintenance and DO factors can contribute only at 42.14%. This is supported by the data for DO measurement that showed no difference in the high deviation that would result in R2 which did not show high numbers. **Temperature**: y indicates the regression equation, the determinant coefficient R2 expressed in the figure showing the large R2: 0.3816 mean temperature factor contributing effects only as much as 38.16%. During temperature measurements, it showed no difference in the height deviation so that R2 did not show high numbers.

Value of average temperature during maintenance ranged from 25.29 to 25.490 C, and this is a stable condition that it is qualified enough for the maintenance of lobster as proposed by Alexander (2006a, b) that the requirements temperature in the maintenance of lobster is 24-260C with a maximum fluctuation day and night 2-30C. Observations of water temperature during maintenance was shown in Figure 1. The analysis of statistical tests is listed in Table 2. Then during the maintenance, temperature was not correlated with growth, this proved the value of "r" ($r \leq 0.2$). Temperature does not affect the growth of lobsters. According to Iskandar (2006a, b) optimum temperature for lobsters maintenance is 24-260 C, in accordance with temperature measurements made are at the value of tolerance so that this situation does not affect the life of lobsters.

The three elements of water quality (temperature, pH and DO) does not affect the life of lobsters because the values of the three factors are at tolerant level for lobster life, if the element of water quality is outside the tolerance it will affect the lives of lobsters.

The correlation between the length of lobsters and the water quality

Results of correlation test to determine the relationship between the growth of water-quality lobster (DO, temperature, and pH) are shown in Table 3. Based on statistical analysis as shown in Table 3, the acquisition of test results of correlation between the quality of water and the growth of lobsters are as follows: between the length of lobster with DO showed a low correlation. It can be proven all values of "r" is $0.2 \leq r \leq 0.4$, whereas temperature and pH on the growth of the lobster are very low or not correlated, as shown by the value of "r" is $r \leq 0.2$. On the whole, it can be stated that the fluctuation changes in the value of DO, temperature, and pH did not affect the length of lobsters.

Table 3. The value of correlation between length and weight of lobster with water quality

Parameter	Value r (correlation)		
	DO	Temperature	pH
Length of cephalothorax (cm)	0.226	-0.033	-0.275
Length of abdomen (cm)	0.239	-0.102	-0.101
Length of total (cm)	0.244	-0.069	-0.203
Weight (g)	0.109	0.016	-0.095

Growth of lobster

Lobsters cephalothorax length

To determine that the treatment given could provide a different and real effect not then ANOVA was performed. The ANOVA results can be seen in Table 5. The observation of the control group showed a mean length in initial cephalothorax maintenance is 3.075 cm, and at the end of the maintenance is 3.794 cm. The difference is 0.715 cm. For treatment group A (13.34% protein), the mean length of 3.018 cm cephalothorax initial maintenance, maintenance end 0.887 cm 3.905 cm difference , for group B (10.7% protein), the mean length of 3.020 cm cephalothorax initial maintenance, maintenance end 3.738 cm, 0.718 cm difference, for group C (13.58% protein), the mean length of initial maintenance cephalothorax 2.909 cm 3.827 cm end maintenance, difference 0.918 cm. The mean total length cephalothorax comparisons are shown in Table 6, where the fourth-highest treatment group difference in length cephalothorax is group C with the tabulated results from the difference between 0.918 cm. However, this difference has not shown significant differences ($P < 0.05$) when compared with other groups.

Table 5. Analysis of the results of ANOVA test toward lobster length and weight.

Parameter	Average	Values significance	Description
Length of cephalothorax (cm)	3.005	0,252	-
Length of abdomen (cm)	2.512	0,503	-
Length of total (cm)	5.524	0,335	-
Weight (g)	5.822	0,361	-

Note: Count with significance level $p < 0.05$, which was not significantly different between treatments.

Table 6. The mean ratio of cephalothorax total length lobster during the breeding period.

Group	Initial length ±SD	Final length ±SD	Accuracy	Growth length
Control	3.075 ± 0.061	3.794 ± 0.037	85.197%	0.719
A	3.018 ± 0.046	3.905 ± 0.045	81.881%	0.887
B	3.020 ± 0.084	3.738 ± 0.141	84.975%	0.718
C	3.062 ± 0.111	3.748 ± 0.089	85.754%	0.686

Note: the highest abdominal growth length is A group

Growth is assumed as the network that meant the addition of structural proteins in the body tissues as proposed by Buwono (2004). Of course, the biological supplements with low protein content will produce poor growth (group B), but otherwise, if biological supplement with optimal levels of protein will produce more optimal growth as well. From the tabulated results from the long accretion cephalothorax, the highest are in group C who were given supplements as much as 13.5% of biological protein. Supplement composition of group C was: 50% green bean sprouts, 30% carrot, and 14% earthworms. From the different tests carried out then, longer cephalothorax in each treatment group was not significantly different ($p < 0.05$). This condition indicates that the feed mill (control group) was not significantly different from biological additional supplements. There is potential to reduce pure composition of feed mill with an additional biological supplement.

The length of lobster abdominal

The calculation of growth of cephalothorax abdominal steps is the entire length of the tested animals that were measured starting from the end carapace abdomen up to the sixth vertebra using shove (calipers) with a precision of 0.02 cm. The results are as follows: Control group mean abdominal length is 2.562 cm at the beginning of the breeding, and at the end of the breeding is 3.200 cm. The difference in average length is 0.638 cm. Group A (protein 13.34%), average length in initial breeding is 2.514 cm, and 3.32 cm at the end of breeding. The difference in average length is 0.806 cm. Group B (protein 10.7%) the mean length is 2.528 cm abdominal at the beginning of breeding, and at the end of breeding is of 3.238cm. The difference in mean length of 0.71 cm. While group C (protein13, 58%), the mean length of the abdomen at the beginning of the breeding is 2.471 cm, and 3.261 cm at the end of breeding. The difference in average length is 0.79 cm. The mean length of the abdomen of lobster during the breeding period is shown in Table 7.

Table 7. Comparison of mean abdomen length of lobster during breeding

Group	Initial length ±SD	Final length ±SD	Accuracy	Growth length
Control	2.562 ± 0.013	3.200 ± 0.028	84.341%	0.638
A	2.514 ± 0.073	3.320 ± 0.072	80.462%	0.806
B	2.528 ± 0.079	3.238 ± 0.132	82.586%	0.710
C	2.471 ± 0.106	3.261 ± 0.064	80.509%	0.790

Note: the highest abdominal growth length is A group.

From the four groups, the highest treatment group difference is the biological treatment using the supplement with protein content of 13:34% (A) with the numbers 0.806 cm difference. This can happen because the protein content in food is essential and should be available for the lobster. The optimal protein content will result in maximum growth of lobsters (Mudjiman 2004). Proteins in food are used for long-bone growth, including growth in the abdomen. The addition of biological supplements with high levels as much as 13:34% (A) proved to have been able to increase growth in lobster abdominal length parameters as proposed by Balazs and Ross (1976). Artificial diets with protein content of 25-35% proved to have been able to increase the growth rate of lobsters. Greatest length progress is group A with additional supplements of protein content of 13.34%. From the statistical tests that were conducted, the power difference, the length of the abdomen of each treatment group were not significantly different ($P < 0.05$). This condition indicates that the feed mill (control group) was not significantly different to supplement existing biological potential to reduce the pure composition of feed mill with an additional supplement biological.

Lobsters total length

From the data tabulated in Table 8 above, it can explain the growth of the total length of lobster during the breeding. In the control group which used 100% feed mill the total length at the beginning of the breeding is 5.637 cm, and at the end of the breeding, it is 6.994 cm. The difference is 1.35 cm. In group A (protein 13.34%), the length average is 5.533 cm at the beginning of the breeding, and at the end of the breeding is 7.226 cm. The difference is 1.693cm. For group B (10.7% protein) the length is 5.548 cm at the beginning of the breeding, and at the breeding end it is 6.977cm and therefore the difference is 1.429cm. For group C (13.5% protein), the average length at the beginning of the breeding is 5.380 cm, and at the breeding end it is 7.088 cm, and it has 1.708 cm difference. The mean total length of the lobster is shown in Table 8. For the entire length of the lobster, we found that protein supplement that is best for the growth of lobsters is the protein levels of 13:58% (C) with the excess length of 1.708 cm. It is because the protein contained in the feed is still at the optimum level (between 25-35%). According to Balazs and Ross (1976), and Buwono (2004), rapid growth is determined whether the protein is absorbed. In general, lobsters need food between 20-60% protein content, while the optimum level is between 30-36%. When the protein content in feed is less than 6% (wet weight), then lobsters will not go grow well (Mudjiman 2006). Protein is one of the main factors affecting lobster growth. When we look at the data on the levels of protein with content of 13:58%, it means proteins that are absorbed by the lobster is also the most high-absorbed, and protein is used for the formation of body parts in addition to activities. The additional supplements with high levels of feed composition of 13:58% in group C is composed of 50% mung bean sprouts, 30% carrot and 14% earthworms, the highest proven growth difference if compared with additional supplements with lower protein content.

Table 8. The mean ratio of total length of lobster during the breeding.

Group	Initial length ±SD	Final length ±SD	Accuracy	Growth length
Control	5.637± 0.053	6.994± 0.043	84.007%	1.357
A	5.533± 0.110	7.226± 0.109	81.235%	1.693
B	5.548± 0.155	6.977± 0.275	83.865%	1.429
C	5.380± 0.216	7.088± 0.148	80.627%	1.708

Note: the highest growth of total length is C group.

From the analysis test that was done, the total length of each group was not significantly different ($P < 0.05$). This condition indicates that the feed mill group (K) was not significantly different from biological supplements. There is potential to reduce the pure composition of feed mill with biological supplements.

Lobster weight

Results tabulated in Table 9 on lobster weight shows that the average lobster weight control treatment at the beginning of the breeding is 5.905g, and it became 11.793g at the end of the breeding, it means that the difference is 5.89 g. For group A (protein 13.34%) the weight is 5.679 g at the beginning of the breeding, and at the end of the breeding it was 13.2g, it means that the difference is 7.56 g. Group B (10.7%), average initial breeding weight is 5.850 g, average final breeding weight is 12.513g, thus the difference is 6.613 g. Group C (13.58% protein), the weight is 5.859g at initial breeding, and the weight at the end of the breeding is 12.615 g, as much as 6.756 g different.

Food major function is to provide energy for the activity of body cells. Proteins are part of the nutrients in food working for growth and energy sources, and another function of protein is in regulating metabolism. The body needs the energy generated in the metabolism in the formation of components such as muscle tissue which affects the weight of lobsters. The quality of protein in food lobster not only defined by the content in food sources alone but is determined also by the balance of amino acids they contain (Murtidjo 2007). Lobsters require proteins as much as 20-40% (Lim 2006). Said lower feed quality when essential amino acid levels are also low in protein, essential amino acid balance will determine the quality of feed (Buwono 2004).

Supplements type A (protein13, 34%) proved capable of producing excess growth which is highest when compared with type B and C. Supplements produce the highest weight difference supplement with protein content of 13.34%. Protein required Lobster is a balanced protein is not the most phones, even low feed levels will show its protein a higher weight when compared with a supplement containing a higher protein (Afrianto Eviliawaty 2008). Supplements types B and C have a lower weight difference because supplements containing protein that is less obvious weight will inhibit the growth of lobsters, otherwise, if it is high protein supplements will result in lobster become lazy and consequently difficult molting, and weight growth is inhibited. Mean lobster weight ratio is shown in Table 9.

Table 9. The mean weight ratio of lobster during the breeding.

Group	Initial length ±SD	Final length ±SD	Accuracy	Growth length
Control	5.905± 0.368	11.793±0.327	52.910%	5.888
A	5.679± 0.090	13.242±0.690	43.472%	7.563
B	5.859± 0.501	12.615±1.795	48.282%	6.756
C	5.850± 0.322	12.513±0.768	48.685%	6.663

Note: the highest weight lobster is group A

In the calculation on accuracy for the control group, A, B, and C we can see the low accuracy rate for the calculation of data which was taken preliminary and final only, so that statistically it will cause high deviation, and in turn, the high deviation will cause a low accuracy rate.

From the above tabulation, it can be concluded for the weight parameter, then the excess weight that most of the lobster group treated with the protein content of biological supplements is 13:34% (group A), with the result of excess weight 7.561 g. This can be explained that the proteins are organic substance which contains levels of hydrogen, nitrogen, sulfur, and phosphorus. Substance is the main food that contains nitrogen. Protein is essential for life of lobster because it is an active protoplasm in all living cells, not only the protoplasm of living cells are composed of protein but also the nuclei that control the cell activity. Protein is the largest part of muscle meat, organs, and bones (Murtidjo 2007).

From the tabulation, the highest weight is group A with supplementation of biological protein content 13.34%. From the analysis conducted, the test of lobsters weight did not show significantly different results (P <0.05). This condition indicates that the feed mill group (K), not significantly different from biological supplements, there is potential to reduce the composition of feed mill with a supplement purely biological.

The composition of the optimal biological supplements.

Optimal composition of supplements can be known from the ANOVA test conducted. The test results were the growth of the three treatment given did not produce significant difference, because the levels of protein contained in supplements do not have biological difference. But it still provided the protein content in optimum boundary according to Iskandar (2006a, b) lobsters protein needs ranged from 35-40%, so the supplements produce the same growth.

Correlation between cephalothorax length with lobster abdominal

Correlation between cephalothorax length with lobster abdominal is a very close relationship (r: 0.804). If cephalothorax experience addition in length then it will be followed by the addition in abdomen. According to Showalter (2006), cephalothorax growth and abdomen are comparable or equal.

Correlation between total length with and weight of lobster

Correlation between total length with weight of lobsters is a close relationship (r: 0.777), meaning that this can be explained that the main function of the protein is to repair tissue and to encourage growth, growth that covers the length and weight of lobster (Murtidjo 2007).

CONCLUSION

The use of three kinds of biological and feed supplement plant in the ratio 1: 3 has the same effect on the growth of freshwater crayfish (*Cherax quadricarinatus*). In the breeding period for 3 months starting from PL 60, the biological supplementation tended to give better results compared to the feed from factory only. The composition of biological supplement with protein content 13.34%, 10.7%, 13.58% gave the same effect on the growth of *C. quadricarinatus* (PL 60). There is a very close correlation between cephalothorax with abdominal, and between total length with the weight of lobsters.

REFERENCES

Afrianto E, Eviliawaty. 2005. Fish feed and its development. Kanisius. Yogyakarta. [Indonesian]

Afrianto E, Eviliawaty. 2006. Shrimp-pond making techniques.. Kanisius. Yogyakarta. [Indonesian]

Afrianto E, Eviliawaty. 2008. Fish food (manufacture, storage, presentation, development). Kanisius. Yogyakarta. [Indonesian]

Asdak C. 2004. Hydrology and watershed management. 3rd ed. Gadjah Mada University Press. Yogyakarta. [Indonesian]

Bahtiar Y. 2006. The cultivation of freshwater crayfish. Agromedia Pustaka. Jakarta. [Indonesian]

Balazs GH, Ross E. 1976. Effect of protein source and level on growth and performance of captive freshwater prawn, *Macrobrachium rosenbergii*. Aquaculture 7: 299-313.
Boyd CE, Lichtkopler F. 1979. Water quality management in pond fish culture. International Center for Aquaculture, Agricultural Station, Auburn University. Alabama.
Buwono D. 2004. The need for essential amino acids in the diet of fish. Kanisius. Yogyakarta. [Indonesian]
Cholik F, Artati, Arifudin R. 1986. Water quality management. In: Fish Manual Series 1 No. 36. Research and Development Center for Fisheries. Jakarta. [Indonesian]
Effendie MI. 1997. Fisheries Biology. Pustaka Nusatama. Yogyakarta. [Indonesian]
Ghufron MHKK. 1997. Biology crab and milkfish in polyculture pond systems. Dahara Prize. Semarang. [Indonesian]
Government Regulation (Peraturan Pemerintah) Number 82 Year 2001, 14 December 2001 on: Management of water quality and water pollution control.
Haliman WR, Adijaya DS. 2005. Vannamei shrimp. Penebar Swadaya. Jakarta. [Indonesian]
Handayani SR. 1992. Prospect of the use of liquid extract of rubber seed (*Havea brasilliensis* Meull arg) in the transport of tiger prawn seeds (*Phanaeus monodon* Fabricius). [Thesis S1]. Faculty of Fisheries. Bogor Agricultural University. Bogor. [Indonesian]
Iskandar K. 2006b. Lobster (seeding, arrest, enlargement). Kanisus. Yogyakarta. [Indonesian]
Iskandar. 2006a. Cultivation of freshwater crayfish. Agromedia Pustaka. Jakarta. [Indonesian]
Lim 2006. Introduction to freshwater crayfish. www.budidaya.lobster air tawar.com. [Indonesian]
Mujiman A. 2006. Food fish. Penebar Swadaya. Jakarta. [Indonesian]
Murtidjo A. 2007. Guidelines for fish feed mix. 6th ed. Kanisius. Yogyakarta.
Petasik. 2005. Hatchery of Papua local freshwater lobster. Penebar Swadaya. Jakarta. [Indonesian]
Priskila F. 2007. Techniques for preparing and making a cake to feed shrimp (*Macrobrachium rosenbergii* DeMan) in Shrimp Hatchery Center Probolinggo, East Java Province. Shrimp Hatchery Center. Probolinggo. [Indonesian]
Showalter C. 2006. Australian red claw crayfish. www.fishgeeks.com
Sing TC. 2003. Cultivation of freshwater crayfish. *A*gromedia Pustaka. Jakarta. [Indonesian]
Srigandono B. 1989. Experimental design. Faculty of Animal Husbandry, Diponegoro University. Semarang. [Indonesian]
Stickney RR. 1979. Principles of warm water aquaculture. Departemen of Wildlife and Fisheries Science, A&M University. Texas.
Sukmajaya Y, Suharjo I. 2003. Freshwater lobster fishery commodities are prospective. Agromedia Pustaka. Jakarta. [Indonesian]
Wardoyo STH. 1987. Water quality criteria for fisheries in the analysis of environmental impacts. PPLN-PUSDI-IPPSL. Bogor Agricultural University. Bogor. [Indonesian]
Wiyanto RH, Hartono R. 2007. Freshwater lobster hatchery and rearing. Penebar Swadaya. Jakarta. [Indonesian]