Optimum Level of Dietary Protein for Prawn*¹Osamu DESHIMARU*² and Yasuo YONE*³

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In order to determine the optimum level of dietary protein for prawn, *Penaeus japonicus*, the growth and feed efficiency of prawn were examined by using purified diets containing 2 to 66.2% protein. The feeding experiment was conducted for four weeks at 25–28°C.

The prawn grew well on the diets containing from 48 to 57% protein, and the 52% protein diet produced the maximum weight gain. The daily feed intake ratio was high for a low protein diet, and declined to a constant and normal level for the diets containing more than 52% protein. High feed efficiency was obtained within the 52 to 62% protein level, while poor efficiency resulted with diets containing more than 62% or less than 52% protein.

From these findings, it was concluded that the optimum dietary protein level for the prawn was within the range of 52 to 57%, this gave good results on the basis of weight gain and feed efficiency.

It has been reported by several workers that penaeid shrimps, such as *Penaeus setiferus*¹⁾, *Penaeus aztecus*²⁾, and *Penaeus indicus*³⁾, required diets containing less than 40% protein for favorable growth. On the other hand, it has been found by DESHIMARU and SHIGENO⁴⁾, and DESHIMARU and KUROKI⁵⁾ that the growth of prawn, *Penaeus japonicus*, was promoted with a diet containing more than 50% protein. These findings suggest that the requirement of the prawn for protein is considerably higher compared with those of other penaeids. However, a desirable dietary protein level for the prawn has not yet been established.

In the present study, in order to determine the optimum dietary protein level for the prawn, the growth and feed efficiency of the prawn were examined by using the modified purified diet⁶⁾ with different protein levels.

Materials and Methods

Prawn and Feeding Method

The prawn, weighing approximately 0.8 g in average, was used as the test animal. They were initially fed on a compounded feed for one week, and then twenty-five prawn were selected and maintained in a polyvinyl chloride aquarium (70 liters) for each test group. The feeding experiment was

conducted for four weeks at 25–28°C. Other rearing conditions were the same as those described in the previous paper⁵⁾.

Test Diet

A mixture of casein and egg albumin in a 9:1 ratio was used as the protein source in the diet. Ten test diets with different protein levels were provided by replacing the casein-albumin mixture with glycogen (Table 1). Crude protein content of the casein-albumin mixture was determined to be 91.7% by Kjeldahl method. Dietary protein level of each test diet was calculated from the compounded amount of the casein-albumin mixture. A 2% level of glycine, which was added to the test diet as an attractant, was also included in the protein content. The protein levels of the test diet were within a range of 2.0 to 66.2% in the present study. The test diets were prepared as a dry pellet with less than 10% moisture, after adjusting the pH to 6.4–6.6 with 25% NaOH solution.

Results and Discussion

The growth curves of the prawn fed on the test diets with the different protein levels, and the relationship between the dietary protein level and

*¹ Studies on a purified diet for prawn-XII.

*² Kagoshima Pref. Fish. Exper. Sta., 21-1 Kinko-cho, Kagoshima, Japan (弟子丸 修: 鹿児島県水産試験場).

*³ Fish. Res. Lab., Kyushu Univ., Tsuyazaki, Munakata, Fukuoka, Japan (米 康夫: 九州大学農学部附属水産実験所).

Table 1. Composition of the test diet

Ingredient	No. of diet									
	1	2	3	4	5	6	7	8	9	10
Protein* ¹	0	10	20	30	40	50	55	60	65	70
Glycogen	70	60	50	40	30	20	15	10	5	0
Others* ²	30	30	30	30	30	30	30	30	30	30
Crude protein* ³ (%)	2.0	11.2	20.3	29.5	38.7	47.8	52.4	57.0	61.6	66.2

*¹ A mixture of casein and egg albumin in a 9:1 ratio.

*² Soy bean oil, 3; Pollack liver oil, 3; Vitamin mixture[†], 4; NaH₂PO₄·2H₂O, 10; KCl, 2; Trace metals, 0.2; Cholesterol, 2; RNA, 0.5; Glycine, 2; and Cellulose, 3.3 g/30 g.

*³ The composition is the same as reported previously⁵.

*³ Crude protein content of the test diet was calculated based on nitrogen content of the casein-albumin mixture as well as the glycine which was added as an attractant.

Fig. 1. Growth curves of the prawn fed on the diets containing different protein levels.

* Dietary protein level.

the percent gain of body weight, feed efficiency, or daily feed intake ratio are illustrated in Figs. 1 and 2, respectively.

Growth Curve

Among ten test diets, high growth was exhibited by the prawn fed on the diets (Nos. 6, 7, and 8) containing protein within the range of 47.8 to 57.0%. The diets with 20.3 to 38.7% protein levels (Nos. 3, 4, and 5), and with a 61.6% protein level (No. 9), however, lowered the growth of prawn. The diets containing as low as 2 and 11.2% protein (Nos. 1 and 2), and as high as 66.2%

Fig. 2. Relationship between the protein levels in the diet and percent gain of body weight, feed efficiency, or daily feed intake ratio.

protein (No. 10), remarkably depressed the growth of prawn. The two diets, which contained the highest and the lowest level of protein, produced a negative gain after two weeks of feeding.

Relationship between the Protein Levels in the Diet and the Percent Gain of Body Weight, Feed Efficiency, or Daily Feed Intake Ratio

As shown in Fig. 2, the maximum percent gain of body weight was obtained with the 52% protein diet. When the diet contained less than or more than 52% protein, the percent gain of the prawn was depressed. The daily feed intake ratio was found to exceed 30% by the prawn on the 2% and 11% protein diets. The intake ratio decreased with the rise in protein level, and reached a constant and normal level with the diets containing more than 52% protein. A low feed efficiency found on diets containing less than 40% protein was remarkably ameliorated at higher protein levels of 52 to 62%, but depressed again at a 66% protein

level. From these results, it was concluded that the optimum dietary protein level for the prawn ranged from 52 to 57% on the basis of the percent gain of body weight and feed efficiency.

ANDREWS *et al.*¹⁾, VENKATARAMIAH *et al.*²⁾, and COLVIN³⁾ found that *P. setiferus*, *P. aztecus*, and *P. indicus* required diets containing less than 40% protein for favorable growth. Recently, NEW⁷⁾ reported in his review that the optimum protein level for penaeids is probably in the 27–35% region. The difference in the optimum dietary protein level for *P. japonicus* and other penaeids may be due to the difference in feeding habit, as the former is carnivorous while the latter is omnivorous or herbivorous.

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