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OYSTER CULTURE—STATUS AND PROSPECTS

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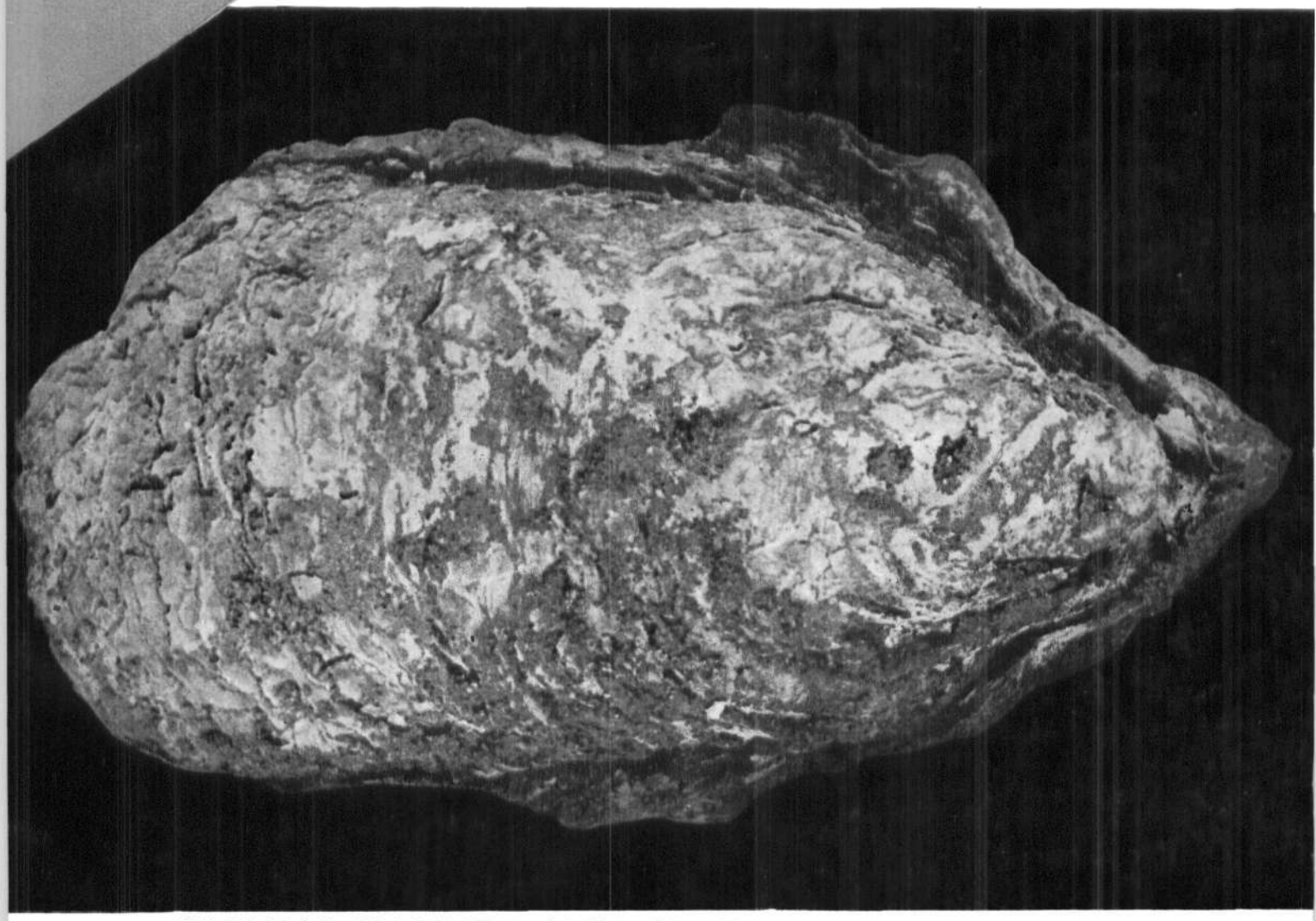

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POST-HARVEST TECHNOLOGY

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INTRODUCTION

In recent years great interest is envinced in several countries in the culture of molluscan shellfish. In the tropics favourable conditions exist for rapid growth and marketable oysters are obtained within ten to twelve months. Investigations have been conducted at the Central Marine Fisheries Research Institute and success has been achieved in perfecting the techniques of oyster culture in coastal waters (Nayar and Mahadevan, 1983). The awareness that shellfish have to be purified and rendered harmless goes back to the time of the Roman Empire. During the first century B.C. the Romans consumed cockles and oysters after treating them in tanks known as cockle washery (Yonge, 1962). Presently the commercial producers of shellfish in many countries, usually follow purification procedures though they differ from country to country. While chlorinated seawater has been widely in use for depuration of molluscan shellfish, recently U.V. or ozone treated seawater has come to be used in French and Australian shellfish depuration plants. Harvesting of oysters is done during prespawning period, when the meat condition is good. The spawning season of *Crassostrea madrasensis* is April-May with a mild secondary spawning period in August-September. High condition factor of 90-150 has been observed before spawning indicating the plumpness of the meat. After spawning the meat is watery and thin. Harvesting method of oysters differs according to the method of culture. Dredging, tonging and handpicking are some of the harvesting methods for oysters which are cultured on bottom. At Tuticorin, since oysters are cultured in trays, harvesting is done manually and the oysters are transported to depuration plant in a fibreglass reinforced plastic dinghy (Pl. I a).

In this chapter the techniques followed in India in handling and processing oysters after harvest are described.

PURIFICATION

Oysters being filter feeders may harbour bacteria and other microorganisms and may also accumulate contaminants present in the surrounding water which is known as bioconcentration. The reverse process called depuration is the process of purification by which the shellfish are rendered free of the harmful materials. In depuration, the shellfish are placed in tanks supplied with seawater artificially sterilized. The process may either be continuous or discontinuous. In continuous depuration system, 10-20% seawater in the purification tanks is continuously renewed with running filtered seawater. In the discontinuous system the frequency of the water change ranges from two to three times a day (Fauvel and Pons, 1978).

Nayar *et al.* (1983) have designed and operated a simple method to purify the oysters cultured in the Institute's farm at Tuticorin. This method assures effective purification of oysters at the rate of 14,400 oysters (1,300 kg) per day. The oysters are arranged in twentysix synthetic twine knitted trays each measuring 60 cm × 60 cm × 15 cm. and placed on wooden frames which are arranged in a concrete tank measuring 2.5 m × 2.5 m × 1.0 m. Firstly the oysters are thoroughly hosed by a strong jet of filtered seawater (Pl. I b) to remove external mud and dirt which are flushed out through the outlet of the tank. By this time, the purification tanks each measuring 2.5 m × 2.5 m × 1.0 m. are got ready and filled with seawater to a height of 70 cm. In each tank, trays with oysters

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numbering 2,400 are placed. A continuous, slow flow of seawater into the tanks and exit through the drain valve is kept up so as to maintain a water column of 70 cm inside the tank. The oysters are allowed to remain in the tank for twelve hours to rid the oysters of microorganisms.

Subsequently seawater in the purification tank is drained and the oysters are once again hosed with a strong jet of seawater. By this procedure the accumulated faeces are removed from the tank. The purification tank is again filled with filtered seawater, the oysters are relaid and the process is repeated for another twelve hours. At the end of this period, the oysters are kept for one hour in seawater purified by treating with 3 ppm. chlorine. Then the oysters are washed once more in filtered seawater and kept ready for marketing. This procedure makes the oysters free from bacteria and renders them suitable for human consumption.

Transport and Storage of Live Oysters

Oysters can survive out of water for several days, if carefully handled and kept moist and cool. However, it is desirable that the oysters reach the consumer market within three days of harvest if they are to be in prime condition. They should be transported in wet gunny bags which are kept moist from time to time. They should be kept in a manner that protects them from mechanical damage. The method of packing depends on the value of the product, journey time and the market for which it is sent (Stroud, 1980).

For marketing purpose, consignments of 300 oysters each kept in wet gunny bags and packed in bamboo baskets were sent twice by train to Madras 560 km away. The consignment reached the destination in a wholesome condition with 'nil' mortality. For processing studies, 5,500 oysters packed in 37 wet gunny bags were transported by road for twelve hours to Cochin. There was no mortality either enroute or at destination. This indicates that live marketable size oysters packed in wet gunny bags can be safely transported for 25-30 hrs, without mortality. Small holding tanks having filtered seawater or artificial seawater and provided with adequate aeration facilities would keep the oysters alive for a few days at the wholesalers premises.

Shucking

Shucking is the removal of meat from the oyster. One develops skill in shucking after some practice. Further each person develops his own individual opening technique.

The materials required for shucking are a shucking table, shucking knives, a perforated stainless steel table and rubber gloves for preventing cuts from the sharp edges of the oyster shell. The shucking knife is made of stainless steel, 30 cm long, has a stout wooden handle and the distal end is flattened into a cutting edge of 2.5 to 3.0 cm (Quayle, 1969).

For shucking the oyster it is placed on the table with the cupped or left valve down with the hinge pointed towards the opener's left. Sometimes experienced shuckers hold the oyster in this position in their left hand and do the shucking (Pl. I c and d). The sharp edge of the shucking knife is inserted between the two valves of the shell close to the hinge (Fig 1). After the knife edge has entered inside, the blade is forced

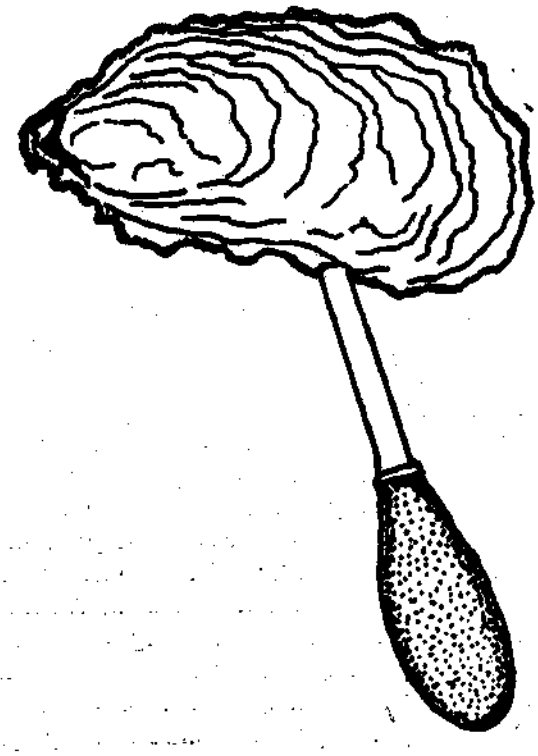

Fig 1. Position of shucking knife in the oyster while opening.

further into the shell cavity of the oyster to about 2 to 3 cm when a movement of the knife to the right and left will sever the adductor muscle of the oyster. A prying motion of the knife will break hold of the hinge and the two shell valves of the oyster will separate. The upper valve is discarded, the oyster meat is separated by cutting the base of the adductor muscle attached to lower valve and flipped into the container. If the oyster is to be served on the half shell, it is cleaned of any shell fragments and left in the cupped lower valve.

Plate I. *a* Harvested oysters. *b* Oysters kept in tank for initial cleaning. *c* and *d* Oyster meat being shucked from the depurated oysters.

Several methods have been tried to reduce the labour of hand shucking. These include the shearing of the hinge or beak of the oysters by guillotine and a wide range of treatments that cause the shell to gape open, including the use of chemicals (weak hydrochloric acid), heat, cold, vacuam, microwaves and lasers (Wood, 1972). Among all these methods, the easiest is freezing the oysters before shucking (Stroud, 1980) or placing the depurated oysters in a hot-water tank in which temperature is not high enough to cook the oysters, but sufficient to open them (Nowak, 1970). A skilled shucker can remove meat from 120 to 150 oysters in an hour.

Processing of Oyster Meat

Freezing :

After purification whole oysters (shell on) can be frozen satisfactorily spread in single layers in an air blast freezer. Oysters can also be frozen in the half-shell. They should be laid in a single layer on trays in an air blast freezer with polypropylene film stretched over each tray to protect the open surfaces of the oyster meat.

Frozen whole oysters packed in polythene bags can be kept in good condition for six months in a cold storage at —30°C. The liquid within the shell acts as a glaze to protect the meat from dehydration. The meat of frozen whole oysters is suitable for preparing dishes.

Freezing Oyster Meat

If the demand for frozen whole oysters is not much, it is economical to freeze shucked meat. Oyster meat frozen either individually or in blocks (in 1 kg or 2 kg slabs) will yield an excellent product after thawing.

Canning of Oyster Meat

Oyster in brine :

Oyster meat is chilled, washed and blanched in 3% brine containing 0.1% citric acid for 4-5 minutes. Ninety gm of blanched meat is packed in cans (112 gm net wt.) and a hot 2% brine with 0.1% citric acid is added. The packed cans are seamed and sterilized at 115°C for twentyfive minutes. The cans are then chilled immediately, wiped to remove water present on the outside and kept in storage (Stroud, 1980).

Smoked Oyster :

For preparation of smoked oyster meat, the meat in washed, treated with 5% brine for 5 minutes, drained, dipped in edible oil, spread in a single layer on nylon wire mesh, drained again and loaded into the smoking chamber (Samuel *et al.*, 1982). The meat is held is dense smoke and maintained at a temperature of 40°C for 30 minutes and later at 70°C for 80-90 minutes. In the smoking chamber the materials are turned over once in 15 minutes to ensure uniform smoking of the meat. The smoked oysters are packed in cans and sufficient quantities of hot refined edible oil is added. The cans are then seamed, sterilized at 115°C for 25 minutes and immediately cooled and stored for marketing (Stroud, 1980).

Meat of cultured oysters harvested from oyster farm at Tuticorin was shucked and processed. The shucked meat was washed well and dipped in 1% salt solution containing 0.2% citric acid to avoid drip loss. The meat was then packed in 2 kg units, quick frozen and transported at—20°C in insulated van to Integrated Fisheries Project, Cochin. The meat thus transported was canned either in oil or as smoked oysters. About 2,218 cans with net weight of 80 gm of oyster meat were obtained from 500 kg of oyster meat (Samuel *et al*, 1982) at the cannery of the Integrated Fisheries Project, Cochin. The canned oysters were sold in major cities of India and was well received.

Utilization of Oyster Shells

The oyster shells constitute about 90% of the total weight and contain 52-55% of calcium oxide and therefore are suitable raw material in calcium carbide, lime, fertilizer, cement and other industries. Further, the oyster shells are ideal for use as spat collectors for the collection of oyster spat. The shells can also be distintegrated to suitable size and used as poultry grit.

Oyster shells (100 kg) were disintegrated and shell grit of four different grades 5 mm, 2 mm, 1 mm and $\leq$ 1 mm were obtained. On trying them in a local poultry farm 2-3 mm size grit was found to be suitable as an ingredient in poultry feed. The bulk of the oyster shells were sold to calcium carbide industry since they could be disposed of without incurring any expenditure towards processing as in the case of shell grit. The shells are also being utilized as spat collectors in the hatchery as well as in spat collection from nature.

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