NUTRITION AND FEEDING OF *P. MONODON* IN THE PHILIPPINES

Chhorn Lim and F.P. Pascual
SEAFDEC Aquaculture Department

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The culture of Penaeus monodon in the Philippines is still in its early stage of development. Previously, shrimps were stocked in milkfish ponds, given no special care, and harvested as an extra crop. Due to the high market price, high consumer demand and availability of the seeds through artificial propagation, intensive monoculture of P. monodon has been developed in recent years. In this type of farming, the contribution of natural fish food organisms, grown in the culture environment, to the dietary requirements of the shrimp becomes insignificant. Consequently, an external food source must be provided to achieve higher production. Traditionally, supplementary feeding with trash fish, mussel meat, african snails, frog meat, chicken entrails, carabao hide, etc., has been applied in the Philippines. Considering the difficulty in procuring, storing and transporting the product, controlling water quality of the rearing environment, and time and labor involved in feed preparation and feeding, this practice is uneconomical and impractical. Thus, it is desirable to develop acceptable and nutritionally adequate artificial diets at the least cost to replace the unpredictable and/or unavailable fresh or frozen foods which have been traditionally used.

The objective of this paper is to review briefly the available information on nutrition and feeding of Penaeus monodon in the Philippines.

Nutrient Requirements

Protein Quality

The nutritional values of several animal and plant proteins as potential feed ingredients for P. monodon have been evaluated. Results indicate that squid meal was better utilized by P. monodon mysis than shrimp head meal, fish meal, ipil-ipil leaf meal or copra meal. In another study, postlarvae were fed with fresh brown mussel meat and artificial diets containing squid meal, shrimp meal spirulina and casein as protein sources. Results indicate that squid meal and shrimp meal were good protein sources for P. monodon followed by fresh brown mussel meat, casein and spirulina.

Ipil-ipil leaf, seed meals and copra meal are not good protein sources for P. monodon when used solely as major protein sources. Ipil-ipil meals have been identified to contain a lysine derivative, mimosine, whic is toxic to the shrimp. However, mimosine content is reduced by

soaking the leaves for 24 hours in fresh water. When used in combination with fish meal and shrimp head meal, soaked ipil-ipil leaf meals can be incorporated up to one-third of the total protein content in the diet without any apparent harmful effect.

Studies on the optimum inclusion rate of fish meal and shrimp head meal have been conducted in the laboratory and then verified under actual pond conditions. Results indicate that the diets in which three-fourths of the total protein was supplied by the combination of fish meal and shrimp head meal provided better growth than those in which the animal protein was supplied either by fish meal or shrimp head meal alone. The combination in which two-thirds of the animal protein came from fish meal and one-third from shrimp head meal was the most efficient for the growth of P. monodon.

The effect of various feeding regimes (artificial diet, fresh brown mussel meat, fresh brown mussel meat + artificial diet and artificial diet + fresh squid) on the maturation and fecundity of P. monodon spawner has been evaluated. Results indicate the superiority of fresh brown mussel meat over artificial diet and artificial diet + fresh squid. However, the combination of artificial diet and fresh brown mussel meat was found to be better than any feeding regime.

Protein levels

The optimum levels of crude protein requirements for P. monodon have been reported to be from 40 to 50 percent of the dry ration. Similarly, the data obtained from our study using isocaloric purified diet containing graded levels of protein in the form of casein show that dietary level of 40 to 45 percent crude protein in the diet was necessary for good growth survival and best feed conversion.

Lipids

Lipids or fats, due to its caloric value contribute significantly to the energy levels of the diets even when present in low quantities. Besides being concentrated energy sources, lipids furnish the essential fatty acids and the fat-soluble vitamins necessary for the growth of the animals.

A study was conducted at the SEAFDEC Aquaculture Department to determine the effect of corn oil, copra oil, soybean oil, beef tallow, pork lard and fish oil on the growth of P. monodon juvenile. Results show that beef tallow is a good lipid source for P. monodon when based on the growth. However, based on the feed conversion values and survival rates, fish oil is preferable to beef tallow. It can be concluded that fish oil is best followed by beef tallow, soybean oil, copra oil, corn oil and pork lard.

Feeding Practices

The optimum feeding rate for P. monodon juvenile in a controlled environment has been studied. With a diet containing 30 percent protein and about 3,000 kcal of ME/kg, a daily feed allowance of 12 percent of the biomass provided highest weight gain and best feed conversion. However, if shrimps are to be raised in environments where natural foods are available the daily feeding rate should be lower than 12 percent of the biomass.

The effect of the time and frequency of feeding on the growth of P. monodon was studied. Shrimps were fed at a rate of 10 percent of the body weight daily with 30 percent protein diet. When fed once daily, shrimp fed in the morning (0900 hours) had higher weight gain and survival rate than those fed at 1300 hours or 1700 hours. With the same quantity of feed given, shrimp fed 3 times daily out-performed those fed one two or four times per day.

Diet Preparation

One improtant physical characteristic of the shrimp ration is water stability. Feed pellets must remain intact in the water for a sufficient period because shrimps are slow eaters. A wide variety of various carbohydrate sources available locally have been tested for their binding capacity. Sago palm starch or agar incorporated at 5 percent level in combination with 15 percent wheat flour gave adequate water stability up to 12 hours. Gelatinizing sago palm starch or dissolving agar prior to mixing with other feed ingredients was found necessary. Different qualitites of sago palm starch (crude, semipurified and purified) were evaluated for their suitability as binder. The semipurified sago starch was preferable than the crude or purified sago starch in terms of binding capacity and cost, results show.

Researches were also conducted to determine suitable techniques of diet preparation. Extruding the pellet through the die with a smaller diameter hole provided a more compact pellet due to higher pressure exerted by the meat grinder during the extrusion process. Likewise, grinding the ingredients to a fine consistency significantly improved the durability of the pellet. Steaming the moist extruded pellet for 5 minutes prior to the drying process increases pellet stability.

In addition to water stability the diet must be attractive and palatable to the shrimp. Plain water, shrimp, mussel, squid and fish extracts were incorporated into purified diets for evaluation of their attractiveness to P. monodon postlarvae. Prawns were readily attracted to diets containing shrimp and mussel extracts. These were followed by fish and squid extracts. Diet prepared with plain water was the least preferred.