The use of local raw materials and fermented feeds for the growth of Giant Prawns (*Macrobrachium rosenbergii*)

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Abstract. The purpose of this study was to evaluate the effect of local raw materials feed and fermented feed on the growth of giant prawns. This study was conducted using a completely randomized design (CRD) consisting of 3 treatments with 3 replications, each treatment was (A) commercial feed as a control; (B) feed based on local raw materials and (C) feed based on fermented local raw materials. The study was conducted at Sukawening Village, Dramaga District, Bogor Regency. The giant prawn that used has an initial weight of 0.31±0.005 g with stocking density of 50 fish/m². The container used was a tarpaulin pond measuring 2x3x0.5m². The study was conducted for 53 days. Observation variables include growth parameters, feed conversion, protein and fat retention, body amino acids and digestive tract enzyme activity. The results showed that feed based on local raw materials was able to produce relative growth (620±10.43%), specific growth rate (3.80±0.28%/day), protein retention (43.26%) and fat retention (36.1%) higher than other treatments and gave the lowest feed conversion value (1.07) compared to commercial feed and feed based on fermented local raw materials. These results indicate that feed based on local raw materials potential to be applied to giant prawn culture.

1. Introduction

The giant freshwater prawn (*Macrobrachium rosenbergii*) has been a promising local prawn commodity. The giant freshwater prawn has some advantage over other freshwater shrimps, including the achievement of large body size and wide adaptability in several aquaculture environments with a salinity range of 10%-12%. Therefore, the giant freshwater prawn has a bright prospect of raising public consumption both at home and abroad in order to satisfy people's nutritional needs.

The lobster farming business has been done by farmers or by fish farmers. However, the problem is that the high price of feed reduces the profits obtained by farmers. One of the reasons for the high price of feed is that raw materials such as fish meal and soybean meal still rely on imports. The use of local feed as an alternative feedstock to reduce import feed is one of the solutions to lower the price of feed. According to Wardono [1] using local raw materials for feed could save production costs by 25-30%. According to Neraca [2] feed based local feedstuff is capable of lowering the value of the FCR (feed conversion) of catfish from 1.5 to 1.2, leading to an increase in the margin of grower by 50%.
In addition to the use of feeds-based local raw materials, the microbial applications in fish feed also play an important role in increasing feed efficiency. Through a process called fermentation, the digestibility of feed ingredients can be increased because bacteria produce extracellular enzymes that play a role in the breakdown of nutrients such as protein, carbohydrates, fat and fiber into simpler compounds that are more easily digested and absorbed by the fish digestive tract.

Through the use of feed based on local raw materials and fermented feed based on local raw materials, it is hoped that an efficient type of feed will be obtained at a low price. The feed is expected to reduce the production costs of a good local fish farming business so that it can increase the welfare of farmers by obtaining maximum profits. However, at present there is little information about the use of local raw materials and the application of fermentation in giant freshwater prawn feed. Therefore, it is necessary to conduct research with the aim of evaluating the use of local raw materials and the application of fermentation in giant freshwater prawn feed.

2. MATERIALS AND METHODS

The research was carried out at the location of the farmer in Sukawening Village, Dramaga District, Bogor Regency, West Java. This study used nine tarpaulin ponds measuring 2 x 3 x 0.5 m². The individual used for research were giant freshwater prawns with an average weight of 0.31±0.005 g, a length of 1-2 cm, and stocking density of 50/m⁴. This study was conducted using a completely randomized design (CRD) consisting of 3 treatments with 3 replications. The treatments were: (A) commercial feed as a control; (B) feed based on local raw materials and (C) feed based on fermented local raw materials.

During the study, giant freshwater prawn ponds were given shelter. Giant freshwater prawns is fed 5% of the biomass weight three times a day (morning, afternoon and evening) for 2 months. Growth observations were carried out every two weeks. The local raw materials used were trash fish meal, bran meal, corn meal and cassava starch residue meal. While the microbes used for fermentation process was Bacillus subtilis TS2b.

2.1 Preparation of microbes and the fermentation process of feed raw materials

Before use, probiotic bacteria were grown on Tryptic Soy Broth media, incubated under static conditions at 28 °C for 24 - 48 hours. Feed raw materials such as trash fish meal, cassava starch residue meal, bran meal, imported fish meal, corn meal and soybean meal were weighed according to the formulation (Table 1), put into a 50 L basin, then added a sterile distilled water with comparison of 1:6 and stirred until evenly distributed. After that, 1% inoculum of B. subtilis TS2b (10⁹ CFU/mL) was added, then incubated at 28°C for 48 hours. The fermented raw materials are then dried and ground again to become fine flour.

2.2 Test feed

The test feed used was iso protein (40.80 compounds 1.74%) and iso energy (3637.51 kcal) with the formulation and nutrient content contained at table 1.
Table 1. Formulation and composition of the test feed proximate

| No. | Raw Material Type                | Formulation/Composition of Feed (%) |
|-----|----------------------------------|-------------------------------------|
|     |                                  | Feed B | Feed C |
| 1   | Trash fish meal                  | 26     | 26     |
| 2   | Imported Fish meal               | 20     | 20     |
| 3   | Soybean meal                     | 20     | 20     |
| 4   | Bran meal                        | 10     | 10     |
| 5   | Corn meal                        | 6      | 6      |
| 6   | Cassava starch residue meal      | 8      | 8      |
| 7   | Premix                           | 2      | 2      |
| 8   | Fish oil                         | 1      | 1      |
| 9   | Palm oil                         | 1      | 1      |
| 10  | Choline cloride                  | 0.5    | 0.5    |
| 11  | Tapioca starch                   | 4.48   | 4.48   |
| 12  | Methionine:Lysine                | 0.02   | 0.02   |
| 13  | DCP                              | 1      | 1      |
|     | Total                            | 100    | 100    |

Proximate (%)

| No. | Ash       | 15.61 | 17.71 |
|-----|-----------|-------|-------|
| 2   | Crude Protein | 39.13 | 38.60 |
| 3   | Crude Lipid   | 6.46  | 4.70  |
| 4   | Crude fiber   | 3.48  | 4.50  |
| 5   | NFE         | 35.33 | 34.50 |

Note: NFE = Nitrogen free Extract

The production of feed based on local raw materials is carried out by weighing all the feed ingredients according to the formulation (Table 1), then mixed and stirred until evenly distributed and then pelleted with a pellet machine. The production of feed based on fermented local raw materials was done by adding feed raw materials that have been fermented with fish oil, palm oil, methionine-lysine, premix, choline chloride and tapioca stirred until evenly distributed and made into pellets, as well as the treatment of feed B. Feed A was commercial feed with protein content of about 30.78%, fat 5.75%, fiber 4.70%, ash 11.79% and NFE 46.99%. While the following amino acid composition in each treatment is presented in Table 2.
Table 2. Amino Acid Composition of feed A (commercial feed), feed B (feed based on local raw materials), feed C (feed based on local fermented raw materials)

| Amino Acids (%) | Feed |   |   |
|-----------------|------|---|---|
|                 | A    | B | C |
| Serine          | 1.99 | 1.94 | 2.06 |
| Glutamic acid   | 5.9  | 5.64 | 5.99 |
| Phenilalanine   | 2.58 | 2.1  | 2.63 |
| Isoleucine      | 1.57 | 1.93 | 2.02 |
| Valine          | 1.8  | 2.24 | 2.24 |
| Alanine         | 1.79 | 2.39 | 2.34 |
| Arginine        | 3.01 | 2.78 | 2.86 |
| Glycine         | 2.45 | 2.9  | 3.01 |
| Lysine          | 1.85 | 2.78 | 2.3  |
| Aspartic acid   | 2.96 | 3.5  | 3.89 |
| Leucine         | 2.65 | 3.29 | 3.18 |
| Tyrosine        | 1.44 | 1.25 | 1.61 |
| Proline         | 2.12 | 1.92 | 1.98 |
| Threonine       | 1.8  | 2.08 | 2.01 |
| Histidine       | 1.19 | 1.27 | 1.19 |

2.3 Research Parameters
Parameters measured included relative growth [3], specific growth rate [3], feed conversion [4], protein and fat retention, and digestive tract enzyme activity of giant freshwater prawns.

Relative growth can be expressed by the formula of [3]:

\[
RG = \left(\frac{Wt - Wo}{Wo}\right) \times 100\%
\]

Description:
- RG = Relative growth (%)
- Wt = Average of final weight (g)
- Wo = Average of initial weight (g)
The Specific Growth Rate was calculated by [5] using the formula:

\[ SGR = \frac{\ln Wt - \ln Wo}{T} \times 100\% \]

**Description:**
- **SGR**: Specific growth rate (%)
- **Wt**: Average of final weight (g)
- **Wo**: Average of initial weight (g)
- **T**: Time of rearing (days)

Feed efficiency was analyzed based on [4] using the formula:

\[ FCR = \frac{FC}{(Wt + D) - Wo} \]

**Description:**
- **FCR**: Feed conversion ratio
- **Wt**: Final Biomass (g)
- **Wo**: Initial Biomass (g)
- **D**: Dead fish weight during the study (g)
- **FC**: Feed consumed during the study (g)

2.4 *Data analysis*

The data obtained were used for the calculation of the test parameters. The effect of treatment on test parameters was analyzed using analysis of variance (ANOVA), if the results of the ANOVA test showed a significant difference, it would be further tested using Duncan's test at a 95% confidence interval. The tool used is the SPSS of software program version 16.00.

3. RESULTS AND DISCUSSION

The relative growth of giant freshwater prawns during the study increased by 5-6 times from the initial weight. The relative growth in sampling I, II and III showed that feed C (feed based on fermented local raw materials) was higher than feed B (feed based on local raw materials) and A (commercial feed). However, in the last sampling, feed B had the highest relative growth (620±10.43%) and the lowest was feed A (427.95±1.93%) (Figure 1). Similarly, the calculation of the specific growth rate of giant freshwater prawns. During the I, II and III samplings, the specific growth rate of giant freshwater prawns fed with feed C was higher than feed A and B. However, in the last sampling, feed B (3.80±0.28 g/%/day) was higher compared with feed C (3.54±0.04 g/%/day) and A (control) (3.14±0.06 g/%/day) as shown in Figure 2.
During the 15th to 45th day of rearing, giant prawns on feed C were higher than other treatments. However, during the last sampling, the highest relative growth was seen in feed B. This could be due to the fact that when the giant freshwater prawns were in the post-larva stage, digestive enzymes such as proteases, amylase and lipase had not yet fully developed. The availability of simple nutrients from fermented feed is higher than other feeds so that it can be directly absorbed by the giant freshwater prawns and can increase the growth of young giant freshwater prawns. However, as they mature, the ability of these prawns to digest feed become higher, their digestive enzymes are fully formed so that the use of fermented feed is no longer effective in increasing growth. The protein content of feed B which was higher than the other treatments was seen to be able to meet the protein requirement for the growth of giant prawns (Table 1). According to Palinggi [6] and Nawir [7] a higher protein content to a certain amount will result in better growth in fish. This happens because fish require high levels of protein to a certain level to meet the body's protein needs.

In addition, the high growth of giant freshwater prawns in feed B was thought to be due to the availability of essential amino acids such as valine, leucine, lysine isoleucine and so on (which played a role in increasing fish growth) in sufficient quantities in feed B (Table 2). Feed B had a higher content...
of valine, leucine, lysine, isoleucine and other amino acids when compared to other treatments and it was suspected that the amount was able to support the growth of the giant prawns being reared. Moreover, in field-scale research there are many factors that influence the results of the study, especially those related to environmental factors. Temperature, dissolved oxygen, pH, levels of nitrite, nitrate and ammonia, abundance of plankton and other environmental factors affect the appetite, growth and survival of fish so that it is more difficult to control compared to laboratory scale research.

Feed B has the highest protein retention which was 43.26%, followed by treatment C, which was 40.81% and the lowest was protein retention in the control treatment (feed A) which was 33.64% (Figure 3). According to Halver [8], the value of protein retention indicates the quality of protein in the feed, the higher the value of protein retention, the better the feed. Based on this statement, it can be seen that feed B and C have better protein quality, especially protein content and amino acid balance, which is more suitable for rearing giant prawns than feed A. [9] and [10], protein retention is influenced by several factors including the protein content of the feed, the balance of amino acids and the energy ratio of the feed.

![Figure 3. Protein retention (%) of giant freshwater prawns treated with different types of feed](image)

Fat retention describes the ability of fish to store and utilize dietary fat. The fat retention of giant prawns in this study showed that the feed B resulted in the highest fat retention of 36.1%, followed by feed C of 32.8% and the lowest was feed A of 28.3% (Figure 4). This is thought to occur because excess glucose is converted into fat reserves through the process of lipogenesis which is stored in body tissues.
Figure 4. Fat retention (%) of giant prawns treated with commercial feed (A), feed based on local raw materials (B) and feed based on fermented local raw materials (C) during rearing.

Feed Conversion Ratio (FCR) or feed conversion ratio (Figure 5.) during the study from the highest to the lowest were feed B (1.07); C (1.65) and A (1.43). FCR is calculated to determine how much feed is needed to increase 1 kilogram of fish weight. The less feed given, the smaller the FCR value so that the more efficient and high-quality feed is used [11]. The results of this study showed that the use of feeds B and C gave a smaller FCR value than the control feed (feed A). This indicates that the use of feed B and C is more efficient than commercial feed.

Figure 5. Feed conversion ratio (FCR) of giant prawns treated with commercial feed (A), feed based on local raw materials (B) and feed based on fermented local raw materials (C) during rearing.

To determine the digestibility of the treated feed and to assess the different feed ingredients, an analysis of the activity of digestive enzymes such as proteases and amylase was carried out. Protease is a proteolytic enzyme that plays a role in the process of breaking down proteins into short chain peptides and amino acids. While amylase is an enzyme that plays a role in the process of breaking down starch.
into simpler compounds including glucose. The activity of protease enzymes in the digestive tract of giant prawns treated with feed B and C was lower than that of feed A (Table 3). The highest amylase enzyme activity in giant prawns was obtained in treatment A and the lowest was in treatment B. The high and low enzyme activity in the digestive tract of fish was caused by several factors, including the complexity of the feed structure, feed content, gut ability, eating habits, temperature and season [12]. The lower protease and amylase activity in treatments B and C indicated that giant prawns were better able to digest feed B and C than feed A. This was probably due to the complexity of the structure of feed B and especially feed C which was simpler than feed A. secretes many enzymes to digest protein and carbohydrates in feed.

Table 3. The activity of protease (U/mL) and amylase (U/mL) enzymes in the digestive tract of giant prawns treated with commercial feed (A), feed based on local raw materials (B) and feed based on local fermented raw materials (C) during the study

| Enzyme Activity (unit/mL) | Treatments |
|---------------------------|------------|
|                           | Feed A     | Feed B     | Feed C     |
| Protease                  | 0.044±0.01 | 0.035±0.02 | 0.033±0.01 |
| Amilase                   | 0.030±0.004| 0.011±0.003| 0.025±0.011|

4. CONCLUSION
Provision of feed based on local raw materials and feed based on fermented raw materials in giant freshwater prawn nursery was able to produce growth (620±10.43%), specific growth rate (3.80±0.28%/day), protein retention (43, 26%), fat retention (36.1%) and higher in giant prawns than commercial feed treatments and resulted in the lowest feed conversion value (1.07).

5. REFERENCES
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