EDIBLE OYSTER HATCHERY AND CULTURE

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INTRODUCTION

Edible oyster is one of the most widely cultivated bivalves. It is among the first of the marine species to be cultured and hence has a long history. As early as in the first century B.C, the Romans were first to culture the edible oysters. Then Japan developed various methods for farming the edible oysters. Other leading oyster producing countries are U.S.A. Korea, France and Australia. In 1992, edible oysters formed 29% of world molluscan aquaculture production of 2.5 million tons. In India, Hornell inititated experiments on spat collection of *Crassostrea madrasensis* at Pulicat Lake. Realising the resouce potential, nutritive and commercial values of edible oysters, the Central Marine Fisheries Research Institute made attempts to evolve suitable farming techniques for edible oysters in the early 1970's. This paper contains various aspects of technology of farming the edible oyster *C. madrasensis* along with its distribution and a few biological details.

The edible oyster, popularly known as 'Aali' in Tamil and 'Muringa' in Malayalam, is a sedentary bivalve. The flesh is encased by two shell valves, the lower valve is cemented to the substratum and the upper valve acts as a lid. The hinge mechanism connecting both valves, allows the valve to open or close. The animal feeds by filtering the microscopic organisms in the water which pass through the gap between the two valves. The flesh of oyster is highly nutritious containing 8-10% protein and 2% fat, in addition to minerals like calcium, phosphorus, zinc and iodine.

Edible oysters occur attached to hard substrata in the intertidal areas, backwaters, muddy bays, lagoons, and creeks along the east and west coasts of Inda. The four species of commercially important edible oysters are *Crassostrea madrasensis* (Indian Backwater Oyster). *C.gryphoides* (west coast oyster), *C.rivularis* (Chinese oyster) and *Saccostrea cucullata* (Indian Rock oyster).

RESOURCES AND DISTRIBUTION

Oyster fishery is localised and at subsistence level. Surveys indicate an estimated annual production potential of 2000 t of oysters along our coast. Among the four commercially important edible oysters, *C.madrasensis* is the dominant species distributed along the coasts of Orissa, Andhra Pradesh, Tamil Nadu and Kerala. In Karnataka, *C. madrasensis* is distributed in Nethravathi, Mulki and Kali river estuaries. It also occurs in Andaman Islands at Port Blair, Havelock Island, Mayabander and Diglipur.

C. gryphoides is well distributed in northern Karnataka, Goa and Maharashtra.

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C. rivularis is found in coastal waters and creeks of Gujarat and the oysters are exploited particularly for the shells.

S. cucullata is distribuited widely all along the Indian coasts, Andaman and Lakshadweep islands in the shallow coastal and intertidal areas attached to rocky substrata.

Technology of oyster farming

The technology of oyster farming consists of two important phases namely: collection/ production of seed oysters and growing the seed oysters to marketable size.

Oyster seed production

a) Seed collection from wild.

The seed requirement for culture is met either from wild or through hatchery system. The collection of seed from wild depends on the spawning season and provision of suitable spat collectors or cultch materials at appropriate time. At Tuticorin, the peak spawning period for oysters is April-May with a secondary spawning in August-September. At Ashtamudi Lake, Quilon, the peak spawning occurs during November-February.

Spat fall prediction

The spat fall is predicted by studying the gonadial maturity stages or by appearance of oyster larvae in the plankton samples. When 70% of female oysters are with ripe gonad, spat collectors are used to collect the spats. If the collectors are placed much earlier or after the spatfall, the collectors get silted or fouled, rendering them unsuitable for spat settlement.

Spat collectors

The choice of spat collectors depends on the culture method adopted, materials availability, economical and practical considerations. The spat collectors tried at Tuticorin are lime coated semicylindrical roofing tiles, oyster shells, coconut shells and asbestos sheets. The spat collectors should be rough, free from slime, without any secretion of resins and strong enough to retain the oysters. Experiments indicated that lime coated tiles and oyster shell are suitable for large scale spat collection. The tiles are arranged in trays and are placed on racks, whereas oyster shells are arranged on a nylon rope of 1.50 m, length, as strings and placed on racks. Vast potentiality of oyster seed availability along intertidal bay areas has been demonstrated.

Mass production of oyster seed through hatchery system

By establishing a shellfish hatchery at Tuticorin in 1980, the CMFR Institute succeeded in mass production of both cultched and cultch free spat. The hatchery techniques consist of 6 phases of operation i.e., selection and holding of broodstock, induced spawning, larval rearing, preparation of cultch materials, production of spat and culture of algal food.

Selection and holding of broodstock

Oysters of length ranging from 60-90 mm are ideal and 30% of them should be 60-75 mm in order to have assured availability of males. 25 oysters are selected, cleaned and placed on synthetic twine knit PVC frame in a 100 l fiberglass tank and pre-cooled seawater (at 20°C - 22°C) is filled in the tank and aerated. Mixed algae (2-3 l) with cell concentration of 1.5-2 million cells/ml is given as food daily.

Induced spawing

The conditioned oysters are induced to spawn by trasferring them to seawater with temperature of 34-35°C. This sudden change of water temperature stimulates spawning in oysters. Once spawning is completed, the oysters are removed from the tray.

Larval rearing

The fertilized eggs undergo cleavage within 45 minutes. At the end of 4 hours, the eggs attain morula stage and begin to swim and at 20 hours, 'D' shelled larval stage is attained. *Isochrysis galbana* is provided as larval food. The rearing density and feeding protocol for the various larval stages are as follows:

Stage & size of larvae	Rearing density(larvae/ml)	Algal cells/day
'D' shape (60 μ)	5	3000-4000
Umbo (150 μ)	3	4000-5000
Eyed stage (280 μ)	2	5000-8000
Pediveliger (330 μ)	2	10,000-12,000

Spat settling and seed production

For cultchless seed, oyster shell grit or polyethylene sheets are provided as spat collectors. The oyster shells are cleaned, hole is drilled centrally in the shell valves and are provided in the larval rearing FRP tanks for spat settlement. Once the larvae attain eyed stage, the spat collectors are uniformly spread in the bottom of the tank and the released larvae settle on the shells.

FARMING METHODS

Selection of suitable method of farming of oysters depends on the depth, nature of substratum, tide, wave action, salinity and productivity of the water area. The seed oysters could be grown either by bottom or off-bottom culture methods. The rate of

production depends on the method of culture adopted. Oysters are sown on the bottom either at intertidal or subtidal level. The bottom should be firm and free from predators and silting.

Off bottom culture methods:

Rack and tray method

The young oysters scrapped from tiles of the culchless seed produced in the hatchery are initially reared in box type cages(40x40x10cm) webbed with 2.5 mm synthetic twine covered with velon screen. After nursery rearing for 2 months by suspending the cages from racks, oysters of 50mm length are transferred and reared in rectangular trays. Twenty trays each with 200 oysters are reared on a rack occupying an area of $25m^2$. At the end of one year, oysters attain a mean length of 78 mm and a maximum of 105 mm. The production rate is 120t/ha/yr with a return of 30% on investment.

Stake method

The stake is the support used to keep the spat set on spat collectors above the bottom. It is a casuarina or eucalyptus pole of 1.50 m height with a nail on the top and two nails on the sides. To protect the spat against predation, the top of the stake is covered with a piece of velon. The rate of production is 20t/ha/year.

Rack and string method

A string can hold six shell valves having 80 to 100 spat and 3 to 4 strings are enclosed in a velon screen bag. These strings are suspended from racks for nursery rearing in the areas which are calm with good movement of water. After 2 months rearing, the bags are removed and the strings are transferred to oyster farm. In the farm the shell strings are suspended from racks. Each rack occupying 80 m^2 area, holds 90 strings. The growth of oysters is 8.3 mm/month. The production rate is 80 tonnes/ha/year. By incurring Rs.82,945/- as the annual operational cost, an annual net profit of Rs.22,505 could be realised for a 0.4 ha farm at Tuticorin. By rearing 600 strings in 0.04 ha farm at Ashtamudi, production of 80-150 tonnes was obtained in 7-8 months at 44.8% return.

HARVESTING

The cultured oysters are harvested depending on the condition factor which is measured as

$$\text{condition factor} = \frac{\text{weight of dry meat}}{\text{Volume of shell cavity}} \times 100$$

The average condition factor ranged from 41 during postspawning period to 78 during prespawning period. Prior to spawning, oyster meat will be flump and gonad is ripe. Harvesting season depends on the spawning season which is March-April and August-September.

DEPURATION

The harvested oysters are cleaned and placed in tanks under a flow of filtered seawater. In this sytem 10-20% of seawater is continuously replaced in the tank and oysters are held for 12-15 hours. As a result the bacterial load of the shellfish is reduced. After cleaning the depurated oysters can be transported for 25-30 hours without mortality.

SHUCKING

Shucking is the process of removal of meat from depurated oysters. The oysters, after depuration are kept in boiling water for 2-3 minutes and transferred to shucking table. Using a stainless shuckng knife between the valves, the valve is removed and meat is flipped into the container by cutting the base of adductor muscle. The meat thus collected is processed in salt and citric acid solution and packed in 2 kg slabs for freezing. After thawing the frozen meat, the meat is canned and stored.

UTILIZATION OF OYSTER SHELL

The oyster shells being useful as spat collectors could be disintegrated to suitable size for using as poultry grit. The shells contain 52-55% calcium oxide and are used in the manufacture of calcium carbide, lime and fertilizers.

PEST AND PREDATORS

Pest and predators cause considerable damage. Common pests occurring on oysters are barnacles, ascidians, serpulids, anemones and sponges. Predatory gastropods caused 13% mortality of the oyster stock cultivated in rack and tray system whereas no incidence of the gastropod predation was observed in rack and string method or stake method.

PROSPECTS

There are vast stretches of backwaters, estuaries and bays along the Indian coast suitable for oyster farming. Experimental culture works carried out in Bheeminipatnam, Kakinada, Muttukadu, Athankarai along the east coast and Asthamudi, Dharmadam and Mulky in the west coast indicate the possibility of oyster farming. The limited domestic demand and lack of awareness about oyster culture are the important factors that require attention. Also concerted effort to develop value added products from oyster meat to expand domestic and to explore overseas markets is needed for commercialisation of oyster culture in India.