Feeds and feeding

Prawn larvae feed by filtering particulate matter. Food particles must be small enough to enter their mouths, yet large enough to be retained by their setae (filters).

Larvae in the first stages do not actively search for food. *Artemia* density must be high enough so that the larvae will frequently encounter their feed. Late stage larvae and post-larvae are more active in searching for food.

In preparing food for the larvae, the following should be remembered:

- The feed has to contain components which attract larvae.
- Feed quality is of paramount importance; cost is secondary.
- Feed should be hygienically prepared and stored.
- Prepared feed should be immediately used in the tank and any additional feed should be kept under refrigeration.
- Prepared feed should remain in suspension in the water.
- The particle size of the feed should suit the requirements of each stage of the larvae.

Live food

Macrobrachium larvae cannot collect food directly by themselves. Live Artemia salina nauplii (Brine Shrimp Nauplii, BSN), a small crustacean rich in protein and essential fatty acids, is given as feed to prawn larvae. No commercially effective substitute has yet been found for Artemia nauplii.

Where to find Artemia?

Artemia, popularly known as fairy shrimp, brine shrimp or 'sea monkey, is a primitive crustacean inhabiting very saline water beyond the tolerance of finfish. It is found in natural and man-made salterns, lakes and flats, from the temperate to subarctic regions.

When conditions of salinity and oxygen content are right, the brine shrimp bears its young alive, in the form of nauplii. But if the salinity rises above 120 to 180 ppt, each embryo becomes encased in a highly resistant cyst. The development of the embryo then ceases, but it remains viable for many years, even centuries! The resistant cysts are transported by birds and wind. When conditions return to normal, development of the embryo resumes and within 24 hours the nauplii hatches.

There are many strains of brine shrimp, each with differing nutritional qualities and hatching rates. Cysts with low hatching rates are sold cheaper, but the poorest quality are actually quite expensive in terms of the number of nauplii produced per gram of cyst. The best quality cysts come from southern San Francisco Bay and the Great Salt Lake, Utah, in the USA. Other sources are China, Brazil and Australia. Attempts are underway in several tropical cQuntries to commercially produce *Artemia* cysts. Locally produced cysts are marketed in India and Thailand, but their quality is not consistent.

Artemia nauplii, or brine shrimp nauplii (BSN), are the major operating expense of a freshwater prawn hatchery. Its proper use should therefore be considered in some detail.

Calculating the weight of cysts required

The number of cysts/gram and the hatching rate are given on each can of *Artemia* cysts. For example, one popular brand contains 250,000 cysts/gram and their hatching rate is 80 per cent. Therefore, to get 25 million nauplii, you need:

$$\frac{25{,}000{,}000 \text{ nauplii}}{250{,}000 \text{ cysts/g} \times 0.8 \text{ nauplii/cyst}} = 125 \text{ g of cysts}$$

Decapsulation

The outer shell of the *Artemia* cyst is removed by decapsulation. This has several advantages:

- It disinfects the *Artemia* cysts.
- Disinfection reduces the chance of introducing disease from the cysts.
- There is no need to separate empty cyst shells from the newly hatched nauplii.
- No empty cysts get introduced into the larvae rearing tank, thus helping to keep the water clean and preventing the clogging of the siphon intake screens.
- Unhatched decapsulated cysts are more nutritious than newly hatched BSN.

Several buckets and a fine meshed cloth, or a Nitex screen bag, are required for the decapsulation procedure. Sufficient ice must be kept on hand to control the temperature of the decapsulation solution. The following steps should be followed to remove the capsule:

1. Put 200 g of cyst in three litres of freshwater and hydrate them for about an hour with strong aeration.
2. After an hour, drain the cysts on a screen cloth of 120 micron mesh. Then wash them thoroughly in running water.
3. Prepare the decapsulation solution as follows:

   Dissolve 160 g of bleaching powder and 120 g of sodium carbonate together to make a solution of 4-5 l. Mix well, allow the solution to settle undisturbed for 30-45 minutes, then decant the clear liquid. This should be done while the cysts are hydrating.
4. Add the cysts to the decapsulation solution and strongly aerate for about 20-25 minutes. Simultaneously add ice to keep the temperature below 40°C. If the bleaching powder is weak, two solutions prepared according to the instructions for Step 3 may be necessary. In this case, decapsulation should be limited to ten minutes in each solution (see Figure 17a facing page). When the cysts become orange, decapsulation is complete. If the cysts have not become orange, then this stage has to be repeated.
5. When decapsulation is complete, stop aeration, filter the decapsulated eggs through a net of 120 micron mesh and wash them under tapwater until no chlorine odour is detectable.
6. Dissolve 10-20 g sodium thiosulphate in two litres of water and add this solution to the washed cysts (as in step 5). Aerate now for 5-10 minutes to neutralize any residual chlorine.
7. Rinse thoroughly in tapwater.
8. Place the decapsulated cysts in a small quantity of freshwater (2-3 l) for a few minutes. The decapsulated cysts will sink to the bottom of the container, while the small quantity that are undecapsulated will float. Remove these by siphoning and store in brine; they could be used in the next decapsulation.
9. The cysts at the bottom should be filtered as before and washed for the last time, then taken for hatching or for preservation in saturated brine for use later. For storage, 50 ml brine should be mixed with every 100 g of cysts (see Figure 17b).

Fig. 17a Controlling the temperature in decapsulation solution.

Fig. 17b Decapsulated cysts stored in brine

Hatching

Artemia cysts can be hatched immediately after decapsulation. The necessary conditions required for this are:

The cysts should be stocked in the incubator at 1-2 g/l (dry weight) or according to the supplier's recommendation. Therefore, the volume of the incubator depends on the hatchery's daily requirement of ***Artemia*** cysts.

Whatever the volume, the salinity should be 28-31 ppt or should follow the supplier's recommendation. The pH should be between 8 and 9. Sodium bicarbonate ($NaHCO_3$) can be added to bring the pH of the hatching water to 8.5-9 before adding the cysts. Hatching begins within 18 hours and may continue for a further 12-18 hours. The procedure thereafter should be as follows:

1. About 30 minutes before collection, add ***50*** ml of ***50*** ppm formalin to disinfect the nauplii.
2. When hatching is complete, stop aeration and cover the tank with opaque cloth or plastic so that the nauplii can settle to the lighted bottom of the tank. *Artemia* nauplii should be fed to larvae as soon as possible after hatching. Since hatching begins after 18 hours of incubation and extends to 36 hours, it may be advisable to partially harvest a tank before hatching has been completed. ***Artemia*** nauplii are most nutritious while they contain the yolk sac, which is why they should be fed as soon as possible after hatching.
3. Collect the nauplii in a phytoplankton net of ***250*** micron by siphoning or draining. The water used for hatching of ***Artemia*** nauplii should be thrown away. Collect the cysts that have not yet hatched. These may hatch in the larvae rearing tank or the larvae may consume them. If the cysts have not been entirely decapsulated, stop siphoning, or close the plug of the drain pipe, just before completion of drainage, so that the shells of the eggs can be separated. This will allow the shells to float and will help in their collection for removal.
4. Before supplying the nauplii to the tank, they should be rinsed in clean, 12 ppt saline water.
5. Transfer the nauplii from the phytoplankton net to a bucket and put them in the larvae rearing tank in the quantities necessary.

A new batch should be hatched every day, following this procedure, and fresh nauplii should be supplied to the larvae.

Prepared food

Along with the live feed, larvae should be supplied artificial feed as well. Prepared feed can be given from the tenth day onwards, when *Arternia* nauplii can be reduced to about 2.5 BSN/ml.

Feed preparation

Taking into consideration the protein needs of the larvae, the ingredients listed alongside may be used for preparation of an artificial feed.

1.	Powdered milk	60g
2.	Cornflour	20g
3.	Egg (2 nos.)	70g
4.	Fish/prawn	BOg
5.	Cod liver oil	3.5 ml
6.	Vitaminmix	2g
7.	Agarpowder	4g
8.	Tetracycline	0.50g

Mix these ingredients in a blender, then steam to prepare a 'custard'. After cooling, grind in the blender. Particles both too large and too fine should be removed by wet screening (see Figure 18 a). Custard particles should be fed manually and feeding behaviour carefully observed (see Figure 18 b).

Fig. 18a Wet sieving **prepared food**

Ag. 18b Monitoring behaviour during hand feeding

Feeding

It is generally not necessary to supply Artemia naupili on the day of hatching. From the 2nd to the 10th day, the density of the Artemia naupliishould be maintained at 5 BSN/ml by adding newly hatched naupliiin the morning and evening. Subsequently, the density of the naupffi may be halved, as prepared feed is given.

The quantity of *Artemia* naupii to be added will depend on the volume of water in the tank and not on the number of larvae. At the rate mentioned above, a 5-*t* tank will require 4.3 kg of *Artemia* cysts for a 50-day rearing cycle. The density of the nauplii should be determined before feeding so that the number given can be adjusted to maintain the desired level.

In the case of prepared feed, the following should be considered:

- The size of the particles should correspond to the size of the fry.
- Overfeeding will pollute the rearing water and may cause mortality of the fry. Underfeeding causes malnutrition and cannibalism, and may effect normal growth.
- Quality and cleanliness of the feed should be checked before feeding.

The best way to give prepared feed is as follows:

- Turn off aeration;
- Hand feed until all larvae are actively feeding;
- Resume aeration.

Careful observation during hand-feeding prevents overfeeding and detection of health problems (see Figure 18 B).

As the age of the larvae increases, the amount of feed should be increased. When prepared feed is first given, at Day 10, every 5-t tank should be. given 15-30 g/tank. Subsequently, the rate may be increased to 100 g/tank/feeding. Completion of the larvae cycle may require 6-8 kg of feed.

From Day 10, particle size may be gradually increased up to 1 mm as the larvae grow.