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# Food Preference of *Penaeus vannamei*

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# FOOD PREFERENCE OF *PENAEUS VANNAMEI*

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*ABSTRACT* The preference of *Penaeus vannamei* for 15 food items used in maturation was determined. The foods in order of preference were ranked as follows: *Artemia*, krill, Maine bloodworms, oysters, sandworms, anchovies, Panama bloodworms, Nippai maturation pellets, Shigueno maturation pellets, conch, squid, Salmon-Frippak maturation pellets, Rangen maturation pellets and Argent maturation pellets.

## Introduction

There is a paucity of published prawn preference papers. Studies have been undertaken to determine the distribution of potential prey from the natural shrimp grounds (Hilderbrand 1954, 1955, Williams 1955), but whether shrimp distribution is influenced by prey distribution is uncertain. Some information on the natural diets of penaeids is available from analyses of the shrimp foregut contents (Broad 1962, Dall 1968, Rubright 1978). Even in some aquaculture ponds, the natural benthos may comprise the majority of the shrimp's diet despite the presence of artifical feeds (Rubright 1978, Anderson *et al.* 1987, Reymond and Lagardere 1990).

Some species of shrimp feed selectively and exhibit dietary preferences. Karim and Aldrich (1970) found that *Penaeus setiferus* exhibited a greater selectivity than *Penaeus aztecus*, but both preferred live *Artemia* over five artificial diets. *P. durorum* evidenced an increase in consumption of artificial diets as the content of *Artemia* increased (Sick and Baptist 1973). Hysmith *et al.* (1972) found that *P. aztecus* preferred chopped fish (whiting) over fish meal pellets, with soybean meal pellets the least preferred of the three. Meyers and Zein-Eldin (1972) indicated that, given a choice, shrimp prefered odiferous rations. Quarberg (1974) found that when *P. aztecus* were offered arthropods, the insect larvae were selected over the insect nymphs which, in turn, were preferred over the adults. Dead arthropods were consumed more than live arthropods but this may have been due more to the ability of live arthropods to escape capture than to preference. He also reported that natural benthos were preferred over artificial rations. When several different artificial feeds were offered, Quarberg found that Purina Marine ration, Ralston Purina trout chow and M-G 32 were consumed more often than M-G 28, Domino catfish feed and co-op fish feed. He found that the rations were not necessarily chosen for preference, but may have been chosen due to the stability and density of the pellets. Hardin (1981), working with *P. stylirostris*, noted that one marine ration which included fish meal was preferred over another artificial diet made with soybean. In another study, six commercially prepared artificial diets were tested against a control of chopped fish, with the fish the most preferred (Anon. 1972). Of the six artificial diets, a high density basal diet was most preferred, while a basal diet substituting soybean meal for fish meal was least preferred (Anon. 1972).

At present, fresh or frozen natural products are used as the primary feeds for controlled maturation of penaeid shrimp, and studies have been conducted on some of these foods. Hill and Wassenberg (1987) noted that *Penaeus esculentes* consumed animal matter in the following order of preference: the prawn *Metapenaeus bennettae*, the bivalve *Donax deltoides*, the bivalve *Perna canaliculus*, and the prawn *P. longistylus*. Brown *et al.* (1979) found that *P. setiferus* consumed mussels more readily than oysters. Ogle (1991), in a survey of maturation facility managers utilizing *Penaeus vannamei*, noted that squid was the most commonly used natural food (94%) followed by bloodworms (64%) and oysters (43%). This use pattern was apparently due to availability and cost, not necessarily because of shrimp preferences. As little was known regarding the preference of *P. vannamei* for the various feeds being used in maturation, the following study was conducted.

## Materials and Methods

The feeding preference of *P. vannamei* was determined for 15 food items (Table 1). Each treatment (ration) was evaluated in duplicate 1-m diameter tanks, with five individually weighed shrimp in each tank. Shrimp ranged in size from 7.6 g for the first week to a

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TABLE 1

**Ranking of food items offered to *Penaeus vannamei* in order of decreasing preference, with preference established on the basis of consumption.**

| | |
|---|---|
| 1. | *Artemia sp.* |
| 2. | Krill (*Euphausia superba*) |
| 3. | MAINE BLOODWORMS (*Glyceria dibranchia*) |
| 4. | OYSTERS (*Crassostrea virginica*) |
| 5. | SANDWORMS (*Nereis virens*) |
| 6. | ANCHOVIES (*Anchoa mitchilli*) |
| 7. | PANAMA BLOODWORMS (*Americonuphis reesei*) |
| 8. | NIPPAI MATURATION PELLETS |
| 9. | SHIGUENO MATURATION PELLETS |
| 10. | CONCH (*Strombus gigas*) |
| 11. | SQUID (*Lolliguncula brevis*) |
| 12. | SALMON & Frippak maturation pellets |
| 13. | RANGEN MATURATION PELLETS |
| 14. | Argent maturation pellets |

**Series 1 Experiments—capitalized, Series 2 Experiments—not capitalized.**

final size of 11.1 g for week 14. The tanks were filled to a depth of 22 cm with natural baywater obtained from the Mississippi Sound. The water was adjusted to 16 ppt using Instant Ocean artificial sea salt and maintained at a temperature of 26±3°C. Aeration was provided by one airstone/tank. Prior to being stocked into experimental tanks, shrimp were held in a 8,000-l raceway where they were maintained on a commercial shrimp grower pellet (Zeigler Bros., Inc., Gardner, PA).

Each trial lasted five days, as a longer experiment period resulted in poor water quality. Since addition of a filter also removed food particles, the water was left unfiltered. Food was offered daily in the afternoon, at rates of 15% of shrimp body weight for fresh foods and 3.5% for dry feeds. Several hours after feeding, the lights were turned off until the following morning. Observations on consumption of feed items were routinely continued into the evening, with checks made by flashlight.

Each experiment was duplicated, with two different foods being offered in each tank during each five-day trial. All foods were kept frozen and natural foods were chopped into small pieces, weighed and allowed to thaw shortly before placement in tanks. All feed items were placed on opposite sides of the tanks. The feeds were placed in reverse order for each duplicate tank and placement was alternated daily in all tanks. The feed item in each tank consumed to the largest extent was considered to be the preferred food for that tank (Table 2). After all experiments were conducted, foods were compared and ranked according to the number of times each food was selected. The proportion of each food that was consumed was determined visually after an 18-hour period or when one food was completely consumed. If the relative consumption could not be clearly determined in a given tank, the two food items would be removed and reweighed for actual consumption. In cases where both foods were totally consumed, the first food consumed entirely was noted as the preferred food. Pellets were counted and examined for wholeness before being placed in the tanks and again immediately before removal from the tanks. When two sets of similarly shaped and colored pellets were offered, each set was alternately dyed using Aquashade.

TABLE 2

**Series I. Combinations of 11 food items tested over a 10-week period.**

| | Tank 1 | Tank 2 | Tank 3 | Tank 4 | Tank 5 | Tank 6 |
|---|---|---|---|---|---|---|
| | **Maine** | **Conch** | Nippai | Shigueno | **Sandworms** | |
| Week 1 | Squid | Squid | **Maine** | **Panama** | Shigueno | |
| | **Sandworms** | Conch | **Anchovies** | Conch | Salmon | |
| Week 2 | Squid | **Maine** | Rangen | **Shigueno** | **Sandworms** | |
| | **Sandworms** | Rangen | **Salmon** | **Anchovies** | **Shigueno** | |
| Week 3 | Anchovies | **Nippai** | Rangen | Panama | Squid | |
| | **Oysters** | **Oysters** | **Squid** | Oysters | **Nippai** | |
| Week 4 | Sandworms | Salmon | Rangen | **Maine** | Shigueno | |
| | **Oysters** | **Anchovies** | Anchovies | Anchovies | **Anchovies** | Salmon |
| Week 5 | Nippai | Conch | **Oysters** | **Maine** | Squid | **Shigueno** |
| | **Anchovies** | Salmon | Rangen | Rangen | **Panama** | **Panama** |
| Week 6 | Shigueno | **Conch** | **Shigueno** | **Conch** | Nippai | Squid |
| | **Maine** | Shigueno | **Panama** | **Panama** | **Anchovies** | **Nippai** |
| Week 7 | Rangen | **Maine** | Rangen | Conch | Nippai | Squid |
| | **Oysters** | Nippai | **Oysters** | Salmon | Conch | Salmon |
| Week 9 | Conch | **Sandworms** | Shigueno | **Panama** | **Nippai** | **Squid** |
| | **Maine** | **Sandworms** | Salmon | **Oysters** | **Maine** | |
| Week 10 | Sandworms | Panama | **Maine** | Panama | Panama | |

**Results based on two replicates for 5 days. Preferred food in bold.**

**Nippai, Rangen, Shigueno—Maturation pellets. Maine and Panama—Bloodworms.**

Water in the tanks was swirled; food, debris and detritus were allowed to settle and were daily siphoned off the bottom. The tanks were devoid of any substrate to ensure complete removal of food and provide an unobstructed view of the food as it was being consumed. At the termination of each five-day trial, the water and shrimp were replaced. Each set of shrimp was used only once in the preference experiments.

Any dead shrimp were removed in the mornings and new shrimp were weighed, added to the tanks and feed rates adjusted.

Two series of experiments were conducted. In the first series, every combination of 11 food items were compared in paired tests (Table 1). Although several trials were conducted simultaneously with the available tanks, 10 weeks were required to test the 55 combinations of the 11 food items. A second series of four food items was subsequently tested and added to the preference table. The second series of experiments followed the same procedure as the first series, with the exception that not all combinations were compared. A food item was compared to the established table based upon expected performance. Based upon results of the first test, the food would be compared to another food ranking higher or lower until its ranking was established.

## RESULTS

Adult frozen brine shrimp was the most preferred food of *P. vannamei* (Table 1). In general, fresh foods were preferred over artificial pellets. Nippai maturation pellets were the most preferred of the artificial diets.

In the first series, the rankings were consistent in all combinations. A food item would be less acceptable than all items above it in ranking and more acceptable to all items below it in ranking. Since this consistency was established in series 1, it was considered unnecessary to compare the food items in series 2 to every other item. This facilitated the updating of the table without an inordinate amount of experimental testing. The preferences are not ranked as to strength of preference. In some trials, one item was consumed to a slightly greater extent on only one of the five days. This was still ranked as

preferred. In only one case, Frippak maturation pellets and salmon, no true preference was detected. Therefore, these two items were equally ranked. (Table 1).

After the foods were presented into the tanks, shrimp were observed picking up the first food with which they made contact. As the shrimp continued around the tank, this food would be discarded for the next food group, but in most cases the shrimp eventually consumed most of one food type.

During this study, we noted that when shrimp were offered a preferred food, this often seemed to stimulate the animals to consume a less preferred food. The shrimp would then consume more of the less preferred food than normal, even if this food had a low preference ranking. Also, the shrimp would consume 30 per cent of their body weight per day for the entire five-day trial period if fed two greatly preferred foods. If two foods were found to be less palatable, the shrimp would consume very little of either.

## Discussion

Squid are the most utilized food item for facilities maturing *P. vannamei* (Ogle 1991), but in the present study, squid were not well liked and ranked below two artificial maturation pellets. However, squid are readily available, inexpensive and promote maturation and spawning more than other natural food items used alone (Chamberlain 1988).

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