

# CMFRI bulletin 42

Part Two

DECEMBER 1988



## NATIONAL SEMINAR ON SHELLFISH RESOURCES AND FARMING

TUTICORIN

19-21 January, 1987

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Sessions II-VI

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CENTRAL MARINE FISHERIES RESEARCH INSTITUTE  
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## PROCESSING AND PRODUCT DEVELOPMENT OF BIVALVES AND GASTROPODS

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### 73. PROCESSING AND PRODUCT DEVELOPMENT OF BIVALVES AND GASTROPODS

—Theme Paper

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#### INTRODUCTION

Food eating habit of the people is changing very fast particularly in recent times, due to improvement in socio-economic conditions of the people, availability of new resources as food, application of enriched, prepared foods etc, for the convenience of the customers. In this changing situation, processing good quality food in different parts of the country. The domestic market is vast and practically remains untapped as far as fishery products are concerned. In the export sector also, product diversification is the urgent need of the hour. Even after three and half decades of fisheries development, the sea-food export industry still depends for its export earnings on one single item namely frozen shrimp, though other items like lobsters, squids, cuttle fish and fishes like pomfret earn foreign exchange to some extent.

#### WORLD PRODUCTION OF PROCESSED OYSTERS, CLAMS, MUSSELS AND GASTROPODS

In recent years, a few categories of bivalves have become a popular seafood item in many countries. A considerable quantity of oysters, clams, mussels and gastropods are processed into frozen products, canned products and dried products in different countries of the world. The following table indicates the quantity of these commodities produced by important countries.

#### *Commercially important bivalves and gastropods in India*

In our country, oysters, clams, mussels and a few gastropods are local delicacies along the coastal region from where they are collected. They are good sources of food material available at reasonable prices and the local population buy them for culinary purposes. These varieties are not marketed in the interior region of the country, except in the form of canned products and as pickles to a limited extent in recent years.

Bivalves are by far the most important group compared to gastropods, for commercial exploitation and utilisation as food. Among the bivalves, edible oysters (*Crassostrea* sp), Window pane Oysters (*Placenta placenta*), various clam species (*Meretrix meretrix*, *M. Casta*, *Villorita cyprinoides*, *Gafrarium tumidum*, *Tapes pinguis*, *Katelysia opima*, *Donx* sp, *Anadara granosa*, *Paphia* sp, *Tridacna maxima*), the green mussel (*Mytilus viridis*) and brown mussel (*Mytilus* sp) etc, are utilised as food and also to some extent for processing and export.

The gastropods are mainly fished for their beautiful shells which are of ornamental value and for the manufacture of lime. The meat is sometimes used as bait. Only a few species are utilised as food to a very limited extent by the coastal population. The gastropods which can be utilised as food include limpets (*Cellana radiata*), *Trochus* sp, whelks (*Thais rudolphi* and

**World Production (Qty in Metric tons)**

	1984	1983	1982	Countries
<b>I. Frozen Products</b>				
a) Oyster Meat	3,105	3,528	4,162	Canada & U. S. A.
b) Clam Meat	15,053	15,906	15,890	U. S. A. & Rep. Korea
c) Mussel Meat	8,726	8,016	2,559	Denmark & New Zealand
d) Univalves	3,745	2,307	4,344	Chile
Total	30,629	29,757	26,955	
<b>II. Dried products</b>				
a) Oyster Meat	548	954	1,075	
	548	954	1,075	Rep. Korea
<b>III. Canned products</b>				
a) Oyster meat	8,426	12,504	8,648	Rep. Korea & Japan
b) Oyster specialities	2,455	2,666	4,504	U. S. A.
c) Clam meat	21,436	20,465	19,700	U. S. A., Italy, Spain & Chile
d) Clam Chowder	34,910	36,967	37,515	U. S. A.
e) Clam specialities	6,703	3,047	3,834	USA
f) Mussels	8,000	10,979	11,000	Netherlands
g) Mussel Meat	17,392	15,081	17,567	Denmark, Spain & Rep. Korea
h) Univalve Meat	1,581	1,885	710	Chile
Total	100,903	103,594	104,553	

(Source : FAO - Yearbook of Fishery Statistics 1984, Fishery Commodities, Vol. 59)

*T. bufo*), olives (*Oliva* sp), buttonshell (*Umbo-nium vestiarium*) and the sacred chank (*Xancus pyrum*). Meat from some other gastropods may also be edible, but further studies are needed to find out their suitability for human consumption. At present, the meat from *Umbo-nium* sp is perhaps the only gastropod utilised for food in some places in Maharashtra coast.

The availability of the above resources in sufficient quantity for commercial processing and marketing has to be studied carefully so that the resources are not depleted due to large scale exploitation.

**Chemical composition of bivalves**

Oysters, clams and mussels form a reasonably good source of protein and glycogen, though the protein content is not as high as in the case of fin-fish. Following is the chemical composition of the above mentioned bivalves.

	Edible oyster meat	Farm oyster
Moisture %		80.05
Crude protein %		12.26
Glycogen %		2.66
Ash % (DWB)		11.69
<b>Clam meat</b>		
Moisture %		78.50
Protein %		10.09
Fat %		2.52
Glycogen %		6.68
Ash %		0.86
<b>Mussel meat</b>		
Moisture %		85.00
Protein %		8.40
Fat %		1.20
Glycogen %		3.50
Ash %		1.40

### *Processing of bivalves*

Oysters, clams and mussels are mainly processed into frozen, canned, smoked and canned, dried and pickled products. The different stages involved in the processing of bivalves are briefly described below:

#### *Depuration/Purification*

After harvesting the bivalves are washed well in running water to remove the mud, dirt etc. Their intestines are often loaded with mud and sand, besides bacteria depending on the bacterial quality of the environment. The gut contents impart a muddy flavour and grittiness to the meat, if retained within. Manual removal of sand from stomach is time consuming and also will result in distortion/damage. Therefore, a cleaning operation to achieve depuration as well as elimination of bacteria is a very important step that should precede processing of bivalves.

Depuration means starving of the bivalves in filtered sea/water from their natural habit at normally for a period of 12-24 hours. The bivalves do not feed, but at the same time, they will empty their intestine through excretion. During this process, mud, sand etc. are also emptied from the alimentary canal and the bacterial load is considerably reduced.

Live animals after depuration in filtered water from natural habitat for 12-24 h are relaid in filtered natural water chlorinated to 3-5 ppm level for 2-3 h. Though depuration in chlorinated water offers no significant improvement in the bacterial quality of the meat, treatment with chlorine after depuration and holding the live animals in that system for 2 h show definite improvement in the bacterial quality of the meat.

#### *Shucking operation*

Shucking means removal of the meat from the shell of bivalves and this can be done manually, or by immersing the live animals in boiling water/sea water or by steam cooking for a few minutes until the shell of the animal gape or open. Manual shucking is a strenuous job and highly time consuming. In commercial operation, shucking is mainly done either by boiling or by steam cooking.

### *Average shucking yield (after cooking) from raw material*

Edible oyster	: 3-4%
Clam ( <i>Meretrix</i> sp & <i>Villorita</i> sp)	: 9%
Green mussel	: 19%

The shucked meat is washed well in water/running water to remove the shell pieces, dirt etc, if any, adhering to the meat. In the case of mussel the byssus is to be removed. The shucked and cleaned meat have to be chilled if there is some delay in further processing.

#### *Freezing of bivalve meat*

**Oyster meat:** Prior to freezing, the oyster meat is washed again and immersed in 1-2% salt solution containing 0.2% citric acid for about 10 minutes. One problem in the freezing of oyster meat is the high amount of drip loss due to freezing and thawing, which is found to be in excess of 20%. The brine treatment will reduce the drip loss to some extent. After the brine treatment, the oyster meat is drained, and packed in suitable unit size (1 Kg/ 2 Kgs/ 5 Kgs) in duplex cartons with polythene lining. The packed material is frozen at -30°C using contact plate freezer and stored at -20°C.

**Clam meat:** During the Year 1981, frozen clam meat was added on to the list of seafood exports from India. Today, there are a few seafood processing plants processing the clams for the purpose of export.

After depuration and shucking, the clam meat are graded according to size and the following size grades are followed by the freezing industry.

#### *Size grades for frozen clam meat (Count/Kg)*

300-500	1000-1200
500-700	1000-1500
700-1000	Broken

After size grading, the clam meat are washed in 5 ppm chlorinated water. The washed clam meat may also be boiled in 2-3% brine for just half to 1 minute to reduce the bacterial load. Packing is done in 2 Kg units in duplex cartons with polythene lining, the blocks are frozen using contact plate freezer at -30° C

within a period of 2-2½ h and stored at below -20°C.

Very recently, clam meat is also frozen as IQF (Individually quick frozen) for the purpose of export.

*Mussel meat:* Freezing of mussel meat is yet to be tried on a larger scale on a commercial basis by the freezing industry either for domestic market or for export. The freezing procedure is not much different from that of clam meat.

After depuration and shucking, the meat from mussels are carefully cleaned to remove the byssus, shell pieces and washed thoroughly in 5 pp chlorinated water. If necessary, the mussel meat may be boiled again in 2-3% brine for 1-2 minutes. Packing may be done in 1/2 Kg, 1 Kg or 2 Kg units and packed in duplex cartons with polythene lining, and frozen in contact plate freezers. The frozen mussel meat are stored at below -20°C.

#### *Canning of bivalves*

Canning is an important method of processing of seafood, whereby a stable finished product is obtained which can be stored at ambient temperature for a considerable length of time, usually for one year or more.

#### *Oysters*

Canning of oyster meat and smoked oyster meat are being done on a pilot plant scale/semi-industrial scale by the Integrated Fisheries Project, Cochin, for the last 5 Years utilising the cultured edible oysters (*Crassostrea madrasensis*) from the oyster farm of C.M.F.R.I. unit and a freezing plant there. The frozen oyster meat are transported in insulated trucks to Cochin, which involves a transportation time of 8-10 h. The frozen meat when received at Cochin are stored in frozen storage at below -20°C. The frozen meat are utilised for canning.

The technological process for canning of oyster meat involves thawing of frozen oyster meat in the chill room at 0°C overnight. Next day morning, the oyster meat block is immersed in chilled water to separate the meat.

#### *Canned oyster meat in brine*

The thawed oyster meat is blanched in 3%

brine for 2-3 minutes. The blanched oyster meat is packed in easy open type quarter dingley aluminum cans and hot 3% brine with 0.2% citric acid is added to nett weight. The quarter dingley cans have nett weight of 112 gm. They are exhausted for 6-8 minutes seamed and sterilised at 115°C for 30 minutes in superpressure autoclaves and then the cans are cooled down to room temperature within the autoclave itself.

#### *Smoked-canned oyster meat*

The thawed oyster meat is cold blanched (brined) by immersing in 5% salt solution for 3-5 minutes and arranged inside the smoking chamber. Hard wood saw dust is burnt to generate the smoke and the smoking is done initially at 40°C for 30 minutes and then at 70°C for 75-80 minutes. During the smoking process, the flavour of the oyster meat is improved due to absorption of volatile and other substances from the smoke, colour of the meat changes from bluish green to light brown and the texture improved due to partial dehydration.

The smoked oysters are packed in easy to open type quarter dingley aluminium cans, 80-85 gm in each can. Hot, double refined ground nut oil is added to nett weight (112 gms) and the cans are exhausted, seamed and sterilised at 115°C for 25 minutes in superpressure inside the autoclave itself.

#### *Canned clam/mussel meat in brine*

There had been some attempts by the seafood canning plants in India to process and export canned clam and mussel meat during the last decade, but good progress could not be achieved in this direction. The processing method adopted for canning clam and mussel meat is basically the same as described in the previous paragraphs for the canning of oyster meat in brine. The blanched meat were packed in 8 oz. (Nett wt : 200g) round tin containers, and these cans were given a sterilisation time of 45 minutes at 115°C temperature.

But at present, there is no canning of clam/mussel meat in India on a commercial/semi-commercial scale.

### *Pickling of oyster/clam/mussel meat*

In order to develop products from these bivalves suitable to the Indian taste, detailed studies have been conducted and methods formulated for the processing of oyster clam/mussel meat into pickles by the Scientists of the Central Institute of Fishery Technology. Pickling of clam meat and mussel meat had been taken up by the entrepreneurs on a commercial scale, and this product is already available in the market in some cities and towns in India.

In general, the procedure involves frying of the depurated, shucked and washed meat in edible oil (gingelly oil) until the meat becomes light brown/brown in colour. The fried meat is kept apart. Required quantities of ingredients like mustard, garlic, ginger, green chilly and curry leaves are fried together in refined oil for 2-3 minutes. At this stage, pre-determined quantities of pepper powder, chilly powder, turmeric powder etc are added, followed by the fried meat. The entire mass is boiled under stirring for a few seconds and removed from the flame. When sufficiently cooled, Vinegar is added and mixed thoroughly. The pickle is packed in pasteurised glass screw cap bottles and stored at room temperature. The shelf-life of pickles made from oyster/clam/mussel meat have been found to be around 6 months.

### *Drying of oyster/clam/mussel meat*

Drying of bivalves is not a common practice in India. Nevertheless, the procedure is outlined here.

The depurated, shucked and washed meat from oyster/clam/mussel are blanched in 3-5% boiling brine for 2-5 minutes depending on the size of the meat. The purpose of blanching is mainly to inactivate the enzymes, reduce the bacterial load and moisture content from the meat. Now, the meat is either sun-dried/dried in a hot-air drier. Drying should be done properly to reduce the moisture content to the level of 10-15% in order to have sufficient shelf-life.

### *Possibility of new products from bivalves*

There are possibilities of producing some diversified products from bivalves and some of them are briefly mentioned below: In all the

cases the bivalves are to be purified (depurated) shucked and washed before they are used for making the products.

### *Frozen products*

#### *Minced meat*

The oyster/clam mussel meat may be sent through a meat cutter or meat mincer having a screen of 2-5mm diameter to obtain coarse pieces of minced meat. Mincing may be done after blanching the meat in 2-3% salt solution for 3-4 minutes. The minced meat thus obtained may be packed in duplex cartons with polythene lining and frozen using a contact plate freezer and stored it below -20°C.

This frozen minced meat may be used for making cutlets meat balls etc by blending with boiled potatoes, onion, chillies etc. The frozen minced meat may also be useful for making different types of soups etc. (eg. Oyster and corn soup)

#### *Battered and breaded IQF meat*

Oyster meat and mussel meat may be useful for producing battered and breaded products. The shucked oyster/mussel meat is to be blanched mildly in boiling 2-3% brine for 3-4 minutes. The blanched meat is dipped in a batter mix made of wheat flour, salt, sugar, spices, Vegetable oil etc as per the taste and breaded with bread powder. Now the battered and breaded meat may be individually quick frozen to -30°C using a suitable freezing equipment. The IQF meat may be packed in polybags and stored at below -25°C.

The battered and breaded IQF meat is ready for frying in hot vegetable oil as it is taken out of frozen storage/freezer cabinet of the home refrigerator.

### *Canned products*

For the purpose of making diversified canned products all the three commercially important bivalves namely oysters, clams and mussels may be useful.

#### *Minced meat*

The shucked meat may be used for mincing directly or after mild blanching using a meat

mincer. The minced meat is packed in suitable cans. The juice that runs out of the minced meat may be collected, boiled and added into the cans as liquid medium. The cans are to be exhausted, seamed and sterilised.

The canned minced meat may be used for making soups, cutlets, meat balls etc.

#### *Soups/soup stock*

During the mincing operation for oysters/clams/mussels a considerable quantity of liquid flow out from the meat. Some quantity of this liquid is added into the can as the medium, but still surplus quantity of liquid may be present.

This liquid may be boiled with spices, tomatoes, onions, salt etc. and canned as soup or nectar. The hot liquid is filled into cans, seamed and sterilised.

The soup/nectar may be used as a soup stock for preparing soups or as a flavouring agent for other preparations.

#### *Chowder*

The example for this product is clam chowder. The shucked clam meat are thoroughly washed and then chopped in a grinder or meat cutter. Diced potatoes and bacon are added. Other ingredients like tomatoes, onions, white pepper and salt also added in stages. Now the ground clam meat along with all ingredients are boiled for about 10 minutes filled into cans under string. Now, the cans are exhausted, seamed and sterilised.

#### *Extracts*

The examples for this product is clam extract. When the clams are shucked by steaming and also when the clam meat is blanched, considerable amount of liquid/juice is released from the meat. This liquid is collected, filtered and concentrated by boiling. The concentrated extract is filled into cans, exhausted, seamed and sterilised. Clam extract may be useful as a food for convalescents and invalids.

#### *Marketing of Bivalves and Gastropods*

##### *Domestic market*

Bivalves in live condition or their shucked meat are marketed to some extent in India along

the coastal regions of Kerala and Karnataka and mussel meat in north Kerala coast.

Edible gastropods are occasionally collected and utilised as food, by fishermen in the coastal areas. The meat from button shell, *umbonium*, is perhaps the only species that is reported to be sold in fish stalls in Malvan (Maharashtra).

Oysters are eaten in live condition in some countries and are considered to be a delicacy, with increased number of tourists from developed countries visiting India, there is a possibility of serving live oysters in large hotels and restaurants in our country. This possibility should be explored further. Oysters will remain alive for about 24 h under the shade outside sea water after harvesting. If transportation by train/air and distribution is arranged properly, it may work out economical to market them live. Similarly, mussels and clams also could be marketed live to large hotels in the country.

Marketing of frozen oyster, clam and mussel meats within the country is also a possibility. But this will require educating the people regarding the nutritional qualities of their meat, preparing of recipes to guide the customers to use them as per the local taste, distribution to various consuming centres and sales promotion through advertisement and publicity.

Among the canned products, smoked oyster meat has very good demand in large cities and towns within the country though expensive. Similarly, smoked mussels and clams also may find a good market within the country.

#### PRODUCTION OF CANNED OYSTER MEAT (FOR DOMESTIC MARKET)

	Quantity : in Kgs		Value : in Rupees		
	1985-86	1984-85	1983-84	1982-83	1981-82
Q:	602.2	254.5	252.5	352.5	96.0
V:	48,393	20,448	22,698	25,184	6,856

(Source: Integrated Fisheries Project, Cochin-16)

Pickles made from clam meat and mussel meat are already produced and marketed to some extent on a commercial scale. This requires

further sales promotion with the aim of increasing production and marketing.

Similarly, boiled and dried meat of oyster, clam and mussels may be powdered and used as a protein supplement in various types of foods like soup powders, chutney powders etc. Possibility of marketing such products should be explored further.

#### *Export market*

As mentioned earlier, frozen clam meat are exported from India from the year 1981 onwards to countries like Japan/Kuwait, Federal Republic of Germany, U. S. A., and U. A. E. The quantity exported and value realised are given below:

EXPORT OF FROZEN CLAM MEAT					
Quantity: in m. tons		Value: in Rs. Lakhs			
	1985-86	1984-85	1983-84	1982-83	1981-82
Q:	392	1034	654	510	16
V:	62.37	148.71	83.25	97.36	1.11

Some attempts were made to export canned clams and mussels during the last decade, but the quantity exported and value realised are negligible, as seen below:

#### *Export of canned clam and mussels*

Qty: in m. tons		Value: in Rs lakhs			
Year	1981	1980	1979	1975	
Clam Qty :	10.0	—	—	0.1	
Value :	1.85	—	—	0.04	
Mussel Qty :	—	0.07	1.5	0.1	
Value :	—	0.04	0.48	0.03	

Some quantity of clam meat pickle also had been exported to Japan and U. A. E. during the years 1981 and 1982

Year	1982	1981
Q :	9.1	1.6
V :	0.61	0.28

Good potential for export of frozen, pickled, canned smoked and canned oysters, clams and mussels exist. But in order to exploit these markets, we must be in a position to effect regular supply of these commodities in considerable quantities.

#### *Conclusion*

It is possible to process marketable products from various types of bivalves by freezing, canning, smoking and canning, pickling, drying etc which may find a good domestic market with effective popularisation measures. A good potential already exists for export of these products to various countries.

But exploiting the domestic and export markets call for large scale availability of raw-material regularly. For this, we may not be in a position to depend entirely on natural resources as the known resources are limited. So, large scale farming of oysters, clams and mussels on commercial basis will have to start immediately. Culture techniques for farming, processing methodology and market potential already exist within the country. The only missing link appears to be the commercial farming of the valuable bivalves.