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Mussel Culture

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Introduction

Mariculture of bivalves greater importance in meeting the increasing protein demands of the human population. Bivalve groups such as oyster, mussel and clam are the most important cultivable organisms all over the world. Of these, *P. viridis* and*P.indica* forms the most dominant cultivable species. The Central Marine Fisheries Research Institute (CMFRI) has developed eco-friendly techniques for mussel culture. Recently, CMFRI has taken up efforts to popularize mussel culture in all coastal districts of Kerala.

Scope for mussel farming

Kerala state is endowed with the mussel resources and survey reveal that two species viz., *Pernaviridis*((green mussel) and *Pernaindica* (brown mussel) are present along the rocky shores . The latter is mostly restricted up to the south of Kollam from Cape Comorin in west coast and the former is distributed throughout. Annually about 15000 t of mussels are exploited from these regions. During post- monsoon period there is heavy settlement of mussel spat along the entire Kerala coast. This seed can be used for farming (See the annexure for a resent estimate of mussel seed resources in central Kerala). Mussel reaches harvestable size (55-70mm) within 4-5 months when cultured.

Experiments indicate if farming activities confined to November to May, mussel can be successfully cultured in the most estuaries of Kerala since ecological conditions will be congenial for good growth and survival. Similarly the Arabian Sea bounding the shores of Kerala can also be used to culture of mussels during the fair season (Oct to May).

Background information

The CMFRI has developed technologies for farming of mussel in early seventies and since then it have been upgraded and refined for commercial production. The Institute has conducted a series of experiments on location testing in various estuaries ans sea along the west coast of India. In Kerala, location testing for mussel culture has been done in estuaries areas using rack and rope method.

The Calicut Research Centre of CMFRI, Calicut took steps to expand mussel culture practices in the north Kerala region in small scale with the involvement of fishermen. The Research Centre successfully demonstrated mussel culture in the Dharmadam estuary during 1995-96. This created some awareness among the local fishermen. During 1996-97, mussel culture was done on a large scale at Padanna with the involvement of a group of twenty five fisherwomen. Financial support was extended by the DWCRA. These programme proved that mussel culture can be profitably undertaken utilizing the available water spread area in the estuaries of North Kerala. In Central Kerala it was demonstrated in the Chettuva estuary in Trichur district during 1997 and now it is extended up to Munambam estuary and nearby areas of Sathar Island.

Open sea culture of mussels was initiated by the CMFRI off Vizhinjam and off Calicut during the 1970's. Recently, a pilot scale demonstration of long – line culture was alsop carried out boffAndhakaranazhi near Alleppey. During 1998-99, a group of

fishermen from Vypinisland took the initiative to launch raft culture of mussels in the sea off narakkal with technical collaboration from CMFRI. Currently farmed mussel production from Kerala stateis estimated to be nearly 20,000t

Taxonomy

Phylum	-	Mollusca
Class	-	Bivalvia
Sub class	-	Pteriomorpha
Order	-	Mytiloida
Sub order	-	Mytilacea
Family	-	Mytilidae
Genus	-	Perna
Species	-	viridis

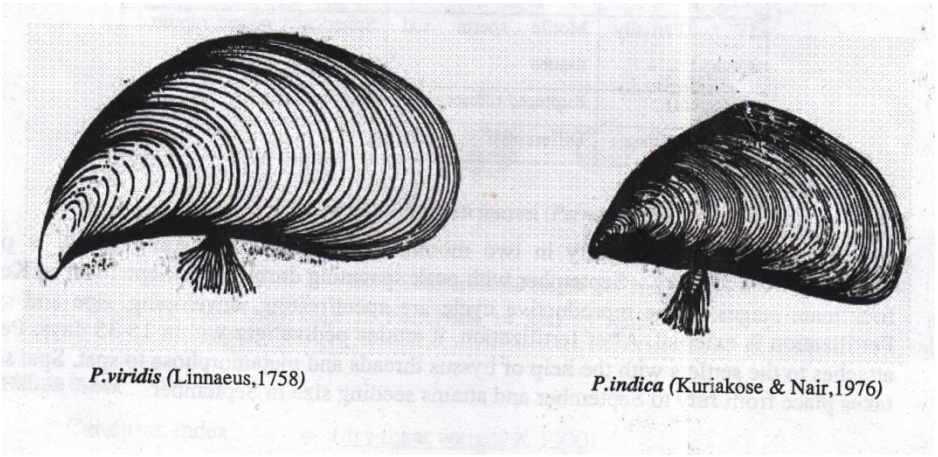
Common names

English : Green mussel/Brown mussel
Malayalam : Kallumaekai/Kadukka/Chippi
Tamil : PachaiAali/Kallikai

Morphology

The external shell colour of young green mussel is beautiful jade green and in older specimens it is bluish- green at the anterior half. The shell colour of brown mussel is dark brown. Tnerior of the shell is margaritaceous and shining in both the species. Two equal sized shells protect the internal organs. The shell are thick, equal, equilaterial, elongate, triangularly ovate in outline and hinged at the anterior end. The posterior end of the shell is almost round.

Diagnostic characters	***Pernaviridis* (Linnaeus,1758)**	***Pernaindica* (Kuriakose&Nair 1976)**
Common name	Green mussel	Brown mussel
External shell colour	Green/ Bluish green	Deep brown
Dorsal ligamental margin	Curved	Straight
Mid dorsal margin	Arcuate	Highly angular
Posterior margin	Rounded	Rounded
Ventral margin	Highly concave	Straight
Mantle margin colour	Yellowish green	Brown
Excurrent aperture opening	Mouth open and wide; Passage into the mantle cavity small; restricted by septum, rectum and posterior adductor not visible through the opening.	Mouth and passage into the cavity are of same width; rectum and posterior adductor prominently visible through the opening.
Ventral mantle margin	Inner fold of the posterior ventral margin thin, extensible, smooth, tentacles or papillae absent.	Inner fold of the posterior margin very thick not extensible; provided with 18-22 thick branching tentacle.
Posterior byssal retractors	Two, short, thick bundles; anterior bundle arises from the posterior and diverges in the form of a 'V'	Two, short, thick bundles; anterior bundle arises from the posterior and diverges in the form of a 'W'



Food and Feeding

Mussels are ciliary- mucoidfilter feeders, which feed on phytoplankton, zooplankton and detritus.

Growth

Green mussel shows a rapid growth rate by length of 8mm-13.5mm per month. Under average culture conditions, green mussel and brown mussel attain a length of 80-88mm with 36.5-40g weight and 65mm with 25-40g in 5 months respectively. The farmed mussels give a better meat yield compared to mussels from the natural bed. The average edible portion of the meat yied is 27.2%- 33.3% of the total weight. Growth by length and weight are probably the most importanr criteria for assessing the success of the culture system.

The growth of mussel is influenced by a number of environmental factors such as water quality, food availability, settling density, water current and tidal exposure.

Reproduction

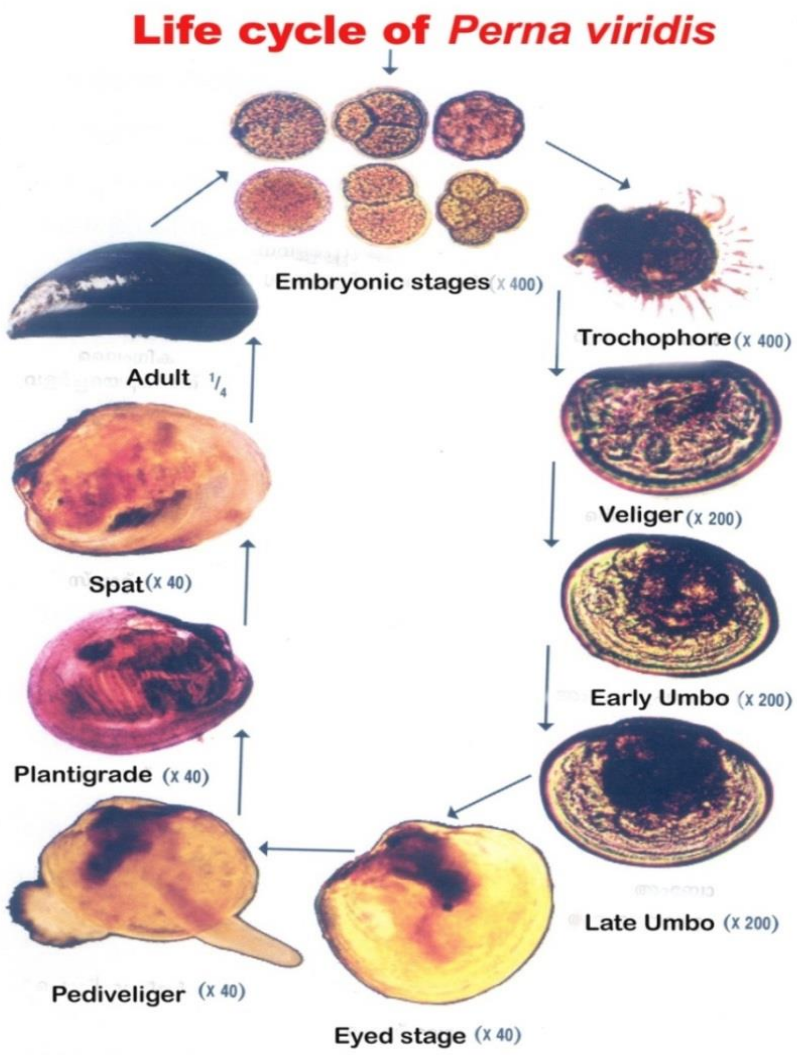
Mussels are known to be unisexual. Hermaphrodites are observed very raely. The gonad of mature female can easily be distinguished

by its bright orange-red colour form that of the male, which is creamy yellow.

Stage	Male	Female
I (Immature)	Sperm non motile	Ova without any shape
II (Maturing)	Sperm non motile	Granulation in the ovary
III (Mature)	Sperm motile	Spherical ova
IV (Partially spent	Motile sperm and tissues	Spherical ova and reputed ova
V (Spent)	Reputed tissues	Reputed tissues
(Indeterminate)	Differentiation impossible	

Mussels attain sexual maturity in two months (15-28mm). Spawning period is prolonged extending from January – September with peak spawning during June –September in Kerala. The four main stages in the reproductive cycle are spent/ resting, developing, ripe and spawning. Fertilization is external. After fertilization, it attains pediveliger within 15-35 days. Pediveliger attaches to the settlers with the help of bysuus threads and metamorphose to spat. Spat settlement takes place from July to September and attains seeding size in September.

Male Female



1. Egg 2. Egg with sperm 3. 3-9 Early developmental stages 10. Trochophore
11. Veliger 12. Eyed/ umbo stage 13. Plantigrade14. Spat 15 Adult.

Condition index

*Condition index = (dry meat weight X 1000) / Volume of shell cavity

** Percentage edibility = Meat weight X 100 / Whole mussel weight

* Condition index is generally related to the reproductive cycle. Condition of mussel indicates degree of fatness of a mussel or the extent to which the meat fills the cavity. The ideal condition index of mussel is 70-140. This will be high during non-spawning period.

**percentage edibility, the percentage edibility is high the mussels can be harvest3ed. Percentage edibility varies from 20-45%.

Distribution of mussels

The *P.canaliculus* or the green lipped mussel is restricted to new Zealand while the green mussel *P. viridis* is widely distributed throughout the Indo pacific area .it has been reported to occur in China, Japan,Persian Gulf, Indonesia, Hong Kong and in the Pacific Islands. *Pernaindica*isfound only along the Indian coast. *Pernaperna*is found along the coasts of African continent, South Africa and Sri Lanka.

Mussel popularly known as "Kallumekai/Kadukka/Chippi" in Malayalam. Green mussel *Pernaviridis* and brown mussel *Pernaindica* are available along the Indian coast. The green mussel *Pernaviridis* is extensively distributed as sub tidal and intertidal beds along both the coasts. Along the Kerala coast, the major locations are Koduvally, Mahe, Chombala, Moodadi, Thikkodi, Elathur, Chaliyam and south beach, Anchangadi, Ethai, Narakkal, Chellanam, Andhakaranazhi,Azheekal, Parimanam, Neendakara and Port Kollam.

Along the Karnataka coasts the mussel beds are mostly seen in subtidal beds and major resources are located in Uchila, Someswara, Suratkal, Matukopal, Malpe, Coondapur, Byndur,Bhatkal, Basaldurga, Dhareshwar, Gokarn, Kodar, Karungadi, Karwar, Angola, and Gangoli.

In Goa, mussels beds have been observed at Mapusa, Panjim, Margoa and Canacons. Along the Maharastra coast, mussel beds are seen in rocky coastal regions as well as in the small creeks. Extensive mussel resources are available along Dahoi, Jaigad, kalbadevi, Bhatye, Purnagad, Taramumbri, Devegad, Chowl, alibag and Urar. Along the Gujarat coast, mussel population is spares, observed only in Jamnagar region at Sikka, Baid, same, sachana and near Dwaraka.

In Tamil Nadu, Pondicherry and Andhra Pradesh extensive beds are not reported. However, mussel resources have been observed at Chunambaru estuary, Ennore, Kandaleru, Visakhapatanam, Kakinada, Nellore, Vedukunnappalli, Pathapalam and Ponnapudi. In Chilka lake meager occurrence of mussel has been reported. Sparse mussel beds have been observed at some locations in the Andaman and Nicobar Island and it is absent in Lakshadweep Islands.

Mussel seed availability along the Indian coast / area suitable for farming

State	Location
Kerala	Ashtamudi lake , Thangaserry Bay, Azheekode, Maliyankara, Sathar Island, Chettuva, Ponnani, Kadalundi, Dharmaadam, Valapattanam, Padanna, Neelaswaram etc.
Karanataka	Mulky, Suratkal, traisi, Baindur, Gokarn, Belikeri, Arga, Amdalli, Harwada, Karwar Bay, Manjalietc
Tamil Nadu	Coleroon estuary, Gadilam estuary, Kovalam, Kadiyapatanam, Coachel, Kodimunna, Vaniakundikurumpana, Melemidalam, Aazhimala, Pulinkidi, Mulloretc
Pondichery	Kadaloor
Andhra Pardesh	Bhimunipatanam, Kakkinaada, Dommulpeta,Chinamylavarilanka etc.
Maharashtra & Goa	Bhatye creek, kalbadevi creek, Jaigad creek, Dabhal creek, Purangad creek, Budhal coast, Tulsunde creek etc.
Andaman & Nicobar Island	Sippighar, Bimbleton, Kalpather, Garacharma, Mittagari, Haathitope, North Bay, Minnie Bay etc.
Gujarat	Navabander
Orissa	Gopal pure port (Badrajpally), Gopalpur Rocky shore, Gopalpur back water, Bahuda estuary etc.

Some common species of mussel in the world

Scientific name	Common name	Country
Pernaviridis	Green mussel	India,China,Indonesia, Malaysia, Philipines, Singapore, Thailand
Pernaindica	Brown mussel	India
Pernacanaliculus	Green lipped mussel	New Zeeland
Mytilusedulis	Blue mussel	China, Korea(Rep.)

Fishery

In India annual mussel production wich was less than 10,000 tones in the beginning of this decade, has been doubled by 2002 through increased exploitation and farming in coastal waters. I Kerala, traditional mussel fishery exists along the coast and mussel farming is now a flourishing activity in the state. Among the maritime states, Kerala stands first contributing 95% of the total mussel production. In the year 2005-06 farmed mussel production was 10060 tones.

Farming Techniques

Site selection

Open sea and estuarine areas free from strong wave action are suitable for farming. Clear seawater with rich plankton production (17-40µg chlorophyll/l,) is ideal for mussel culture. Moderate water current (0.17-0.25m/s at flood tide and 0.25-0.35m/s at ebb tide) will bring the required planktonic food and will carry away the excessive build-up of pseudofaeces and silt in the culture area. The water should have a salinity of 27-35 ppt. and temperature of 26°C - 32° C . Site should be free from domestic, industrial and sewage pollution.

Open sea farming

In open sea farming, the depth at the site should be above 5m without strong wave action, less turbulent and with high primary productivity. Long line and raft culture techniques are ideal for open sea farming. Mussels grown on long lines become smothered by naturally settling juvenile mussels and other fouling organisms. Effective utilization of easily available materials for fabrication of long line and raft can be done. Disadvantages of this farming are the poaching and unpredicted climate changes. Protected bays are ideal for mussel farming.

Estuarine farming

Compared to open sea, estuarine ecosystems with less turbulent and shallow depth (<4m) are suitable for mussel farming. Culture of mussels on horizontal ropes results in high productivity due to the effective utilization of the primary productivity. Rack culture id ideal for estuarine conditions. Fluctuation is salinity during monsoon season and pollution through domestic and industrial waste are the main constraints in estuarine mussel farming.

Methods of farming

Rack method

This method is suitable for estuaries and shallow bays. The racks are fabricated placing bamboo/casurinapolse vertically and horizontally tying and lashing with nylon/coir ropes.Bamboo or casurina poles are driare driven into the bottom and spaced at a distance of 102m. These stakes are connected horizontally with poles. The horizontal poles should be above the level of water at high tide and seeded ropes are suspended from the same.

Raft method

This method is ideal for open sea conditions. Square or rectangular rafts are fabricated with sturdy bamboo or casuarina poles. Buoyancy for the raft is provided by tying 5 barrels of 200 liter capacity one each at the four corners and one in the middle (metal oil barrel painted with anticorrosive paint or synthetic material). Ideal size of the raft 5 X5 m. the raft are Positioned at suitable site in the sea using 50-100kg of iron, granite or concrete anchors. Three seeded rope can be suspended from one meter area of the raft.

Long –line method

This method is considered ideal in unprotected open sea conditions. The main line is synthetic rope of 16-20mm diameter. The long-line, which is supported by 200 litters barrels tied to it and spaced at 5m. The long-lines and barrels are anchored in position at both ends using concrete blocks and nylon ropes. Seeded ropes are suspended in the long-line.

Horizontal Culture

This method is ideal in shallow areas with a minimum level of water column. Seeded rope were suspended by tying upward by ropes to horizontal poles; but both the ends will be stretched and tied in vertical poles erected in opposite sides in the farm structure. In the estuaries of Malabar, most of the farmers are following this method.

Bouchot culture

Bouchot(stake culture) method was done in the shallow waters of Ashtamudilake at Dalawapuram, Kollam with farmers participation. Mussel seed (20-25mm) were collected from the estuary and seeded on casuarina poles, bamboo split of one meter length @1.5kg/pole, strip. Production of 12kg/pole, bamboo split were obtained with in a period 3 months. This method is very simple and received good response from the local farmers.

Seed collection and seeding on rope

The site selected for collection of seed should be free from pollutants. Seeds collected from the submerged (sub tidal) areas will be healthier. After removing other organisms and weeds, the seeds were washed thoroughly in sea water. About 500-750g of seed is required for seeding on one meter length of rope. The ideal size of the seed is 15-25mm 1ith 1-2g weight. The length of the rope is decided by considering the depth where the raft/rack is positioned. While suspending the seeded rope on rack it must be tied in such a way that the upper seeded portion of the rope should not get exposed during the low tide.

Nylon rope of 12-14mm 0r 15-20mm coir rope can be used for seeding. Old cotton net, cotton mosquito net or cheap cotton cloth are used for covering the seeds around the rope. Cotton netting of required width and length is placed on the floor and required quantity of seeds spread over the net from one end to the another. The rope is kept above the net and is tightly stitched in such a waythat the seeds spread uniformly around the rope. The cloth will disintegrate within 2-3 days . By this time seeds will secreted byssus thread and will get attached itself to the rope.

To avoid slipping of the mussels, knots are made on seeded rope at the distance of 25cm. Placing split bamboo pegs in the rope(12-14mm) at regular intervals will also serve the purpose.

Growth-out-phase

The Seed, which get attached to ropes, show faster growth in the suspended column water. If the seed is not uniformly attached, crowded portion always show slipping. To avoid slipping, periodical examination of seeded rope and thinning of the same is essential. The ropes also should be suspended in such a way that it will not touch the bottom as well as the seeded portion is not exposed for longer period during low tide. Seeded mussel on the upper portion of the rope shows faster growth due to the abundance of phytoplankton. For better growth the seeded ropes should be spaced at a distance of 25 cm.

In open sea – farming, growth of mussel is very rapid. They attain 80-110 mm in 5-6 months with an average growth of 13.5mm/month and an average weight of 35-45g. This growth is observed in farms at various locations. In estuarine farming, mussels attain 75-90mm in 5 months with an average weight of 35-40g and an average production of 10 -12 kg/m rope.

Calendar of mussel farming activities in Kerala

Activity	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Awareness Programmes	✓	✓	✓									
Training (Phase-I)				✓	✓							
Site Selection		✓	✓									
Farm Construction					✓	✓						
Collection of seed and seeding				✓	✓	✓						
Farming Activities							✓	✓	✓	✓	✓	
Training programme and workshop PhaseII)										✓	✓	
Harvest												✓
Marketing												✓

Management

Constant vigil is required to see that the raft/rack is in position. Thinning may be done if necessary to avoid loss of mussel and to provide enough growing space. Periodic removal of fouling organisms like barnacles, tubiculouspolycheates and ascidians is to be done for improved growth.

Diseases and Poisoning

Mussels are said to be harmful when consumed during periods of retide(in Malayalam it is called polavellam) . This mainly occurs due to dinoflagellates bloom or bloom of diatoms, or cyanobacteria. They will produce potent toxins that can find their way through the

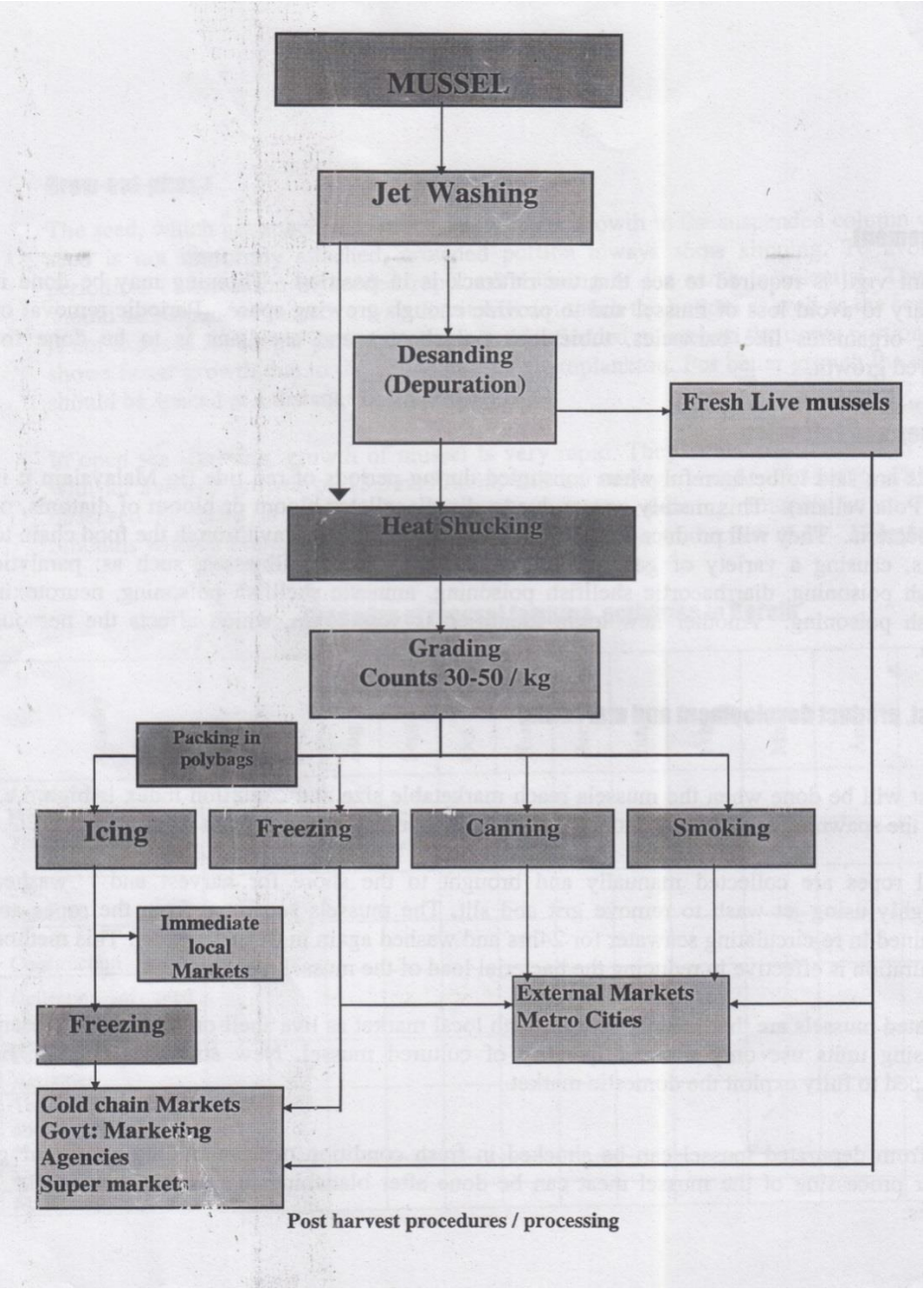
food chain to humans, causing a variety of gastro-intestinal and neurological illnesses, such as: paralytic shellfish poisoning, diarrhaeortic shellfish poisoning, amnesic shellfish poisoning, neurotoxin shellfish poisoning. Another new toxin identified is yessotoxin, which affects the nervous system.

Harvest, product development and marketing

Harvest will be done when the mussels reach marketable size and condition index is high, i.e., before the spawning and onset of monsoon. Normally harvest season is from April to June.
Mussel rope are collected manually and brought to the shore for harvest and washed thoroughly using jet wash to remove grit and silt. The mussels separated from the ropes are maintained in re-circulating seawater for 24 hrs and washed again in fresh seawater. This method of depuration is effective in reducing the bacterial load of the mussel meat .

Depurated mussels are then mainly sold through local market as live shell-on mussel. At present processing units use only a small quantity of cultured mussel. New strategies need to be developed to fully exploit the domestic market.

Meat from depurated mussel can be shucked in fresh condition or after boiling or steaming. Further processing of the mussel meat can be done after blanching in 5% salt solution for 5 minutes.



Post harvest procedures / processing

Products and export

A variety of products have been developed in India from mussel meat. These products have been developed by R & D activities of CIFT, Kochi.

In the retail market, few mussel products are available. The latest product in line is the condiment incorporated ready-to-eat fried mussel meat in vacuum packs.

For further economic utilization, value added products of mussel like seafood cocktails are prepared and marketed by seafood export firms in India. The export of these items from indiais showing an increasing trend.

Nutritional value of 100g heat blanched mussel meat.

Composition	quantity	Adult male (%) of daily requirement	Adult female (%) of daily requirement
Energy	172 Kcal	2.9	3.8
Protein	23.8 g	19	24
Oil (fat)	4.48 g	2.2	2.9
Omega 3 fatty acids	782 mg	*	*
Cholesterol	27 mg	-	-
Calcium (Ca)	56 mg	7	
Iodine (I)	0.065 mg	43	43
Iron (Fe)	7 mg	70	47
Phosphorous (P)	285 mg	29	29
Potassium (K)	270 mg	11	11
Selenium (Se)	0.038 mg	19	19
Sodium (Na)	410 mg	13	13

Zinc (Zn)	0.95 mg	6	6
Vitamin A (Retinol)	0.05 mg	5	5
Vitamin E (Tocopherol)	1.9 mg	19	19
Vitamin B1 (Thaamine)	0.009 mg	0.6	0.6
Vitamin B2 (Riboflavin)	0.28 mg	16	21
Vitamin B6 (Pyridoxine)	0.19 mg	9.5	12
Vitamin B12 (Cobalamine)	0.009 mg	0.5	0.5
Nacin	1.4 mg	7	9.3
Pantothenate	<1 mg	< 20	20
Vitamin C (Ascorbic acid)	4.4 mg	7	7

Ratio Omega 3 to Omega 6 is 13:5
Source; United State Dept. of Agriculture Handbooks
" Composition of Foods Nos. 8.15,1987 & 8.13,1989.

Overseas markets

Mussels are exploited to different countries in the frozen and dried condition. They are also airlifted in the iced condition to the Gulf countries where mussels are in great demand. There is an increasing demand for mussels in the global markets, especially in UAE, China, Mali, Singapore, Sri Lanka, Australia, Greece, japan, Lebanon, Mexico, New Zeeland, and rep. Korea. The export of mussel products shows an increasing trend.

With globalization, seafood trade will be subjected to increasingly greater regulation, control, issue related to environmentally sustainable practices. Seafood safety would assume greater significance in the future. Eco- labeling and HACCP certification would be made mandatory for all seafood products. Contaminants frequently monitored include bacterial loads, heavy metals, antibiotics and pesticides, algal blooms for HAB (Harmful Algal Bloom) toxins.

Microbiological criteria (as per guidelines)						
Directive – 91/492/EEC						
Bacterial sp.	**Limit**	**n***	**c***	**m***	**M***	**Production area specification**
Salmonella	Absence in 25 g					
Faecal coli	<300/100g					Production area A
	<6000/100g					Production area B
	<60000/100g					Production area C
E.coli	<230/100g					Production area A
	<4600/100g					Production area B

A = Direct consumption, B = Need depuration, C= Not approved.

Animal Product – cooked crustacean and Molluscan shell fish						
Decision – 93/51/EEC						
Salmonella	Absence in 25 g	5	0			
S. aureus		5	2	100cfu/g	1000cfu/g	
Any pathogen	Quantities to effect human health					
Thermo tolerant coliforms	-	5	2	10cfu/g	100cfu/g	
E. coli	-	5	1	10cfu/g	100cfu/g	
Mesophilic aerobic bacteria	-	5	2	10^4cfu/g	10^5cfu/g	Whole product
		5	2	5x10^4cfu/g	5 x10^5cfu/100 g	Shelled / Shucked
		5	2	10^5cfu/g	10^6cfu/g	Crab meat

n* = Number of units comprising the sample
m* = limit below which all results are considered satisfactory
M* = acceptability limit beyond which the results are considered unsatisfactory
c* = number of sampling units giving bacterial counts of between m and M

Present status of mussel farming

In India mussel production through culture shows an increasing trend. Now under NATP programme of mussel culture became a popular one in most of the maritime states of India . In the Indian subcontinent estuarine farming of mussel was first started in Kerala particularly at Dharmadom in Kannur district, padanna and Cheruvatur in HosdurgTaluk of Kasargod district.

The establishment of mussel farms in Kerala State led to an increase in mussel production. In Kerala, the impotant event that has taken place in mussel farming is the women participation (Women Self Help Group).

Seed production in captivity

Keeping brood stock in captive tanks and by induced maturation and spawning, seed can be produced in hatchery. In India, CMFRI has developed hatchery technology for mussel seed production. But hatchery production of mussel seed is not yet commercialized.

Role of CMFRI in mussel farming

Training programmes are conducted in collaboration with Aquaculture Development agencies to different categories of trainees like in-service personnel, private entrepreneurs, NGO's and fisher groups especially women. Demonstration farms are set upin all the suitable areas like estuaries and open sea. Creating awareness among funding agencies, other state government organizations and panchayats for release of funds under various developmental schemes have helped in the commercialization of mussel farming in all the maritime states especially in Kerala.

One of our farmers (Shri. G.S.Gul Mohamed) received the "KARSHAKA SIROMANI" National award for the year 2002, constituted by the Ministry of Agriculture, Govt. of india for the best Mussel farmer. This is the first time that such a prestigious national award to a Keralite farmer from fisheries sector. Shri.Gul

Mohamed started musel farming in estuaries from 1996 utilizing the technology developed by Central Marine fisheries Research Institute (CMFRI).

Economics for a model mussel farm for 3 years
Rack and rope culture in estuary Mussel farm 5m x 5m
Seeded rope 100 nos.

1. Fixed cost (material cost)			
Item	**Quantity**	**Rate**	**Amount**
Bamboo poles (9= poles + 10 horizontal poles	30nos	350	10500
Nylon rope (3mm/4mm)	2kg	280	560
Nylon rope (12mm)	13kg	250	3250
PVC pipe (2.5 "/3") for seeding in pre stitched tubes	1m	100	100
Total			**14420**
2. Recurring cost (Labour charge)			
Stitching charge	100	7	700
Canoe hire charges	5 days	300	1500
Labour charges (farm construction, seeding and harvesting	8 days	1250	10000
Mussel seed (20-25 mm)	150kg	100	15000
Cotton netting materials	25m	40	1000
Marketing (shell on) **	800 kg	25	20000
Miscellaneous			1000
Total			**49200**

3. Labour charges (Meat shucking)			
Depuration charge *	800kg	10/kg	8000
Shucking charge	200 kg	50	10000
Fuel charges			3000
Marketing	200 kg	50	10000
Total			**31000**
Total financial expenditure			
Shell on (1+2+3 *) = 14420 +49200+8000= Rs. 71620			
Heat shucked meat (1+2**+3) = 14420+29200+31000= 74620			

**Except the marketing charge
*Depuration charge only

	Total yield		**Income**
Product	Total quantity	Rate	Amount
Shell on	800kg (8kg/rope)	Rs. 150/kg	1,20,000
Heat shucked meat	200kg (25% meat)	Rs.650/kg	1,30,000

Net profit

Shell on = 1,20,000 – 71,620 =48,380(67.5%)
Shucked meat = 1,30,000 – 74,620 =55,380 (74.2%)

*Meat percentage may vary according to the water body and climatic variations