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RECENT ADVANCES IN FINFISH AND SHELLFISH NUTRITION

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LIVE FOOD ORGANISMS - *ARTEMIA*

PART II - *ARTEMIA* CYST AND BIOMASS PRODUCTION

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INTRODUCTION

The brine shrimp, *Artemia*, a crustacean which is naturally found in hypersaline waters throughout most of the world, has become the most important source of live-feed for the last twenty years. All its life stages such as cysts after decapsulation, freshly hatched nauplii, juveniles, preadults and adults, are used as live-feed according to the feed-size requirement of the predator. *Artemia* decapsulated cysts and freshly hatched nauplii form as ideal food for the larvae of cultured fish and crustaceans in their hatchery phase while juveniles, preadults and adults form as suitable diet for prawn/fish juveniles in their nursery phase. *Artemia* grows from nauplius stage to adult stage in about two weeks. During this short period, nauplius with 0.4 mm in length and 0.002 mg in weight grows into an adult with about 8 mm in length and 1 mg in weight thereby ensuring 20 fold increase in dimension and 500 fold increase in biomass. After attaining adult stage, the brine shrimp produces nauplii/ cysts (according to the prevailing environmental conditions) at the rate of upto 300 numbers per batch and goes on producing at the interval of about five days throughout its life period of six months. For cysts and biomass production, Artemia can be cultured in large scale in salt water ponds where environmental parameters cannot be fully controlled. They can also be produced in hatcheries and laboratories under controlled conditions.

PRODUCTION IN SALT WATER PONDS

In India, a vast area of salt ponds, all along the coastline, are used in salt production during dry season and these man-made solar saltpans offer excellent scope for carrying out Artemia culture. Many of these saltpans have most of the infrastructures required for this purpose. The area, selected for Artemia culture, should have suitable climatic conditions such as moderate temperature (ranging from 25°C to 35°C) and salinity (with a range of 30 ppt to 200 ppt). It should have a high evaporation rate with little rainfall and be closer to the sea from where water can be easily drawn to the reservoir either by pumping or through tidal influence. It is desirable to drawn water to the reservoir from mangroove area which has a very high productivity. The water source should be free from pollution and the pond should maintain the water level without having any seepage or leakage.

In a classic typic of solar saltpan, water enters the first evaporation pond from the reservoir. After increasing slightly in salinity by solar evaporation, water flows from the first evaporation pond to the next of the series and this continues until the water becomes brine i.e., saturated with sodium chloride. The brine is then introduced to the crystalizing ponds where sodium chloride crystallises. Artemia can be intensely cultured in evaporation ponds with minimum inputs.

Subsequent to initial fertilization, freshly hatched *Artemia* nauplii have to be inoculated at the rate of 1 to 10 numbers per litre of pond water (Sorgeloos and Kulasekarapandian, 1984). Nauplii stocking has to be done at night or early hours of the day to minimise the temperature stress. Growth of the population has to be monitored by collecting data on the population composition which can be carried out by analysing the population samples after grouping them as nauplii, juveniles, preadults and adults. Changes in the population composition can be correlated with the overall production status of the population. For example, presence of only adults reflects the status of no recruitment. Reproductive status of the adults, which can be found out by observing the presence of nauplii/cysts and shell glands in the brood sac, will also indicate whether the population is in growth phase or in stationary phase. (Determination of population density through sampling procedure will not help in view of strong heterogenic distribution of *Artemia*). Data on the parameters such as minimum-maximum water temperature, rainfall, salinity levels and water turbidity have to be daily collected. These informations are necessary to ensure continuous recruitment through ovoviviparity by adjusting the intensity of fertilization, harvest and water management.

When the population is mostly of adults, they can be manually harvested with a dipnet. Large net, with a cod-end having less than 100 microns mesh size, is to be installed in the canal/gate that connect two evaporation ponds. *Artemia* will be retained when the water flows from one evaporation pond to another. The net should be emptied at about 1 hour intervals to avoid the death of the accumulated *Artemia* in the cod end.

If the intention is cyst-harvest, <u>Artemia</u> have to be exposed to higher salinity levels (above 150 ppt) thereby subjected to stress. This can be achieved by careful water management as at very high salinities (250 ppt and above), <u>Artemia</u> become weak and finally die. The salinity stress, created, will result in the induction of oviparity (Fig. 1). The liberated cysts will float and due to wind action, they will accumulate on the shore from where they can be harvested.

Eventhough it is reported that in Thailand, a production of 15 g live weight/m^3/day and 60 kg dry cysts/ha/5 months is achieved, one can expect an average production of 10 to 20 kg dry cysts/ha/year and a few metric tons of live biomass in saltpans.

PRODUCTION UNDER CONTROLLED CONDITIONS

Biomass production

Biomass production under controlled conditions can be carried out either in batch or in flow-through culture systems.

In both culture systems, provisions are made to maximise oxygenation of the medium and to ensure food availability to all the larvae, while culturing at high density.

Biomass production by batch culture system

In batch culture system, nauplii were reared upto adult stage, without any water renewal, in air-water-life (AWL) operated raceway, which provides continuous aeration, almost homogenous circulation of the medium and uniform distribution of the added feed within a short time. Raceway system further keeps all particulate matter in suspension thereby minimising sediment accumulation.

Construction of air-water-lift raceway

An *Artemia* raceway essentially consists of a rectangular tank with a central partitioning (Fig. 2). The distance between the central partitioning and the lengthy side of the tank is called the channel width. In order to obtain an optimal water circulation, the distance between central partitioning and the small side of the tank is to be about 1 to 2/3 of the channel width. The partitioning should also be kept 2 to 5 cm off the bottom of the tank either by suspending it from two or more wooden bars resting on the sidewalls of the raceway or by keeping it in its central position on top of small blocks. The water depth should not exceed 1 metre to ensure optimal water circulation with the help of axial blowers. Various materials such as concrete, marine plywood and fibreglass, can be used to construct raceway tanks.

PVC pipes and elbows are used to construct air-water-lifts, which have to be fixed to the central partitioning by rings with screws to keep them in a well defined position in raceway. For optimal water circulation, the elbow outflows should make an angle of 30-45° with the central partitioning (Fig. 3). The interval between successive air-water-lifts should be 25 to 40 cm. The diameter of the air-water-lift is related to the water depth and if the water level is 40 cm, the inner diameter of air-water-lift should be 40 mm which will provide 6.6 litre/minute/AWL of air to displace 12.5 litre/minute/AWL of water. (If the water level is 20 cm, the inner diameter of the AWL should be 25 mm to provide 2.7 litre/minute/AWL of air which will displace 4 ,itre/minute/ AWL of water). 3-6 mm diameter polythene tube can serve as aeration line and it can be mounted in the AWL through a hole at the top of the PVC elbow. To assure the best water-life-effect, the aeration lines should extend as deep as possible in the AWL. All aeration lines will be drawn from a central air distributing container so that each aeration line need not have a separate regulating valve system.

Culture procedure

It is convenient to carry out batch culture in raceway system in 50-100 ppt salinity because contamination with ciliates and other competitiors and predators, can be avoided in high saline media. Stocking has to be done with freshly hatched nauplii and rate of stocking depends upon the feed availability and water management. 10,000 instar I nauplii per litre can be stocked if feeding is maintained at 15-20 cm transparency with rice bran. As *Artemia* is a non-selective filter feeder, it can be cultured by feeding with a wide range of feed both live and inert materials. However, the particle size of the feed should be less than 50 microns. Hence, the feed should be squeezed (if inert feed) or passed (if algal feed) through 50 microns sieve. Soluble products are not taken up by *Artemia* and hence the feed if it is an inert one, should be properly prepared to get rid off the dissolved matter. This can be achieved by aerating the feed solution for 1-2 hours and allowing the feed particles to settle by cutting off the aeration for ½ hour. Dissolved matter will be in solution and it will be discarded, while only settled product will be used as feed. As *Artemia* is a continuous filter feeder, medium must contain adequate food at all times and hence food distribution is very important. Transparency of the culture medium found to be a very useful parameter for determining the food level present in the medium. During rearing, particulate wastes, such as faecal pellets and exuviae, will form and they have to be continuously removed from the culture medium from 4th culture day onwards, as they affect the water quality and hamper the food uptake by *Artemia*. This can be achieved by pumping the water

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achieve this, air supply system is to be connected with the nitrogen supply unit, by a timer and a magnetic valve. At every three hours, the timer activates the magnetic valve which closes the air supply but allows the nitrogen to pass through the medium for a period of five minutes. After the supply of nitrogen for 5 minutes, the oxygen drastically decreases from 60% to 8% saturation thereby creating a sudden and effective stress. Subsequent aeration will keep the animal in living condition. Only after 1-1½ hours, the dissolved oxygen content will reach to the original level of 60% saturation, thereby indicating that the stress will fairly be a prolonged one. Artemia will produce haemoglobin in oxygen stress and hence the animals will become red-coloured. Within a week, eggs will be formed in the ovaries and coated with the secretion of the shell gland in the ovisac. The cysts, liberated will be collected in a 110 microns filter bag.

STORAGE OF HARVESTED BIOMASS AND CYSTS

Adult Artemia, harvested from saline (more than 100 ppt) waters, will remain alive for 3 to 5 hours eventhough they are provided as feed directly after collection and subsequent washing with freshwater/seawater. If the biomass, harvested, has to be stored, it has to be frozen for which the live biomass has to be spread out in thin layers in plastic bags/ice trays and be transferred to -25°C in a quick freezer.

The harvested cysts have to be cleaned, processed and stored in closed containers in saturated brine or under vacuum/nitrogen atmosphere.

REFERENCE

Sorgeloos, P. and S. Kulasekarapandian 1984. Production and use of *Artemia* in aquaculture. C.M.F.R.I. Special Publication No. 15, pp. 74.