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Ecofriendly onshore marine pearl culture – an overview

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ABSTRACT

The onshore marine pearl culture technology developed by CMFRI at Visakhapatnam has been taken up on a commercial scale in the vicinity of Visakhapatnam. Hatcheries for the pearl oyster Pinctada fucata *have been established. The pearl oysters were grown in cement tanks of 75t capacity from 5 mm to 50 mm DVM. The growth rates of pearl oysters fed with different species of diet* Chaetoceros, Nanochloropsis *and* Isochrysis *at different cell concentration showed wide variations. The growth rate of oysters reared at a density of 100 nos./sq.m is better compared to that at higher densities. The depth of seawater and rate of water exchange per day have been standardized. Raw seawater filtered through a specially designed slow sand filter is being used in hatchery and culture tanks. The filtered seawater is directly used for all purposes without any treatment with chemicals or antibiotics. Usage of chemicals is undesirable even for cleaning purposes. The algal cell concentration up to 1.2 million/ml was achieved on a sustained basis in outdoor mass culture tanks. Use of only live feed and avoiding chemicals make this technology ecofriendly. Several factors related to growth and maintenance of hygiene of pearl oysters in onshore culture tanks are discussed.*

Introduction

The marine pearl culture is one of the oldest sustained mariculture technologies. The Japanese are practicing this in shallow sheltered areas. Due to the use of the same site continuously over a prolonged period, there have been reports of some problems associated with the accumulation of waste matter in these grounds. There are no efficient mechanisms to completely eliminate this, resulting in shifting of the rafts to new culture sites. The problem has also affected the growth of oysters and quality of pearls (Matsui, 1958; Algarswami, 1970; Algarswami, 1983).

It has been mentioned by Daniel (1993) that none of the locations in the Indian main land are suitable for raft culture. Some of the suitable locations are Lakshadweep Islands and Andaman and Nicobar Islands, while Gulf of Mannar is partially suitable. This is one of the main reasons for the country lagging behind in the establishment of commercial pearl culture industry, inspite of the availability of technology, for the past two decades. Onshore marine pearl culture technology recently developed by Rao and Devaraj (1996) is mostly free from pollution problems. The technology with particular reference to its eco-friendly nature and associated advantages are presented and discussed here.

Materials and methods

The pearl oysters *Pinctada fucata* were originally transported from Tuticorin. They were reared in the CMFRI laboratories, in private shrimp hatcheries and two private onshore (pearl) culture farms. The rearing tanks varied in size from one tonne FRP tanks to 120 t cement tanks. The pearl oysters were specially reared for maturation and used as broodstock for further propagation. Thus continuous availability of pearl oyster spat became possible and they were reared to adult size in onshore tanks. The salinity and temperature are measured on daily basis with the help of a refractometer and thermometer respectively. For the hatchery rearing, the methodology developed by Algarswami *et.al.*(1983) is being adopted. The microalgal feed required for feeding is produced at

the rearing sites by following the standard phytoplankton culture methods, with suitable local modifications.

Technology

The seawater is drawn from a clean location near the shore by laying a pipeline of suitable length and diameter. At the sea end the pipeline is connected to a filter buried in the sand. Thus semi-filtered seawater is pumped to the culture site. Seawater outlet is also connected to slow sand filter. Here the filtration rate is regulated by the second chamber (coal chamber) where the filtered seawater travels upwards before entering the storage chamber. The filtered water is mainly utilized for phytoplankton culture and hatchery operations, without any chemical or antibiotic treatments.

Feed production: The ciliate free inocculum of the required phytoplankton species are maintained in sterile, filtered water. From the inocculum level, the cultures are enhanced to desired levels up to 10 t tanks through different stages. The filtered seawater is enriched with Conway medium (Walne, 1974). This gives a concentration of about 1.2 million cells/ml on a sustained basis throughout the year, in outdoor conditions in about 48 hours.

Onshore tank: The onshore cement tanks size varies from 20 t onwards, depending on the culture site. It has a sloppy bottom and side walls of 1.2 m height. At 1 metre level all the walls are provided with ventilator holes to flush out hot air. The tanks are provided with aeration facility. The seawater intake system is connected to each tank, so that raw seawater can be let into tanks at any time. The tanks are totally covered with black covering to avoid growth of filamentous algae and blooming of unwanted phytoplankton. 10% of seawater from the tank is replaced daily.

Oyster stock: The pearl oyster *Pinctada fucata* are stocked at suitable densities from 500 to 75/sq.m depending on the size. Granite stones are

keft at the bottom of the tank and the pearl oysters will attach themselves to the stones. The stones are adjusted to desired density of oysters at regular intervals. The growth rate recorded at 100 no./sq.m. of 30 mm DVM is better compared to higher densities. Each tank is connected to a feed tank from which phytoplankton feed drips throughout the day, ensuring constant supply of feed. The flow rate is adjusted in such a way so as to ensure the maintenance of cell concentration at desired level in relation to the size of the pearl oysters.

Feed species: Several species of phytoplankters were tried as feed, individually and in combination. The species are *Chaetoceros calcitrans, Chaetoceros* sp., *Skeletonema* sp., *Tetraselmis* sp., *Chlorella* sp., *Isochrysis galbana and Nanochloropsis salina.* Among them, a combination of *Chaetoceros calcitrans, Nanochloropsis salina* and *Isochrysis galbana* gave the best growth rates in terms of length and weight of pearl oysters. A concentration of 20000 to 80,000 cells/ml is being maintained to get better results depending on the size and density of pearl oysters.

Growth : Under the prevailing temperature and salinity conditions (Fig. 1) 5 mm pearl oyster spat will attain a dorsoventral measurement of 50 mm and a weight of 10-12 grams, in about 6-8 months. This may be considered as a proper size for the first implantation with 3-4 mm nuclei. It takes about 6 months for the pearl formation. A minimum of 25 % pearl harvest can be achieved from the implanted oysters.

Survival: The mortalities from 5 mm to 50 mm in about 6 to 8 months is low and will be less than 10 %. Under the onshore conditions post implantation mortalities are also least and are less than 10 %. The tanks and stones need to be cleaned occasionally with salt. Cleaning with detergents and chemicals is totally avoided. As there is no significant settlement of fouling and boring organisms like algae or epifauna in onshore system the oysters need to be cleaned rarely. Only ascidians are occasionally found over the pearl oysters, which can easily be removed.

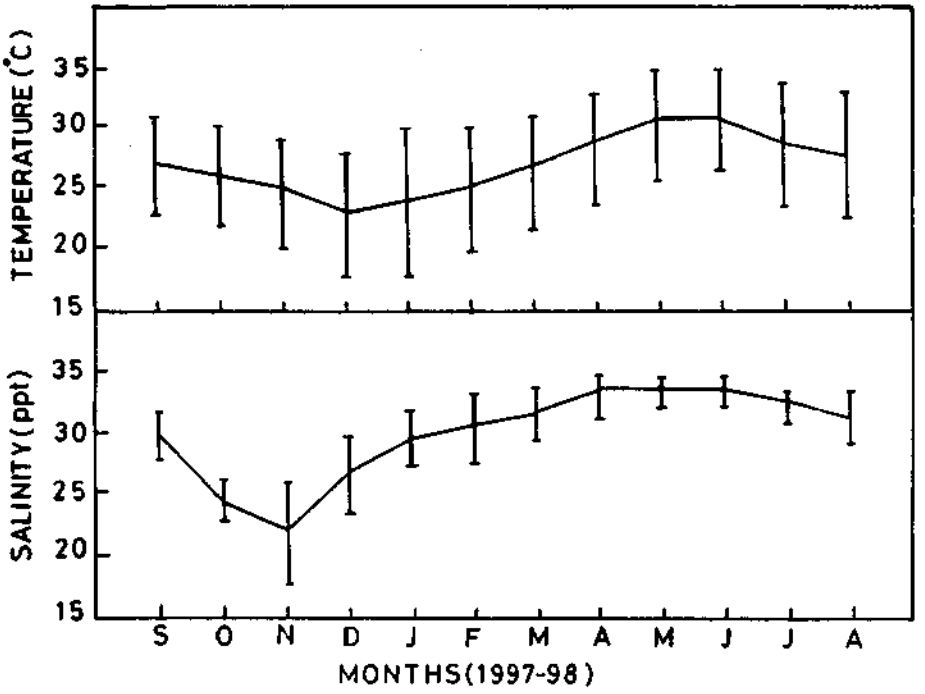

Fig. 1. Salinity and temperature profile of pearl oyster culture tanks.

Discussion

According to Dharmaraj *et al.* (1987), fouling is a major problem in the sea based pearl culture operations. The foulers also adversely affect the growth of pearl oysters and pearls (Nishi, 1961). The near absence of foulers, borers and predators is a very good advantage in onshore pearl culture, which will enhance the growth rates. Chellam (1987) and Daniel and Durairaj (1993) recorded high adult pearl oyster mortalities of about 45% in the sea due to various problems. The minimum mortalities occurring in onshore culture from spat to pearl production stage will enhance the rate of gross pearl production and adds to economic sustainability. Better growth of pearl oysters in onshore system than in inshore culture is achieved by the constant availability of live feed species at desired concentrations throughout the period and maintenance of hygiene in the culture tanks. Thus the use of untreated seawater,

nonuse of chemicals, darkening of the tank and use of only live feed makes onshore pearl culture ecofriendly, resulting in much better growth and low mortality.

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