

Nutritional Requirements of Prawn V : Requirements for Choline and Inositol

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Nutritional Requirements of Prawn-V

Requirements for Choline and Inositol*

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Abstract

The dietary choline and inositol requirements of prawn, *Penaeus japonicus*, were examined by the feeding trials using the artificial diet.

The growth and survival of prawn received the choline- or inositol-deficient diets were found to be inferior to those of the complete diet group. The required levels of choline chloride and inositol were estimated to be approximately 60 mg and 200 mg per 100 g of the diet, respectively, under the experimental conditions used.

The dietary choline requirements of fresh water and marine fishes have been demonstrated in salmon and trout,¹⁻³⁾ channel catfish,⁴⁾ carp,⁵⁾ eel,⁶⁾ and red sea bream.⁷⁾ However, there are no informations concerning the choline requirement of crustaceans. Recently, the authors have reported that the phospholipid contents in prawn, *Penaeus japonicus*⁸⁾ and shrimp, *Palaemon paucidens*⁹⁾ were considerably high as compared with those of neutral lipid throughout molting cycle. These results postulate that the choline requirements of crustaceans are probably high. Also, the inositol requirements of aquatic animals have been established in salmon and trout¹⁻³⁾, carp^{10,11)}, eel⁶⁾, and red sea bream^{7,12)}, and some deficiency symptoms have been observed in these animals.

The present paper deals with the choline and inositol requirements of the prawn, *P. japonicus*.

Experimental

Prawn. The prawn, *P. japonicus*, 0.5–1.0 g in body weight, was obtained from the Subtropical Marine Biological Laboratory, Kagoshima, Japan.

Diet. The modified artificial diet of the previous papers^{13,14)} was used as a basal diet in this experiment. Soybean casein in the artificial diet was substituted by milk casein. The commercial vitamin-free casein (from milk) was further purified by extraction with boiling ethanol two times. Each diet was correctly adjusted to pH 6.8

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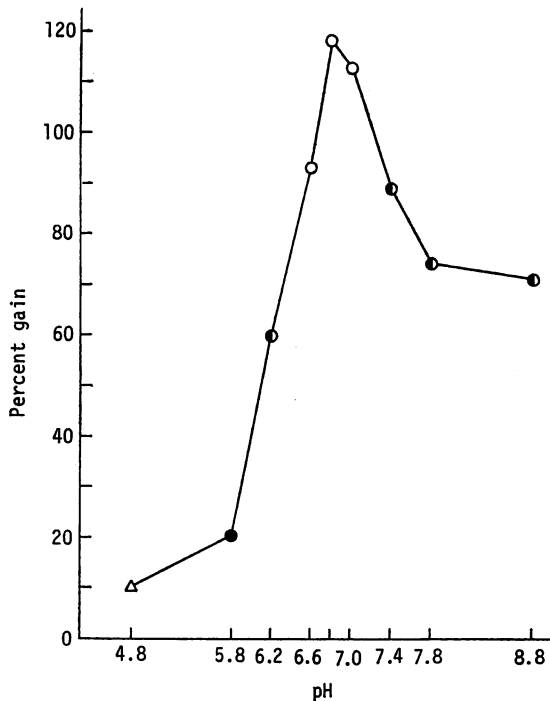


Fig. 1. Effect of pH in the diet on the growth of prawn.
 Rate of food intake: (Δ) 0%, (\bullet) 50%, (\odot) 70%, (\circ) 100%.
 (Average body weight of prawn: 0.5 g; Feeding period: 30 days)

before heating of it. The pH of diet affected on the appetite and growth of prawn. As shown in Fig. 1, the growth of prawn was apparently retarded in the pH of below 6.2 and above 7.8.

Choline and inositol to be tested were individually deleted from the complete diet.

Feeding method. The prawns were maintained in the troughs (30 liters) equipped with circulating systems by filtration through a sand bed. The troughs were supplied at the rate of 2 liters per min. with the sea water previously adjusted at $25 \pm 1^\circ\text{C}$. Further, one-third of sea water was renewed every day. Twenty animals per one trough were used in each experimental, and after 30–40 days feeding of each test diet, the average weight and survival of animals were determined.

Results

Qualitative requirements for choline and inositol. The results of the feeding experiments of prawn maintained on the choline- and inositol-deficient diets and on the complete diet involving 300 mg of choline chloride and 200 mg of inositol per 100 g of diet are shown in Table 1. The prawn received the complete diet indicat-

Table 1. Effects of dietary choline and inositol on the growth of prawn.

| Diet | Feeding period (days) | No. of prawn at start | Average body weight | | Percent gain |
|-------------------------|-----------------------|-----------------------|---------------------|-----------|--------------|
| | | | Initial (g) | Final (g) | |
| Complete diet | 30 | 20 | 0.49 | 0.90 | 84 |
| Choline-deficient diet | 30 | 20 | 0.40 | 0.52 | 30 |
| Inositol-deficient diet | 30 | 20 | 0.50 | 0.65 | 30 |

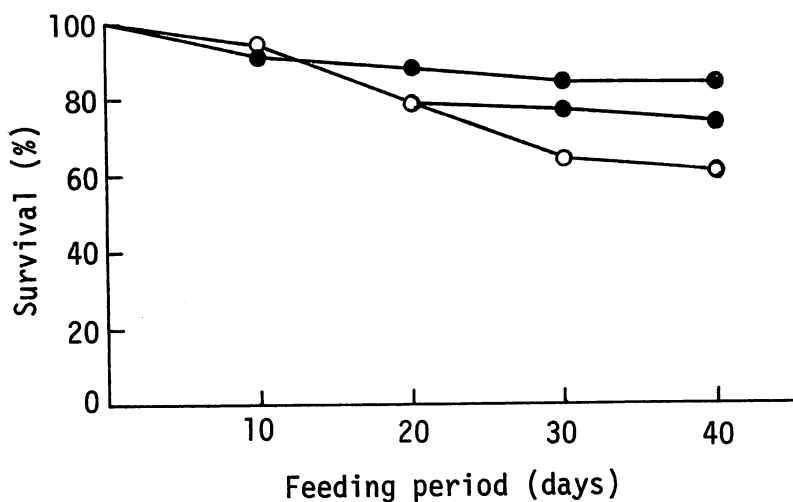


Fig. 2. Survival of the prawn kept on complete diet and choline-deficient diet.

—●— Complete diet
—○— Choline-deficient diet

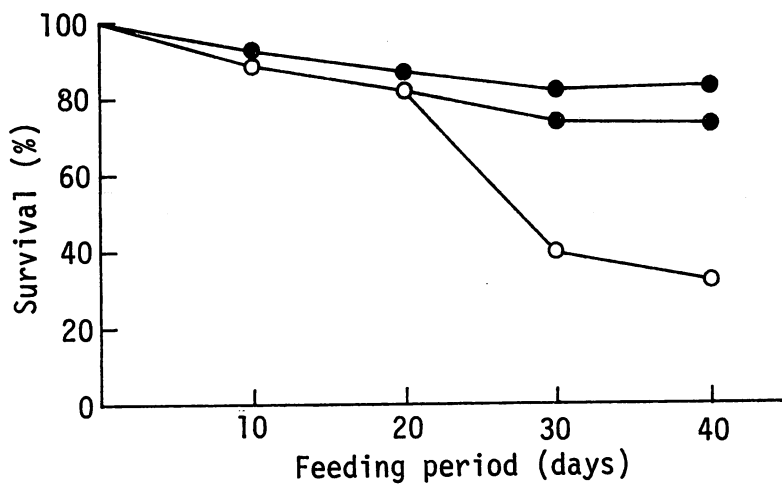


Fig. 3. Survival of the prawn kept on complete diet and inositol-deficient diet.

—●— Complete diet
—○— Inositol-deficient diet

ed 84 percent gain of body weight and the abnormality in their morphology and behavior was not observed. But, the growth of prawn received either choline- or inositol-deficient diets was found to be inferior to that of complete diet group. The survival of prawns kept on the complete diet and choline- or inositol-deficient diets is shown in Figs. 2 and 3. In the groups received the diets deficient in choline and inositol, the lowering of survival was observed after about 30 days feeding, and the nearly half number of prawns was dead after about 40 days feeding. The recovery test initiated after 20 days feeding on the choline- or inositol-deficient diets indicated a significant decrease of mortality.

Quantitative requirements for choline and inositol. To decide the quantitative requirements, the prawn was fed on the diets supplemented with 0, 2.4, 12, 60, and 300 mg of choline chloride, respectively, per 100 g of dry diet for 40 days. As shown in Table 2, the quantitative requirement for choline chloride was estimated to be about 60 mg per 100 g of diet from the survival and average body weight gain. The quantitative requirement for inositol was estimated to be about 200 mg per 100 g of diet from the feeding trials at levels 0, 20, 40, 100, and 200mg of inositol per 100 g of dry diet, under the experimental conditions used (Table 3).

Table 2. Effect of choline levels in the diet on the growth and survival of prawn.

| Choline chloride added (mg/100 g of diet) | Feeding period (days) | No. of prawn | | Survival (%) | Average body weight | | Percent gain |
|--|-----------------------------|--------------|-------|-----------------|---------------------|--------------|-----------------|
| | | Initial | Final | | Initial (g) | Final (g) | |
| 300 | 40 | 20 | 18 | 90 | 0.96 | 1.96 | 105 |
| 60 | 40 | 20 | 16 | 80 | 0.97 | 1.93 | 99 |
| 12 | 40 | 20 | 11 | 55 | 0.95 | 1.48 | 56 |
| 2.4 | 40 | 20 | 11 | 55 | 0.90 | 1.25 | 39 |
| 0 | 40 | 20 | 6 | 30 | 0.87 | 1.06 | 22 |

Table 3. Effect of inositol levels in the diet on the growth and survival of prawn.

| Inositol added (mg/100 g of diet) | Feeding Period (days) | No. of prawn | | Survival (%) | Average body weight | | Percent gain |
|--------------------------------------|-----------------------------|--------------|-------|-----------------|---------------------|--------------|-----------------|
| | | Initial | Final | | Initial (g) | Final (g) | |
| 200 | 40 | 20 | 18 | 90 | 0.96 | 1.97 | 105 |
| 100 | 40 | 20 | 17 | 85 | 0.75 | 1.29 | 72 |
| 40 | 40 | 20 | 12 | 60 | 0.77 | 0.98 | 27 |
| 20 | 40 | 20 | 10 | 50 | 0.78 | 0.91 | 17 |
| 0 | 40 | 20 | 11 | 55 | 0.73 | 0.91 | 25 |

Discussion

It was demonstrated by the present experiments that the prawn requires the dietary

choline and inositol for growth, though there are no informations on the biosynthesis of these vitamins in the prawn.

The dietary concentration of choline chloride for the normal growth of prawn was estimated to be about 60mg per 100g of diet, under the experimental conditions adopted. The value obtained in this experiment was slightly low as compared with 200–400mg per 100g of diet in carp.⁵⁾ Fatty livers due to lack of choline are generally known in animals, however, the variation of lipids in the hepatopancreas of prawn was not studied in the present experimental.

The dietary inositol requirement of prawn was thought to be 200 mg per 100 g of diet, and it seemed to be slightly higher than 44 mg¹⁰⁾ and 26.5 mg¹¹⁾ per 100 g of diet in carp, and 90 mg per 100 g of diet in red sea bream¹²⁾. Since it has been recognized that inositol requirement varied with the carbohydrate content in diets,^{12, 15)} the relationship between inositol requirement of prawn and the carbohydrate content in the diet remained to be investigated in future.

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