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GOLDEN JUBILEE YEAR
CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY

Annual Report

2006-2007

Central Institute of Fisheries Technology

(Indian Council of Agricultural Research)

Matsyapuri P.O., Cochin - 682 029

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Contents

Abbreviations used in the text

APW	-	Alkaline Peptone Water
As	-	Silver
ASTM	-	American Society for Testing and Materials
ATCC	-	American Type Culture Collection
ATIC	-	Agricultural Technology Information Centre
BHC	-	Benzene Hexa Chloride
BLAST	-	Basic Local Alignment Search Test
BRD	-	Bycatch Reduction Device
BV	-	Biological Value
CCA	-	Copper Chrome Arsenic
Cd	-	Cadmium
CD	-	Computer Disc
CIFRI	-	Central Inland Fisheries Research Institute
CIFT	-	Central Institute of Fisheries Technology
CIN	-	Cefsulodim Irgosan Novobiocin agar
CNSL	-	Cashew Nut Shell Liquid
CoFiSmKi	-	Community Fish Smoking Kiln
CPE	-	Constant Phase Element
CPUE	-	Catch Per Unit Effort
DDT	-	Dichloro Diphenyl Trichloro Ethane
DHA	-	Dicosa Hexaenoic Acid
DSP	-	Dihoretic Shellfish Poison
EAEC	-	Entero Aggragative *E. coli*
EC	-	European Commission
EHEC	-	Entero Hemorrhagic *E. coli*
EMB	-	Eosin Methylene Blue
ELISA	-	Enzyme Linked Immuno Sorbant Assay
ELSD	-	Evaporative Light Scattering Detector
EPA	-	Eicosa Pentaenoic Acid
EPEC	-	Entero Pathogenic *E. coli*
EVOH	-	Ethyl Vinyl Alcohol
FAO	-	Food and Agricultural Organization
FDA	-	Food and Drug Administration
FDWCS	-	Fishermen Development Welfare Cooperative Society
FRP	-	Fibreglass Reinforced Plastic
GIS	-	Global Information System
GSMT	-	Glycine Sarcosine Methyl Transferase
HACCP	-	Hazard Analysis and Critical Control Point
HCH	-	Hexa Chloro Hexane
HDPE	-	High Density Poly Ethylene
Hg	-	Mercury
HMDE	-	Hanging Mercury Drop Electrode
HPLC	-	High Pressure Liquid Chromatography
ICAR	-	Indian Council of Agricultural Research
INCOIS	-	Indian National Centre for Ocean Information Services
IPTG	-	Iso Propyl β-D-1 Thio Galactopyranoside
IS	-	Indian Standards
LAB	-	Lactic Acid Bacteria
LCMS MS	-	Liquid Chromatography Mass Spectrograph
LOA	-	Length Over All
LPG	-	Liquefied Petroleum Gas
MFP	-	Myofibrillar Proteins
ML	-	Maximum Load
MOE	-	Modulus of Elasticity
MOR	-	Modulus of Rupture
MPN	-	Most Probable Number
MRL	-	Maximum Residue Limit
MUFA	-	Mono Unsaturated Fatty Acid
MUG	-	Methyl Umbillifenyl β-D Glucuronide
N	-	Nitrogen
NCBI	-	National Centre for Biotechnology Information
NEH	-	North East Hill
NGO	-	Non Gazetted Organisation
NIT	-	National Institute of Technology
NPN	-	Non Protein Nitrogen
NPU	-	Net Protein Utilisation
NSM	-	Non Saponifiable Matter
OCP	-	Organo Chloro Pesticides
OLS	-	Ordinary Leased Square
PA	-	Poly Amide
Pb	-	Lead
PCR	-	Polymerase Chain Reaction
PFGE	-	Pulsed Field Gel Electrophoresis
PER	-	Protein Efficiency Ratio
PEST	-	Polyester
PFZ	-	Potential Fishing Zone
PP	-	Poly Proplyne
PSP	-	Paralytic Shellfish Poison
PUFA	-	Poly Unsaturated Fatty Acid
PV	-	Peroxide Value
PVC	-	Poly Vinyl Chloride
RT-PCR	-	Reverse Transcriptase Polymerase Chain Reaction
RYBN	-	Red Yellow Blue Neutral
SDMT	-	Sarcosine Dimethylglycine Methyl Transferase
SE	-	Standard Error
SFA	-	Saturated Fatty Acid
SPP	-	Sarco Plasmic Proteins
SS	-	Stainless Steel
TMA	-	Tri Methyl Amine
TPC	-	Total Plate Count
TSS	-	Total Soluble Sugar
TVN	-	Total Volatile Nitrogen
USA	-	United States of America
WSSV	-	White Spot Syndrome Virus
WTO	-	World Trade Organization
YHV	-	Yellow Head Virus

Preface

The Central Institute of Fisheries Technology (CIFT) is completing fifty years of its useful existence, in the year 2007. Standing at the threshold of the Golden Jubilee year, we in CIFT look back with pride and satisfaction to our achievements in the last half a century. We genuinely feel satisfied about the contributions we could make in bringing up the fishing and fish processing industries of the country to their present status as the largest single foreign exchange earner and provider of employment and nutritious food to millions of rural poor. During the year under report also, the Institute continued to serve the fishing and fish processing industries by extending all technical guidance and help in the context of their changing needs.

In our programmes in fishing technology this year, we have been giving importance to inland, riverine and reservoir fisheries in different parts of the country. Fibre glass canoes and fibre glass sheathed canoes made of rubber wood (for the rubber producing areas like the North East and Kerala) introduced by CIFT have become very popular. Boats designed for fishing in fast flowing rivers of the North East like the Brahamaputra have also caught the attention of the local fishing industry. Aluminium boats for reservoir fisheries was another innovation tried during this year. CIFT in the last year had made an Aluminium boat for the first time which has since been tried in the Malampuzha reservoir of Kerala. Based on these trials, we are improving the design to popularize Aluminium as a boat building material. As India is having rich Aluminium resources, this can be a turning point, saving our scarce wood and forest resources. The first steel trawler introduced by CIFT along the Saurashtra coast has also generated a lot of interest in that area. Different construction materials for making fishing boats like rubber wood, coconut wood, fibre glass etc. were used and their performance compared.

Research in fishing gear and methods was mainly focusing on responsible fishing by developing and pouplarising fuel saving and conservation oriented gear technologies. A number of Bycatch Reduction Devices (BRDs) have been developed and optimized for protection of juveniles and non-targeted species caught during commercial trawling. Passive fishing methods like trap fishing were encouraged with better gears, like collapsible and durable traps, for catching high value species like lobsters. Bottom set gill nets were used for fishing in Kabani reservoir of Karnataka.

On the post harvest side, the emphasis was on studies pertaining to the utilization of freshwater fishes. Chemical composition (including amino acid composition and fatty acid composition), ice storage and frozen storage shelf life, light salted and smoked products from split open fish, preparation of coated products using fillets and microbial quality of Rainbow trout were studied in detail. Extensive studies on all these aspects were taken up on Mahseer also. Improved solar dryers with LPG backup designed by the Institute were demonstrated to entrepreneurs in different parts of the country, including the North East hilly region,

which has received wide recognition. Taste and flavour enhancers from crab and shrimp was another success story. Technologies for the preparation of value added ready-to-eat products from low value marine fishes, freshwater fishes, crabs etc. have been successfully commercialized. Newer applications for Chitosan, the versatile product from prawn shell waste, commercialized by the Institute, were found out. Fish curries prepared according to regional recipes from different parts of the country were used for the preparation of retortable pouch packed products. They were successfully marketed by entrepreneurs who took the technology from CIFT. Active food packaging with Carbon dioxide emitters and Oxygen scavengers in the pack was another area where investigations gave encouraging results. Quality assurance of fishery products meant for export and improvements in hygiene in internal markets and fishing boats were areas where we could make significant contribution during the year. Designs given by the Institute for model fish markets have received acceptance in different parts of the country. Several simple and effective technologies for producing useful products from fish waste were also developed.

Side-by-side with applied research, basic studies on the microbiology and biochemistry also received due attention. Newer molecular methods for detection of pathogenic bacteria in seafoods were popularized in place of the time consuming biochemical methods. Genes for salt tolerance were isolated from marine bacteria and handed over to National Centre for Biotechnology Information for possible incorporation in crops grown in saline soils.

Several promising bioactive compounds from aquatic sources were isolated and their potential pharmacological applications explored. Technologies for preparing useful biochemicals from fishery wastes were also developed. The impact of environmental pollution on the fishery resources and processed fishery products was followed by regular monitoring of the levels of heavy metals, pesticide, antibiotics and other chemical residues.

Regional Centres of the Institute tackled location specific problems of the respective regions. Extensive training programmes and demonstrations were conducted in North Eastern states, Andamans and Lakshadweep islands.

The year thus witnessed creditable work, in spite of fast decreasing scientific manpower, for which I want to compliment all my colleagues. I take this opportunity to thank the fish processing industry, state governments and the ICAR, for their help and co-operation in all our activities. I would also request for constructive criticism and helpful suggestions to improve our work, so that we can continue to serve the nation better in the coming years.

(Dr. K. Devadasan)
Director

Cochin
21st May 2007

Executive Summary

- Coconut wood panels treated with Copper-Chrome-Arsenic, Creosote, dual preservative, Cashew Nut shell liquid and Neem oil did not show any change in strength in compression parallel to grain and static bending
- Studies on the damage caused by marine borers on chini wood (*Tetrameles nudiflora*) showed 59% loss of volume and 33% loss in weight
- Applying two coats of epoxy paint or sheathing with FRP accorded a 100% protection to rubber wood panels against marine wood borers
- The influence of CCA on corrosion of fasteners used in preservative treated wood was studied and results showed that CCA does not affect corrosion at lower retentions to a significant level
- Corrosion resistance of different brands of fishing hooks tested in Salt Spray Chamber as per ASTM B – 117 showed that Indian brands had good corrosion resistance and is in par with the popular imported brands
- The dyed nylon monofilament samples showed substantial increase in elongation (27 to 40%) than control, but not much variation in breaking load was found between dyed and control samples and dyeing offered better resistance to nylon multifilament material against weathering
- Aluminium composite was developed by reinforcing pure Aluminium with Cerium oxide and Nickel oxide
- Studies on the changes of corrosion rates of Stainless Steel (SS316) due to the long term exposure under marine environment showed that the corrosion rate was maximum during first month of exposure and rate reduced significantly to minimum upto six months and later it slowly started increasing
- Studies on the heavy metal profile of the Cochin estuary revealed that the Zinc, Cadmium, Lead and Copper concentration varied between 0-78.06, 0-3.21, 0-7.79 and 5.00-21.75 ppb respectively
- Analysis of the wet breaking load and wet knot breaking load of polyamide monofilament yarns showed that there is considerable difference in strength properties between various brands
- Floats of different materials and shapes collected from various parts of the country were found to vary considerably with reference to buoyancy and bursting strength
- Details of trawl systems collected from Kerala coast show three variants of shrimp trawl, one deep sea shrimp trawl, one cuttlefish trawl, and two variants of squid-fish trawl
- Covered codend experiments to determine codend selectivity of fish resources, using 18 m semi-pelagic trawl fitted with 100 mm diamond mesh codend and 30 mm cover showed that depending on seasons and fishing areas, exclusion rates ranging from 18% to 94% of the catch components, predominantly juveniles and sub-adults, were observed from 100 mm diamond mesh codend
- Selectivity data in respect of 49 species were collected for deriving selectivity parameters using 18 m semi-pelagic trawl fitted with 40 mm diamond mesh codend and 30 mm cover in which about 64% of the catch was retained in the codend and 34% was excluded
- Radial Escapement Device with 150 mm mesh netting (Covered codend method) showed 100% efficiency in excluding seven species of fin fishes and eight species showed escapement above 50%
- Collapsible crab traps operated in Cochin backwaters, using chicken waste as bait

showed higher catches of *Scylla serrata*

- Fishing experiments with CIFT designed bottom set gill nets were initiated at Kabani reservoir in Karnataka, in collaboration with CIFRI Research Centre, Bangalore
- The experimental bottom trawling conducted at five transects (15-40 m depth) along Veraval coast revealed a decline in sediment organic matter
- The abundance of macrobenthos and meiobenthos along Veraval coast increased after the closed season (May to September)
- Designed and evaluated 27 m and 30 m semi-pelagic trawls for exploitation of off bottom fishery resources
- Designed and fabricated foldable traps for reservoir fisheries
- Selectivity experiments using square mesh codend showed that the percentage escapement of smaller fishes from 30 mm, 40 mm and 50 mm were 18%, 30% and 45% respectively
- Studies on the impact of semi-pelagic and bottom trawling operations in terms of biodiversity revealed that the semi-pelagic trawl system has a lower impact on the resources in terms of biodiversity, characterizing it as an eco-friendly trawl system
- Preliminary survey of the small-scale mechanized trawlers operating from Veraval harbour showed that 69.8% of the vessels belong to the category 15-15.6 m LOA
- Significant changes in the turbidity and TSS of water were found immediately after bottom trawling. Total biomass of macro and meiobenthos fluctuated due to the trawling disturbance
- In the near real time fishing along the PFZ advisories derived from the three parameter approaches developed by Space Applications Centre, average CPUE/hr from the PFZ areas were found to be 36.99 ± 3.49 S.E, whereas the CPUE/hr realized off Veraval from Sagarkripa from non-PFZ areas was worked out to be 13.01 ± 1.90 S.E
- Geo-referenced catch details from commercial fishermen were correlated with PFZ advisories of INCOIS and the mean CPUE recorded was worked out to be 49.20 ±4.88 per hour
- Survey work carried out in fishing villages adjoining Rengali reservoir in Deogarh district to develop suitable gears based on the traditional ones revealed significant results
- The chemical, physical and sensory characteristics of Rainbow trout (*Oncorhynchus mykiss*) collected from Munnar were studied
- Rainbow trout had a high quality shelf life of seven days and practical storage life of 15 days in ice
- The procedure to prepare light salted and light smoked products from split opened Rainbow trout was standardized
- The procedure for the preparation of coated trout fillets was standardized
- Light salted and light smoked fillets from Rainbow trout stored at 3 ±2°C had a shelf life of 30 days
- Whole Rainbow trout stored at -20°C had a high quality shelf life of six months
- The biochemical parameters such as protein fractions, amino acid profile and fatty acid profile of Rainbow trout were studied
- A method to recover the meat and prepare cutlet from the filleting waste of Mahseer (*Tor khudree*) was developed
- Cutlet prepared from the meat of the filleting waste of Mahseer had a shelf life of more than six months at -20°C
- The steaks prepared from the fillets of Mahseer weighing 18.5 kg and packed in polythene pouches had a shelf life of 20 days in ice
- Salted and smoked partially dried fillets of Mahseer packed under vacuum in polyester/

polythene laminate had a shelf life of 10 days while the control packed in air had a shelf life of only eight days at ambient temperature

- The preparation of light salted and spiced semi-dried fish fillets from common carp (*Cyprinus carpio*) was standardized
- Fish drying studies in LPG based dryer showed that the dried fish is hygienic and of good quality
- Shelf life of light salted shark with appropriate treatment can be extended to six months
- Light salted Jew fish treated with Calcium propionate at 0.5% level developed fungal growth after one month storage at ambient temperature
- Packaged dried fish samples sold through retail outlets remained in acceptable condition for only one month
- Shelf life characteristics of edible fish powder were determined
- Crab flavour and prawn flavour incorporated vegetable curry was prepared after incorporating taste enhancers
- Comparison of fatty acid composition of tuna and rohu eye balls was done
- Quality parameters and yield of Carrageenan prepared from seaweed (*Kappaphycus alwarizi*) were studied
- Fish Calcium was prepared from scales of catla
- Chitosan chloride was prepared and properties were studied
- Anti-microbial property of Chitosan was studied on food-born bacteria
- Chitosan was used for high pressure treatment of wood as a preservative
- Gelatin prepared from skin of fresh water fish rohu was studied for its quality parameters
- Effect of Chitosan in absorption of Lead in animals was studied
- Indigenous thermoformed trays made of High Impact Polypropylene were found to be suitable for packing ready to eat meals consisting of single par boiled rice and sardine curry
- Cutlets prepared using Croaker (*Otolithus* sp.) packed in indigenous high impact Polypropylene and imported high density polythene trays and kept in frozen storage at -20±2°C had a shelf life of more than eight months
- Ready to eat fried seer fish steaks in Polypropylene containers vacuum sealed inside a pouch of PEST/Aluminium oxide/cast PP had a shelf life of three months
- Ready to serve Punjabi curry and UP Mughalai curry from Mahseer remained good even after one year at room temperature
- See-through retortable pouches made of polyester, nylon, cast PP coated with Silicon dioxide was found to be suitable for processing smoked tuna
- Active packaging studies indicated that both Oxygen scavengers and Carbon dioxide emitters were effective in enhancing the shelf life of dry fish and chilled fish, respectively
- Nutritional quality of canned mackerel in brine was superior compared to control diet with regard to PER, NPU and BV
- Quality of mackerel in brine processed at 130°C was better than products processed at 121°C and 115°C with regard to sensory, textural and colour parameters
- Ready to serve crab products such as crab koftha, crab butter masala and crab soup was developed
- Different regional fish curry recipes were standardized and conducted acceptance study of already standardized fish products processed in indigenous polymer coated Tin free steel cans
- Fish enriched noodles were prepared by incorporating edible fish powder made from

fresh water fish, rohu (< 500g)

- Studies on flavor imparting by botanical means such as curry leaves, basil leaves and clove oil in smoke curing of *Gudusia chapra* showed better quality to that of control
- Good quality fish wafers were prepared from Rawas (*Elethronema tetradactylus*), Karali (*Chirocentrus dorab*) and Chor bombil (*Saurida tumbil*) using corn flour and Sago powder. Addition of Tomato puree gave good flavor and pleasant color to the product
- Hygiene and sanitation survey in selected markets of Kerala, Tamil Nadu and Southern Karnataka showed that the microbiological quality of fish and shellfish sold in these markets is poor
- Contamination in market samples were found to be originating from the water and ice used in the market
- The fish and fishery products meant for export was found to be very good in quality parameters. The sanitary and hygienic conditions in peeling sheds and processing units were found to be satisfactory
- Isolated instances of peeling operations on floor and in open air was also noticed in some landing centers
- Evaluation of chemical parameters like amines, heavy metals, pesticide residues, antibiotic residues and additives like sulphite were found to be much below tolerance levels
- Some samples of fish (10%) were found to contain high levels of phosphates
- The South West Coast of India was found to be free from the biotoxin PSP and DSP
- A rapid method for detection of phosphate and sulphite were standardized for commercial adoption
- The risks in the form of development of antibiotic resistance towards medicinally important antibiotics in bacteria (*E. coli*) isolated from freshwater fish, scampi and black tiger shrimp was negligible
- Hydrogen sulphide (H_2S) producing bacteria showed marked increase during spoilage of freshwater fish
- Studies on processing and quality aspects of air bladder for export market from species like Koth and Ghol was carried out
- The overall quality of fish smoke cured in working model (movable) of CoFiSmKi was better than the permanent (un-movable) model of CoFiSmKi
- Studies on dry fish revealed that market samples had moisture content of more than 20% and sand content was less than 1%. Shelf life of dried Ribbon fish (*Trichiurus lepturus*) from market stored at ambient temperature under laboratory conditions was found to be four months, while it was five months for *Harpodon neherius* and *Coilia dussumieri* and more than six months for *Acetes indicus*
- A more sensitive method for detection of biogenic amines was standardized using the HPLC and Evaporative Light Scattering Detector (ELSD)
- A herbal organic preservative for prevention of blackspot in shell-on prawns was standardized
- A new chemical method for improving the colour and appearance of fillets was developed
- Heavy metal residues of Cadmium, Chromium, Mercury, Nickel and Copper in fish and fishery products were found to be much below the tolerance levels
- The Lead content in some samples of fish and shellfish was higher than the tolerance limits
- Most of the chemical parameters tested for farm water were within the permissible limits
- Common seafood borne pathogens like *Vibrio cholerae*, *Salmonella* and *Listeria monocytogenes* were absent in the fish and fishery products

from processing plants as well as collected from different markets in Kerala and Tamil Nadu

- *E. coli* O157:H7 isolated from shrimp *P. indicus* from retail market in Cochin is reported for the first time from seafood in India
- *E. coli* serotypes isolated from aquaculture system were O157 and O6 (from shrimp), O8 (from sediment) and O142 and O112ac (from feed
- When exposed to direct sun light, *E. coli* survived for 60 to 105 min in water. Significant reduction (5 log) was observed in 15 to 30 min in seawater
- The tdh gene for virulence in *V. paraheamolyticus* was not detected in shrimp, post larvae and fish samples analysed, thereby indicating that they have no pathogenic potential
- Four *Actinomycete* isolates from Puffer fish exhibited antibacterial activity against *E. coli* and *S. aureus*
- *Bacillus* spp. isolated from Puffer fish produced thermo-tolerant amylase and proteolytic enzymes at 55°C
- *C. botulinum* type B was detected in pasteurized crab sample
- *Yersinia enterocolitica* detected in squid samples from retail market in Cochin is reported for the first time from seafoods in Kerala
- Fish and shellfish from retail market in Cochin were found to be contaminated with other *Yersinia* spp., such as *Y. intermedia*, *Y. fredriksenii* and Y. *kristensenii*
- The envelop proteins of White Spot Syndrome Virus VP19, VP28, VP68, VP281, VP466 and the capsid protein VP26 were PCR characterized
- Eight rare *Salmonella* serotypes were identified from seafood samples
- Active lactose utilizing *Salmonella salmae* and *S. indica* were isolated from seafood
- PFGE pattern for *Salmonella* from seafood has been developed
- A matrix effect was observed for cephalopod (squid, cuttlefish and octopus) during PCR assay and the ink was found to interfere with the detection of *Salmonella* by direct PCR assay of squid, cuttlefish and octopus samples
- The microflora of cephalopods revealed a preponderance of Gram negative bacteria comprising of *Vibrio*, *Pseudomonas*, *Flavobacterium*, *Acinetobacter*, *Shewanella* and *Moraxella*
- The aerobic mesophilic bacterial count on gutted Rainbow trout (*Oncorynchus* spp.) collectd from Munnar ($<10^5$cfu/g) decreased by one log cycle. Significant reduction (>90%) was also noticed in total Coliform counts after eight days of storage
- In hot smoked trout stored under vacuum, the aerobic mesophilic bacterial count exceeded 10^8 cfu/g after three months storage whereas in cold smoked trout stored under vacuum, the count exceeded 10^8 cfu/g after two months storage
- In smoked common carp samples with and without adding spices and stored under air and vacuum at 0-2°C, the aerobic mesophilic count exceeded 10^7 cfu/g after one month in all the samples irrespective of the storage atmosphere
- The osmotolerant genes for ectoine biosynthesis in saline soil bacteria *Bacillus* spp. and for Glycine betaine biosynthesis in marine cyanobacteria were characterized
- Gene sequence of *Saccharomyces cerevisiae* HAL1 mRNA (an antiporter gene responsible for osmotolerance) was submitted to National Center for Biotechnology Information (NCBI), USA
- *Oratosquilla nepa*, a Squilla species available

along Gujarat coast was collected from the fishing vessels and analyzed for various proximate composition and biochemical tests

- *Crassostrea gryphoides*, a giant edible Oyster collected from Navibandar area was analysed for proximate composition and microbiological parameters
- Fresh and frozen samples of Scombroid fishes like Skipjack tuna, Yellow fin tuna, Indian Mackerel, King fish, Horse mackerel etc. were monitored for the presence of Histamine and Mercury contents
- Microbiological and chemical parameters when tested for the fresh squid, the total Coliforms count were found to be increased from 110 MPN/g to 140^{+} MPN/g and faecal Coliforms from Nil to 140^{+} MPN/g
- Significant difference in mesophilic, aerobic and hygiene indicator bacteria was found in commercially sold freshwater fish at Burla at different stages of processing i.e., before and after washing, and between edible meat portion and intestinal flora
- All Streptococcal and Staphylococcal strains isolated from freshwater fish, fish curing environments and fishery products at Burla showed resistance to Vancomycin at 5, 10 and 3 ppm level
- Extracts of *Eichhornia crassipes* demonstrated excellent pharmacological activity. The extractions from the plant were found to have excellent anti-inflammatory and anti ulcerogenic acitivity
- The anti-inflammatory effect was found to be better than the reference drug (Ibuprofen) and the leaf extract showed slightly more efficacy than the root. The phytochemical screening of the extracts showed the occurrence of triterpenoids in both root and leaf, and flavonoids in root
- Administration of Eichhornia extract significantly reduced the secretion of gastric juice compared to the ulcer induced rats indicating that oral pretreatment with Eichhornia significantly maintained the activity of gastric peptic activity at near normal level
- Composition of fish waste - head and viscera - indicate high potential for fats and vitamins. The non-protein Nitrogen composition of the waste also revealed the presence of biochemicals of biological significance
- Taurine forms about 40% of the total non-protein Nitrogen from head and gut fish waste, which can be commercially exploited
- Evaluation of physico-chemical and functional properties of fish proteins from different habitats exhibited variations
- Evaluation of Barracuda (*Sphyraena jello*) protein indicated variation in the physico-chemical and functional properties as a function of size
- Hazard analysis on fish and fish products for domestic and international markets revealed that the OCP concentrations in the samples were well below the hazard levels and are safe for human consumption
- As far heavy metals are concerned, in fish products other than dry fish, the levels were much below the prescribed MRL by FDA (2001) for fresh fish but slightly higher than the MRL by EC (2001) and FAO (1983)
- Energy efficient fish dryers with LPG/electrical back up system was designed and developed
- Bare hull model of 18 m trawler and 18 m gill netter cum long liner was tested at NIT, Calicut. Tests with three speeds and four displacements for the two models (24 nos.) have been carried out
- The circuit design for processing the data from the Dissolved Oxygen Monitoring System was started

- The circuit design for processing the data for Fuel Consumption Monitoring System was started
- Among the fish marketing personnel, the variables such as age, education, experience, investment, annual income and number of marketing personnel did not have any association with the adoption
- In case of fish landing centres, of the six practices evaluated among the fishermen, the adoption score was higher for one practice viz., use of clean containers for fish handling (81.03%)
- The perception index for the impact of popularisation efforts undertaken among fishermen was 55.26% and the impact score was moderately good for the two factors viz., use of clean containers for fish handling (75.90%) and use of adequate ice to preserve the fish (67.69%)
- The R^2 value (Multiple Regression Coefficient) revealed that all the ten independent variables taken together had accounted for 71.60% of variation in the adoption level and the F value was highly significant (13.64%)
- Among the aquafarmers in selected four districts viz., Trichur, Alleppey, Ernakulam and Kannur, the F values showed that there was highly significant difference among them on the variables such as age, number of information sources utilized, and in availing the consultancy services, though, there was no significant difference among them in terms of area under prawn culture
- Among the pre-processors, the overall impact perception index was 57.83 with the standard deviation of 10.82. The impact index was moderately good for the four impact factors viz., use of adequate water for pre-processing (73.33%), improvements in post harvest handling of raw materials with ice (69.17%), use of adequate quantity of chlorine for washing (65.00%) and use of adequate quantity of detergents (61.67%)
- Regarding the effectiveness of various measures taken by the State Fisheries to implement FAO Code of Conduct, the effectiveness perception index among fisherfolk was found to be 58% when ten criteria were evaluated on a three point rating scale
- Post-Tsunami studies revealed that in Nagapattinam district, there was 58% increase in the number of FRP 'vallams' (country boats) in the fishing villages, though there was a slight reduction in the number of mechanized fishing boats in the district. In Cuddalore district, the number of mechanized boats, wooden/FRP 'catamarans' and FRP vallams had increased significantly due to the various subsidy schemes of the Fisheries Department and the NGOs
- For the effective coastal zone management, the training camps and other interventions aimed to create awareness and motivation among the fisherfolk to solve the problems through community participation and efforts of village panchayath in areas such as alternate livelihood enterprises, responsible fishing techniques, sustainable agriculture and aquaculture practices, effective management of natural resources, prevention of environmental pollution and sea erosion, and meeting drinking water needs were held.
- Analysis of 38 samples of fresh fish from markets indicated that overall quality of fresh fish in retail market was good. Thirteen samples were contaminated with *E. coli* and 14 samples were contaminated with Coagulase +ve Staphylococci. However the counts were less than 20 in all positive samples

Introduction

The Central Institute of Fisheries Technology (named at the time of inception as Central Fisheries Technology Research Station) was set up following the recommendations of a high power committee constituted by the Ministry of Food and Agriculture, Government of India. It started functioning at Cochin in 1957 under the Department of Agriculture of the then Ministry of Food and Agricultural with a small nucleus of staff for research work in fishing craft and gear. Other Divisions soon followed. The administrative control of the Institute was brought under the Indian Council of Agricultural Research on 1 October, 1967.

The Institute is the only national centre in the country where research in all disciplines relating to fishing and fish processing is undertaken. Research Centres at present function at Veraval (Gujarat), Visakhapatnam (Andhra Pradesh), Burla (Orissa) and Mumbai (Maharashtra). The Hoshangabad (Madhya Pradesh) and Calicut (Kerala) Centres were closed down in June 2004 and March 2006 having completed the work assigned to the Centres.

Mandate

- To evolve innovative and cost-effective technologies for fish harvest
- To develop and standardize various aspects of post harvest technologies
- To develop technologies for extraction of biomedical, pharmaceutical and industrial products from aquatic organisms
- To act as a repository of information on harvest and post harvest technologies with a systematic data base
- To conduct transfer of technology through training, education and extension education programmes
- To provide consultancy services and to popularize the innovations for overall development of the fishery industry

Organizational set-up

The institute is headed by the Director with whom all administrative and financial powers are vested. He is assisted by a Senior Administrative Officer, Administrative Officer and Assistant Administrative Officers for dealing with matters relating to general administration and Assistant Finance and Accounts Officer for looking after the financial and accounting aspects as also internal audit of the Institute. The Technical Section is headed by a Technical Officer who attends to the technical maters including those connected with research projects handled by the Institute, implementation of Right to Information Act-2005 and Intellectual Property Rights and Patents under Institute Technology Management Unit. Official Language Implementation Section is headed by the Assistant Director (Official Language).

The research work is carried out by the following Research Divisions:

1. Fishing Technology Division
2. Fish Processing Division
3. Quality Assurance and Management Division
4. Microbiology, Fermentation and Biotechnology Division
5. Biochemistry and Nutrition Division
6. Engineering Division
7. Extension, Information and Statistics Division

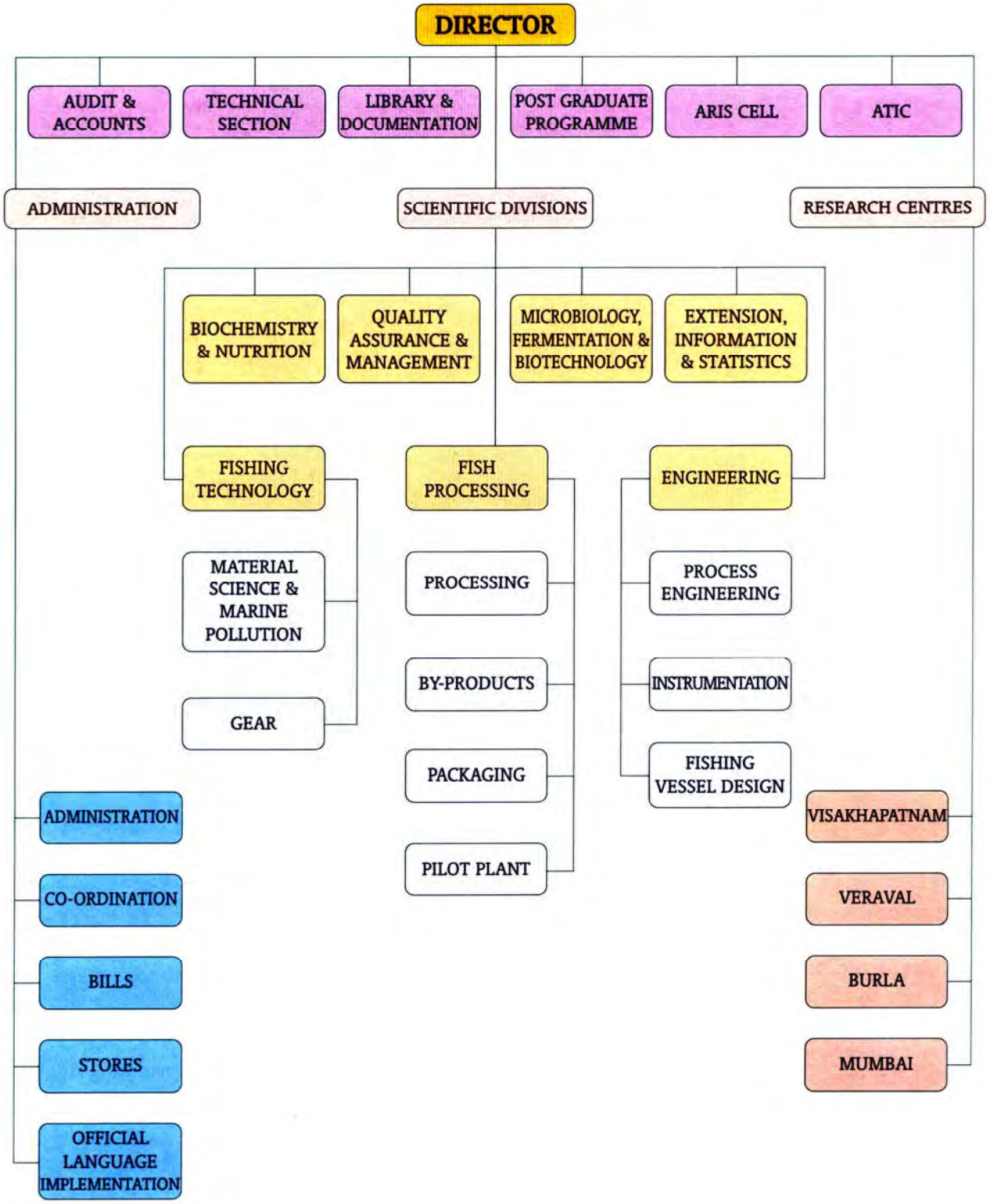
The Institute is housed in its own building in Willington Island, Cochin, and at all Research Centres, except Burla, where it functions in buildings owned by the State Government. It has very good residential quarters for the staff at Cochin and Visakhapatnam, and library and I.T. facilities. A well equipped workshop, an animal house, model fish processing halls, pilot plant facilities and a good fleet of vehicles are also available. An Agricultural Technology Information Centre (ATIC) functions in its own building within the main campus.

Budget allocation and actual expenditure for the year 2006-2007

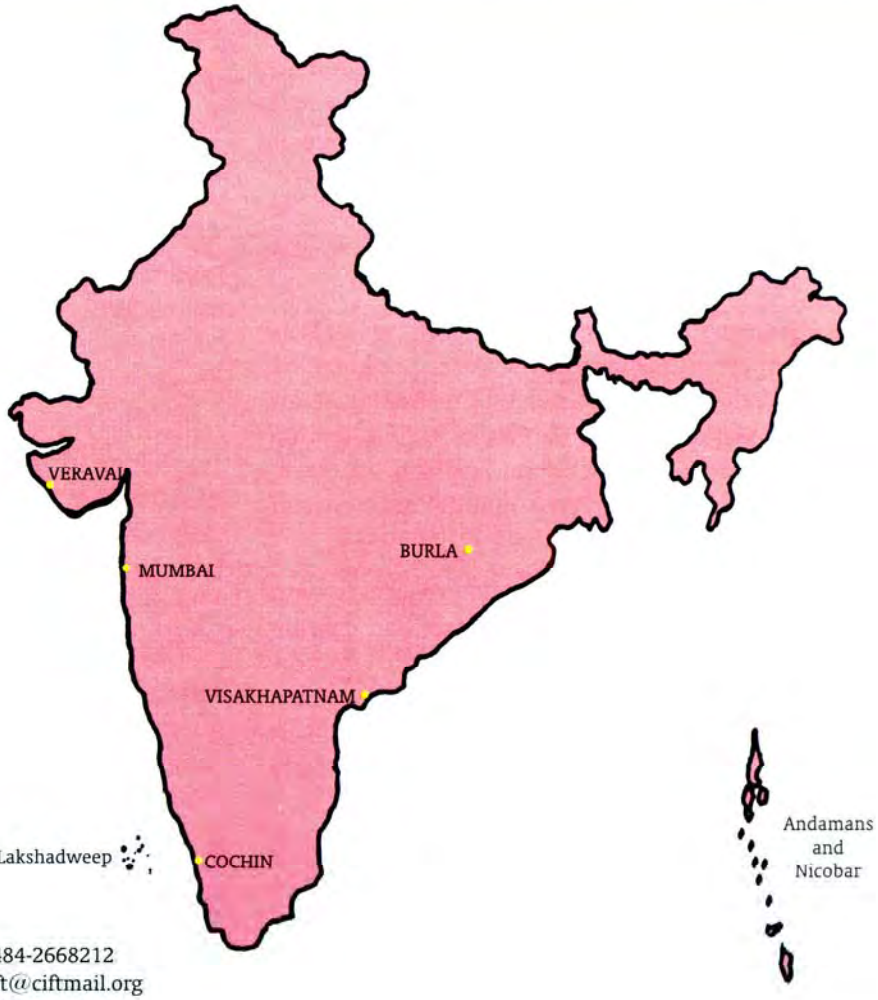
(Rs. in Lakhs)

Particulars	Non-Plan			Plan		
Budget Head	**Budget Estimate**	**Revised Estimate**	**Expenditure**	**Budget Estimate**	**Revised Estimate**	**Expenditure**
Establishment charges	720.00	771.00	763.67	-	-	-
Overtime allowances	0.40	0.40	0.40	-	-	-
Travelling allowances	11.40	14.40	14.40	6.29	6.29	6.29
Other charges	75.20	188.20	188.20	385.62	342.51	342.51
Works	19.00	26.00	26.00	55.00	55.00	55.00
NEH	-	-	-	15.00	15.00	15.00
Information Technology	-	-	-	10.00	10.00	10.00
HRD	-	-	-	7.65	7.65	7.65
Other items	-	-	-	1.00	1.00	1.00
TOTAL	**826.00**	**1000.00**	**992.67**	**480.56**	**437.45**	**437.45**

Organogram


DIRECTOR
AUDIT & ACCOUNTS
TECHNICAL SECTION
LIBRARY & DOCUMENTATION
POST GRADUATE PROGRAMME
ARIS CELL
ATIC
ADMINISTRATION
SCIENTIFIC DIVISIONS
RESEARCH CENTRES
BIOCHEMISTRY & NUTRITION
QUALITY ASSURANCE & MANAGEMENT
MICROBIOLOGY, FERMENTATION & BIOTECHNOLOGY
EXTENSION, INFORMATION & STATISTICS
FISHING TECHNOLOGY
FISH PROCESSING
ENGINEERING
MATERIAL SCIENCE & MARINE POLLUTION
PROCESSING
PROCESS ENGINEERING
GEAR
BY-PRODUCTS
INSTRUMENTATION
PACKAGING
FISHING VESSEL DESIGN
PILOT PLANT
ADMINISTRATION
CO-ORDINATION
BILLS
STORES
OFFICIAL LANGUAGE IMPLEMENTATION
VISAKHAPATNAM
VERAVAL
BURLA
MUMBAI

Addresses of Headquarters and Research Centres



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A Quick Glance at Past Research Achievements

- CIFT has developed and introduced 12 standard designs of mechanized wooden fishing boats in the size range of 7.67 to 15.2 m LOA for coastal and intermediate range. It is estimated that over 80% of the nearly 54,000 mechanized wooden fishing crafts in the Indian fishing fleet confirm to the popular CIFT designs or its later adaptations.
- Hull maintenance of the fishing vessels is important for increasing its service life. CIFT has developed a package of technologies for protection against bio-deterioration, fouling and corrosion for increasing the life span, substantially reducing maintenance cost of fishing vessels.
- Aluminium-Magnesium alloy sheathing with cathodic protection and prescribed coating system was developed as a cost-effective substitute for Copper sheathing for wooden hulls as protection against marine borers. This technology is widely used in the small-scale mechanized vessels.
- Epoxy resin based coating developed has improved the life span of cast iron propeller, making it a cost-effective substitute for Bronze propeller in fishing boats.
- Spheroidal graphite cast Iron with Nickel (21-24%) was recommended as substitute for conventional Manganese-Bronze for propellers of fishing boats, resulting in cost savings of 25-30%.
- Superior cost-effective antifouling paint formulations incorporating Cuprous oxide and modified indigenous resins were developed for protection against fouling in fishing boats.
- CIFT has developed technologies for the chemical preservation and upgradation of low cost timbers to make them more durable. These have extended the service life of fishing crafts and contributed towards the efforts against deforestation.
- Technology was evolved for upgradation of cheaper secondary species of wood as substitute for boat scantling, by impregnation with styrene-polyester monomers, fortification with Creosote/Tributyl tin oxide and polymerization with gamma irradiation.
- CIFT has made immense contribution towards the standardization of the netting, netting yarn and netting twine used for fishery purposes. These developments have led to an increase in the productivity of the fishing gear and increase in net profits due to low maintenance and long service life of the nets.
- CIFT has made significant contributions in the development of fishing gear and methods for the traditional sector, traditional motorized sector, small-scale mechanized sector and large-scale industrial sector in Indian fisheries, which is reflected in the increase in fish production.
- Improvements were made in the design and durability of lobster traps as substitute for traditional traps of short life span and low efficiency, for harvesting of spiny lobster.
- A mini-trawl for operation from traditional crafts powered by outboard motors of 8-15 hp, for shallow water shrimp trawling was introduced.
- The purse seine was introduced and popularized for operation from traditional plank built canoes (Thangu vallom) powered by outboard motors, for efficient harvesting of pelagic shoaling fishes. Since its introduction, the mini-purse seine has become very popular among the fishermen of motorized sector along the coast line of Kerala, significantly contributing to the landings of pelagic resources such as sardines, mackerel and anchovies.

- Specially designed trawl for shrimp trawling with vertical opening and extra long wings on either side was found effective for sweeping of wider horizontal area along the sea bed resulting in increased shrimp catch.
- Bulged belly trawl with relatively high opening was designed to improve the catch of fin fishes without compromising on shrimp catch.
- In high opening trawls, vertical opening of the trawl is increased by innovative design improvements, facilitating capture of demersal as well as off-bottom resources.
- Large mesh trawl with relatively large meshes in the front portion resulted in significant reduction in trawl resistance, making use of the herding effect of large meshes on fin fishes. These deigns have been well accepted by the trawler fishermen of Gujarat, Karnataka and Kerala.
- Otter boards are sheer devices used in trawls for keeping the trawl mouth horizontally open. Different sizes of flat rectangular boards and vertically cambered otter boards have been introduced by CIFT for the benefit of small-scale mechanized fleet, during the course of its development. V-form otter boards with high stability, better hydrodynamic efficiency, low maintenance cost and longer service life is now replacing the flat rectangular boards in the small-scale mechanized sector. Overall savings by adoption of V-form otter boards in place of flat rectangular boards is about 15%.
- Purse seines for catching pelagic fishes such as sardine and mackerel, from small mechanized vessel has been developed.
- Long lines for sharks using indigenous hooks has been developed as a low energy resource-specific alternative to energy intensive, less selective fishing methods such as trawling.
- Troll lines for predatory fishes such as Spanish mackerel and barracuda using buffalo horn, stainless steel spoon and fish head jigs were developed.
- Marine gill net optimized for catching sardine, mackerel, Spanish mackerel, pomfret and hilsa, in terms of material and mesh size were introduced for the benefit of non-motorized and mechanized segments of the industry.
- Gear systems have improved the capture fishery production from the inland open water resources significantly over the years. Trammel nets and monolines were also introduced in reservoir systems.
- Technology for the extraction of Chitin from shrimp shell and conversion to Chitosan has successfully addressed a very serious environmental threat due to the careless disposal of the waste. Eight parties have already taken this technology and started production and marketing. Nearly 20% of the available shell waste is being used by these industries for conversion to Chitin and Chitosan. In addition to creating employment, this has become a highly remunerative industry.
- Ready-to-serve fish curry products in retortable pouches can be stored at ambient temperature. This revolutionary technology has been already given to more than a dozen parties who have already started production and marketing. This technology has long term impact in terms of value addition.
- Isinglass is a product that has got application as a clarifying agent in breweries, mainly in the beer industry. The technology was transferred to an industry for commercialization. This has resulted in the production of a value added product which has got demand in domestic and foreign market.
- The technology for extraction of Poly Unsaturated Fatty Acids (PUFA) from fish oil is a very important contribution towards nutritional security by providing a vital nutritional component. Many multinational

companies are importing PUFA-enriched products and this technology will lead to import substitution. This value-added product will help in increasing the income of the fishermen.

- Collagen-Chitosan film has wide applications as a wound dressing and in dental surgery. It replaces the imported Teflon membrane used in dental surgery and the cost will be only a small fraction of that of the imported material. The raw material is fish air bladder, which does not find any use now. This technology can utilize the industrial waste and thus can enhance the income of the fishermen.
- Database on biochemical composition of fish serves as the major source of data for product formulation and nutrition labeling.
- A single step microbiological assay was perfected for detecting residues of eight antibiotics in seafood., viz. Chloramphenicol, Oxolinic acid, Tetracycline, Oxytetracycline, Furazolidine, Nalidixic acid, Neomycin and Trimethoprim which are commonly found used in aquaculture farms in India. The method can detect the antibiotic residues to a level of 0.1 ppm. About 65 seafood factories in Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat exporting seafood to EU and US are direct beneficiaries of this technology.
- A two step nested PCR method for the detection of White Spot Syndrome Virus in shrimps was developed, standardized, assessed and introduced for commercial use. This method will detect the presence of as small as 10 virions per host larvae. The technology is being used for regular testing of post larvae before introduction to the farms.
- A RT-PCR method to test the presence of the devastating Yellow Head Virus in shrimp farms was developed, assessed and commercialized. This is the only test method for YHV now available in India. The method is being currently used for screening frozen shrimp for YHV, being exported to the US, to meet the phytosanitary regulations of the WTO.
- An improved ELISA method for detection of residues of Chloramphenicol, a 'zero tolerant' antibiotic, in processed seafood for export to EU, US and Japan was evolved. This improved method was assessed and commercialized in 2003. It is now regularly used to monitor Chloramphenicol level in farmed and processed shrimps. Hundreds of shrimp farmers and seafood exporters have gained by the technology.
- The 'Chloritest paper' developed for detection of ppm levels of Chlorine in process water, an essential requirement to implement sanitation and hygiene practice in food processing industry, was transferred to M/S Glaxo Laboratories. This has resulted in the rejection of seafood/food items on the basis of contamination with pathogens significantly, resulting in substantial savings of foreign exchange to the country.
- Suitable programmes were organized for implementation of HACCP in the seafood industry. A software and multimedia CD was also developed for HACCP.
- Throughout India the effluent treatment system attached to seafood processing units is a neglected area resulting in serious environmental problems. To alleviate this problem of pollution by the seafood industry, an efficient effluent treatment plant was deigned to treat the effluents confirming to the Pollution Control Board standards.
- The following engineering equipment have been developed by CIFT for use in fishing and fish processing:
  - SS Tllting Kettle
  - Oil fryer for battered and breaded products
  - Tunnel Dryer
  - 15.5 m fuel efficient steel fishing vessel

- Fibreglass canoes
- Environmental data acquisition system
- Temperature-Salinity meter
- Ship borne data acquisition system
- Speed and distance log
- Trawl depth meter

- The following aspects having management and policy level implications in fisheries have been studied by the Institute:

- Idle capacity in fish processing plants in India
- Price analysis of Indian seafood in the export market
- Economics of artisanal fisheries
- Economics of operation of fishing vessels on both West and East coast of India
- Price spread in domestic fish markets of Kerala and Gujarat
- Fuel utilization pattern by the fishing industry in India
- Assessment of harvest and post harvest losses in fisheries
- Estimation of inland fish landings in reservoirs

- The Institute also undertakes research studies which provide feedback to technology development and transfer. The following are some of the works undertaken:

- Socio-economic profile of fisherfolk in different parts of the country and development of socio-economic status scale.
- The areas and extent of participation of women in fisheries related activities.
- The types and activities of co-operatives and other organizations in fisheries and the role played by them in small scale fisheries.
- Adoption behaviour including extent of adoption, communication, decision making, response to technological gaps of fishermen in traditional, mechanized and motorized sectors and fish curers in relation to technology transfer by the Institute.
- Evaluation of the training and extension programmes taken up the Institute in terms of gain in knowledge, awareness, practices and constraints.
- Studies on ban on monsoon trawling, coastal zone management and socio-legal issues.

Research Achievements

Headquarters, Cochin

Fishing Technology Division

Research projects handled

- Studies on biodeterioration and material upgradation for marine applications
- Optimization and upgradation of traditional fishing systems for inland and marine sector
- Standardisation of traditional fishing system with special references to reservoirs
- Development studies on responsible trawl systems
- Bycatch Reduction Devices for selective shrimp trawling
- Impact of Copper Chrome Arsenic (CCA) wood preservative on the aquatic environment
- Standardisation of fishing gear materials and fishing accessories
- Improved fishing craft and gear for NEH region
- Application of remote sensing and GIS for marine fishery resources management
- Investigations on the effect of bottom trawling on the benthic fauna of Saurashtra coast, Gujarat

Chief findings

- Coconut wood panels treated with Copper-Chrome-Arsenic, Creosote, dual preservative, Cashew Nut shell liquid and Neem oil did not show any change in strength in compression parallel to grain and static bending.
- Studies on the damage caused by marine borers on chini wood (*Tetrameles nudiflora*) showed 59% loss of volume and 33% loss in weight.
- The treated rubber wood canoes given for experimental fishing through Fishermen Co-operative Societies at Kumbalam, Chellanam, Thalassery, Vaikom and Alapuzha were found to be free from biodeterioration or any physical damage after 51months of operation.
- Applying two coats of epoxy paint or sheathing with FRP accorded a 100% protection to rubber wood panels against marine woodborers and these physical barriers could effectively control leaching of CCA components.
- Bioaccumulation studies on *Tilapia mossambica* reared in aquaria where CCA treated panels were exposed showed that the pattern of accumulation for Copper and Arsenic in the tissues was in the order - liver>gills>gonads>muscle.
- The influence of CCA on corrosion of fasteners used in preservative treated wood was studied and results showed that CCA does not affect corrosion at lower retentions to a significant level, but in 42 kg m^{-3} retention, the corrosion rate was found to accelerate significantly when analysed statistically.
- Corrosion resistance of different brands of fishing hooks tested in Salt Spray Chamber as per ASTM B – 117 showed that Indian brands had good corrosion resistance and is in par

with the popular imported brands.

- The dyed nylon monofilament samples showed substantial increase in elongation (27 to 40%) than control, but not much variation in breaking load was found between dyed and control samples and dyeing offered better resistance to nylon multifilament material against weathering.
- Aluminium composite was developed by reinforcing pure Aluminium with Cerium oxide and Nickel oxide. Electrochemical evaluation revealed that this composite has significantly higher corrosion resistance in marine environments.
- Studies on the changes of corrosion rates of Stainless Steel (SS316) due to the long term exposure under marine environment showed that the corrosion rate was maximum during first month of exposure and rate reduced significantly to minimum upto six months and later it slowly started increasing.
- Studies on the heavy metal profile of the Cochin estuary revealed that the Zinc, Cadmium, Lead and Copper concentration varied between 0-78.06, 0-3.21, 0-7.79 and 5.00-21.75ppb respectively. Copper was detected throughout the year.
- Analysis of the wet breaking load and wet knot breaking load of polyamide monofilament yarns showed that there is considerable difference in strength properties between various brands.
- Floats of different materials and shapes collected from various parts of the country were found to vary considerably with reference to buoyancy and bursting strength.
- Details of trawl systems collected from Kerala coast show three variants of shrimp trawl, one deep sea shrimp trawl, one cuttlefish trawl, and two variants of squid-fish trawl. Mesh sizes varied from 1500 to 30 mm in fish/squid-fish trawls, 50 to 20 mm in coastal and deep sea shrimp trawls and 400 to 30 mm in cuttlefish trawl.
- Covered codend experiments to determine codend selectivity of fish resources, using 18 m semi-pelagic trawl fitted with 100 mm diamond mesh codend and 30 mm cover showed that depending on seasons and fishing areas, exclusion rates ranging from 18% to 94% of the catch components, predominantly juveniles and sub-adults, were observed from 100 mm diamond mesh codend.
- Selectivity data in respect of 49 species were collected for deriving selectivity parameters using 18 m semi-pelagic trawl fitted with 40 mm diamond mesh codend and 30 mm cover in which about 64% of the catch was retained in the codend and 34% was excluded.
- Radial Escapement Device with 150 mm mesh netting (Covered codend method) showed 100% efficiency in excluding seven species of fin fishes and eight species showed escapement above 50%.
- Field experiments with horizontally oriented oval, semi-circular and vertically orientated oval Fish Eye BRD designs showed 100% efficiency in excluding seven, eight and 12 species respectively and escapement above 50% was shown by 25, 8 and 37 species respectively. Among these semi-circular Fish eye showed minimum target catch loss.
- Collapsible crab traps operated in Cochin backwaters, using chicken waste as bait showed higher catches of *Scylla serrata*.
- Fishing experiments with CIFT designed bottom set gill nets were initiated at Kabani reservoir in Karnataka, in collaboration with CIFRI Research Centre, Bangalore.
- Three improved fishing canoes were fabricated at Guwahati using low cost wood and sheathed with FRP. The canoes were handed over to the Dept of Fisheries, Assam for distribution to Fishermen Cooperative Societies.

- The experimental bottom trawling conducted at five transects (15-40 m depth) along Veraval coast revealed a decline in sediment organic matter.
- The abundance of macrobenthos and meiobenthos along Veraval coast increased after the closed season (May to September).

Report of work done

Utilization of coconut wood for marine purposes

Coconut panels of size 50 x 50 x 200 mm and 20 x 20 x 300 mm from a tree of 75 years old were air seasoned and treated with Copper-Chrome-Arsenic, Creosote, dual treatment, Cashew Nut shell liquid, and Neem oil. Static bending tests and compression parallel to grain tests of the treated panels and untreated control panels were carried out. The test results showed no statistically significant difference between treatments with reference to MOR, ML and MOE but all treatments show significant difference from control. CNSL had significant effect on the compressive stress at maximum load. One set each (six replicates in each set) of the treated samples were exposed to atmospheric, soil and estuarine conditions to evaluate the field performance. The panels were exposed along with untreated control panels and are inspected periodically to assess the condition.

Quantification of marine woodborer damage

The monthly retrieval of samples of chini wood (*Tetrameles nudiflora*) of size 26 x 11 x 2 cm exposed to Cochin harbour waters for marine woodborer attack was continued and the damage assessed. There was very heavy borer attack and 1/3rd portion of the test panel was broken away due to boring by the end of 10 months. The volume of wood lost due to the attack was calculated as 59% of the original volume. Analysis of the weight of the wood lost due to the attack showed a 33% loss in the original weight.

Performance monitoring and popularization of rubber wood canoes

The treated rubber wood canoes given for experimental fishing through the Kumbalam Inland

An FRP sheathed rubber wood canoe after three years of operation

Fisherman Development Welfare Co-operative Society and the Chellanam FDWCS were periodically inspected and found to be free from biodeterioration or any physical damage after 51months of operation. The canoe (FRP sheathed) being operated by Kannur City FDWCS and Thalassery Inland FDWCS at Pinarayi, Kannur are in good condition. The third FRP sheathed rubber wood canoe of size 6.5m LOA handed over for experimental fishing to the Vechoor Lime Shell Co-operative Society, Vaikom and Ambalapuzha Lime Shell Co-operative Society are also being operated successfully by the fishermen for lime shell collection. All the five canoes were free from biodeterioration and any physical damage.

Impact of Copper-Chrome-Arsenic wood preservative on the aquatic environment

Biodeterioration of rubber wood panels treated with CCA to three retentions viz. 16 kg m^{-3}, 29 kg m^{-3}, 42 kg m^{-3}, dual preservative (16 kg m^{-3} CCA followed by 150 kg m^{-3} Creosote) and panels coated with paint and sheathed with FRP was studied under the estuarine conditions for a duration of six, 12 and 18 months. It was observed that on prolonged exposure for 12 to 18 months the CCA treated panels of lower retention of CCA viz. 16 kg m^{-3}, showed susceptibility to borer attack especially due to *Teredo* spp. Higher retentions viz. 29 kg m^{-3}, 42 kg m^{-3} of CCA preservative in wood imparted higher degree of protection. Dual treated panels performed equally well as CCA treated panels of 42 kg m^{-3} retention.

Untreated rubber wood panel after exposure for 12 months in the estuarine condition

Nails retrieved after corrosion studies

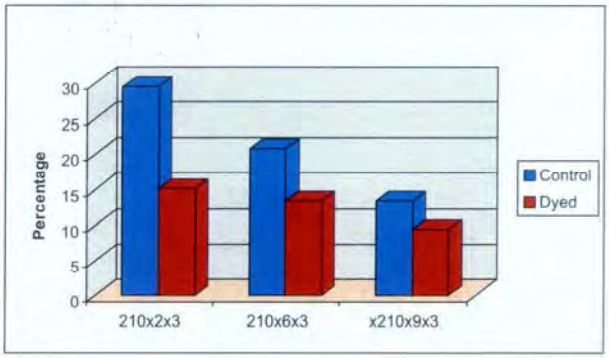
Painted and FRP sheathed panels accorded a 100% protection against woodborers. The FRP sheath also ensures that there is no leaching of the constituent chemicals into the aquatic environment.

The leaching of the treated panels in aquaria where fish *Tilapia mossambica* was grown was also studied by assessing the bioaccumulation of Copper, Chromium and Arsenic. It was found that the metals Copper, Chromium and Arsenic that leached out from CCA treated panels have the potential to get bioaccumulated. The concentration of Copper, Chromium and Arsenic was highest in liver. The pattern of accumulation for Copper and Arsenic in the tissues of Tilapia was in the order - liver>gills>gonads>muscle. Significant accumulation of Chromium was observed in liver, gonads and gills while in muscle tissues accumulation was very low.

The influence of CCA on corrosion of fasteners used in preservative treated wood was studied. The rate of corrosion of Copper, Iron and painted iron nails and galvanized iron screws in rubber wood treated to three different retentions of CCA viz. 16, 29, 42 kg m^{-3} and untreated wood was experimented. In the laboratory, experiment was done by providing accelerated condition using salt spray chamber and in the field, by immersion of nailed wood panels in the estuary. The role of corrosion products in the degradation of the wood around the fastener was also studied. The rate of corrosion was estimated by weight loss method. The results shows that CCA does not affect corrosion in 16 and 29 kg m^{-3} retentions to a significant level, but in 42 kg m^{-3} retention, the corrosion rate was found to accelerate significantly when analysed statistically. The rate of corrosion was least in galvanized iron and painting of iron nail is found effective in reducing corrosion. Also corrosion products were not found to accelerate degradation of wood around the fasteners.

Evaluation of properties of dyed netting materials

The effect of synthetic dyes on the properties of fishing gear material viz., nylon multifilament twine of 2x3, 6x3 and 9x3 and nylon monofilament yarn of 0.32 and 1.0 mm diameter were studied. After conditioning in standard atmospheric conditions the



Percentage loss in breaking load due to 45 days exposure to natural sunlight

properties of these dyed samples were tested in comparison to control. The dyed monofilament samples showed substantial increase in elongation (27 to 40%) than control. In the case of breaking load, not much variation was found between dyed and control samples. The properties of the dyed samples were tested for weathering and abrasion resistance in comparison to control. Dyed samples of nylon multifilament twine of 2x3, 6x3 and 9x3 were exposed to natural weather conditions along with control. Retention of breaking load of sunlight exposed samples showed that dyeing offered better resistance to nylon multifilament material against weathering.

Development of Aluminium composite incorporating oxides of Cerium and Nickel for marine conditions

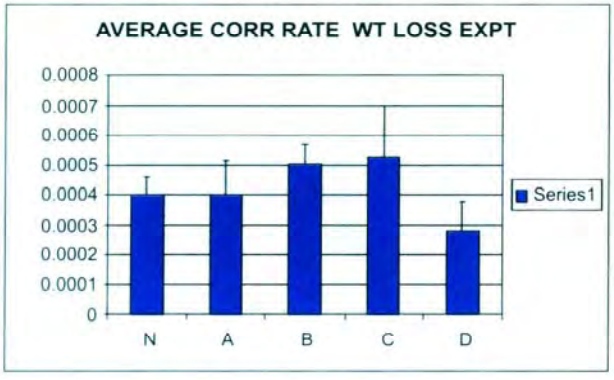
Aluminium metal matrix composite was developed by reinforcing Cerium oxide and Nickel oxide in pure Aluminium. Comparison was made between different groups of treatments viz., NiO and CeO_2 concentration in all the groups were ranged from 0.05 to 0.4%. Linear sweep voltametric analysis of the composite revealed that the treatment having 0.4% Cerium oxide and varying amounts of Nickel oxide recorded significantly higher polarization resistance, lowest corrosion current density and lowest corrosion rate. The average corrosion rate varied from $2.7x10^{-4}$ to $5.2 x10^{-4}$ mpy and the coupons with 0.4% CeO_2 and varying amounts of Nickel oxide recorded lowest corrosion rate.

Long term immersion studies in 3.5% NaCl to evaluate the open circuit potential variation during the exposure in Sodium chloride revealed that the batch of coupons with 0.4% CeO_2 and varying amounts of Nickel oxide had shown significantly higher open circuit potential compared to other treatments. Reinforcement with Nickel oxide itself had improved the surface microstructure of the pure Aluminium. The addition of CeO_2 promoted the formation of more continuous α phase on grain boundaries, which acted as a corrosion barrier.

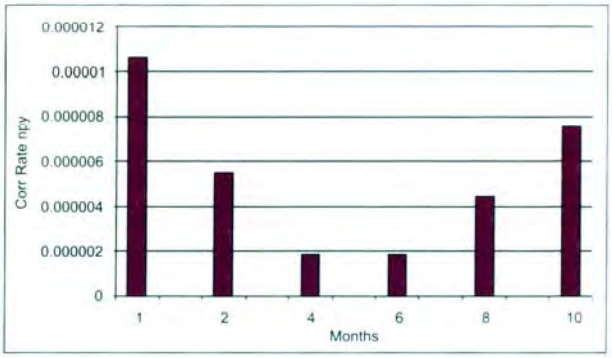
Evaluation of stainless steel corrosion under marine environment

Studies were conducted to evaluate the changes of corrosion rates of Stainless Steel (SS316) due to the long-term exposure under marine environment by weight loss method. Results revealed that the corrosion rate was maximum during first month of exposure and rate reduced significantly to minimum upto six months and later it slowly started increasing.

The long term exposed panels of Stainless Steel (SS316) were subjected to electrochemical impedance spectroscopy to evaluate the changes in the corrosion behaviour of the material. The impedance data clearly shows that there is a decrease in the polarization resistance in the high frequency region of impedance spectra during the study. There is an increase in Constant Phase Element (CPE) and 'n' also,



Corrosion rate in Aluminium composite



Corrosion rate pattern of stainless steel

indicating the slow deterioration of the material.

Monitoring of pollution in the estuarine environments of Cochin

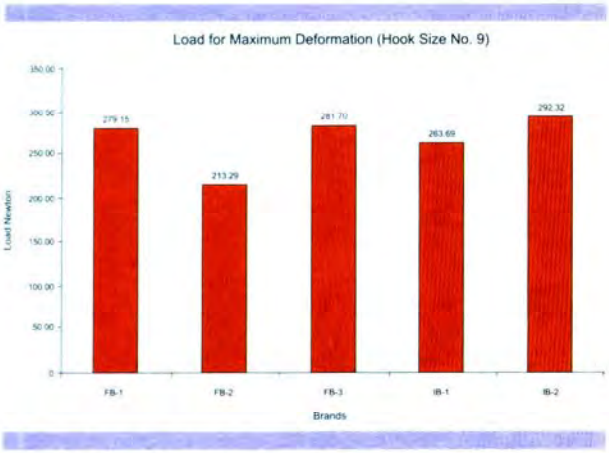
The monitoring of quality parameters of water samples collected from the three stations of Cochin estuary namely, Mattancherry wharf, Ernakulam wharf and north oil tanker berth were continued. The water samples were filtered and analysed for Cadmium, Zinc, Copper and Lead using anode stripping voltammetry with HMDE (Hanging Mercury Drop Electrode). The results revealed that the Zinc, Cadmium, Lead and Copper concentration varied between 0-78.06, 0-3.21, 0-7.79 and 5.00-21.75ppb respectively. Copper was detected throughout the year. Among the stations, higher levels of Zinc, Cadmium, Copper and Lead was recorded in Mattancherry wharf area.

Standardisation of fishing gear materials and fishing accessories

Fishing gear materials viz., samples of polyamide (PA) monofilament yarns, fishing hooks, floats and sinkers of different dimensions and brands were collected from different parts of the country, covering Assam, Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Tamil Nadu and West Bengal. The physical, chemical and mechanical properties of these samples are being evaluated. Analysis of the wet breaking load and wet knot breaking load of 170 samples of polyamide monofilament yarns of 32 different dimensions shows that there is considerable difference in strength properties between various brands.

The fishing hook samples collected were analysed for material composition. It was found that the hooks generally contain 98.46% w/w of Iron and 0.76% w/w Carbon. The studies on the correlation between the material composition and the mechanical properties of fishing hooks are under progress. A total of 120 types of fishing float samples were collected. They were made of materials like PVC (Polyvinyl chloride), HDPE (High Density Polyethylene), Aluminum, glass etc., variously shaped like spherical, cylindrical/disc, egg-shaped and apple-shaped. The sizes of PVC cylindrical floats range from 50/10 to 150/190. The PVC egg floats include sizes 5" and 6". The HDPE spherical floats include sizes 4", 5", 6", 8", 10" and 12". The sizes of HDPE cylindrical floats range from 50/10 to 150/20. HDPE apple shaped floats include sizes No.1, No.3, No.8 and No.9. The buoyancy measurements revealed that buoyancy is highly varied between different brands of floats. The buoyancy ranged from 608 to 958 gf in 5" spherical floats. The bursting strength of different types of floats was tested using high-pressure autoclave. The bursting strength of 5" HDPE spherical floats ranged from 8 kg cm^2 to 34 kg cm^2 among different brands.

The collected sinkers include sinkers made of stone/granite, coral, baked clay, cement, Iron and



Load for deformation for different brands of hooks

Fishing floats after bursting strength test

Lead. Two types of baked clay sinkers were collected from the northern coast of Kerala. They were having a mean weight of 7 g and 10 g and are used only in gill nets. From the northern parts of Kerala, bent Lead plates were collected which is also used in gill nets. The sinkers made of Lead are found to have a weight range of 10 – 250 g and are mostly bean/barrel shaped. It was observed that the trawl fishing gears at different parts of the country use generally same type of sinkers whereas high degree of diversity is observed in sinkers used in other gears especially in gill nets.

Status of trawl systems in the small-scale mechanized sector, off south-west coast

Details of trawl systems of Kerala coast were collected, using specially designed questionnaires and design templates. Size of trawlers currently operating off Erankulam, ranged from 7.8 to 21.2 m in LOA and from 96 hp to 176 hp in installed engine power. Trip duration ranged from 4 to 10 days and crew onboard numbered from 6 to 8. Three variants of shrimp trawl, one deep-sea shrimp trawl, one cuttlefish trawl, and two variants of squid-fish trawl were observed. Mesh sizes varied from 1500 to 30 mm in fish squid-fish trawls, 50 to 20 mm in coastal and deep-sea shrimp trawls and 400 to 30 mm in cuttlefish trawl.

Studies on fish behaviour in the proximity of trawl systems

Remote-operated Underwater Vehicle LBV 150s (Seabotix, USA) with underwater television cameras and recording system, was acquired. Demonstration-cum-training was organized from 8 to 10 August 2006, for the benefit of scientists and technical officers. Training was imparted by Mr. Mathew Nerz, Seabotix, USA. The instrument will be deployed for observations of fish behavior in the proximity of gear systems, for developing responsible trawl systems.

Codend selectivity of trawls for fish resources off south-west coast

Seventy four covered codend experiments were conducted from MFB Matsyakumari, to determine codend selectivity of fish resources, using 18 m semi-pelagic trawl fitted with 100 mm diamond mesh codend and 30 mm cover. Depending on seasons and fishing areas, exclusion rates ranging from 18% to 94% of the catch components, predominantly juveniles and sub-adults, were observed from 100 mm diamond mesh codend. Major species retained in the codend were *Pampus argenteus* (FL 105-180 mm), *Portunus pelagicus* (CL 110 mm), *Charybdis feriatus* (CL 140 mm), *Megalaspis cordyla* (TL 215-220 mm), *Parastromateus niger* (TL 175-190 mm), *Rastrelliger kanagurta* (TL 110-242 mm), *Uroteuthis (Photololigo) duvauceli* (ML 110 mm) and *Congresox* sp. (TL 1300 mm). 100% exclusion was shown by 46 species, >50% exclusion by 13 species and 100% retention was shown by five species. Selectivity data in respect of 70 species were collected for deriving selectivity parameters.

Twenty three covered codend experiments were conducted from MFB Matsyakumari, to determine codend selectivity of fish resources, using 18 m semi-pelagic trawl fitted with 40 mm diamond mesh

Covered codend selectivity experiments, onboard MFB Matsyakumari, off south-west coast

codend and 30 mm cover. About 64% of the catch was retained in the codend and 34% was excluded. 100% escapement was shown by four species, >50% escapement by 10 species and 100% retention was shown by 15 species. Selectivity data in respect of 49 species were collected for deriving selectivity parameters.

Bycatch Reduction Devices for selective shrimp trawling

Field experiments with horizontally oriented Fish eye BRD (10 x 30 cm) installed in the upper half of the codend of shrimp trawl showed 100% efficiency in excluding Seven species of fin fishes viz., *Parastromateus niger, Leiognathus equulus, Pampus argenteus, Thryssa mystax, Alepes djedaba, Encrassicholina devisi*, and *Stolephorous waitei* and 25 species showed escapement above 50%. Semi-circular Fish eye BRD (20 x 30 cm) showed 100% efficiency in excluding two species viz., *Caranx sexfasciatus* and *Secutor ruconius* and eight species showed escapement of more than 50%. Loss of target catch viz., shrimp and squid (*Uroteuthis (Photololigo) duvauceli*) was minimal in these two designs. Field experiments with vertically orientated oval Fish eye BRD (20 x 30 cm) showed 100% efficiency in excluding 12 species of fin fishes and one lobster species. Thirty seven species showed escapement above 50%, while catch loss of cephalopods and shrimp was comparatively higher in this design.

Fixing of Fish eye BRD to the shrimp trawl codend

Field experiment with Radial Escapement Device of 150 mm mesh netting (Covered codend method) showed 100% efficiency in excluding seven species of fin fishes escapement such as *Uroconger lepturus, Nibea maculata, Scatophagus argus, Selar crumenophthalmus, Trypauchen vagina, Leiognathus brevirostris* and *Penaeus semisulcatus*. Eight species showed escapement above 50%. Among 68 species 19 species shows 0% escapement, consisting of eight species of fin fishes, three species of shrimps, one species of cephalopod, two species of crabs and five species of other molluscan shells. Shrimp loss was about 8.32%.

Operation of Radial Escapement Device

Development of traps

Collapsible crab, lobster and fish traps were designed and fabricated. Fishing trials were conducted with collapsible crab traps in Cochin backwaters using different baits. Of the different baits used, chicken waste as bait showed higher catches of *Scylla serreta* as compared to other baits. Collapsible lobster traps were given to fishermen of Kanyakumari district for fishing trials. The fishing trials were successful and the fishermen have accepted the technology. The design of collapsible lobster traps has been submitted for obtaining patent. A design of collapsible fish trap for inland fishing has been developed and the same was tried in the inland waters of Kerala mainly for *Etroplus* spp. The catch rates of fish were better as compared

Operation of fish trap

to the traditional fish traps. The design of collapsible fish traps has also been submitted for obtaining patent.

Experimental fishing in Hirakud reservoir

Fishing experiments with monofilament simple gill nets and monoline fishing (Hook & Line) were continued at Hirakud reservoir. Fourteen observations were taken with monofilament gill nets and 19 operations were taken with monolines.

Field-testing of collapsible traps for fresh water prawns at Hirakud reservoir in Orissa was initiated. Four numbers of collapsible prawn traps were fabricated and fishing trails are in progress.

Experimental fishing in Malampuzha reservoir

Two collapsible prawn traps were fabricated and fishing trials are in progress at Malampuzha reservoir.

Experimental fishing in Kabani reservoir

Polyamide monofilament gill nets were designed and rigged for surface, column and bottom fishing

Bottom set gill net operation at Kabani reservoir

operations were conducted at Kabani reservoir, Karnataka in collaboration with Reservoir Fisheries Division, CIFRI, Bangalore. The mesh size of the gill nets was 50, 60 and 70 mm with twine size 0.16 and 0.20 mm dia. The catch mainly consisted of *Tilapia* sp.

Studies on gear efficiency index in reservoirs

The questionnaire for collection of data on gear used and catch length particulars for the different species caught in each net has been designed. The review of bio-economic models is under progress. Collection of data from Malampuzha reservoir and Meenkara reservoir for the gear efficiency index study is in progress.

Improved fishing craft

Three sizes (small – 5.85 m, medium – 7.20 m, and large – 8.10 m) of improved wooden canoes were made using cheaper locally available wood (Poma, and Pine). These canoes were given two FRP coatings for the outer and one to the inner side of the canoe. The canoes were given to three Co operative Societies through the Dept. of Fisheries, Assam. The performance of the canoes are being monitored. The carpenters and fishermen were also trained in the construction of improved fishing crafts.

Echosounding operations

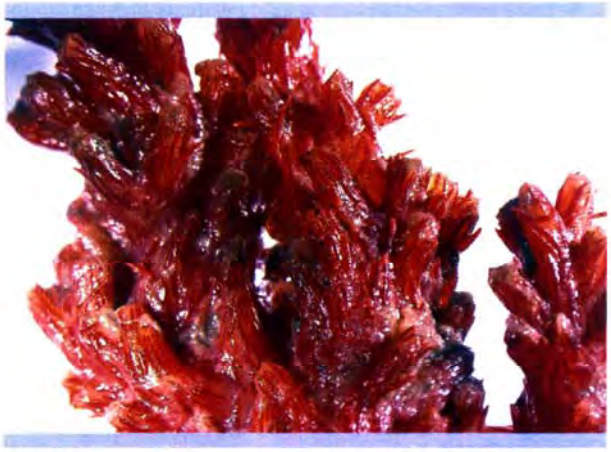
Echosounding operations were carried out using EY 60 Portable Echosounder in Brhamaputra river. The echosoudning was carried out at Guwahati,

North Guwahati, Chandrapur and Palasbari. The depth and nature of bottom were recorded.

Effects of bottom trawling on the benthic fauna off Saurashtra coast

The experimental bottom trawling conducted at five transects (15-40 m depth) along Veraval coast revealed a decrease in sediment organic matter. The sediment organic matter was found to vary between 1.1% and 2.3%. The organic matter, siltation and heavy metals are higher at 15-20 m; decreases with depth and shows lowest values at 35-40 m depth. A positive correlation is noticed between organic matter, siltation and heavy metals. The trawling grounds from 15-40 m depth are soft-bottom and reveal dominance of clayey silt sediment. The sand proportion increased with depth with highest values at 35-40 m depth.

The abundance of macrobenthos and meiobenthos increased after the closed season. The polychaetes that formed the dominant group of macrobenthos were represented mainly by *Sternaspis scutata*, *Prionospio* sp., and *Cossura* sp. Molluscs are dominant at 40 m depth. The numerical abundance and biomass of molluscs increased with depth in relation to the increase of sand proportion. The nematodes and foraminiferans that formed the dominant groups of meiobenthos increased after the trawl ban period. The epifauna collected in dredge mainly composed of dead and damaged molluscan shells. Soft corals and gorgonians were recorded at a depth of 15-20 m in the month of October 2006. This is the first record of live octocorals in the sub-tidal region off Veraval. The soft corals identified were *Litophyton* sp. and *Studeriotes* sp. (Christmas tree soft coral). The gorgonians were young stage of *Subergorgia* sp. and *Juncella juncea* (Pallas) (Whip coral).



Litophyton sp. (Stereomicroscopic view of soft coral)

Fish Processing Division

Research projects handled

- Development of value added products from fresh water fish and their preservation
- Improvement and value addition of traditional fish products
- Development of high value products from fish and fish processing waste
- Development of ecofriendly technologies for the production of water soluble derivatives of Chitin and biodegradable membranes from Chitosan
- Modern technologies for packaging of fish and fishery products
- Suitability of polymer coated tin free steel cans for canning fish and fish products
- Development of extruded products utilizing low value fishes

Chief findings

- The chemical, physical and sensory characteristics of Rainbow trout (*Oncorhynchus mykiss*) collected from Munnar were studied.
- Rainbow trout had a high quality shelf life of seven days and practical storage life of 15 days in ice.
- The procedure to prepare light salted and light smoked products from split opened Rainbow trout was standardized.
- The procedure for the preparation of coated trout fillets was standardized.
- The microbiological changes during icing and smoking of Rainbow trout was studied.
- Light salted and light smoked fillets from Rainbow trout stored at 3 ± 2°C had a shelf life of 30 days.
- Whole Rainbow trout stored at -20°C had a high quality shelf life of six months.
- The biochemical parameters such as protein fractions, amino acid profile and fatty acid profile of Rainbow trout were studied.
- A method to recover the meat and prepare cutlet from the filleting waste of Mahseer was developed.
- Cutlet prepared from the meat of the filleting waste of Mahseer had a shelf life of more than six months at -20°C.
- Salted and smoked partially dried fillets of Mahseer packed under vacuum in polyester/ polythene laminate had a shelf life of 10 days while the control packed in air had a shelf life of only eight days at ambient temperature.
- The preparation of light salted and spiced semi-dried fish fillets from common carp (*Cyprinus carpio*) was standardized.
- The steaks prepared from the fillets of Mahseer weighing 18.5 kg and packed in polythene pouches had a shelf life of 20 days in ice.
- Fish drying studies in LPG based dryer showed that the dried fish is hygienic and of good quality. Drying is faster and the operational cost works out to be cheap.
- Shelf life of light salted shark with appropriate treatment can be extended to six months. Beyond six months the product developed fungal growth, yellow discoloration and foul smell.
- Light salted Jew fish treated with Calcium propionate at 0.5% level developed fungal growth after one month storage at ambient temperature.
- Packaged dried fish samples sold through retail outlets remained in acceptable condition for only one month. On storage all the samples developed fungal growth and rancid odour on examination after one month.

- Shelf life characteristics of edible fish powder were determined.
- Crab flavour and prawn flavour incorporated vegetable curry was prepared after incorporating taste enhancers. Shelf life was also determined.
- Comparison of fatty acid composition of tuna and rohu eye balls was done.
- Quality parameters and yield of Carrageenan prepared from seaweed (*Kappaphycus alwarizi*) were studied.
- Fish Calcium was prepared from scales of catla.
- Chitosan chloride was prepared and properties were studied.
- Anti-microbial property of Chitosan was studied on food-born bacteria.
- Chitosan was used for high pressure treatment of wood as a preservative.
- Gelatin prepared from skin of fresh water fish were studied for its quality parameters.
- Effect of Chitosan in absorption of Lead in animals was studied.
- Indigenous thermoformed trays made of High Impact Polypropylene were found to be suitable for packing ready to eat meals consisting of single par boiled rice and sardine curry.
- Cutlets prepared using Croaker (*Otolithus* sp.) packed in indigenous high impact Polypropylene and imported high density polythene trays and kept in frozen storage at -20±2°C had a shelf life of more than eight months.
- Ready to eat fried seer fish steaks in Polypropylene containers vacuum sealed inside a pouch of PEST/Aluminium oxide/cast PP had a shelf life of three months.
- Ready to serve Punjabi curry and UP Mughalai curry from Mahseer had a shelf life of one year at room temperature.
- See-through retortable pouches made of polyester, nylon, cast PP coated with Silicon dioxide was found to be suitable for processing smoked tuna.
- Active packaging studies indicated that both Oxygen scavengers and Carbon dioxide emitters were effective in enhancing the shelf life of dry fish and chilled fish, respectively.
- Nutritional quality of canned mackerel in brine was superior to control diet with regard to PER, NPU and BV.
- Quality of mackerel in brine processed at 130°C was better than products processed at 121°C and 115°C with regard to sensory, textural and colour parameters.
- Ready to serve crab products such as crab koftha, crab butter masala and crab soup were developed.
- Different regional fish curry recipes were standardised and conducted acceptance study of already standardized fish products processed in indigenous polymer coated Tin free steel cans.

Report of work done

Characteristics of Rainbow trout (*Oncorhynchus mykiss*)

The biochemical, microbiological, physical and sensory characteristics of Rainbow trout were studied in detail. It had NPN – 420mg/100g, TVN – 14mg/100g and Amino nitrogen – 42mg/100g. The muscle was soft and had slight sweet taste.

The aerobic mesophilic count on the surface was 10^5 cfu/g, Total Plate Count in the intestine was $> 10^7$ cfu/g. The surface had a Coliform and Streptococcal count of less than 140 MPN/g each. Coliform and faecal Streptococcal counts were three log higher in the intestine.

Iced shelf life of Rainbow trout

Rainbow trout had a high quality shelf life of seven days in ice and a practical shelf life of 15 days. During iced storage the moisture content increased

by 3%. The fresh sample was free from peroxides, but it reached a value of 56 m.eq.O_2/kg fat by 10 days. The initial pH was 6.77 which rose to 7.15 after 12 days iced storage. The sensory characteristics were more or less retained upto seven days and afterwards showed moderately to rapid decrease.

Frozen storage of Rainbow trout

Dressed samples of Rainbow trout were frozen at -40°C in a blast freezer, glazed and individually packed and stored at -20°C. On freezing the samples did not show significant change in chemical, physical and sensory characteristics. The samples were in very good condition up to six months.

Smoked Rainbow trout

Dressed and split opened Rainbow trout were dip treated in 10% brine containing 0.1% Citric acid for 30 minutes. The samples were initially dried at 30°C for one hour by blowing air in the smoke kiln itself and cold smoked at 40°C for 45 minutes at a relative humidity (RH) of 63% and another set was smoked at 60°C for 45 minutes at an RH of 50%. The cold smoked samples had a moisture content of 74.5% and hot smoked samples 70.75%. The peroxide values were slightly higher in the hot smoked samples than the cold smoked one. The samples had a shelf life of about one month at 3±2°C.

Smoked Mahseer

The preparation of smoked product from the fillets of Mahseer were standardized. The fillets were treated with 15% brine for 30 minutes, dried at 45°C for 2 hours in the smoke kiln itself and smoked at 70°C for one hour. The samples were stored at ambient temperature under vacuum and in air. The vacuum packed samples had a shelf life of 10 days and air packed samples had a shelf life of eight days.

Coated trout fillets

Fillets were prepared from trout, cold blanched in 5% brine containing 0.1% Citric acid for three minutes and pre-dusted with dry batter mix. It was then battered and breaded with medium sized breadcrumbs. The product had very good organoleptic characteristics.

Freeze-dried coated fish portions

Cutlets from filleting waste

The meat from the filleting frame of Mahseer was separated by cooking and hand picking the meat and cutlets were prepared using the meat. The product had very good organoleptic characteristics. The cutlets had a shelf life of more than six months at -20°C.

Mahseer frames

Fortification of cutlets

Fish bones were sterilized at 15 psig pressure for 30 minutes, dried and pulverised to yield a soft powder. It was mixed with cutlet mix at 0.5% level as a source of Calcium and Phosphorous. Inclusion of 0.5% level of bone powder did not affect the flavour of the product.

Light salted and spiced semi-dried fish products

Fish fillets from common carp cut into proper size were dip treated in 10% brine containing 2% Calcium propionate and 0.1% spice mix (equal quantities of powdered cinnamon, nutmeg and clove) for 30 minutes. The sample was dried to 50% moisture level and packed in polyester polythene film under vacuum and in air and stored at 3°C. The vacuum packed samples stored at 3°C had a shelf life of less than one month while the samples stored at ambient temperature had a shelf life of only seven days.

Iced storage of Mahseer fillets

Fresh Mahseer, weighing 18.5 kg, which was in early stages of post rigor, was filleted and the fillets were cut into steaks. These were packed in polythene pouches and studied for iced storage characteristics. They had an iced storage shelf life of 20 days.

Quality evaluation of salted and dried fish collected from market

Fish samples namely kozhuva, silver belly, bral, prawn, manthal, shark, nanthan and parava collected from super markets were subjected to shelf life study at room temperature after initial quality evaluation. Few fish samples namely kozhuva, bral, shark and parava were of poor quality with high levels of TVN viz., 196.00, 212.80, 336.00 and 315.00 mg%/100g. Other samples had TVN and PV values in acceptable limit. But all the samples looked good in appearance. On storage, all the samples developed fungal growth and rancid odour on examination after one month.

Fish drying in LPG based dryer

Drying studies with different species of fish were conducted using LPG dryer. Tilapia was split open, salted in 1:6 ratio, rinsed in 15% salt solution after overnight salt curing and taken for drying in LPG dryer. Another lot was dried in the sun for control. The fish in LPG dryer was dried to a moisture content of 24.54% in 5 hrs. while sun drying took 12 h for drying to a moisture content of 27.2%. The delay in drying time has resulted in slight variations in the biochemical factors.

Jew fish, silver belly, kalava etc. were also dried in the LPG dryer after salting and Calcium propionate treatment at 5% level. Quality evaluation of the dried fish samples were done every month. All dried fish samples remained in acceptable condition for three months. But the texture of the dried fish appeared soft. There was no insect attack, fungal growth or foul smell. The preliminary studies shows that there is quality improvement as well as savings in time, both being important considerations for going for artificial drying.

Studies on light salted fish

Light salted Jew fish was prepared by overnight salting in the salt to fish ratio 1:4 and drying to a moisture content of 24.1%. Biochemical parameters such as TVN, TMA were in the acceptable limit. The fish samples were treated with Calcium propionate at 0.5% level and stored at room temperature for three months. After three months storage the samples were in acceptable condition based on biochemical and organoleptic evaluation.

Studies on light salted shark meat

Shelf life studies of light salted shark meat at room temperature was continued. The salt content in the sample was 11.45% and water activity was 0.700. Organoleptic evaluation showed that few samples developed yellowish to brownish colour change and fungal growth. Ammonia smell was present in the samples. But there was no foul smell indicative of protein decomposition and the Ammonia smell may be due to the liberation of Ammonia from the urea present in the shark meat. The light salted fish products with moisture content around 40% are more prone to fungal attack. This calls for treatments to prevent the fungal attack and work in this line is in progress.

Incorporation of prawn and crab flavour in vegetable curry

Flavour concentrate prepared from prawn and crab meat were incorporated in vegetable curry along with small quantities of Tartaric acid and Monosodium glutamate. Organoleptic studies showed that the products retained its quality even after keeping for one month.

Studies on edible fish powder

Properties of edible fish powder prepared from tuna and *Nemipterus* were compared. Edible fish powder from *Nemipterus* was found to be good.

Carrageenan from sea weed

Pure carrageenan was prepared from sea weed (*Kappaphycus alwarizi*). It has a gel strength of 200 g/cm and very little sulphate content.

Fatty acid composition of catla and rohu were determined. It contained less quantity of DHA and EPA than tuna eye balls.

Fish Calcium and Chitosan

Fish Calcium was prepared from scales of catla after removing the protein. About 8.2% Calcium was obtained from the scales. Chitosan chloride was prepared by treatment with 6N Hydrochloric acid and the product obtained was found to be soluble in water.

Chiotosan was used for the study of anti-microbial property, food born bacteria such as *Listeria monocytogenes*, *Staphylococcus aureus* and Bacillus *cerus*. Different concentration of 0.01, 0.03, 0.05 and 0.1% Chitosan were used for the study. Initial density of bacteria was 10^5cfu/ml, 10^4cfu/ml. It was found that *S. aureus*, 4 log valve cell content was reduced to Nil within 24 hours at 0.05% and 0.1% Chitosan level. Where as impact was more in case of *Bacillus cerus* and *Listeria monocytogenes* showed reduction of 5 log cfu/ml in count at 0.05% and 1% Chitosan level with in 18 hours of exposure. It was found that gram positive bacteria were more susceptible to Chitosan than gram negative bacteria.

Chitosan having 40 mpa viscosity in 1% Acetic acid solution was used for the study of wood treatment in collaboration with Kerala Forest Research Institute, Peechi, Trichur. Experiment is being continued.

Effect of Chitosan in absorption of Lead in animals was studied by feeding of albino rats. Chitosan prevented the absorption of Lead in kidney and liver of rats.

Gelatin from skin of carp

Skin of Indian major carp and exotic carps were used for the studies. Optimum conditions were found out to get maximum yield. It was in the range of 5-12%. Samples prepared were white and crystalline in appearance. Process optimization studies were carried out with rohu skin for the production of gelatin using a fractional factorial design.

Food grade gelatin from the skin of freshwater fish

The response of yield, viscosity and bloom strength of gelatin to different process variations were studied. Bloom strength was 110g/mm and viscosity was 29.25cp.The fractional analysis using Minilab software for the production of gelatin from rohu showed that alkali concentration, skin water ratio, extraction time, and pre treatment time had effect on yield, bloom strength and viscosity of the final product. The bloom strength was low when compared to gelatin prepared from animal source but was superior to that from cold water species. It was low in RYBN on values indicating the clarity of gel.

Indigenous thermoform containers for packing value added fish products

Indigenously developed high impact polypropylene thermoformed trays were found suitable for packing frozen fish products. Cutlets prepared using Croaker (*Otolithus* sp.) minced meat, was frozen using air blast freezer at -40°C, and packed in indigenous high impact Polypropylene and imported

high density polythene trays and kept in frozen storage maintained at -20±2°C. After storage for eight months the samples packed in indigenous PP containers indicated slight loss of spicy flavour compared to those packed in imported HDPE trays. However no difference was noticed in biochemical characteristics which were more or less same for both the samples.

Trials were conducted to process ready to eat fried seer fish steaks in polypropylene containers. Fried fish was packed in PP trays and was vacuum sealed inside a pouch of PEST/Aluminium oxide/cast PP. The products were subjected to thermal processing using over pressure autoclave to a Fo value of 8. The products remained in good condition for a period of three months at ambient storage.

The process parameters for ready to eat meals consisting of sardine curry and single par boiled rice in semi-rigid containers made of high impact Poly propylene trays were standardized. The sardine curry was packed in trays of 220 ml capacity and single par boiled rice in containers of 350 ml capacity. Both were vacuum sealed separately and packed in three layered see-through laminate pouch. The product was then thermal processed in an over pressure autoclave to a Fo value of 10. The samples remained in good condition with respect to biochemical and sensory characteristics even after a period of five months.

Rice and Sardine curry in thermoformed trays

Smoked and thermal processed tuna and other fish products in opaque and see-through pouches

Suitability of indigenously developed see-through retortable pouches for processing smoked tuna was undertaken. Pouches made of three layer laminates consisting of polyester, nylon, cast PP coated with Silicon dioxide were found suitable for thermal processing. Tuna steaks were smoked using coconut wood at 70°C and were thermal processed in see-through pouches in oil, brine and as dry pack to Fo of 10.

Ready to serve fish products from fresh water Mahseer (*Tor khudree*) in Mughlai and Punjabi style had a shelf life of more than one year at room temperature.

Shrink and cling film packaging for chilled and frozen fish products

Studies on shrink packing of white pomfret in four different forms were undertaken. Sample I was control fish air packed without shrink film (LDPE), Sample II was shrink packed whole, Sample III was control ordinary air packed after gutting and Sample IV was dressed fish shrink packed using LDPE shrink film at 150°C. All the samples were quick frozen at -40°C for about four hours and kept in frozen storage at -20°C. Slight yellow discoloration was noticed in Sample I and Sample II, whereas no discoloration was observed in Sample III an IV after nine months storage at -20°C. All the shrink packed samples scored higher organoleptic score compared to air packed sample without shrink film.

Chill storage studies of shrink wrapped pearl spot in gutted and ungutted forms were undertaken. Sample I was without packing and gutting, Sample II was shrink wrapped without gutting, Sample III was gutted and without packing and Sample IV was gutted and packed. The samples were packed with crushed ice and kept in insulated containers in the chilled room at 3°C. Ice storage life for pearl spot control I and III was 15 days whereas for shrink wrapped samples both gutted and ungutted was 19 days.

Active food packaging

Trials were undertaken to find out the effectiveness of Carbon dioxide emitters (Sodium bicarbonate + Citric acid; Citric acid + Sodium bicarbonate + Iron powder) and Oxygen scavengers to enhance the shelf life of fresh fish. Fresh seer fish steaks were packed in high barrier EVOH and PEST/LDPE laminates and were stored in chilled condition. The seer fish steaks were acceptable upto 22, 20 and 10 days in Citric acid + Sodium bicarbonate + Iron, Citric acid + Sodium bicarbonate and control air packs, respectively in EVOH film pouches. Whereas, it was 18, 16 and eight days in laminated pouches. Thus, packing in Citric acid + Sodium bicarbonate + Iron in EVOH pouches enhanced the shelf life of seer fish steaks.

Shelf life evaluation studies of seer fish steaks were conducted using two different CO_2 emitters (combination of Sodium bicarbonate + Citric acid) and Sodium bicarbonate + Citric acid + Iron powder) in two different packaging materials (EVOH and 12 micron polyester laminated with 75 micron polypropylene) in chilled condition upto 24 days. Quality of seer fish were analysed using K-value, Biogenic amines, TVBN, TMA, TBA, PV, Total mesophilic and total psychrophilic counts and sensory analysis. The combination of Sodium bicarbonate + Citric acid + Iron powder in EVOH packing material gave better shelf life compared to others.

Active packaging of fresh fish in pouch

Standardization of regional fish curry recipes

Different regional fish curry recipes were standardized and the acceptance study of the fish products processed in indigenous polymer coated Tin free steel cans was carried out as detailed below:

- At Fisheries College, Berhampur, Orissa, three traditional Oriya fish curry recipes namely - Kalia, Jhol and Besara were standardized.
- At West Bengal Fisheries College, recipes for three regional fish curries namely - Hilsa mustard curry (Sorse Bata Hilisa), Fish masala with catla, Fish Bhappa (Catla) were standardized.
- At College of Fisheries, Ratnagiri, two traditional Maharashtrian fish curry recipes

Bhappa curry from West Bengal

Goan mackerel curry

Gujarati seerfish curry

from mackerel and clam were standardized.

- At CIFT Research Center, Veraval, recipes for four regional fish curries of coastal Gujarat from shrimp, Bombay duck and seer fish were standardized.

Development of extruded products

Preliminary works on production of extruded fish products were carried out using single screw extruder. Process parameters for extrusion were standardized. This includes; Fish to flour ratio, Moisture content of the feed, Feeding rate, Temperature for extrusion and different dies for extrusion.

The physical properties of the products made on the single screw extruder were analysed. The parameters analysed were Water Absorption Index, Percentage Linear Expansion, Shearing Strength, Bulk Density, Colour and Moisture.

Quality Assurance and Management Division

Research projects handled

- Studies on the level of sanitation and hygiene in fishing boats, fish landing centers, transport systems and domestic markets for hazard control
- Chemical residue management in farmed and wild fish and shellfish of India

Chief findings

- Hygiene and sanitation survey in selected markets of Kerala, Tamil Nadu and Southern Karnataka showed that the microbiological quality of fish and shellfish sold in these markets is poor. Total Plate Count of *E. coli* and *Staphylococcus aureus* were in levels much higher than the prescribed tolerance limits.
- Contamination in market samples were found to be originating from the water and ice used in the market.
- The fish and fishery products meant for export was found to be very good in quality parameters. The sanitary and hygienic conditions in peeling sheds and processing units were found to be satisfactory.
- Isolated instances of peeling operations on floor and in open air was also noticed in some landing centers.
- Evaluation of chemical parameters like amines, heavy metals, pesticide residues, antibiotic residues and additives like sulphite were found to be much below tolerance levels. Antibiotic residues were totally absent in all samples collected from markets.
- Some samples of fish (10%) were found to contain high levels of phosphates.
- Hygiene and sanitary conditions onboard fishing vessels at landing centres continued to be unsatisfactory. Based on the survey, a design for landing centres and auction centres was prepared.
- The South West Coast of India was found to be free from the biotoxin PSP and DSP.
- A rapid method for detection of phosphate and sulphite were further standardized for commercial adoption.
- A more sensitive method for detection of biogenic amines was standardized using the HPLC and Evaporative Light Scattering Detector (ELSD).
- A herbal organic preservative for prevention of blackspot in shell-on prawns was standardized.
- A new chemical method for improving the colour and appearance of fillets was developed.
- Heavy metal residues of Cadmium, Chromium, Mercury, Nickel and Copper in fish and fishery products were found to be much below the tolerance levels.
- The Lead content in some samples of fish and shellfish was higher than the tolerance limits.
- Most of the chemical parameters tested for farm water were also within the permissible limits.
- Common seafood borne pathogens *Vibrio cholerae*, *Salmonella* and *Listeria monocytogenes* were absent in the fish and fishery products from processing plants as well as collected from different markets in Kerala and Tamil Nadu.

Report of work done

Studies on the level of sanitation

Studies on fish markets in Kerala, Tamil Nadu and

Southern Karnataka were undertaken. Samples from 12 different district headquarters were collected and analysed for organoleptic, chemical and microbiological parameters. Around 120 samples were analysed and the results revealed that the organoleptic and chemical parameters were satisfactory whereas the microbiological parameters particularly the indicator organisms showed an unusually high level indicating contamination and public health problems. The results of certain chemical parameters and microbiological

Fish chunks displayed without any care

Table 1. Distribution of heavy metals in fishes from retail markets (2004-2005)

Fishes (No. of samples in parenthesis)	Metal levels observed (Range, in ppm)							
	Lead	Mercury	Cadmium	Silver	Nickel	Zinc	Manganese	Copper
Marine fishes (102)	0.08 – 0.9 ppm*	Not detected	0.06 – 0.24 ppm*	Not detected	0.36 – 1.26 ppm*	0.08 – 0.2 ppm*	0.04-0.36 ppm*	0.11 – 0.43 ppm*
Brackish water fishes (30)	0.08 – 0.5 ppm*	Not detected	0.07-0.1 ppm*	Not detected	0.01-0.06 ppm*	0.2-0.4 ppm*	0.06-0.22 ppm*	0.12-0.36
Inland fishes (15)	0.18-2.0 ppm	Not detected	Not detected	Not detected	0.05 ppm	Not detected	Not detected	0.06 – 0.32 ppm

* No sample exceeds limit

Table 2a. General microbial load in fishes from retail markets (2004-2005)

Fishes (No. of samples in parenthesis)	TPC per gram	*E. coli* per gram	*Staphylococcus aureus* per gram
Marine fishes(102)	$7x10^2$ to $8x10^8$	0 to $12x10^3$	0 to $4x10^3$
Brackish water fishes (30)	$9.4 x10^4$ to $1.4x10^7$	Nil	Nil
Inland fishes (15)	$1x10^4$ to $2x10^5$	Nil	$0-2x10^3$

Table 2b. Occurrence of pathogens in fishes from retail markets (2004-2005)

Fishes (No. of samples in parenthesis)	*Vibrio cholerae* in 25g	*Vibrio parahae-molyticus* in 25g	*Salmonella* in 25g	*Listeria* in 25g
Marine fishes (102)	1 (non O1)	8	Nil	Nil
Brackish water fishes (30)	Nil	Nil	Nil	Nil
Inland fishes (15)	Nil	Nil	Nil	Nil

parameters are given in Table 1 and 2 respectively.

Occurrence of some biotoxins in South West Coast of India

Seventy five samples of green mussel were collected from different centres of Kerala and Karnataka and tested for the presence of Paralytic Shellfish Poison (PSP) and Dihoeratic Shellfish Poison (DSP). Results revealed that the entire stretch of South West Coast of India is free from PSP and DSP.

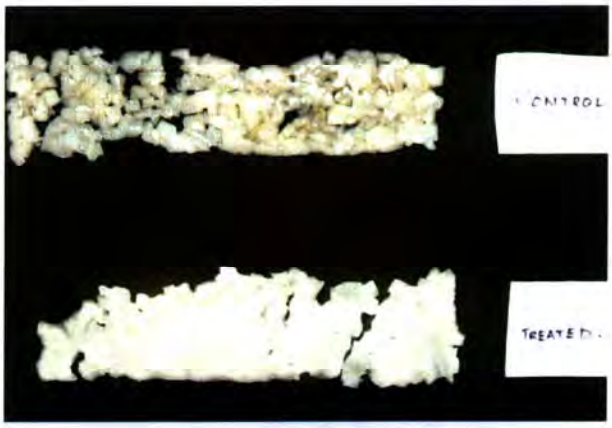
Estimation of heavy metal residues

The levels of Cadmium, Lead, Chromium, Nickel, Copper and Zinc were estimated in farmed fin fish and shellfish collected from major farming areas like Nellore, Bhimavaram, Malampuzha etc. Results showed that all these metal residues except Lead were much below the prescribed tolerance limits. In case of Lead, the level varied between 1.22 ppm – 7.36 ppm. Among different species of shrimp monitored, *Macrobrachium rosenbergii* showed higher levels of metal residues than marine species of prawns. In case of fin fish higher levels of Lead were detected in the species *Saurida tumbil* and rays. In shrimps from Kerala region, the Lead content varied from 1.22 – 7.36 ppm. The antibiotic residues Chloramphenicol, Sulphonamides, Erythromycin, Tetracycline, Streptomycin and ß-lactums were also monitored in the farmed fish samples. It was seen that only low levels of Chloramphenicol (0.091ppb - 0.246ppb), Sulphonamides (around 19.17ppb - 97.82ppb) and Erythromycin (around 29.18ppb – 75.09ppb) were detected in these samples. The other antibiotics namely Tetracycline, Streptomycin and ß-lactams could not be detected in any of the farmed shrimp.

Studies on organic preservatives

Some herbal extracts were studied for their property to prevent melanosis in shrimps. Detailed evaluation using *P. indicus* with herbal extract (0.1%), Sodium meta bisulphite (0.2%) and without treatment revealed that the herbal extract was effective in controlling blackspot formation on an equal footing as that of Sodium bisulphite.

Colour improvement studies of fish fillets



Colour improvement studies of Cuttle fish fillets

Studies for improving the colour of fish and cephalopod fillets

A food grade chemical pigment used for soaking as well as inclusion in the glaze water was found to be effective in providing attractive white colour to fish and cephalopod fillets. Further studies and standardization of the procedure is in progress.

Preparation of maricream from cephalopod proteins

The attractive white protein rich meat of cephalopods was studied for suitability to prepare a ready to eat product similar to icecream. Homogenised, demineralised and deodourised cephalopod meat was cooked and ground into uniform mass. This product is aceptically compounded with milk fat, sugar and flavouring agents followed by pasteurization to give a ready to eat product. The mass on cooling to 0°C followed by quick freezing gave a product similar to icecream. Organoleptic evaluation of the product revealed that squid and cuttlefish meat can be used for preparing 'maricream' to get a product resembling icecream with very good consumer acceptance. Further studies and standardization of the product is under way.

Quality improvement of marinades

Some of the low cost fishes like shark, Ranifish, mackerel etc. were studied for their suitability to prepare high quality marinades. The procedure consisted of slicing the fish, blanching at 80°C for 1½ minutes and keeping in marinading liquor consisting of 1% Acetic acid and 6% salt. The marinade prepared in this way were evaluated for shelf life and consumer acceptance. The results revealed that the product had a shelf life of 12 weeks at ambient temperature with good acceptance.

Microbiological quality of fish and fishery products for export

An estimated 250 samples of frozen, cooked fish and fishery products were tested for microbiological parameters like TPC, *E. coli*, *Staphylococcus aureus*, *Vibrio cholerae*, *Salmonella* and *Listeria monocytogenes*. 99% of the samples were free from incidence of pathogens and occurrence of indicator organisms above tolerance levels. About 1% of the samples showed the presence of *Salmonella*.

Fifty eight samples of different fish and fishery products and food additives were tested for the presence of bacterial inhibitors using Four Plate Method. 11% of the samples were found to be positive for bacterial inhibitors.

Twenty nine samples of pasteurized crab meat meant for export were also evaluated for the presence of Staphylococcal enterotoxins. All the samples were free from Staphylococcal enterotoxins A, B, C and D.

During the reported period some studies were also conducted to monitor the presence of the emerging pathogen *Legionella* in food vending centres. Swab samples collected from taps and shower heads in certain hotels revealed the presence of *Legionella*. Based on the observation, the hotels were advised for suitable treatment pasteurization like soaking with disinfectants for elimination of the pathogen.

Evaluation of fish dried in energy efficient renewable energy fish dryer

Sub adult sardine (10 cm) were used in the study for evaluating the performance of energy efficient renewable energy fish dryer.

The lot of fishes were divided into two and washed and dried with salt (1:4) and without salt in the renewable energy fish dryer at 50°C. The fishes were dried for 8-10 hrs., vacuum packed and subjected to storage studies. The samples were evaluated for chemical and organoleptic parameters. Both the samples remained in good condition in terms of chemical and organoleptic parameters even after a period of 80 days. The samples were better compared to conventional solar dried samples of sardine.

Microbiology, Fermentation and Biotechnology Division

Research projects handled

- Microbial ecology, seafood safety and molecular methods for detection of pathogens and toxins
- Pathogenic and commensal microflora of the capture and culture fisheries in relation to food and environmental safety
- Genomic investigations on aquatic and fish microorganisms and development of molecular diagnostic methods for pathogens
- National risk assessment programme for fish and fish products for domestic and international markets
- Identification and characterization of bacterial genes imparting osmotolerance and their validation in plants
- Development of gene constructs for producing WSSV resistant Penaeid shrimp and its validation in shrimp cell culture system

Chief findings

- *E. coli* O157:H7 isolated from shrimp *P. indicus* from retail market in Cochin is reported for the first time from seafood in India.
- *E. coli* serotypes isolated from aquaculture system were O157 and O6 (from shrimp), O8 (from sediment) and O142 and O112ac (from feed).
- When exposed to direct sun light, *E. coli* survived for 60 to 105 min in water. Significant reduction (5 log) was observed in 15 to 30 min in seawater.
- The tdh gene for virulence in *V. paraheamolyticus* was not detected in shrimp, post larvae and fish samples analysed, thereby indicating that they have no pathogenic potential.
- Four *Actinomycete* isolates from Puffer fish exhibited antibacterial activity against *E. coli* and *S. aureus*.
- *Bacillus* spp. isolated from Puffer fish produced thermo-tolerant amylase and proteolytic enzymes at 55°C. The optimum temperature and pH for protease enzyme production was at 30°C and pH 6.0.
- *C. botulinum* type B was detected in pasteurized crab sample.
- *Yersinia enterocolitica* detected in squid samples from retail market in Cochin is reported for the first time from seafoods in Kerala.
- Fish and shellfish from retail market in Cochin were found to be contaminated with other *Yersinia* spp., such as *Y. intermedia*, *Y. fredriksenii* and *Y. kristensenii*.
- The envelop proteins of White Spot Syndrome Virus VP19, VP28, VP68, VP281, VP466 and the capsid protein VP26 were PCR characterized.
- Eight rare *Salmonella* serotypes namely *Salmonella* Erumu, *Salmonella* Othmarschen, *Salmonella* Rissen, *Salmonella* Riggil, *Salmonella* Takoradi, *Salmonella* Washington, *Salmonella* Worthington and *Salmonella* VI were identified from seafood samples.
- Active lactose utilizing *Salmonella salmae* and *S. indica* were isolated from seafood.
- PFGE pattern for *Salmonella* from seafood has been developed.
- A matrix effect was observed for cephalopod (squid, cuttlefish and octopus) during PCR assay and the ink was found to interfere with the detection of *Salmonella* by direct PCR assay.
- The microflora of cephalopods revealed a preponderance of Gram negative bacteria

comprising of *Vibrio, Pseudomonas, Flavobacterium, Acinetobacter, Shewanella* and *Moraxella*. Other genera like Enterobacteriaceae, Staphylococccus, *Bacillus, Arthrobacter, Nocardia, Micrococcus* and *Streptococcus* were found in lower frequencies.

- The aerobic mesophilic bacterial count on gutted Rainbow trout (*Oncorynchus* spp.) collectd from Munnar was decreased on icing ($<10^5$cfu/g) and one log reduction was noticed. Significant reduction (>90%) was also noticed in total Coliform counts after eight days of storage.
- In hot smoked trout stored under vacuum, the aerobic mesophilic bacterial count exceeded 10^8 cfu/g after three months storage whereas in cold smoked trout stored under vacuum, the count exceeded 10^8 cfu/g after two months storage. The microflora was dominated by H_2S producers and LAB.
- In smoked common carp samples with and without adding spices and stored under air and vacuum at 0-2°C, the aerobic mesophilic count exceeded 10^7 cfu/g after one month in all the samples irrespective of the storage atmosphere. Faecal Streptococci were found in significant numbers. Fungal count was high in all the samples and samples were spoiled.
- The osmotolerant genes for ectoine biosynthesis in saline soil bacteria *Bacillus* spp. and for Glycine betaine biosynthesis in marine cyanobacteria were characterized.
- Gene sequence of *Saccharomyces cerevisiae* HAL1 mRNA (an antiporter gene responsible for osmotolerance) was submitted to National Center for Biotechnology Information (NCBI), USA.

Report of work done

Antibiotic residues in farmed shrimp and processed fishery products

Farmed shrimp, shrimp feed and farm water samples were tested for antibiotic residues. Chloramphenicol was tested by ELISA method. Antibiotic residues were not detected in any of the 12 samples.

Isolation of aquatic and fish microflora capable of producing bioactive/anti-bacterial substances

Ten *Actinomycete* isolates from Puffer fish were screened for production of bioactive/anti-bacterial substances. Four of the isolates exhibited anti-bacterial activity against *E. coli* and *S. aureus*.

Bacteria isolated from Puffer fish were screened for growth and enzyme production at >40°C. Twenty eight bacterial cultures were tested. Eight isolates grew at >40°C. Eight isolates from Puffer fish exhibiting growth at 55°C were identified as *Bacillus* spp. All the isolates produced amylase and proteolytic enzymes at 55°C.

Out of 12 isolates from squid and Octopus, four exhibited proteolytic activity. They were identified as *Bacillus* spp., *Vibrio, Pseudomonas* and *Flavobacterium*. All the isolates produced proteolytic enzymes at temperatures between seven and 55°C and pHs 6.0, 7.0 and 8.0 tested. In *Bacillus* spp. and *Vibrio* tested, the optimum conditions for protease enzyme production was 30°C and pH 6.0. In *Pseudomonas*, highest protease enzyme production was observed at 30°C. However, significant difference was not observed in enzyme production at the three pHs tested. In *Flavobacterium*, effect of temperature on enzyme production was not observed. However, pH influenced significantly. High enzyme production was observed only at alkaline pH (pH 7.0 and 8.0).

Molecular detection of enteropathogenic *Escherichia coli*

Thirty one fish and shrimp samples collected from four different retail outlets in Cochin were screened for *E. coli* O157 EHEC by biochemical as well as direct PCR method. All the samples were found negative for *E. coli* O157(EHEC). But one shrimp sample (*P. indicus*) was positive for *E. coli* O157. Seven isolates were recovered and they were further confirmed by biochemical tests. They were positive for haemolysis, MUG (Methyl Umbilliferyl beta D Glucuronide) and latex agglutination test for *E. coli* O157. This is the

first report of detection and isolation of typical *E. coli* O157 (EHEC) from seafood in India.

All the EHEC virulence genes stx, eae and hly were detected in the seven *E. coli* O157 isolates from *P. indicus*.

Serotyping and biotyping of enteropathogenic *E. coli*

E. coli isolates from aquaculture system which were positive for labile or st toxin were serotyped. The *E. coli* isolates from shrimp belonged to serotype O157 and O6. Sediment carried *E. coli* serotype O8. *E. coli* from feeder canal water were not typable. Feed also carried *E. coli* which was serotyped as O142 and O112ac.

A total of 152 isolates recovered from farmed fish, shellfish, pond water, feeder canal water, sediment and feed of freshwater and brackish water culture systems were biotyped based on utilization of 14 carbohydrates.

Different serotpes of *E. coli* and their biotype

Isolate	Source	Serotype	Biotype
EHEC (8 nos)	Shrimp	O1 57	7311
CTE3 1006	Veterinary	029	7333
CTE4 1006	Veterinary	ONT	7733
ASHE3 20707	Shrimp	06	7333
ASWE3 2107	FCW	ONT	7333
Rao II 2	Fish	ONT	1771
ASWE3 0102	FCW	ONT	7373
AFeE1 1502	Feed	0142	7333
H5	Clincal	08	5112
AME1 1511	Sediment	08	3333
AFeE2 1502	Feed	0112ac	7313
H4	Clinical	0153	5112
ATCC		06	3313
EPEC	Clinical		3310
ETEC	Clinical		1713
EAEC	Clinical		5113
EHEC	Clinical		7710

Inactivation of enteropathogenic *E. coli*

Inactivation of enteropathogenic *E. coli* strains under different conditions of exposure to sun light were studied. Sun light inactivation rates increased with increasing salinity for all the *E. coli* strains. Survival of *E. coli* when exposed to direct sun light in water for 60 to 105 min showed significant reduction (upto 5 log). In freshwater, inactivation rates were markedly lower than that in seawater. *E. coli* counts after exposure to sun light on non selective media were significantly higher (0.5 to 1 log) than selective media (EMB Agar) indicating the presence of stressed cells.

Dark inactivation of *E. coli* was slower in both seawater and freshwater. A 1 log reduction was noticed in 6 hrs, 2 log reduction in 70 hrs (3d) and 3 log reduction in 94 hrs (4d). Survival was noticed even after 20 days, but it was strain-depended.

Molecular detection of *Vibrio cholerae* from seafoods

Method for detection of toxigenic *V. cholerae* by APW enrichment followed by amplification of the gene for 777 bp ctx AB operon, was standardized from pure *V. cholerae* cells. Three clam samples were screened for toxigenic *V. cholerae* by biochemical as well as PCR amplification (779 bp ctx AB operon). *V. cholerae* could not be detected in any of the samples.

Sensitivity of PCR for detection of *V. cholerae* from seafoods

In pure culture, PCR amplification (779 bp ctx AB operon) could detect cells up to 10^3 cells/ml. In presence of the normal background flora of shrimp, it was possible to detect *V. cholerae* at 10^5 cells. A protocol is being refined for sensitivity by changing the PCR conditions and the effect of food matrix.

Molecular characterization of *V. parahaemolyticus* isolated from aquatic environments

A PCR method was standardized for detecting the virulence factors of *V. paraheamolyticus*. *V. paraheamolyticus* isolates from shrimp, post larvae and fish were screened for tdh, trh, tlh and tox-R genes. The isolates carried trh, tlh and tox-R gnes but tdh was not detected in any of the isolates.

Distribution of *Clostridium botulinum* in shellfish

A total of ten samples comprising of three clam, six crab and one mud sample were tested for non-

proteolytic *C. botulinum* by mouse bio-assay. *C. botulinum* type B was detected in one crab sample.

Molecular detection of *C. botulinum*

DNA isolation method was standardized. 1.5ml of 18-24h cultures of non-proteolytic *C. botulinum* type E culture were centrifuged at 100,000 rpm for 4 min at 4°C and the pellet was suspended in 1 ml distilled water and boiled for 10 min, cooled and centrifuged. One ml of the supernatant was used for PCR amplification. DNA could not be recovered. Hence attempts were made to isolate *C. botulinum* DNA by boiling method after pre-treatment with lysozyme. A better yield of DNA was obtained using this method and the recovery of DNA was easier. A 445 bp DNA fragment specific for type E was amplified from *C. botulinum* type E.

Incidence of *Yersinia enterocolitica* in seafoods

Fifteen samples of fish and shellfish were examined for the presence of *Yersinia* spp. by cold enrichment method and plating on to CIN agar. *Y. enterocolitica* was detected in two samples. Fifty presumptive Yersinia isolates were characterized and identified. *Y. intermedia* (10 isolates), *Y. fredriksenii* (2), *Y. kristensenii* (1) and *Y. enterocolitica* (4) were isolated.

Yersinia enterocolitica colonies on CIN agar

Molecular characterization of envelop proteins of White Spot Syndrome Virus

The envelop proteins of White Spot Syndrome

Stx gene eae gene hly gene

Virulent genes in the *E. coli* 0157 isolates from shrimp *Penaeus indicus*

Virus VP19, VP28, VP68, VP281, VP466 and the capsid protein VP26 were PCR characterized. The size of the VP28, VP26, VP68, VP281, VP19 and VP466 genes were 615bp, 615bp, 207bp, 846bp, 366bp and 1401bp respectively.

Osmotolerant genes in microbes from terrestrial and marine ecosystem

Microbes from various ecosystems were screened for osmotolerance and osmotolerant genes for ectoine biosynthesis, Glycine betaine biosynthesis, and Na^+/H^+ antiporters. The osmotolerant genes for ectoine biosynthesis in *Bacillus* spp. isolated from saline soil was characterized. The size of ectA, ectB and ectC genes in *B. halodurans* were 570bp, 1284bp and 390bp respectively.

Prevalence of *Salmonella* in crustaceans and bivalves

Fish (25 samples) and shellfish comprising of clam (24 samples), crab (5 samples), shrimp (10 samples) and shrimp larvae (18 samples), cephalopods and squid (28 samples), cuttlefish (4 samples), octopus (5 samples) from Cochin harbour were analyzed for presence of *Salmonella* by USFDA culture method. Results showed that all trout and Puffer fish samples, shrimp larvae and cuttlefish samples were negative for *Salmonella*. *Salmonella* was detected in clam (25%), squid (10%), octopus(40%), shrimp (30%) and crab (20%). Cephalopod samples were positive for *Salmonella* by culture and ELISA method but was

found to be negative by PCR assay. Hence an assay was carried out to confirm inhibition with different concentrations of cephalopod ink. A PCR assay performed with different levels of cephalopod ink in *Salmonella* PCR reaction mixture along with a suitable control showed that cephalopod ink inhibited the *Salmonella* PCR reaction.

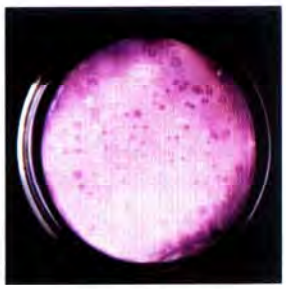
Salmonella serotypes in seafoods

A total of 25 serotypes namely; *Salmonella* Brancaster, *Salmonella* Ohio, *Salmonella* Braenderup, *Salmonella* Derby, *Salmonella* Lindenburg, *Salmonella* Typhimurium, *Salmonella* Newport, *Salmonella* Mbandaka, *Salmonella* Oslo, *Salmonella* Bareilly, *Salmonella* Nchanga, *Salmonella* Emek, *Salmonella* Erumu, *Salmonella* Othmarschen, *Salmonella* Rissen, *Salmonella* Riggil, *Salmonella* Takoradi, *Salmonella* Washington, *Salmonella* Weltevreden, *Salmonella* Worthington, *Salmonella* II and *Salmonella* VI were identified from seafood samples.

Non-radiolabeled probe based detection method for *Salmonella* serovars in seafood

Digoxygenin based non-radiolabeled probe assay has been developed to detect *Salmonella* directly from plates in a complex microflora. Probe was developed for *Salmonella* specific 284bp region of invA gene by random priming using hexamer and Klenow Polymerase. *Salmonella* plate was prepared and colonies were transferred to positively charged nylon membrane (Millipore) and membranes containing the replica of colonies were hybridized at 48°C overnight in a hybridization chamber. Hybridized colonies were detected with colorimetric development system (Roche). All *Salmonella* colonies were detected, whereas, non-*Salmonella* were not detected by this technique.

Colonies on *Salmonella* Agar plate



Replica showing *Salmonella* colonies

PFGE technique for *Salmonella*

Pulsed Field Gel Electrophoresis (PFGE) technique, which has been considered as the most suitable technique for molecular fingerprinting of pathogenic bacteria from different origin for epidemiological studies, has been optimized and standardized for *Salmonella* serotypes from seafood. The entire PFGE process required three continuous working days to complete an assay. Results were observed at different conditions. PFGE assay for *Salmonella* has been optimized at both stepping and interpolation mode.

Detection of lactose utilizing *Salmonella* from seafood

A total 4% of *Salmonella* isolates from seafood were found to be utilizing lactose actively. As per biochemical pattern, these isolates were *Salmonella salmae* and *S. indica.*

Listeria spp. and *Bacillus cereus* in fish in retail domestic trade

Three clam and three squid samples were tested for the presence of *Listeria* spp. and *B. cereus. L. monocytogenes* and enterotoxigenic *B. cereus* were not detected in any of the six samples.

Microbiology of bivalves

Three clam samples, mud and water samples collected from clam harvesting areas in Vembanad lake (Kerala) showed aerobic mesophilic counts in the range of 10^5 - 10^6 cfu/g. A small fraction (<1%) of the microflora of clam was characterised as psychrotrophic organisms. *Pseudomonas* and *Aeromonas* counts were 1.0 x 10^2 and 1.0 x 10^3 cfu/g respectively. Coagulase positive Staphylococci were not detected. *C. perfringens*, faecal Streptococci and *E. coli* were detected.

Microbiology of cephalopods

Two samples each squid (*Loligo duvaucelli*), cuttle

fish (*Sepia* spp.) and octopus (*Octopus* spp.) collected from retail outlets in and around Cochin showed aerobic mesophilic counts in the range of 10^5 -10^6 cfu/g. A small fraction (<1%) of the microflora of squid, cuttle fish and octopus was characterised as psychrotrophic organisms. *Pseudomonas* and *Brochothrix* counts were $<10^2$ cfu/g. Coagulase positive Staphylococci was not detected. Faecal Streptococci, faecal Coliforms and *E. coli* were detected.

Qualitative analysis of the microflora on the surface of cephalopods revealed a preponderance of Gram negative bacteria comprising of *Vibrio, Pseudomonas, Flavobacterium, Acinetobacter, Shewanella* and *Moraxella*. Other genera like Enterobacteriaceae, *Staphylococccus*, *Bacillus, Arthrobacter, Nocardia, Micrococcus* and *Streptococcus* were found in lower frequencies.

Microbiology of freshwater fish

Microflora associated with fresh Rainbow trout (*Oncorynchus* spp.), catfish *(Pangasius sutchi*), Mahseer (*Tor khudree*) and common carp (*Cyprinus carpio*) were studied. The aerobic mesophilic bacterial counts on the surface were in the range of $10^5 - 10^6$cfu/g. Significantly high bacterial load was noticed in the intestine. TPC was $>10^7$ cfu/g. Coliform and faecal Streptococcal counts in the intestine were 3 log higher than that on the surface. The flora was dominated by *Aeromonas* and *Pseudomonas*. The counts of Lactic acid bacteria and *Brochothrix thermosphacta* ranged from 10^1 - 10^3 cfu/g.

Total Coliforms and faecal Streptococci counts were in the range of 10^2-10^3 cfu/g. *S. aureus* was not detected in trout and catfish whereas in common carp, the count was < 60 cfu/g. Faecal Coliform and *E. coli* numbers were <140 MPN/g in Rainbow trout whereas in catfish, their counts were < 20 cfu/g.

Microbiological quality of ice stored and frozen freshwater fish

In Rainbow trout (*Oncorynchus* spp.), the aerobic mesophilic counts was significantly reduced from 10^5 cfu/g on icing. Significant reduction (>90%) was noticed in total Coliform counts (10^3 cfu/g) after eight days of storage. The aerobic mesophilic count in ice stored Mahseer (*T. khudree*) exceeded 10^7 cfu/g after three weeks storge in ice and the microflora was dominated by *Pseudomonas*.

Microbial changes during freezing of Rainbow trout was studied. The aerobic mesophilic bacterial count on the surface was 10^3cfu/g after three months storage. Total Coliform and faecal Streptococcal counts were significantly reduced and their counts were < 20 cfu/g.

Microbiological profile of smoked freshwater fish

In cold and hot smoked trout, the aerobic mesophilic bacterial counts exceeded 10^8 cfu/g after two months storage under air. In hot smoked samples stored under vacuum, the count reached the same level after three months storage. In cold smoked trout stored under vacuum, the count exceeded 10^8 cfu/g after two months storage and the flora was dominated by H_2S producers and LAB. The counts of Lactic acid bacteria and *Brochothrix thermosphacta* increased and they were in the range of 10^3-10^5cfu/g. Total Coliforms and faecal Streptococci were found in significant numbers through out the storage.

In smoked Mahseer samples stored under air and vacuum at 0-2°C, significant reductions were noticed in psychrotrophic bacteria, total Coliforms, faecal Coliforms and faecal Streptococci immediately after smoking. After one month storage, the aerobic mesophilic counts reached 10^8 cfu/g. Significant increase was noticed in total Coliform and faecal Streptococci counts. The fungal counts were $>10^4$ cfu/g in samples stored under air whereas samples stored under vacuum had lower counts (10^3 cfu/g) and samples were spoiled due to fungal growth.

The microflora associated with smoked common carp (*Cyprinus carpio*) with and without adding spices and stored under air and vacuum at 0-2°C were analysed at intervals for microbiological changes. The aerobic mesophilic count exceeded 10^7 cfu/g after one month storage in all the samples irrespective of the storage atmosphere. *B. thermos-phacta* were not detected in smoked samples. Faecal Streptococci were found in significant numbers. Fungal count was

high in all the samples and samples were spoiled.

National risk assessment programme for fish and fish products for domestic and international markets

The ICAR network project was completed in May, 2006 and final report was submitted to ICAR in December 2006.

The project involved participation of seven ICAR Fishery Institutes and College of Fisheries, Mangalore with CIFT as the Nodal Centre. Under the component of CIFT, microbiological and chemical hazards including antibiotic residues in fish and fishery products of domestic and international trade in Kerala,Vishakapatnam and Veraval were surveyed. Heavy metals Cd, Pb, As and Hg were detected in most of the fish, shellfish and cephalopod samples. The metals were present in all the samples irrespective of the habitat. In Kerala region, OCPs were detected in different samples tested namely fish, crustaceans, bivalves, cephalopods, dry fish and fishery products, but their distribution varied. Pesticide accumulation was most in fish, followed by bivalves, cephalopods and other crustaceans. Among fishery products, pesticides were noted in dry fish and shellfish only, maximum being in dry fish. Here also HCH formed significant part of total OCP.

The fish and fish products meant for export markets were found to be of good quality. On the other hand, microbial quality of fish and fishery products in domestic markets were very low and and upto 90% of the shrimp samples from all stations were not confirming to quality standards proposed by European Union (EU) or Indian Standards (IS). 50% of frozen fish collected from the retail cold storages were also found to be of poor quality. About the same level of dry fish also were inferior in quality.

None of farmed shrimp (*P. monodon*) collected from farms in central Kerala and in selected districts in Tamil Nadu showed presence of the antibiotic Chloramphenicol. The antibiotic resistance pattern of major pathogens were also studied side by side with residue analysis. There was no development of antibiotic resistance in *V. cholerae* strains, but *S. aureus*, *E. coli* and *Salmonella* strains showed resistance to antibiotics. Multiple antibiotic resistant strains were also noted.

Identification and characterization of bacterial genes imparting osmotolerance

Identification and characterization of the osmotolerant genes for ectoine biosynthesis viz. Acetyl transferase (ectA), Diaminobutyric acid transaminase (ectB) and Ectoine synthase (ectC) in alkalophilic bacteria *Bacillus halodurans* and *B. pasteurii* isolated from saline soil was carried out by PCR amplification. The size of ectA, ectB and ectC genes in *B. halodurans* were 570bp, 1284bp and 390bp respectively and that in *B. pasteurii* were 543bp, 1281bp and 405bp respectively. PCR products after gel electrophoresis were gel eluted, ligated to pDrive cloning vector and transformed to competant JM109 *E. coli* cells. The positive clones were confirmed, sequenced and were subjected to BLAST. The sequence were found to be highly homologous with the reported sequences of ectA, B, C genes of *B. halodurans* and ectC gene of *B. pasteurii* with 99% identity.

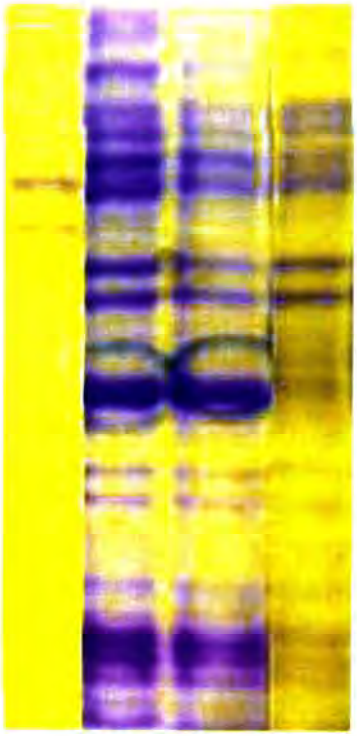
The osmotolerant genes for Glycine betaine biosynthesis viz., Glycine Sarcosine Methyl Transferase (GSMT) and Sarcosine Dimethylglycine Methyl Transferase (SDMT) in marine cyanobacteria *Synechococcus* spp. were characterized. PCR amplification have shown products of size 849bp and 843bp respectively. These PCR products were ligated to cloning vector pDrive and the positive clones obtained after transformation were selected. The presence of insert was confirmed by both PCR amplification and restriction digestion and their identities with the reported sequences were also confirmed.

Gene Sequence of *Saccharomyces cerevisiae* HAL1 mRNA (an antiporter gene responsible for osmotolerance) was submitted to National Center for Biotechnology Information (NCBI), USA with Gene Bank Accession Number: EF015596 Authors: Joseph, T.C., Anburajan, L., Bansal, K.C., Chinnusamy, V. and Thampuran, N.

Development of gene constructs for producing WSSV resistant Penaeid shrimp

White Spot Syndrome Virus (WSSV) envelop proteins from infected shrimps collected from a shrimp farm in Tripunithura, Ernakulam district, Kerala were characterized. The envelop proteins (VP19, VP28, VP68, VP281 and VP466), which are assumed to be critical for the entry of the virus to the host and its infectivity, were amplified. The size of these VP28, VP68, VP281, VP19 and VP466 genes were 615bp, 207bp, 846bp, 366bp and 1401bp respectively.

PCR products were gel eluted and ligated to cloning vector pDrive. Sequencing of the inserts was performed after confirming the presence of inserts by both PCR amplification and restriction digestion. The obtained sequence was subjected to BLAST program and was found to be highly homologous with the reported sequences with 99% identity. The expression of recombinant VP28 gene was done in expression vector pQE30. Directional cloning was carried out using DNA ligase at 4°C overnight and transformed in competent M15 *E. coli* cells. Expression analysis of VP28 gene was carried out in the transformed M15 *E. coli* after adding IPTG for induction. A protein of approximately 28 KDa was expressed in the induced cells.



Expression analysis of VP28 gene for envelop proteins in White Spot Syndrome Virus (WSSV) in the transformed M15 *E. coli*

Biochemistry & Nutrition Division

Research projects handled

- Isolation, identification and characterization of natural bioactive substances of therapeutical importance from Indian waters
- Extraction and properties of natural chemicals from fish and shellfish processing waste
- National risk assessment programme for fish and fish products for domestic and international markets
- Functional properties of proteins from marine, brackishwater, freshwater and deep-sea fish of India
- Resource assessment of deep-sea fishes along the continental slope of Indian EEZ

Chief findings

- Extracts of *Eichhornia crassipes* demonstrated excellent pharmacological activity. The extractions from the plant were found to have excellent anti-inflammatory and anti-ulcerogenic acitivity.
- The anti-inflammatory effect was found to be better than the reference drug (Ibuprofen) and the leaf extract showed slightly more efficacy than the root. The phytochemical screening of the extracts showed the occurrence of triterpenoids in both roots and leafs, and flavonoids in roots.
- Administration of Eichhornia extract significantly reduced the secretion of gastric juice compared to the ulcer induced rats indicating that oral pretreatment with Eichhornia significantly maintained the activity of gastric peptic activity at near normal level.
- Composition of fish waste - head and viscera - indicate high potential for fats and vitamins. The non-protein nitrogen composition of the waste also revealed the presence of biochemicals of biological significance.
- Taurine forms about 40% of the total non-protein Nitrogen from head and guts fish waste, which can be commercially exploited.
- Evaluation of physico-chemical and functional properties of fish proteins from different habitats exhibited variations.
- Evaluation of Barracuda (*Sphyraena jello*) protein indicated variation in the physico-chemical and functional properties as a function of size. The study confirmed that small sized fishes with average weight of 500 g can be considered as candidate species for the purpose of value addition especially for surimi related products.
- Hazard analysis on fish and fish products for domestic and international markets revealed that the OCP concentrations in the samples were well below the hazard levels and are safe for human consumption. But in dry fish samples the values were slightly higher than the limits due to the reduced moisture content.
- As far heavy metals are concerned, in fish products other than dry fish the levels were much below the prescribed MRL by FDA (2001) for fresh fish but slightly higher than the MRL by EC (2001) and FAO (1983).
- Method for the detection of Oxolinic acid using LC-MS-MS was standardized.

Report of work done

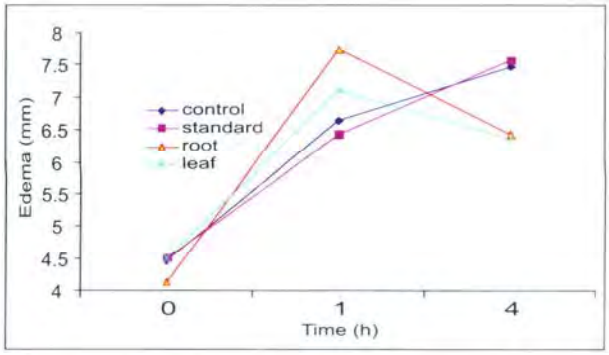
Natural bioactive substances of therapeutical importance

Eichhornia crassipes, a perenial weed seen abundantly in backwaters of Cochin was selected for screening to identify potential bioactivity. The extracts from the plant were found to have excellent

analgesic, antipyretic, hypoglyceimic and wound healing properties. The anti-inflammatory and anti-ulcerogenic acitivity of the plant extract were studied during the period under report.

Anti-inflamatory activity of the methanolic extract of root and leaf of *E. crassipes* was studied by inducing inflammation by injecting 0.1 ml of 3.5% formalin solution into the left hind paw of female albino rats. The results showed that intraperitoneal administration of animals with *E. crassipes* root and leaf extract (70 mg/kg body weight) inhibited formalin induced paw oedema and the activity extended for a period of 4 h.

The anti-inflammatory effect was found to be better than the reference drug (Ibuprofen) and the leaf extract showed slightly more efficacy than the root. The phytochemical screening of the extracts showed the occurrence of tri-terpenoids in both root and leaf, and flavonoids in root.

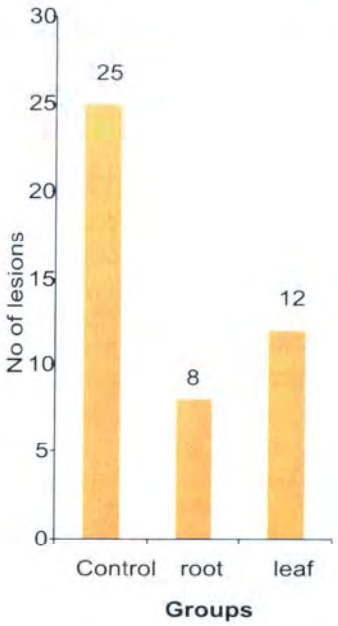


Anti-inflammatory effect of *Eichhornia crassipes* root and leaf

Hind paw of the experimental mice before formalin injection

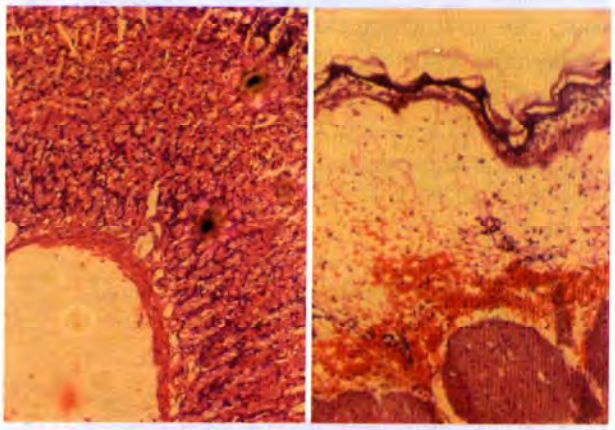
Hind paw of the experimental mice after formalin injection, exhibiting inflammation

The gastro protective activity of the methanolic fraction of *E. crassipes* roots and leaf on the HCl-ethanol induced ulcer model was investigated using albino rats. Oral administration of the HCl-ethanol solution to the control group clearly produced characteristic haemorrhagic lesions with large linear patches of mucosal necrosis. The methanolic fraction

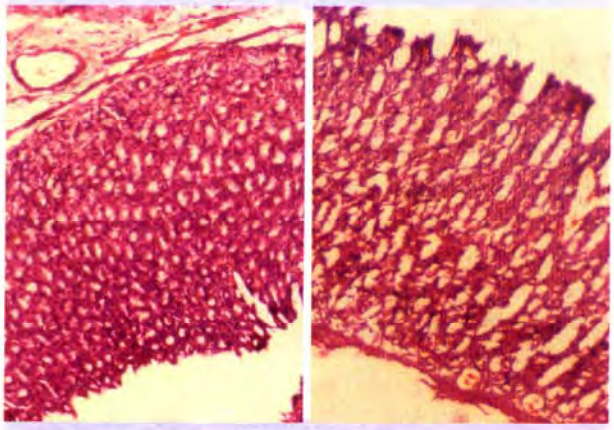


Anti-ulcerogenic effect of *Eichhornia crassipes* root and leaf

Histopathology of gastric mucosa



Control | Ulcer induced



Treated with root extract | Treated with leaf extract

of *E. crassipes* root and leaf (115 mg/kg) produced a significant anti-ulcerogenic effect as compared to the control. The extracts from root were found to have higher activity compared to that from leaf.

Administration of Eichhornia extract significantly reduced the secretion of gastric juice compared to the ulcer induced rats. Oral pretreatment with Eichhornia significantly maintained the activity of gastric peptic activity at near normal level.

Studies on isolation of terpenes from the Eichhornia extract

Methods are being perfected for the isolation of terpenoids, flavanoids and alkaloids from the Eichhornia extract so as to identify the active ingredient. A gel filtration method separated seven fractions and the presence of flavanoids, terpenoids and anthocyanidins was qualitatively confirmed in the eluents. Further works on these lines are in progress.

Evaluation of lipid fraction from fish waste

Lipids from mullet gut and head were extracted and the fatty acid composition was evaluated. Fish gut had a fat content of 25.85% and the total fatty acid was 107.7 mg per g tissue. The saturated, monounsaturated and polyunsaturated fatty acids constituted 36%, 37% and 27% respectively. In the case of lipids extracted from the head which formed 13.76%, PUFA formed the major part (49%) followed by MUFA (47%) and SFA (4%). Fat from silver carp head waste was extracted and the content was 21.5g per 100g minced head. The non saponifiable portion (NSM) accounted for about 4%. Non saponifiable lipids from mullet gut and mullet head lipids were analysed. Total weight of NSM obtained was 59.64 mg and 58 mg respectively per gram of gut and head lipids. Analysis of gut and head lipid by TLC-FID of the NSM revealed three major bands corresponding to Tocopherol, Cholesterol and Ergocalciferol.

Amino acid composition of waste from mullet

Evaluation of NPN fraction from the head region of mullet by HPLC revealed Taurine as important constituent forming about 43% of the free amino acids in NPN. The other free amino acids present in high concentrations include Glutamic acid, Alanine and Histitidine. Besides Taurine, the NPN from intestine contained more free amino acids namely Glutamic acid (10%) and Leucine (10%). Composition of fish waste-head and viscera-indicate high potential for fats and vitamins.

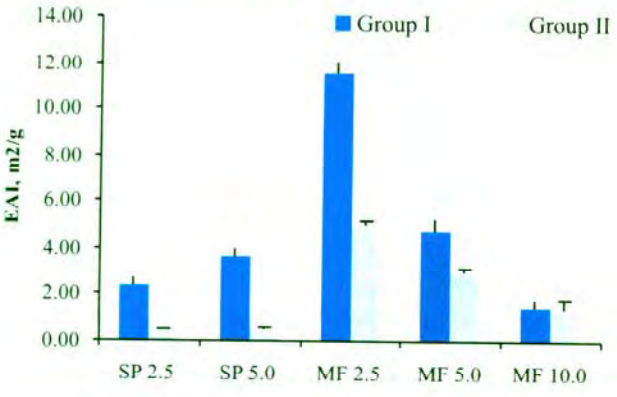
Physicochemical properties of fish muscle protein

Protein extracted from fish from different habitats (freshwater, brackishwater, deep-sea and marine) was subjected to evaluation of physico-chemical properties and functional properties. The surface hydrophobicity of freshwater, brackishwater and deep-sea fishes ranged between 6.6 and 30.6. In

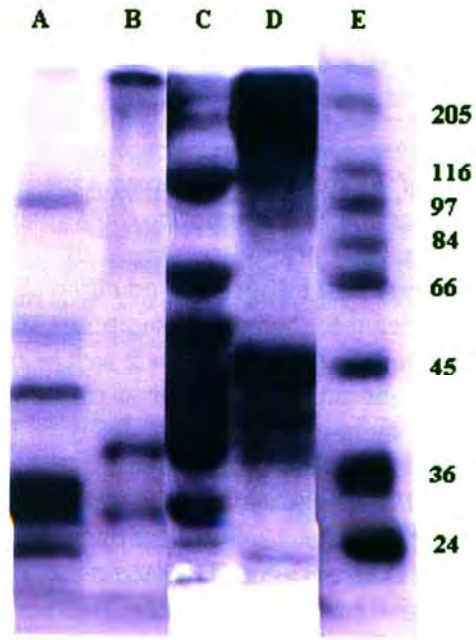
general, proteins from marine fish exhibited more surface hydrophobicity than species from other habitats. The reactive sulphydryl content of proteins from freshwater, brackishwater and marine fishes ranged in between 23.58 (*Cyprinus carpio*) and 46.21 imoles SH/g protein (*Lethrinus lenjan*) while that from the deep-sea fish *Hoplostethus mediterraneus* showed a higher SH content of 57. The Ca^{2+} ATPase values of native proteins from the fish from different habitats ranged from 0.1 to 0.8 imoles Pi/mg protein/ minute. The viscosity of myofibrillar proteins increased with increase in protein concentration. The highest viscosity was obtained in *Xenetedon cancilla* (20.6cP). Fish proteins have moderate emulsion activities which decrease with increase in protein concentration. Emulsion stability for sarcoplasmic proteins was generally low compared to the myofibrillar proteins. Myofibrillar proteins showed a concentration dependent increase in foam expansion for all the species.

Effect of size variation on physicochemical characteristics of Barracuda (*Sphyraena jello*)

The higher Ca^{2+} ATPase content of large sized fish (Group II) and the lower reactive sulphydryl content of small sized fishes (Group I) indicate the native configuration of the myofibrillar protein Myosin. Group I fishes showed more surface hydrophobicity and viscosity compared to Group II fishes. These conformational properties correlated well with the solubility characteristics of proteins from these fishes. Electrophoregram indicates that the protein

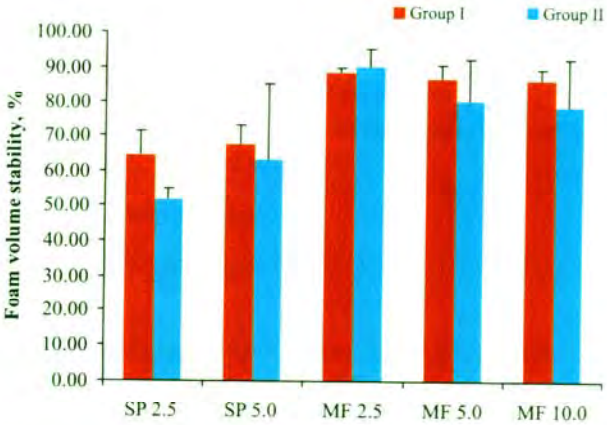


Emulsion activity index (m^2/g) of SPP and MFP of Barracuda at different protein concentrations



SDS-PAGE pattern of Group I SPP (A), MFP (B) and Group II SPP (C), MFP (D), molecular weight markers, molecular weight expressed in kD (E)

expression pattern in various stages of growth could be different. The Group I fishes showed better functionality of proteins, especially for foam expansion, foam stability, emulsion activity and emulsion stability and more importantly gel strength. This leads to confirm that Group I or fishes with average weight of 500g can be considered as candidate species for the purpose of value addition



Foam volume stability (%) of SPP and MFP of Barracuda at different protein concentrations

especially for surimi related products.

Hazard analysis on fish and fish products for domestic and international markets

As the presence of chemical contaminants affect the health of the consumer, monitoring these in the fish meant for human consumption could give useful information on the quality aspect of the fish. Different organizations recommend different levels in the fish meant for human consumption. The OCP concen-trations in the samples were well below the toxic levels and are safe for human consumption. But dry fish samples showed slightly higher values due to the reduced moisture content. 26%, 4%, 8%, 4% and 21% of the samples contained BHC, Heptachlor, Aldrin, Dieldrin and Endrin respectively above the MRL recommended by FAO (1983) and FDA (2001). As far as DDT metabolites are concerned, the level on dry weight basis (average moisture content of the sample - 50%) was below the FDA recommend-ation but about 13% of the samples were above the FAO recommendation of 0.3 ppm. As far heavy metals are concerned, in fish products other than dry fish, the levels were much below the recommended MRL.

Bioactive potentials of marine lipids

Eight species of deep sea fish species were found to contain high proportions of lipids. The lipids, especially those from sharks contained more 30 – 75% non-saponifiable matter. The lipid from species belonging to the Gempylidae family namely *Neopinnula orientalis* and *Synopsis cyanea* contained a high percentage of Cholesterol (61-63 mg%). While the rose shrimp *Aristeus alcockii*, the dogfish *Echinorhinus brucus* and the sackfish *Neopinnula orientalis* contained large amounts of Progesterone, a high amount of Estradiol was present in the slick head *Bathytroctes squamosus*. A notably high content of Vitamin E (nearly 4%) was found in the lipids of liver tissues of the rat-fish *Neoharriotta pinnata*. The liver oils were found to be rich in EPA and DHA along with other unsaturated acids and the fishes belonging to the Gempylidae family (*Neopinnula orientalis* and *Synopsis cyanea*) contained high amounts of Palmitic and Oleic acids. The sea anemones contained large proportion of phospholipids (1.18%) with Sphingomyelin being the dominant class.

Methods for the detection of antibiotics residues and dye residues using LC-MS-MS

Method for the detection of Oxolinic acid using LC-MS-MS was standardized. The limit of quantitation of the samples was determined at 1 ng/g. The limit of detection was fixed at 0.05 ppb based on signal to noise ratio. Method for the detection of Malachite green using LC-MS-MS was standardized.

Engineering Division

Research projects handled

- Design and development of energy efficient renewable energy fish dryers and smoke kilns
- Development of add-on protruding bows for small fishing vessels to reduce fuel consumption
- Development of instruments for fishing industry

Chief findings

- Designed and developed an energy efficient solar fish dryer with LPG back up system. Automatic temperature controllers with electronic display system enable easy monitoring and operation of the solar dryer. Continuous drying is possible in this system without spoilage of the highly perishable commodity to obtain a good quality dried product even during cloudy weather, rainy days and night hours with LPG heating system as thermal back up to supplement heat requirement.
- A domestic purpose solar dryer was developed for drying fish and agricultural products. Air movement pattern to obtain maximum heating efficiency per unit area, facility to vary the flow rate depending on the thermal energy requirements, minimum space for installation and low cost of the system are the advantages of this dryer.
- Developed a fish dryer using renewable energy supported with electrical heating system for continuous drying of fish. Continuous flow of hot air is maintained with the help of Photo Voltaic cells and fans to enable faster drying rate. Integration of solar thermal and solar photovoltaic enhances efficiency of the system.
- Bare hull model of 18 m trawler and 18 m gill netter cum long liner designed by CIFT were tested at NIT, Calicut. Resistance profiles of the designs at different speeds were established. Bare hull model of existing 18 m trawler design at Munambam was tested and its resistance profile against CIFT designs was compared.
- The design of Fish Meat Bone Separator developed and installed at NAS Complex was improved. The design was modified with respect to the processing belt angle, its tightness and the angle and diameter of collecting drum holes to maximise the yield especially of fish with pin bones such as rohu.
- Started the circuit design for processing the data from the Dissolved Oxygen Monitoring System. The emphasis is to develop an economical sensing membrane by applying nanotechnology, so that the system can be made extremely portable and affordable.
- Circuit design for processing the data for Fuel Consumption Monitoring System, was initiated. The emphasis is to develop a non-rotor based sensor.
- Conducted drying trials with different varieties of fish, vegetables, fruits and spices with solar dryers developed at the Institute. The materials were dried upto active water content of 0.65-0.80 and excellent hygienically dried product was obtained.

Report of work done

Energy efficient solar fish dryer with LPG back up system

Designed and developed a novel system for drying fish using solar energy supported by environment friendly LPG back up. The dryer is equipped with solar water heating panels installed at the roof for heating water. The water is collected

Solar dryer with LPG back up

in a calorifier tank made of SS 304 and insulated with mineral wool and covered with Aluminium sheet. The water from the calorifier tank is circulated through the solar collectors using a pump actuated by a differential temperature controller. Two numbers of axial flow fans are provided in the drying chamber for hot air circulation across the stainless steel trays loaded with fish for drying. The circulating air is heated by the hot water passing through the heat exchangers. Automatic temperature controllers with electronic display systems are provided for easy monitoring and operation of the solar dryer. This dryer is equipped with high efficiency LPG heating system as thermal back up to supplement heat requirement for operation during cloudy weather, rainy days and night hours. When the humidity of the circulating air rises above the set limit, exhaust fans will be automatically actuated to flush out the humid air, for controlling the humidity inside the drying chamber. Simultaneously fresh air will be admitted inside the chamber.

When solar radiation is not sufficient during cloudy days and rainy days to heat the water for circulation inside the heat exchanger, LPG back up heating system will be automatically actuated and provide the required set temperature. Thus continuous drying is possible in this system without spoilage of the highly perishable commodity to obtain a good quality dried product.

A prototype of the dryer is fabricated and installed at the Institute. For commercial applications a 500 kg/day capacity solar fish dryer with LPG back up costs about Rs.10 lakhs and 1,000 kg/day costs around Rs.15 lakhs. However, cost of the drying per kg of fish in the solar dryer is less than half that of the electric dryer. They are economically viable, paying for their own installation costs within three years through reduced fuel consumption.

The machine is ideal for drying fish, fruits, vegetables, spices and agro products hygienically and efficiently, without changing its colour and flavour. It dries faster than open drying in the sun, by keeping the physio-chemical qualities like colour, taste and aroma of the dried food intact and with higher conservation of nutritional value. Solar drying reduces fuel consumption and can have a significant impact in energy conservation.

Hygienically dried fish

Domestic purpose solar dryer

Domestic purpose solar dryer having a capacity of 5 kg to dry fish and other agro products was developed. The dryer is made of marine plywood with external water proof coating and covered with glass sheets.

Selective coated black surface materials are provided for efficient absorption of solar energy and to reduce emissivity. Fibre netted wooden framed trays are used for handling materials for drying. Air movement pattern to obtain maximum efficiency per unit area, facility to vary the flow rate depending on the thermal energy requirements, minimum space for installation and low cost of the system are the

advantages of this dryer.

Domestic purpose solar dryer

Fish dryer using renewable energy, supported with electrical heating system

A renewable energy fish dryer supported with electrical heating system for continuous drying of fish was developed. Electrical back up heating system with hot air circulation facility and well insulated design to avoid wastage of thermal energy are the added advantages of this dryer. Continuous flow of hot air is maintained with the help of Photo Voltaic cells and fans to enable faster drying rate.

Several training programmes were conducted among fisher women, through Cochin Corporation and other SHGs to popularise the use of the dryer. Demonstration of the dryer was also carried out at Dimapur, Nagaland during the Agri-Expo 2006 in the presence of Union Ministers, State Ministers of North-East region, Confederation of Indian Industries, ICAR dignitaries and several other visitors.

National Research Development Corporation

Fish dryer using renewable energy, supported with electrical heating system

(NRDC), New Delhi communicated their approval for supply and installation of the solar tunnel dryer by CIFT at the Technology Demonstration Centre in Ivory Coast, to propagate Indian technologies/ machineries and developing business prospects for Indian technologies in West African countries.

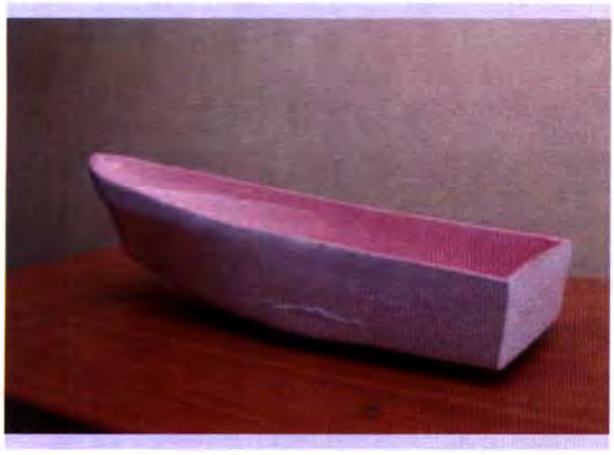
Conducted drying trials with different varieties of fish, vegetables, fruits and spices with solar dryers developed at the Institute. The materials were dried upto active water content of 0.65 - 0.80 and excellent hygienic dried product was obtained.

Hygienically dried and packed fruits and vegetables

Add-on protruding bows for small fishing vessels to reduce fuel consumption

Bare hull model of 18 m trawler and 18 m gill netter cum long liner designed by CIFT were tested

at NIT, Calicut. Resistance profiles of the designs at different speeds were established. Bare hull model of existing 18 m trawler design at Munambam was tested and its resistance profile against CIFT designs was compared. It has been found that at Fn 0.07 corresponding to a speed of 5 knots, the frictional resistance and wave making resistance are almost equal in both cases. Total resistance which is the sum of frictional resistance and wave making resistance is 11% higher in existing design compared to CIFT design at this speed. At Fn 1.1 corresponding to a speed of 8 knots, the wave making resistance is almost six times the frictional resistance in existing designs and the wave making resistance is about 4.5 times the frictional resistance for the CIFT designs. The total resistance of existing designs is found to be about 20% higher than CIFT design at these speed. Collected the fuel consumption versus speed-time characteristics of existing designs and the CIFT prototype design at Munambam, which will be used as guidance in deciding the required efficiency of the protruding bow to be designed at various speeds.



Bare hull model of 18 m vessel

Instruments for fishing industry

Conceptual design of Dissolved Oxygen Monitoring System and Fuel Consumption Monitoring System was completed. Started the circuit design for processing the data from the Dissolved Oxygen Monitoring System and Fuel Consumption Monitoring System. During the conceptual design process it has been found that the rotor type consumption meter presently available in the market is highly inaccurate at low flow rate characteristics of medium class fishing vessels. Therefore the conceptual design was finalised to measure the time taken to consume fixed volume of fuel at intervals using an optical sensor. The system will be designed not to be affected by the pitch and roll motion of the vessel. It has also been decided to explore the possibility of simultaneous measurement of specific gravity of fuel as the energy release of the fuel has direct bearing on its specific gravity and hence on fuel consumption efficiency.

In the case of the Dissolved Oxygen Monitoring System, the stress is to establish the accuracy of measurement of the Dissolved Oxygen versus the cost of various membranes in order to develop the cheapest possible monitor at acceptable accuracy level.

Fish meat bone separator

Working of the fish meat bone separator installed at NAS Complex, New Delhi has been reviewed and found that it is working satisfactorily. The design has been further modified with respect of the processing belt angle, its tightness and the angle and diameter of collecting drum holes to maximise the yield especially of fish with pin bones like Rohu. To attain the specific tightness and angle, various belts were tried and finally a profiled PU belt of 12 mm thickness was selected. A modified design of the meat bone separator was made accordingly and fabrication of the improved design is being done. Further evaluation for its transfer for commercial production is going on.

Fish meat bone separator

Extension, Information and Statistics Division

Research projects handled

- Study on the adoption of hygienic and disease preventive practices in small scale fisheries
- Studies on evaluation of technology transfer and associated variables
- Action research on community based coastal zone management with specific involvement of women
- Assessment of fisheries research in India (impact assessment with reference to CIFT)
- Statistical and econometric evaluation of production and marketing of seafood products

Chief findings

- Among the fish marketing personnel, the variables such as age, education, experience, investment, annual income and number of marketing personnel did not have any association with the adoption. The R^2 value (Multiple Regression Coefficient) indicated that all the independent variables taken together had explained only 28.40% of variation in the adoption level and the F value was highly significant (3.34%). Of the seven variables, education and number of working days in a year had positive influence over the extent of adoption of hygienic practices.
- In case of fish landing centres, of the six practices evaluated among the fishermen, the adoption score was higher for one practice viz., use of clean containers for fish handling (81.03%). Low level of adoption was observed for two practices viz., use of adequate clean water for washing fish (39.49%) and prompt system of waste disposal in the landing centres (40%). The overall adoption was 54.96%.
- The perception index for the impact of popularisation efforts undertaken among fishermen was 55.26% and the impact score was moderately good for the two factors viz., use of clean containers for fish handling (75.90%) and use of adequate ice to preserve the fish (67.69%).
- The R^2 value revealed that all the ten independent variables taken together had accounted for 71.60% of variation in the adoption level and the F value was highly significant (13.64%).
- Among the aquafarmers in selected four districts viz., Trichur, Alleppey, Ernakulam and Kannur, the F values showed that there was highly significant difference among them on the variables such as age, number of information sources utilized, and in availing the consultancy services, though, there was no significant difference among them in terms of area under prawn culture
- For the ten improved practices studied, the average adoption scores were i) Preparation of ponds (93.15%), ii) Eradication of predators and weeds (85.39%), iii) Use of organic manures and fertilizers (68.95%), iv) Use of recommended stocking rate (64.38%), v) Use of PCR tested seeds (84.47%), vi) Use of recommended feeding schedule (77.63%), vii) Use of probiotics (47.95%), viii) Use of aerators (36.99%), ix) Water exchange and quality monitoring (71.69%), and x) Harvesting after prescribed days of culture (70.32%). The overall adoption index was 70.09.
- Most of the respondents have perceived the source of virus infection as seeds/feeds/water and the stage of disease occurrence was found to be during 40-60 days.
- The R^2 value indicated that all the variables taken together had explained 37.30% of variation in the adoption level and the F value

was significant. Only two independent variables viz., age and number of training programmes undergone had contributed significantly towards the extent of adoption of improved practices, while experience had negative influence over the adoption behaviour.

- Among the pre-processors, the overall impact perception index was 57.83 with the standard deviation of 10.82. The impact index was moderately good for the four impact factors viz., use of adequate water for pre-processing (73.33%), improvements in post harvest handling of raw materials with ice (69.17%), use of adequate quantity of chlorine for washing (65.00%) and use of adequate quantity of detergents (61.67%).
- On the adoption of responsible fisheries codes among the fisherfolk, higher adoption was seen in the codes such as use of methods to reduce fuel consumption, interactions with different stakeholders to resolve some common issues and observing fishing holidays like monsoon trawl ban.
- Regarding the effectiveness of various measures taken by the State Fisheries Department to implement FAO Code of Conduct, the effectiveness perception index among fisherfolk was found to be 58% when ten criteria were evaluated on a three point rating scale.
- Preliminary analysis among fisherfolk also revealed that adoption index scores varied from 33 to 100% with reference to the adoption of responsible fisheries technologies such as the use of fuel efficient fishing vessels, use of fuel saving propeller, use of fuel saving propeller nozzle, use of large mesh demersal trawls, use of 'V' form otterboards, application of antifouling paints and use of electronic equipments.
- Post-Tsunami studies revealed that in Nagapattinam district, there was 58% increase in the number of FRP 'vallams' (country boats) in the fishing villages, though there was a slight reduction in the number of mechanized fishing boats in the district. In Cuddalore district, the number of mechanized boats, wooden/FRP 'catamarans' and FRP vallams had increased significantly due to the various subsidy schemes of the Fisheries Department and the NGOs.
- The data from mechanized boat operators revealed that the number of fishing days in a year was about 247 days. They had operated 13-14 m OAL fishing boats with an average investment of Rs. 10-14 lakhs. The engine HP varied from 106-110. The data collected from traditional fishermen revealed that they had operated 8 to 9 m OAL FRP motorized (9-10 HP) vallams with an average investment of Rs. 2.2 lakhs.
- Most of the fisherfolk (both mechanized and artisanal) had the following impact items due to Tsunami: i) Loss/damage to fishing craft, gear and engine ii) More investment and indebtedness after Tsunami, and iii) Drop in fish landings. Few respondents had reported the impact items such as change in the monthly expenses of family, loss of household members, loss/damage to buildings/houses, and change in the use of fishing craft and gear.
- For the effective coastal zone management, the training camps and other interventions aimed to create awareness and motivation among the fisherfolk to solve the problems through community participation and efforts of village panchayath in areas such as alternate livelihood enterprises, responsible fishing techniques, sustainable agriculture and aquaculture practices, effective management of natural resources, prevention of environmental pollution and sea erosion, and meeting drinking water needs were held.
- Two OLS models were developed for studying the impact of the anti-dumping investigation on the quantity of shrimp imports into US and the specific impact on India respectively.

- Yield of four varieties of prawn, CF and octopus were estimated from samples and it was found that there existed significant variations between months. Yield also depended on the source of raw material obtained for pre-processing.
- Study on total cost of production of prawn has revealed that 85% of the total cost of production is on raw material and the rest 15% included cost of freezing, labour charges, water and ice, electricity and freight charges. On an average, the unit cost of production of frozen prawn, excluding the raw material prices, works out to be Rs. 24 approximately.
- An estimate of the low value fishes landed in the Indian coast was made and it was found that during 2002, 33% of the total fish landed was of low value which amounted to 9 lakh tonnes.
- Reviews of State Marine Fisheries Regulation Acts have been attempted and modifications in the existing rules suggested and the areas needing focus identified.
- The revised estimates for fuel utilization pattern by different classes of mechanized fishing vessels in Andhra Pradesh during 2004 was estimated. The estimate gives the consumption pattern of 7941 KL of diesel for small mechanized, 3818 KL for sona, 3684 KL for mini trawlers and 11256 KL for trawlers with the pooled estimate for Visakhapatnam district as a whole being 26699 KL for the year 2004. The consumption in Andhra Pradesh state was 19698 KL for small mechanized, 21744 KL for sona, 3684 KL for mini trawlers and 11256 KL for trawlers, the pooled estimate being 56383 KL.

Report of work done

Hygienic practices at fish landing centres and markets

The project work was carried out in selected four districts of Kerala viz., Trichur, Alleppey, Ernakulam and Kannur among a random sample of 65 fishermen. For fish markets, the study was conducted among 67 fish marketing personnel in Ernakulam district. The results revealed that for fishermen, the average number of fishing days in a year was 241 days with an average annual income of Rs. 0.34 lakhs. The overall awareness index measured for ten improved practices was 85.77 which indicated that the fishermen were well aware about the hygienic practices to be followed in the fish landing centres. The extent of adoption measured for six hygienic practices in the selected landing centres revealed that the adoption scores were in the middle category for five practices and the overall adoption index was 54.96%. The R^2 value in the multiple regression analysis revealed that all the ten independent variables taken together had explained 71.60% variation in the adoption level.

Among the fish marketing personnel, the average awareness index was quite high (93.60%) and the overall adoption index was 89.05%. The contribution of the socio-economic variables towards adoption is indicated by the regression coefficients and R^2 value was found to be 28.40% with a significant F value. Of the seven independent variables, education and number of working days in year had positive influence towards the extent of adoption of hygienic practices.

Good management practices by aquafarmers and small-scale pre-processors

Data were collected on the extent of awareness and adoption of good management practices from the aquafarmers in selected four districts viz., Trichur, Alleppey, Ernakulam and Kannur, and among the small-scale pre-processors in Alleppey district of Kerala.

The 'F' test results revealed that the extent of adoption mean scores for each practice varied significantly between the aquafarmers in the four districts with the overall mean adoption score of 70.09%.

Among the pre-processors, the overall adoption index was 81.25% with the standard deviation of 6.48. The major constraints in adoption of hygienic practices were listed out and the findings of the

study would be helpful in planning and implementing suitable extension mechanisms and schemes through both government as well as private sector interventions in the selected areas.

Evaluation of innovation-decision process among mechanized fishing boat owners

The socio-personal variables of clients such as age, education, occupation, experience, annual income, social participation, material possession, innovativeness, economic motivation, extension participation, training undergone, information seeking behaviour, extent of linkage, attitude etc. were selected and their measurement procedures were determined. The study is being carried out among the mechanized fishing operators in fishing centres such as Cochin, Veraval, Visakhapatnam and Tuticorin.

The technologies for studying the innovation-decision process were selected and they are as follows: 1) Sheathing for under water hulls of fishing boats, 2) Marine anticorrosive painting, 3) Marine antifouling painting, 4) CIFTAL anodes, 5) Use of appropriate engine HP, 6) Size of boat design used, 7) V-form otter boards, 8) Size of trawl design used, 9) Use of large mesh trawl, 10) Responsible fishing techniques viz., use of Turtle Excluder Device, use of square mesh codend trawls etc., and 11) Use of adequate ice on board.

During the period, the interview schedule was finalized and the data were collected from 16 respondents in Tuticorin fishing harbour which revealed that the respondents had operated 12 to 18 m OAL wooden boats with the engines of 98 to 240 HP. The crew size was 7 to 10, and on an average, 240 trips were undertaken in a year. The average catch was three tonnes per trip and the average expenditure per trip was Rs. 30,000/-. Extent of adoption was more in practices such as the use of FRP sheathing for wooden hulls, use of marine antifouling painting, size of boat design used, size of trawl design used, use of large mesh trawls and use of adequate ice on board.

Adoption of responsible fisheries codes in the marine harvest sector

The practices and technologies under the responsible fisheries codes were identified and listed. Combining with the socio-personal variables, which may have influence on the adoption of these codes by fishers, a data collection tool was designed and pre-tested. The collection of data was initiated at Sakthikulangara and Neendakara Centres in Kollam district.

From the data collected, the preliminary analysis revealed that higher adoption was seen in the following codes: i) Use of any method to reduce fuel consumption, ii) Interaction with different stakeholders to resolve some common issues, and iii) Observing fishing holidays like monsoon trawl ban. The average extent of adoption was in the

Data collection in Tuticorin fishing harbour

Evaluation of responsible fisheries codes in progress

'medium' category with reference to the following codes: i) Use of improved gear/practice to increase fish catch, ii) Use of traditional knowledge/practice to avoid fishery resource depletion, and iii) Avoiding throwing away of broken pieces of nets during fishing in sea.

Preliminary analysis among fisherfolk also revealed that adoption index scores varied from 33 to 100% with reference to the adoption of responsible fisheries technologies such as the use of fuel efficient fishing vessels, use of fuel efficient propeller, use of fuel saving propeller nozzle, use of large mesh demersal trawls, use of V-form otter boards, application of antifouling paints and use of electronic equipments.

It was seen that irrespective of the seasonal fluctuations and risk of financial losses, the mechanized fisherfolk continued their traditional occupation of fishing. Almost all were against the present practice of implementing trawl ban during June 15 to July 29. The conservation of non-fish species, avoiding the catch of non-target species/ discards, minimizing bottom bed disturbance etc. were not at all perceived as important for adoption. The mesh size regulations in the codend were not adopted, as they believed that it would reduce catch. The respondents had expressed interest to get training in topics of relevance to them for increasing the profitability and improved standards of living.

Role performance of fish processors and adoption of quality management practices

The independent variables on the profile characteristics of fish processors were selected and an index has been developed to measure the extent of performance on 15 roles. For evaluating the adoption of quality management practices in processing factories, 20 Good Hygienic Practices (GHP), three practices on quality of raw materials, 10 Good Manufacturing Practices (GMP), and seven Standard Sanitation Operation Procedures (SSOP) were selected for the study. Four Good Laboratory Practices (GLP) and seven HACCP procedures to be followed were also listed and questionnaires were developed for data collection.

Post-Tsunami scenario with reference to fishing technology and socio-economic conditions

The study is being conducted in two districts each in Tamil Nadu and Kerala states where Tsunami relief and rehabilitation programmes are in progress. Interview schedules were formulated to collect the data on socio-economic conditions, technological variables, impact of Tsunami, adequacy of relief measures, constraints etc. During the period, data were collected from 25 respondents in Cuddalore district and 15 in Nagapattinam district.

In Nagapattinam district, it was observed that there was 58% increase in the number of FRP vallams in the fishing villages, though there was a slight reduction in the number of mechanized fishing boats. In Cuddalore district, the number of mechanized boats, wooden/ FRP catamarans and FRP vallams had increased significantly due to the various subsidy schemes of the Fisheries Department and the NGOs.

The data collected from 20 mechanized boat operators revealed that the average age of respondents was 39 years with an average of 18 years experience in fishing. The number of fishing days in a year was about 247 days. They had operated 42'-46' OAL fishing boats with an average investment of Rs. 10-14 lakhs. The engine HP varied from 106 to 110.

The data collected from 20 FRP craft fishermen

Data collection in progress at Tsunami affected village

revealed that the number of fishing days ranged from 250 to 320 in a year. The respondents had operated 27'-28' FRP motorized (9-10 HP) vallams with an average investment of Rs. 2.2 lakhs.

Most of the respondents (both mechanized and motorized) had the following impact items due to Tsunami: i) Loss/damage to fishing craft, gear and engine, ii) More investment and indebtedness after Tsunami, and iii) Drop in fish landings after Tsunami. Few respondents had reported the impact items such as change in the monthly expenses of family, loss of household members, loss/damage to buildings/ houses and household articles, and change in the use of fishing craft and gears. The fisherfolk were satisfied with the mitigation measures such as supply/replacement of fishing devices, repair of fishing devices, credit facilities and technological assistance through public/private/NGO sectors. Though the damages to communication facilities, and fishing craft and gear were rectified, the restoration work is in progress with reference to fishing harbour/fish landing centres, fish auction halls, ice plants and approach roads.

Community based coastal zone management with specific involvement of women

Socio-economic studies: Socio-economic studies were conducted among 100 respondents to find out the details on the occupational pattern, number of days employed, educational levels, number of members in a family, type of houses, extent of land/ farm owned, pattern of ownership of fishing craft, investment on craft, gear, engine etc., annual income, immediate needs, problems and suggestions.

The data revealed that more than 90% of the respondents were fishing labourers and a small percentage had their own craft and gear or operated as shareholders. The number of fishing days varied from 200 to 270 in a year. As immediate need, the respondents had reported the following: i) Non-availability of drinking water, ii) Children's education, iii) Financial constraints, iv) Lack of own craft and gear, and v) Housing facilities.

Data were also collected on the number of families, occupational pattern, infrastructural facilities available, important development activities, environmental issues, women and children development activities, technological variables in fishing, agriculture and aquaculture, housing pattern, health, nutrition and drudgery relief activities.

Three Participatory Rural Appraisal (PRA) programmes were conducted to assess the major problems and issues in the coastal zone management and to formulate need based interventions.

Training for coastal women groups: Two training camps were conducted for women Self Help Group members (Kudumbasree) from 18th to 21st July and 25th to 28th July 2006 at Chellanam Field Centre premises. Fifty two selected women group members from different Kudumbasree units in wards 10,11,12,14,16,18 and 19 attended the two training

Training on preparation of value added fish products

camps.

For the effective coastal zone management, the training camps aimed to create awareness and motivation among the people concerned to solve the problems in areas such as alternate livelihood enterprises, responsible fishing techniques, sustainable aquaculture practices, improved agricultural practices, management of natural resources and prevention of environmental pollution, sea erosion, drinking water availability and

sanitation. Each training programme covered these subject areas in details. The camps focused more on the creation of employment opportunities for women group members through the production of value added fish products such as fish pickles, cutlets, and dried fish, and also the production of fruit jam, pine apple squash, besides the production of milk based products such as chocolates, ice-cream, milk halwa etc.

Dr. K. Devadasan, Director, CIFT offered the valedictory address at the end of training camps and requested the trained women group members to form a registered Women Society at Chellanam so as to promote the production of several value added fish products and to take up other alternate job oriented enterprises. He has suggested to combine the production of fish products with other food based products so as to make up the non-availability of low cost fish varieties for about four to six months in a year. The women participants were highly inspired by the training programmes and offered cooperation for further implementation of various welfare and relief activities.

Formation of registered Women Society at Chellanam: The trained women group members had registered a Society named as 'Coastal Women Welfare Society, Chellanam' on 8th November, 2006. Further, technical guidance was given to the members of the Society and now they are engaged in the production of value added fish products such as fish pickles, cutlets and dried fish products.

Dental Clinic at the Field Centre, Chellanam: In collaboration with Amrita Institute of Medical Sciences and South Indian Bank, Chellanam, a Dental Clinic was inaugurated on 22nd December 2006. The Dental Clinic functions for three days in a week in the CZM Field Centre at Chellanam and offers free services to fisherfolk for screening patients for oral cancer and for providing dental treatments besides creating awareness about the disease prevalence in the coastal areas and their prevention measures.

Ward level workshops on coastal zone management plan validation

Ward level workshops were conducted at Chellanam fishing village as shown for validating the plan prepared:

Date	Venue	Ward	No. of participants
19-10-2006	St. George Church Parish Hall	14	40
27-10-2006	SC/ST Cooperative Society Hall	11	29
18-11-2006	Legi Talkies Hall	16	40
25-11-2006	Puthenthodu School Premises	10	40
05-01-2007	Legi Talkies Hall	5	39
16-01-2007	SC/ST Cooperative Society Hall	20	23
27-01-2007	St. Mary's High School	17 & 18	61
17-02-2007	CZM Field Office	12	37

The first workshop was inaugurated by Shri T.K. Augustine, Vice President, Chellanam Panchayath. Dr. K. Devadasan, Director, CIFT presided over the function and stressed the importance of grass root level participation and planning for the successful

Plan validation workshop at Puthenthode in progress

Dr. S. Balasubramaniam, HOD, EIS, CIFT distributing fruit saplings

implementation of coastal zone management plan. Smt. Saira Bhanu, Deputy Director of Fisheries (Zonal) Ernakulam inaugurated the distribution of inputs viz., mangrove/fruit saplings and vegetable seeds to the fisherfolk. Each workshop comprised of an inaugural session followed by a technical session which included the presentation of the coastal zone management plan and group discussions.

A draft on coastal zone management plan for the village was prepared earlier for sustainable coastal zone development based on the Participatory Rural Appraisal Programmes (PRA) and based on this, discussions were conducted at each ward. The final plan will be formulated incorporating the suggestions given in these workshops.

Impact assessment of fisheries research in India

Two technological areas, where CIFT had developed number of innovations/improved practices were selected for the project studies. Accordingly, the first component of impact assessment will be conducted among a sample of seafood freezing plants with reference to the extent of adoption of the improved fish processing practices, the rate of returns to investment, impact of technological adoption, profile of processing plants, marine products processed, countries to which exported, assistance from CIFT for analysis of various tests, quality parameters, etc.

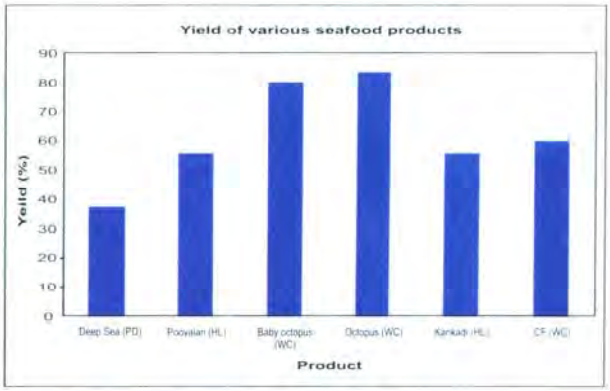
The second component of impact assessment will be conducted among a sample of mechanized fishing boat owners with reference to their socio-personal characteristics, the extent of adoption of trawl fishing innovations, place of operation, economics of fishing operations, impact assessment and constraints. Two sets of interview schedules were developed for these two components and the data collection work has been initiated.

Models for studying the impact of anti-dumping investigations

Two regression models were developed and the impact of the anti-dumping investigation on the quantity of shrimp imports into US and the specific impact on India were studied. Variables used included imports from named and non-named countries, duty levied and investigation dummy. It was observed that the anti-dumping investigations had a negative impact on the imports from the countries which had been named in the investigations. There has also been trade diversion from the named to the non-named countries. The effect on the price in the US market has also been negligible with unit value of imports actually falling.

Yield studies

Data were collected from four pre-processing units in Alappuzha and Ernakulam districts of Kerala on the source, price and variety of raw material procured. The yield of various varieties of shrimp was recorded based on the initial weight of the raw material and weight after peeling. It was found that



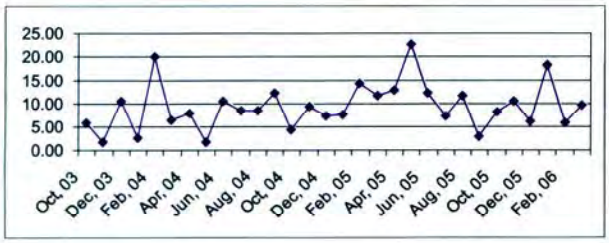
the yield varied between different varieties and within same variety between different grades. The yield for deep sea prawn (PD) was 37.73%, Poovalan (HL) 56.19%, Karikadi (HL) 55.9%, cuttle fish (WC) 60.51%, baby octopus (WC) 80.2%, and octopus (WC) 83.91%.

Cost of production

Expenditure on raw material is the major cost in the production process in the seafood industry. 84.02% of the total costs are accounted for by this. This is followed by transportation costs which account for 3.92%, followed by pre-processing at 3.30% and shipping and clearing at 2.75%.

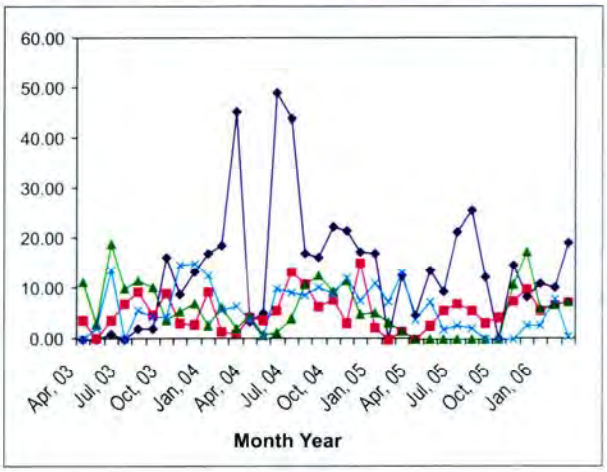
Capacity utilization

Data was collected from 14 EU and three non-EU plants in Chennai on month-wise production from 2003 to 2006. The average seasonal capacity utilization was computed and it was seen that there was high utilization of capacity during the first quarter of the year. The capacity utilization mainly depended on the availability of raw material.



Percentage capacity utilisation of EU plants in Chennai region

Data was also collected on month-wise production from four EU and 10 non-EU plants in Visakhapatnam. It was found that capacity utilization was varying throughout the year and it depended on the raw material availability and type of products processed. Capacity utilization between factories was also observed to be high. Owing to low catches, raw material had to be procured from places like Tamil Nadu and Orissa.



Month-wise capacity utilisation of processing plants in Visakhapatnam

Estimation of low value fish

An analysis of the low value fishes landed in the Indian coast was carried out and it was estimated that during 2002, 32.65% of the total fish landed was of low value. For the purpose of estimation of low value fish, each state was identified and estimates were made state-wise as well.

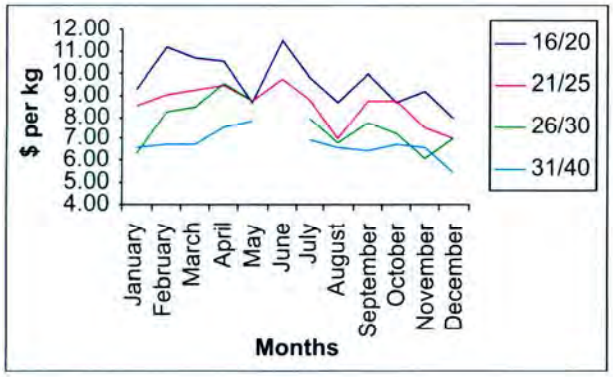
Low value fish landed in India - 2000-2002

Year	Total low value fish (mt)	Total fish landed (mt)	% of total
2000	880480	2756496	31.94
2001	947944	2731256	34.71
2002	920428	2818883	32.65

Analysis of prices in EU market

The data pertaining to week ending prices of shrimp realized in the EU market during 2001 to 2005 was compiled and analysed. The major importing countries of Indian frozen shrimp in the EU are UK, Belgium, Germany, France, Netherlands, Italy and Spain. There were 95 types of products exported to EU market as Frozen shrimp. It was observed that these products were forms of Headless shrimp (HL), Peeled Deveined shrimp (PD), Peeled Un Deveined shrimp (PUD) and IQF shrimp. The trend in monthly

average prices in US $ per kg realized by Headless frozen shrimp in the popular grade 21/25, 25/30, 31/35, 36/40 indicate that the prices were on the decrease till 2004 and there seems slight stability in 2005. It was observed that during 2005, average prices of frozen shrimp exported from Chennai and Tuticorin was $ 4.53 per kg and $ 4.3 per kg which was more than the prices realized from Kochi, Kollam and Mangalore ports ($3.59, $3.25 and $ 3.9 per kg respectively). Analysis of the prices of frozen shrimp exports in the form of PD in the popular grades viz, 26/30, 31/40, 41/50 was carried out and it was found that in general a decrease in price was realized over the years. The analysis of prices of IQF shrimp in the popular grades 100/200 and 200/500 did not reveal any decrease in prices over the years. Except for the grade 31/40, the prices of Indian HL Black Tiger shrimp realizes more price during the first quarter of the year.



Average monthly prices of HL Black Tiger exports to EU

Seasonal indices of Indian Black Tiger shrimp exports to the EU

The seasonal indices of monthly prices realized by headless Black Tiger shrimp during 2005 indicate the high indices during the first part of the year which falls towards the later part for most grades. The seasonal index was maximum for most grades during the period January - March and for grades 16/20, 21/25 and 31/40 the minimum index was during December. The percentage variation between the maximum and minimum indices for headless Black Tiger varied between 28 to 30 percent for different grades. The trend of seasonal indices was similar in case of Peeled Deveined shrimp, the percentage variation between the maximum and minimum indices varying from 19 to 27 percent during 2005 for various grades. The standard deviations for most grades tended to increase towards the later part of the year. The reason behind this feature is fluctuations in prices during the latter part of the year. The higher indices reported during the first part of the year is the result of good demand due to the New Year, Spring and school vacation seasons. Unlike Headless and PD forms, the seasonal indices was very high indicating the demand for IQF products through out the year.

Review of the State Marine Fisheries Regulation Acts & Rules

A review of the Marine Fisheries Regulation Acts of maritime states was attempted. All the states exercise sovereign right to regulate fishing activity within territorial waters, ie. 12 nautical miles. And within this, there are specified areas for different classes of vessels. There is regulation regarding the registration of fishing vessels and licensing of fishing operations in all states and protection of resources. Copies of Acts from all Directorates of Fisheries have been collected and detailed analysis of the present documents are being attempted for bringing out a model comprehensive policy document for consideration of all concerned.

Visakhapatnam Research Centre

Research projects handled

- Development studies on responsible trawl systems
- Studies on environment friendly high yielding semi-pelagic trawl for exploitation of fishery resources of east coast of India
- Optimization and upgradation of traditional fishing systems for inland and marine sectors
- Investigations on responsible trawl systems for mechanized sector
- Standardization of traditional fishing systems with special reference to reservoirs
- Resource assessment of deep sea fisheries and their biology along the continental slope of Indian EEZ
- Under-utilized fish and shellfish from different aquatic resources: Value addition, food safety and waste utilization
- Genomic investigations on aquatic and fish microorganisms and development of molecular diagnostic methods for pathogens
- National Risk Assessment Programme for fish and fish products for domestic and international markets
- Extraction of carotenoprotein and protein isolate from shrimp process waste: Development of an easy method and it's scale up

Chief findings

- Designed and evaluated 27 m and 30 m semi-pelagic trawls for exploitation of off bottom fishery resources.
- Selectivity experiments using square mesh codend showed that the percentage escapement of smaller fishes from 30 mm, 40 mm and 50 mm were 18%, 30% and 45% respectively. The selectivity factors were also determined for eight commercially important species.
- Designed and fabricated foldable traps for reservoir fisheries.
- Fish enriched noodles were prepared by incorporating edible fish powder made from freshwater fish, rohu (< 500g).
- The risks in the form of development of antibiotic resistance towards medicinally important antibiotics in bacteria (*E. coli*) isolated from freshwater fish, scampi and Black Tiger shrimp was negligible.
- Hydrogen sulphide (H_2S) producing bacteria showed marked increase during spoilage of freshwater fish.

Report of work done

Responsible trawl systems

Designed and fabricated 30 m demersal trawl for whole trawl and codend selectivity studies. Designed and fabricated 30 mm, 35 mm, 40 mm and 50 mm, 60 mm and 80 mm square mesh codend also.

In the 30 mm codend selectivity studies the percentage escapement was found to be 18% of the total catch and the species retained comprised of *Leiognathus bindus* (40-75 mm), *L. dussumieria* (45-65 mm), *Gazza minuta* (30-50 mm), *Saurida tumbil* (100-150 mm), *Stolephorus indicus* (65-120 mm), *S. commersonii* (75-100 mm), *Lepturacanthus savala* (150-280 mm), *Secutor insidiator* (50-75 mm), *Dussumieria acuta* (90-150 mm), *Upeneus vittatus* (60-160 mm), *U. sulphurius* (100-160 mm), *Nemepterus japonicus* (75-98 mm), *Apogon* sp. (50-75 mm), *Metapenaeus dobsoni* (35-60 mm), *Loligo duvauceli* (45-80 mm), *Opitsthopterus tardoor* (90-110 mm) and *Otolithus cuveri* (140-200 mm).

Escapement of juveniles from 30 mm square mesh codend

In the 40 mm codend selectivity studies with 30 m demersal trawl, the escapement was found to be 30% of the total catch. The species retained comprised of *Trichiurus lepturus* (310-450 mm), *Leiognathus bindus* (30- 50 mm), *Saurida tumbil* (120-250 mm), *Upeneus vittatus* (100-140 mm), *U. sulphurius* (100-160 mm), *Nemepterus japonicus* (75-98 mm), *Nibea maculata* (50-75 mm), *Otolithus cuveri* (110-210 mm), *Dussumieria acuta* (130-170 mm) and *Thryssa mystax* (140-160 mm).

In the 50 mm codend selectivity studies the escapement percentage of catch was 45.8%. The species retained comprised of *Trichiurus lepturus* (240-500 mm), *Thryssa mystax* (120-150 mm), *Pampus argenteus* (120-160 mm), *Parastromateus niger* (120-160 mm), *Upeneus vittatus* (90-160mm) *Saurida tumbil* (160-190mm), *Leiognathus dussumeri* (40-80 mm) and *Nemipterus japonicus* (60-90 mm).

Whole trawl selectivity was conducted by using 30 m demersal trawl attached with pouches made of PA netting at each panel. An escapement of 0.01 to 1% of the catch was observed consisting of Anchovies (*Stolephorus indicus* and *S. commersonii*), *Thryssa mystax* and *Dussumieria acuta* from the hind belly of the demersal trawl. Bycatch landings of commercial trawlers were monitored at landing centers of Visakhapatnam. The bycatch comprised of Ribbon fishes, Silver bellies, Squilla, Sciaenids, Apogonids, small crabs and Molluscan shells.

Data base on trawl fishery resources of Visakhapatnam was collected.

Semi-pelagic trawls for exploitation of fishery resources

Two designs of semi-pelagic trawls with head rope length of 27 m and 30 m were designed and fabricated. Trawls were field tested at various depths. The parameters suitable for semi-pelagic trawling was standardized for the designs. The CPUE pertaining to 27 m semi-pelagic trawl was recorded as 36 kg/hr. The CPUE yielded by 30 m semi-pelagic trawl was 38 kg/hr. The catches mainly dominated by Ribbon fishes (30%) comprising only two species namely *Lepturacanthus savala* and *Trichiurus lepturus*. Upenoids were the second dominant variety (20%) and they were mainly comprised of *Upeneus vittatus* and *U. sulphureus*. The other dominant varieties were scaienids (10%) comprising of *Nibea maculata* and *Otolithes cuveiri* and Mackerel (8%) with single species *Rastrelliger kanagurta*. Sizeable catches of silver bellies (20%) and anchovies (5%) dominated by *Stolephorus indicus* and *S. commersonii* were also observed.

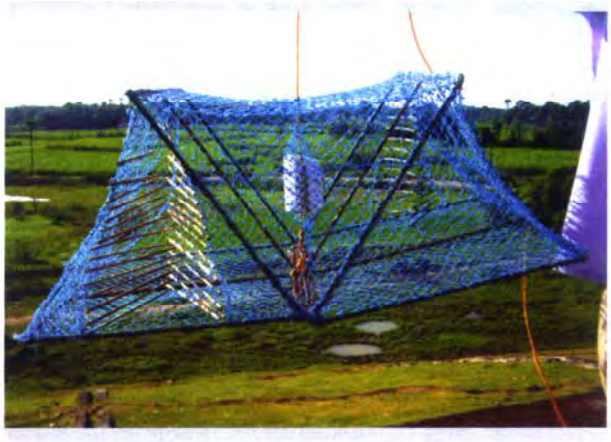
Data base for the semi-pelagic trawl resources of Visakhapatnam coast was prepared. Comparative studies of the catches and operational parameters of semi-pelagic trawls with demersal trawls were also carried out. The studies revealed that the amount of non-target species landed by the semi-pelagic trawls was much less than that of demersal trawl.

Responsible trawl systems for mechanized sector

Selectivity experiments were carried out using 30 mm diamond mesh codend covered with 20 mm codend cover. The percentage of fishes retained was 86.13% and those escaped were 13.87%.

The L25, L50 and L75 for 30 mm square mesh codend for *Saurida tumbil* was 18.02, 23.07 and 28.11 respectively. The L25, L50 and L75 values for *Stolephorus indicus* with 30 mm square mesh codend was 9.3, 11.7 and 11.8 respectively. Selection factor, selection range and selection ratio for *Stolephorus indicus* was 3.9, 2.4 and 0.8 respectively with 30 mm square mesh codend. The L25, L50 and

Selectivity studies on the East coast



Foldable trap for reservoir fisheries

L75 values for *Dussumeria acuta* with 30 mm square mesh codend was 12.7, 14.7 and 16.7 respectively. Selection factor, selection range and selection ratio for *Dussumeria acuta* was 4.9, 3.9 and 1.3 respectively with 30 mm square mesh codend. The L25, L50 and L75 values for *Leiognathus splendens* with 30 mm square mesh codend was 4.8, 5.8 and 6.8 respectively. Selection factor, selection range and selection ratio for *L. splendens* was 1.93, 1.98, 0.6 respectively with 30 mm square mesh codend.

Improvements and standardization of traditional fishing systems

Foldable and collapsible type traps were designed and fabricated for use in reservoir fishing. The foldable trap is made with four square shaped iron frames of 4 mm diameter rods. All the four frames are held and tied together at one side. The remaining three sides are left free and allowed to spread. The outer two frames are left to lay to its opposite direction on the ground as trap bottom and the remaining two inner frames are kept to its 45-50° angle. All the four frames are covered with Nylon 210/1/3 square mesh webbing of 40 mm mesh The bottom part and two entrance funnels are covered with 40 mm mesh HDPE 1.25 mm dia. twine webbing. The foldable traps of 1.0 x 0.5 x 0.45 m size are field tested in an experimental tank. The total cost of the trap is Rs. 200/- approximately. A coconut piece is used as bait and kept in a bait bag and tied in the centre of a trap. It was observed that 40-50% of prawns entered into the trap in 30 minutes. This is more advantageous to traditional ones. The foldable Nylon traps are durable, easy to fabricate and easy to transport.

The collapsible trap is made with two square 4 mm diameter iron frames of 0.5 x 0.5 m size. The two frames are covered with HDPE 40 mm mesh size webbing. The entrance funnels are made of HDPE 20 mm webbing. Four disc shaped PVC floats are tied at four corners of upper frame to lift the trap and four sinkers are attached to the lower frame to hold the bottom of the trap.

The traps were distributed to the fishermen of Raiwada reservoir for fishing operations.

Data on reservoir fishery resources and CPUE per gear is being collected for incorporating into a GIS

Handing over of collapsible trap to fisherman at Raiwada reservoir

data base. GIS data base on fishery resources of reservoirs was initiated.

Upgradation of traditional fishing systems

Survey was conducted in artisanal fishing villages around Visakhapatnam and Bheemilipatnam on fishing methods and the catches prevailing. Monofilament gill nets targeted mainly to catch mackerels were operated, with mesh size of 4 to 6 cm. Smaller meshed trammel nets specially designed to catch prawns were also operated. These units made of Polyamide multi filament twine has inner layer of 20 mm mesh size and two outer layers of 100 mm mesh size. The good catches of oceanic resources has encouraged the fishermen to make innovations in use of Hand lines and Troll lines. Vertical lines with No. 9 mustad hook are targeted to catch seer fishes and No. 4 mustad hook is used for yello fin tuna and little tunas. Troll lines with hook No. 9 is used in troll lines. Good catch of tunas and shellfishes was seen.

Stock assessment of deep sea fisheries

Sampling was carried out in two experimental fishing cruises of FORV Sagar Sampada i.e. Cruise No. 241 and 247 (Leg-I & II). EXPO model fish trawl and HSDT (CV) were used for stock assessment studies. A total of 41 teleost species belonging to 29 families, five elasmobranchs belonging to three families, shrimp, crabs and squids were the catch. Shrimp consists of *Arestius alckoci*, *Solenocera hextii* and *Heterocarpus* sp. Crabs are mainly represented by *Charbdis smithi* and squids are represented by *Simplectoteuthis oualniensis* and *Loligo duvaceli* which was found to be distributed only between 101-200 m depth range.

In the West coast, maximum catch was observed at 110 – 120 Lat (122.75 kg/h) followed by 140-150 Lat (78.78 kg/h) and 130 – 140 Lat (58.44 kg/h). Where as in the East coast, catches were dominated at 190 – 200 Lat (566.81 kg/h) shelf area. In the depth wise high stocks were observed at 101-200m (265.79kg/h) followed by 601-700m (130.78 kg/h) and 801-900m (107.69 kg/h). Species belonging to *Priacanthidae* (16.26 kg/h) and *Stromatidae* (10.31 kg/h) are dominated in the deep sea catches.

A total of 1150 individuals of 27 fish species were studied for their gut contents, in which only 260 individuals were observed with food and other were with empty stomachs. *Nemichthys scolopasu* (75.56 g) followed by *Bathyuroconger brane* (65.00g) have shown high feeding intensities. *Synagrops japonicus* (4.25g), *Hoplostethus mediterraneus* (42.00g), *Psenopsis cyanea* (30.14 g) and *Eridacnis radcliffei* (26.51g) have shown medium feeding intensities, remaining other species collected exhibited ≤ 20 feeding intensities. Five groups of gut contents were observed in which crustaceans are the most frequently occurring group. These consisted of *A. alckoci* and *Heterocarpus* sp. and crustacean appendages. Fish group mainly consisted of mesopelagic lantern fishes, fish spines, scales and other unidentified fish species. Mollusc group is represented by squids.

To estimate niche variation and resource (food) partitioning, the diet composition data was subjected to un-weighed pair-group average (UPGA) hierarchical cluster analysis which formed five feeding guilds at ≥ 60% dissimilarity level. Guild 1 consisting of *Neopenula orientalis*, *Syngrops japonicus*, *Cubiceps basteri*, *Rauleia* sp., *Bathytroctes calcara*, *Psettodes erumei*, *Cynoglossus carpentari*, *Coloconger raniceps* and *Bathyuroconger brane*, had most evenly distributed diet array, and mollusc are the important prey groups. *Glyptophidium argentium*, *Neobythtis steatite*, *Psenopsis cyanea*, *Luciobrotula bartsch*, *Dicrolene tristis*, *Hypopleuran canium* and *Nemichthys scolopasu* are forming Guild 2, which fed on crustaceans. Five species viz. *Xenomystax trucidens*, *Alepocephalus bicolor*, *Bembrops caudimaculata*, *Chelidoperca investegatoris* and *Hoplostethus mediterraneus* are forming Guild 3, which fed on crustacean and other miscellaneous items. *Corypaenoides macrolepis*, *Saurenchelys taenolea* and *Lamprogrammus exutus* are forming Guild 4, feeding on fish and crustaceans. *Eridacnis radicliffei* forming an individual feeding guild fed on all prey groups, showing 100% dissimilarity with teleostians.

Gel formation capacity of freshwater fish meat and product development

During the storage (-20°C) of degutted mrigal (*C. mrigala*) and common carp (*C. carpio*) for 12 months, the gel strength of the meat of mrigal and common carp decreased from 450 to 280 gcm and 420 to 210 gcm respectively. Rapid decrease of gel strength was noticed during the first six months. 15-20% loss of salt soluble protein content in meat was noticed during the entire storage period of two species. Slow increase of total volatile base nitrogen content and hypoxanthine content in both species was noticed during storage. The spread of red colour from red muscle to white muscle was noticed in all cases on storage. The fading of the myosin bands in the SDS-PAGE pattern of both fish meats was observed during the storage.

Histamine and histamine forming bacteria in salted and dried fishery products

The histamine level in the meat of salted (10-11%) and dried (28-32% moisture) flying fish (*C. cyanopterus*) increased during storage at ambient temperature. Salted and dried mackerel and seer became too rancid and discoloured after three months and six months espectively but flying fish retained acceptable appearance with high level of histamine (> 100 mg%) even after six months of storage. Two halotolerant histamine forming bacteria were isolated from the salted and dried flying fish which could produce histamine in 10% and 20% salted histidine broth.

Value added products from marine and freshwater fish

The storage studies of the edible fish powder prepared without deboning from small sized freshwater fish (< 500g), catla (*Catla catla*), common carp (*Cyprinus carpio*) and medium sized ribbon fish (*Lepturacanthus savala*) have been completed. The fish powder stored well at room temperature for five months, six months and six months respectively. The chemical composition of freshly prepared edible fish powder from catla was Moisture – 3.47%, Protein – 69.97%, Fat – 3.22%, Calcium – 1529 mg%, Phosphorus – 1801 mg% and Iron – 4.65 mg%.

The powder was free from *E. coli*, coagulase positive Staphylococci and fungi. The fresh powder had a water activity (a_w) of 0.259.

The chemical composition of freshly prepared edible fish powder from ribbon fish was Moisture – 2.61%, Protein – 72.15%, Fat – 8.87%, Calcium – 827 mg%, Phosphorus – 1663 mg% and Iron – 5.42 mg%.

Changes in biochemical and microbiological parameters were noted during storage of fish powder at room temperature and were found to be within acceptable limits. The edible fish powder was found to be rich in protein, calcium and phosphorus and can be used as a fortifying agent to improve the food value and taste of different food items.

Fish enriched noodles

Fish noodles were prepared using small sized freshwater rohu (<500g). Edible fish powder prepared from rohu was incorporated at 15% level in flour dough. The nutritional composition, quality and organoleptic assessment of fish noodles were carried out.

Fish enriched noodles prepared from rohu

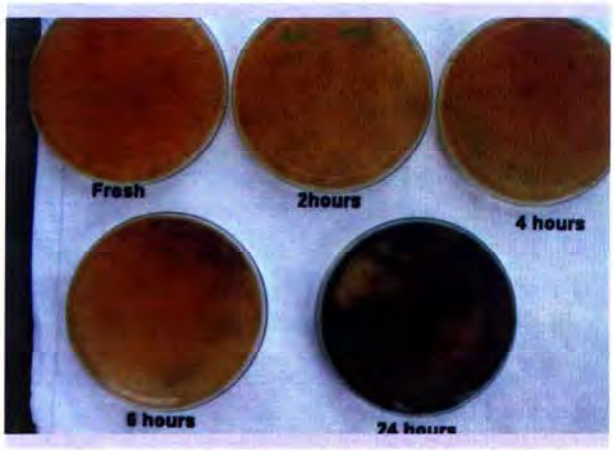
Value added frozen products from thermal processed freshwater fish

Ready-to-fry instant dough was prepared from thermally processed small sized rohu (<500g). Control (dough with 1.5% salt) and treated (dough with salt, spices, potatoes and onions) samples were pressed into different shapes using Aluminum moulds and stored in frozen storage at -20°C. Overall

quality of the products was good even after two months of storage and further studies are under progress.

Pathogenic bacteria in fish and fishery products

Changes in the bacteriological quality of fresh water fish, rohu (*Labeo rohita*) kept at ambient temperature were studied. Hydrogen sulphide (H_2S) producing bacteria showed marked increase during spoilage. During the first two hours of storage there was negligible increase in H_2S producing bacteria but by the end of four hours the counts were above 1000 cfu/g. Thereafter, there was rapid increase in H_2S producing bacteria, count reaching a value of 2.5 x 106 cfu/g after 24 hours. Changes in the Hydrogen sulphide (H_2S) producing bacterial loads in the mucus of rohu kept at ambient temperature and at 1-4°C were also studied. H_2S producing bacteria showed marked increase during storage of mucus at room temperature from 2400 cfu/ml (at 0 hours) to 40,000cfu/ml (at the end of 24 hours of storage). In mucus stored at 1-4°C, the increase in H_2S producing bacteria counts were relatively lower and reached a maximum value of 7200 cfu/g at the end of 24 hours of storage. The bacteria present in the mucus were able to produce H_2S under aerobic and anaerobic conditions.



Increase in Hydrogen sulphide producing bacteria during spoilage of freshwater fish

Freshwater fish (*Catla catla* and *Labeo rohita*) procured from domestic markets had more than acceptable levels (above 100 cfu/g) of coagulase positive Staphylococci. However, Salmonella, Listeria and *Vibrio cholerae* were not detected in these fish samples.

Preliminary studies on Acetes shrimp and health benefits

To evaluate the neutraceutical and pharmaceutical use of Acetes shrimp by direct consumption, the nutritional elements like protein, fat, calcium, P, Fe, Chitin and colour pigments in the whole Acetes shrimp collected locally were estimated.

Preliminary studies on the accumulation of Cadmium in cephalopods

To know the Cd contamination levels in the cephalopods from the region, different varieties of cephalopods available were collected. Edible tissues like body part, tentacle meat etc. were analysed. Some new varieties of cephalopods caught by FORV Sagar Sampada during its East coast cruise were examined for Cd concentrations.

Surveillance of crustaceans for shrimp viruses and Vibrios

Ten samples of post-larvae of *Penaeus monodon* from hatcheries were screened for the presence of WSSV and two samples were found to be positive for the presence of WSSV in the second step of nested PCR. Pathogenic Vibrios such as *Vibrio vulnificus, V. alginolyticus, V. harveyi* and *V. cholerae* Non O1 were isolated from *P. monodon* hatcheries and aquaculture farms. The diversity of Vibrios appears to be greater in hatchery environment than in aquaculture farms. Antibiotic resistance pattern of pathogenic Vibrios was studied. *V. vulnificus* isolates showed resistance to Gentamicin and Ampicillin and were sensitive to Chloramphenicol, Norfloxacin and Tetracycline. *V. alginolyticus* isolates were resistant to Nitrofurantoin, Ampicillin. *V. cholerae* Non O1 and *V. harveyi* showed resistance to Ampicillin. The response of Vibrios to different salt concentrations and pH was studied. *V. alginolyticus* was found to be capable of metabolizing amino acids and sugars over a wide range of salt concentrations.

National Risk Assessment Programme for fish and fish products

Microbial risks associated with freshwater fishes *L. rohita*, *C. catla*, giant fresh water prawn *M. rosenbergii* and brackish water shrimp *P. monodon*, produced in Andhra Pradesh was studied. A total of 113 samples comprising of *L. rohita* (40 samples), *C. catla* (28 samples), *M. rosenbergii* (20 samples), *P. monodon* (23 samples) and *P. indicus* (1 sample) were analysed. Freshwater prawn samples had higher mean Total Plate Count (TPC) levels (3.1 x 107 cfu/g) than brackish water shrimp (1.5 x 10^6 cfu/g) and fresh water fish samples (1.3 x 10^6 cfu/g). 29% of *C. catla* samples, 43% of *L. rohita* samples, 46% of *P. monodon* samples and 65% of *M. rosenbergii* samples had TPC values above 5x10^5 cfu/g. Faecal *Streptococci* was the most frequently encountered faecal indicator in fish. *E. coli* counts were comparatively higher in fresh water prawn samples. 23% of rohu, 32% of catla, 25% of Black Tiger shrimp and 50% of scampi samples had *E. coli* counts above the maximum acceptable limit of 20/g. *Salmonella* and *V. parahaemolyticus* were not detected in rohu, catla, scampi and Black Tiger shrimp. The percentage incidence of *V. cholerae* in fish and prawns was about 6%. 48% of *E. coli* isolates from fish and prawn procured from Andhra Pradesh were sensitive to all ten antibiotics tested. *E. coli* strains showed no resistance to Gentamicin; very low resistance towards Chloramphenicol (1%), Norfloxacin (3%) but higher resistance towards Ampicillin (26%) and Tetracycline (19%).

The quality of freshwater fish, scampi and Black Tiger shrimp with respect to faecal indicator bacteria needs improvement. There is an urgent need to popularize good hygiene and sanitation practices among fish farmers and fish handlers. The risks in the form of development of antibiotic resistance towards medicinally important antibiotics in bacteria (*E. coli*) isolated from freshwater fish, scampi and Black Tiger shrimp was negligible.

Veraval Research Centre

Research projects handled

- Studies on processing parameters and indices of fish and fishery resources and products specific to Gujarat
- Investigations on responsible trawl systems for mechanized sector
- Application of Remote Sensing and GIS for marine fisheries resource management
- Investigations on the effect of bottom trawling on the benthic fauna of Saurashtra coast (Gujarat)
- Marine fisheries appraisal of Maharashtra
- Marine fisheries appraisal of Gujarat

Chief findings

- Microbiological and chemical parameters when tested for the fresh squid, the total Coliforms count were found to be increased from 110 MPN/g to 140 MPN/g and faecal Coliforms from Nil to 140 MPN/g.
- *Oratosquilla nepa*, a Squilla species available along Gujarat coast was collected from the fishing vessels and analyzed for various proximate composition and biochemical tests. The interesting observation was that, heavy metals like Cadmium was found upto 8 ppm.
- *Crassostrea gryphoides*, a giant edible Oyster collected from Navibandar area was analysed for proximate composition and microbiological parameters.
- Fresh and frozen samples of Scombroid fishes like Skipjack tuna (*Katsuwonus pelamis*), Yellow fin tuna (*Thunnus albacares*), Indian Mackerel (*R. kanagurta*), King fish, Horse mackerel (*M. cordyla*) etc. were monitored for the presence of Histamine and Mercury contents. The Histamine content was found to be in the range of 1.73-58 ppm, within acceptable limits and Mercury was found to be very low. In the ink samples from Cephalopods the Cadmium content was in low concentrations ranging from 0.2 - 1.9 ppm.
- Studies on processing and quality aspects of air bladder for export market from species like Koth and Ghol was carried out.
- Studies on the impact of semi-pelagic and bottom trawling operations in terms of biodiversity revealed that the semi-pelagic trawl system has a lower impact on the resources in terms of biodiversity, characterizing it as an eco-friendly trawl system.
- Preliminary survey of the small-scale mechanized trawlers operating from Veraval harbour showed that 69.8% of the vessels belong to the category 15-15.6 m LOA.
- Significant changes in the turbidity and TSS of water were found immediately after bottom trawling. Total biomass of macro and meiobenthos fluctuated due to the trawling disturbance.
- In the near real time fishing along the PFZ advisories derived from the three parameter approaches developed by Space Applications Centre, average CPUE/hr from the PFZ areas were found to be 36.99 ± 3.49 S.E, whereas the CPUE/hr realized off Veraval from Sagarkripa from non-PFZ areas was worked out to be 13.01 ± 1.90 S.E.
- Geo-referenced catch details from commercial fishermen were correlated with PFZ advisories of INCOIS and the mean CPUE recorded was worked out to be 49.20 ±4.88 per hour.

Report of work done

Processing parameters and indices of fish and fishery resources and products specific to Gujarat

Frozen storage studies on processing and quality aspects of Squid *Uroteuthis (Photololigo) duvauceli*

Air bladder of Koth and Eel being dried

Value added shrimp product

was carried out. In India frozen squid export recorded an increase of 8.79%, 20.59%, 22.59% and 12.50% in terms of quantity, value (US$) and unit value realization respectively. The catch and export of squid has increased significantly from Gujarat. In 2005-06, the frozen squid and cuttle fish to the tune of 21105 and 16538 metric tons were exported and valued at 203.05 and 141.56 crores rupees respectively from Gujarat region. Fresh squids were collected from the landing center and was frozen at -40^{0}C. Storage studies were carried out for microbiological and chemical parameters. The total Coliforms count increased from 110 MPN/g to 140 MPN/g and fecal Coliforms from Nil to 140 MPN/g. However all foodborne pathogens were found to be absent in storage samples.

Oratosquilla nepa, a squilla species available at Gujarat coast was collected from onboard and analyzed for various proximate composition and biochemical tests. The total protein, moisture, total lipid and minerals were 16.21%, 80%, 1.2% and 2.5% respectively. The interesting observation was that, heavy metals like Cadmium was found upto 8 ppm. The study is under way.

Crassostrea gryphoides, a giant edible Oyster collected from Navibandar area was subjected to various compositional and microbiological tests. The average weight of the Oyster was 48 g, moisture content 89.7% and protein 4.57%.The *E. coli* count was 75 MPN/g and metals like Cadmium, Lead, Copper, Iron and Magnesium are 0.71, 3.33, 37.63, 29.88, 606.01ppm respectively.

Samples of fresh and frozen Skipjack tuna (*Katsuwonus pelamis*) and Yellow fin tuna (*Thunnus albacares*) were analyzed for Histamine and Mercury contents. The Histamine content was found to be in the range of 1.73-58 ppm, within acceptable limits and Mercury content was low.

Trials were conducted on prawn recipes of Gujarat region like dried Bombay duck curry, Prawn pulp curry, seer fish curry and prawn biriyani. Their suitability and standardization for pouch packing is being conducted at the Head Quarters.

Value added seafood product

Responsible trawl systems for mechanized sector

The catch retained in bottom trawl (34 m HOBT)

and semi-pelagic trawl was analysed in terms of their impact on biodiversity. Different diversity indices like Shannon-Wiener index (H'), Margalef's index (d), Pielou's evenness index (J'), Simpson's diversity index (1-λ'), Brillouin index (H) and Fisher's index (α) were used to discriminate catch figures of both forms of trawling. The mean H' in bottom trawl (1.19 ± 0.081 S.E.) was found to be higher than the mean H' of semi-pelagic trawling (0.823 ± 0.081 S.E.), indicating higher biodiversity impact of the bottom trawl. The catch retained in bottom trawl was found to have more species (S) than that of semi-pelagic trawl.

Species richness calculated as per Margalef's index (d) revealed a different scenario, where although the mean d ± S.E. for bottom trawl (1.46 ± 0.123) was slightly more than that of semi-pelagic trawl (1.37 ± 0.108), there was no significant difference between them at $p<0.05$ level. Pielou's evenness index (J') suggested that different species retained in semi-pelagic trawl are more evenly (equitably) distributed than those encountered in bottom trawl.

Bycatch collection from private trawler

Three designs of net were tried during the period for 38 m bottom trawl with 40 mm square mesh codend, 34 m HOBT with 40 mm square and Diamond mesh codend and semi-pelagic trawl (18 m RMT 8P) with codend mesh size of 50 mm. The retention CPUE for 50 mm diamond mesh codend for semi-pelagic trawl was worked out to be 29.03%, for the 38 m Bottom trawl (40 mm Square mesh), the retention was 17.89 % and that for the 34 m HOBT Diamond mesh codend the retention was 24.56%. The major species retained in the codend were *Trichiurus lepturus* ,*Johnius dussumieri*, *Sepiella inermis* and *Uroteuthis (Photololigo) duvauceli*. The major species that escaped constituted of juveniles of *T. lepturus*, *Parapenaeus longipes* and *Thryssa dussumieri*.

Selectivity parameters for commercially important fish species were derived using cover codend method. The selection factors for commercially important fish species was determined.

Sampling onboard

Remote sensing and GIS for marine fisheries resources management

Near real time fishing was carried out in the identified Potential Fishing Zones developed from the three parameter approach by Space Applications Centre (SAC), Ahmedabad. Department fishing vessel MFV Sagarkripa was employed for ground truth validation studies. PFZ from INCOIS was also validated by collecting data from the local fishermen. Plankton profile and pigment characterization studies were carried out upto a depth of 50 m off Veraval. The samples were processed in liquid nitrogen and analyzed at NIO, Cochin. The main species encountered were *Coscinodiscus* sp., *Navicula* sp. *Rhizosolenia* sp. and *Chaetoceros* sp. For developing a cumulative suitability index for inclusion in GIS, data regarding the fishermen

villages, number of fishing vessels and other demographic data were collected from Fisheries Department of Okha, Mangrol, Veraval and Diu.

Effect of bottom trawling on the benthic fauna off Saurashtra

The experimental stretch was divided into five zones from 15 m to 40 m off Veraval and the experimental corridors were randomly selected in the respective depth zones. Trawling in the experimental corridor was carried out with a 34 m High opening bottom trawl with 7 nos. of 30 cm dia. floats, 20 kg sinkers and a codend mesh size of 40 mm.

***Physico-chemical parameters*:** The physico-chemical parameters of water like salinity, pH, temperature, turbidity, transparency, dissolved Oxygen, chlorophyll content, nitrates, phosphates, silicates, TDS, TSS and conductivity were analyzed. TSS and turbidity were the only factors that were showing some changes before and after the trawling and all other parameters showed no significant change before and after the trawling disturbance.

Changes in the benthos distribution: Observations revealed that the total biomass of the macrobenthos fluctuated at all stations after the trawling operations. The major group of macrobenthos encountered both before and after trawling were Polychaetes, Crustaceans, Coelenterates, Molluscs, Echinoderms, benthic fishes and unidentified fragments. Polychaetes, coming under the families Oweniidae, Amphaeretidae, Spionidae, Sepulidae, Hesionidae and Scalibregmatidae formed the major group of organisms before and after sampling in all the stations. Crustaceans constituted of prawn juveniles, copepods, ostracods and lobster larvae. Gastropods and bivalves were the major components among the mollusks. Brittle stars were the only organisms that formed the component in Echinodermata. Juveniles of *Trypauchen vagina* and *Polynemus hexadactyla* form the fish component among the benthos.

Burla Research Centre

Research projects handled

- Post harvest technologies of freshwater fish in Orissa, adjoining states and NEH region
- Exploration of potential fishing zones (PEZ) of major reservoir systems

Chief findings

- Significant difference in mesophilic, aerobic and hygiene indicator bacteria was found in commercially sold freshwater fish at different stages of processing i.e., before and after washing, and between edible meat portion and intestinal flora.
- All Streptococcal and Staphylococcal strains isolated from freshwater fish, fish curing environments and fishery products showed resistance to Vancomycin at 5, 10 and 3 level.
- The overall quality of fish smoke cured in Working Model (movable) of CoFiSmKi was better than the permanent (un-movable) model of CoFiSmKi.
- Studies on flavor imparting by botanical means such as curry leaves, basil leaves and clove oil in smoke curing of *Gudusia chapra* showed better quality to that of control.
- Survey work carried out in fishing villages adjoining Rengali reservoir in Deogarh district to develop suitable gears based on the traditional ones revealed significant results.

Report of work done

Quality assessment of freshwater fish of wet fish markets

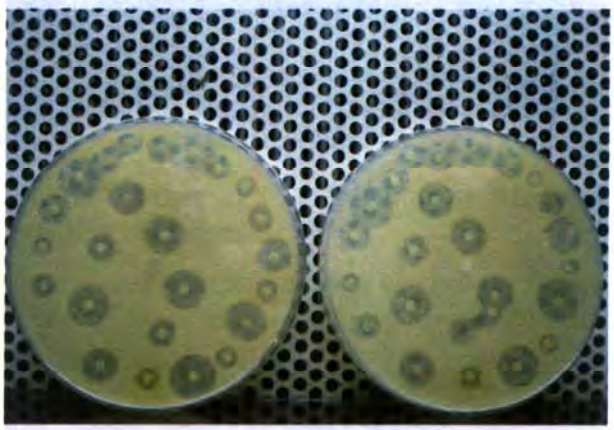
Fish samples collected from different markets of Sambalpur were tested for the quality parameters which included moisture, fat, TVN, alpha-amino Nitrogen, peroxide value, TPC, Coliforms, *E. coli*, total Staphylococci, coagulase positive Staphylococci and sensory characteristics.

Studies on *Gudusia chapra* at different stages of smoke curing

Bacteriological, physical and sensory studies were carried out on *G. chapra*, a freshwater fish collected from local fish markets at different stages of smoke curing in controlled conditions. Significant difference was observed in all quality parameters of raw fish, immediately after curing and after few days of curing.

Antibiotic resistance of Streptococcal and Staphylococcal isolates

Streptococcus and Staphylococcus isolates from different sources were subjected to sensitivity tests to 51 different antibiotics. All the isolates were resistant to Vancomycin at 5,10 and 30 μ level. With other antibiotics, the response varies from isolate to isolate.



Antibiotic resistance pattern in Staphylococci

Bacteriological studies on post harvest handling of freshwater fish

Bacteriological studies were carried out on freshwater fishes on different stages of handling i.e., before and after washing and also on edible meat portion and on gut-flora of the fishes. Quality of value added products developed at the Centre were screened. Fish samples were screened for Salmonella

and other bacteria both in edible meat portions and viscera. Marked difference is seen in occurrence of these bacteria in the parts. Suspected Salmonella were isolated (>20 strains) for further characterization. Samples were screened by employing traditional as well as rapid detection methods. None of the strains were Salmonella.

Quality assessment of *Gudusia chapra* smoke curred in two different fish smoking kilns

Bacteriological studies were carried out on *G. chapra* smoke cured by using two models of CoFiSmKi developed at the Centre. The overall quality of fish smoke cured in Working Model (movable) of CoFiSmKi was better than the permanent (unmovable) model of CoFiSmKi.

Smoke cured fish

Flavour enhancing studies in smoke curing of low cost fish

As a part of flavor imparting studies by botanical means, curry leaves, basil leaves and clove oil were employed in smoke curing of *G. chapra* by using two models of CoFiSmKi developed at the Centre. Bacteriological, biochemical and sensory characteristics of control and experimental products was assessed.

Optimization and up-gradation of traditional fishing systems for inland fisheries

Collapsible fish traps with (1.1 m x 0.7 x 0.6 m) frame covered with black nylon webbing (80 mm mesh size and 2 mm twine size) with a frame made up of 6 mm SS rods were introduced for inland fishing.

Comparative studies were undertaken with High Tenacity Monofilament Twine with different mesh sizes with Nylon Multifilament Twine 210D/1/2 and the fish catches were more with multifilament twine.

Fishing operations undertaken were: 33 operations employing HTM simple gillnet, 46 operations employing Nylon twine 210D/1/2 of Simple gillnet, 39 operations with collapsible traps and 39 operations with hook line.

Out of 33 fishing operations conducted with HTM simple gillnet employing different mesh sizes from 30 to 60 mm with 5 mm intervals, highest catch was recorded with 40 mm mesh size. The dominating species were *E. vacha* and *C. mrigal* consisting 14% each among the total catches. Whereas, operation of simple gillnet (46 operations) with same mesh sizes and intervals showed highest catches at 35 mm mesh size and *S. silondia* was highest among all consisting 34.8% of total fish catches.

Survey work on traditional operating fishing gear in Rengali reservoir, Orissa, revealed that:

1. In mounting head rope the hanging coefficient was irregular
2. No footrope is seen with any gillnets under operation, and
3. Maintenance of fishing gear was minimal and this is identified as potential area of imparting training to the fishermen.

Extension Activities

The Centre organized training cum demonstrations on *"Hygienic preparation of smoke cured freshwater fishes and prawns" and "Eco-friendly fishing gear for sustainable fisheries"* as listed below:

(i) At Sapne, Sambalpur district on 20th and 21st February, 2006. The Community Fish Smoking Kiln built at the village was formally inaugurated by District Magistrate and Collector, Sambalpur, Government of Orissa and keys of smoking kiln were handed over to the Secretary, Women Self Help

Burla model CoFiSmKi

CoFiSmKi inauguration at Sapne

Group. The kiln will be used for the benefit of fisher women groups. A total of 100 fishermen and women participated in the programme.

(ii) At Barkote, Deogarh district, Orissa from 6th to 8th March, 2006. A total 32 fishermen all belonging to ST category attended training on experimental fishing and twines were distributed free of cost to all fishermen for fishing operations. A total of 13 women Self Help Groups were trained on *Preparation of value added products from freshwater fishes and prawns*. Among the women trainees 23.5% belonged to SC while 74.5% were ST and the rest belonged to OBC groups.

(iii) At Thebra, Jharsuguda district on 17th and 18th March, 2006. Community Fish Smoking Kiln built for the benefit of fishermen community of Thebra was inaugurated by Deputy Director, Fisheries, Government of Orissa and the keys were handed over to the Secretary of Women Self Help Group. Among the beneficiaries 58.5% and 41.5% were females and males, respectively. The female trainees included 10% SC, 87% ST and 3% OBC. And among male beneficiaries were 23% SC, 73% ST and 4% OBC.

(iv) At Jhikimikisahi, Deogarh district on 22nd and 23rd July, 2006. One smoking kiln was inaugurated by the District Collector, Deogarh, Orissa and keys of the kiln were handed over to the Secretary, SHG of the village.

As a part of village adoption programme follow up, technological needs in four fishing hamlets, Sapne, Rampaluga, Thebra and Pujaripali (Jampali) were assessed and minor operational problems associated with all the Community Fish Smoking Kilns were attended. In all the four fishing villages lemon saplings were distributed to cater the future Vitamin C requirements. Lemon is one of the major ingredient in the preparation of smoked fish curry.

In Jhikimikisahi smoke curing of fish was demonstrated on 30th & 31st August. Personal hygiene aspect was also demonstrated employing Palm Impression Technique. Second CoFiSmKi at Jhikimkisahi was inaugurated on 7th October, 2006 by Dr. B. Meenakumari, HOD, FT, CIFT in a glittering ceremony and the keys were handed over to the Secretary of women Self Help Group of the village. Dr. Meenakumari also distributed nets to the selected economically under-privileged fishermen.

Handing over of keys of CoFiSmKi

Mumbai Research Centre

Research project handled

- Chemical and microbiological evaluation of marine and inland fish and fishery products of Maharashtra

Chief findings

- Studies on dry fish revealed that market samples had moisture content of more than 20% and sand content was less than 1%. Shelf life of dried Ribbon fish (*Trichiurus lepturus*) from market stored at ambient temperature under laboratory conditions was found to be four months, while it was five months for *Harpodon neherius* and *Coilia dussumieri* and more than six months for *Acetes indicus*.
- Analysis of 38 samples of fresh fish from markets indicated that overall quality of fresh fish in retail market was good. Thirteen samples were contaminated with *E. coli* and 14 samples were contaminated with Coagulase +ve Staphylococci. However the counts were less than 20 in all positive samples.
- Good quality fish wafers were prepared from Rawas (*Elethronema tetradactylus*), Karali (*Chirocentrus dorab*) and Chor bombil (*Saurida tumbil*) using corn flour and Sago powder. Addition of Tomato puree gave good flavor and pleasant color to the product.

Report of work done

Studies on storage of dry fish

Storage studies at ambient temperature of dry fish samples belonging to *Harpodon nehereus*, *Lepturacanthus savala*, *Coilia dussumieri* and *Acetes indicus* from retail markets of Dadar was carried out. Initially all samples were free from visible insect intestation. After one month storage, insect infestation was observed in all samples except *A. indicus*. On storage *H. nehereus* was seen infected with Lasioderma and Necrobia. Heavy insect infestation of Dermestes was observed in *L. savala*. *C. dussumieri* was infested with Dermestes and Necrobia. Fungal infection was also observed in Bombay duck. There was heavy damage due to insect infestation and larvae after three months storage. Insects infestation was not observed in *A. indicus*. Shelf life was four months for *L. savala*, five months for *H. nehereus* and *C. dussumieri*. It was more than six months for *A. indicus*. The samples were collected and stored during monsoon and initial moisture content was more than 20% which affected their shelf life. Sand content was less than 1% in all samples.

Proximate composition of dry fish samples before storage

Name of species	Moisture %	Ash %	Salt %	Acid insoluble ash %
Harpodon nehereus	23.61	12.70	2.62	0.94
Lepturacanthus savala	22.80	13.10	2.83	0.63
Coilia dussumieri	22.08	12.92	2.51	0.54
Acetes indicus	22.29	21.70	3.82	0.34

Five Dermestes adult insects were introduced in 50 grams each of above four samples to study its effect. Live adults and larvae were observed after one month storage. After two months, dry fish was unfit for human consumption. *L. savala* was most damaged.

Five samples of dry fish belonging to *C. dussumieri*, *A. indicus*, *H. nehereus*, salted *Rastrelliger kanagurta* and salted *Scomberomorus* sp. from Marol market were analyzed for proximate composition. Moisture content was less than 20% in *H. nehereus*. No insect infestation was observed initially as well as after two months of storage.

Quality of fresh fish from retail market

A total of 38 samples of fresh fish belonging to 28 species from Vashi retail market were analyzed.

The samples were analyzed for bacterial quality including faecal indicator organisms and for the presence of pathogens. T.B.C./g was lowest in *Johnius dussumieri* at 34,500 while it was highest at 3,84,000 for *Sphyrena jello*. Twenty samples had T.B.C. more than 1,00,000 per gram. *E. coli* was detected from 13 samples and none of the samples had count more than 20 per gram. Coagulase +ve Staphylococci was detected from samples and counts were less than 20 in all samples. *Salmonella, V. parahaemolyticus, V. cholera* and *Listeria* were absent in all the samples analyzed. Based on organoleptic, biochemical and bacterial parameters, overall quality of market samples were found to be good except presence of *E. coli* in 13 samples and Coagulase +ve Staphylococci in 14 samples.

Quality of ice and water from retail market

Analysis of three samples of ice and water showed that two samples of ice was contaminated with faecal Coliforms. T.B.C. of more than 100 per m.l. was observed in two ice and one water sample. *V. cholera* was absent in all samples analyzed.

Value added fishery products and proximate composition

***Fish wafers/flakes*:** Wafers were prepared from *Chirocentrus dorab, Lepturacanthus savala, Eleuthronema tetradactylus, Upeneus sulphureus, Scomberomorus commersoni, Saurida tumbil, Megalapsis cordyla* and *Johnius dussumieri*. It was observed that wafers from *E. tetradactylus, C. dorab* and *S. tumbil* were of better quality in crispness, flavour and taste. Product using corn starch, arrowroot and sago flour along with tomato puree had good colour and flavour. Composition formula for making a good product is worked out. The cost of product is worked out to be Rs. 20 per 100 gram for *E. tetradactylus* locally called as Rawas, which is a fairly costly fish in Mumbai. Final cost of product depends mostly on the cost of fish.

***Fish sauce*:** Sauce was prepared from *C. dorab* locally called Karali by self fermentation. The fishes are cut into pieces and mixed with salt in 3:1 ratio. After a few days saturated brine is added and proximate composition is determined. It is kept at ambient temperature for fermentation.

***Pickle from non-penaeid prawns*:** Prawn pickle was prepared with CIFT method using non-penaeid prawns locally called as Karali. They are small non-penaeid prawns of *Paleomon* sp. which are used for drying and fetch less value. The falvour and taste was good. The pickles were stored at room temperature in glass bottles and studied for shelf life. It was in good condition up to six months.

***Proximate composition*:** Proximate composition of *Lacterius lacterius, Cynoglossus dubius, J. dussumieri, S. tumbil, Selago cema, U. sulphureus* and Kuchi (Perch) was carried out.

Analysis of industrial samples

***Analysis of ice and water*:** A total of 27 samples of ice were analyzed for bacterial quality. The samples are analyzed for IS 4257 or as "E" parameters of EU requirement. Thirty water samples were analyzed either as per IS 4257, "E" parameters of EU requirement or as per 98/83/EEC based on request from processing units.

***Analysis of sea foods from fish processing factories*:** Forty three samples of fish, crustaceans and cephalopods were analyzed for bacterial quality. The samples were analyzed for total bacterial count, *E. coli* count, fecal Coliforms count, Coagulase +ve Staphylococci count and for the presence of Salmonella, *V. cholera, V. parahaemolyticus* and Listeria.

***Chemical analysis of commercial samples*:** Two samples of frozen fish were analyzed for TVBN and one sample was analyzed for presence of TMA.

Transfer of Technology

Transfer of technology programmes in NEH region

The technology transfer programmes envisaged by CIFT under NEH component are given below:

- Fabrication of FRP boats and trainings (Manipur)
- Technology transfer on preparation of value added fish products, fish drying and fish ensilage (Manipur)
- Training on hygienic handling of fish and quality control aspects (Nagaland)
- Training on responsible fishing and extension methods (Arunachal Pradesh)
- Fabrication and training on improved gill nets and collapsible fish traps (Manipur)
- Fabrication, installation and training on Community Fish Smoking Kilns (Manipur)

Participation in North East Agri-Expo 2006

CIFT participated in the Agri-Expo 2006 from 27 to 31 March 2006 at Dimapur, Nagaland, which was organized by the Govt. of Nagaland in collaboration with ICAR, New Delhi and other organizations. Dr. Mangala Rai, DG, ICAR, Shri Neiphiu Rio, Hon'ble Chief Minister, Govt. of Nagaland and Shri Sharad Pawar, Hon'ble Union Minister for Agriculture visited the fisheries stall at NE Agri-Expo.

Dr. Nawab Ali, DDG (Engg.) and Dr. S. Ayyappan, DDG (Fy.), ICAR at the NE Agri Expo near the CIFT Solar tunnel dryer

Fabrication of FRP boats and training

During the period, 48 persons selected by the Department of Fisheries, Manipur were trained in FRP boat building and insulated icebox fabrication. Training was conducted in two batches and the duration of training was 45 days for each batch. Thirty eight FRP boats of size 5.55 m to 6.20 m fabricated at Manipur were distributed to fishermen by the Hon'ble Fisheries Minister Shri N. Mangi Singh on 19 July 2006 in the presence of Dr. K. Devadasan, Director, CIFT and Shri Sarat Kumar Singh, Director, Dept. of Fisheries, Manipur. The FRP boats distribution function held at the Lamphelpat ICAR Complex was jointly organized by CIFT and Fisheries Department, Govt. of Manipur. The Fisheries Minister, in his address hoped that fishermen of Manipur would find the FRP boats more convenient and efficient than the wooden boats they have been using traditionally. CIFT has also requested the Director, Dept. of Fisheries, Manipur to arrange the materials and labourers required for the FRP boat construction at Imphal during 2007 so as to continue the programmes further.

Distribution of FRP boats at Manipur

Training on Preparation of value added products, fish drying and fish ensilage

A training programme on the Preparation of value

added products, fish drying and fish ensilage was conducted from 17 to 19 January 2007 at Imphal, Manipur. Twenty one entrepreneurs from Self Help Groups and nine department officials attended the training. Demonstrations of the products have already been carried out in Assam, Meghalaya and Arunachal Pradesh. Preparation of value added products is being promoted as a Self Help Group activity with the help of the respective state governments.

Training on Hygienic handling of fish and quality control aspects

A training course on Quality control aspects of fish was conducted at CIFT, Cochin from 16 to 28 October 2006 for three fisheries officials deputed by the Director of Fisheries, Govt. of Nagaland.

Training on Responsible fishing and extension methods

In collaboration with Krishi Vigyan Kendra (KVK), Deomali, Tirap district, Arunachal Pradesh, two one day training programmes on Responsible fishing and extension methods were organized for the fisherfolk and fisheries officials of the district on 16 and 17 January 2007.

On 16 January 2007, the training was conducted at KVK Campus, Deomali and Shri S.C. Debnath, SDO, Deomali chaired the inaugural session of the training programme. District Fisheries Development Officer, Shri L. Lassa presented an overview of fisheries in the district. Dr. S. Balasubramaniam, Head, EIS Division, CIFT inaugurated the programme. Thirty participants attended the programme at Deomali.

Inauguration of the training programme at Deomali

The second training programme on 17 January 2007 was held at Khonsa, which was attended by 40 fisherfolk and officials. Inaugurating the training, Tirap district Deputy Commissioner Shri T. Tapok said that traditional fishing method by using poison was not only destroying fish production in larger scale, but also polluting the environment. Therefore, there must be a complete ban on widely practised traditional methods of fishing. He called upon the trainees of the district to take maximum benefit from the training programme.

Another training programme for Fisheries officials was inaugurated by Smt. Varsha Joshi, IAS, Secretary, Dept. of Fisheries, Govt. of Arunachal Pradesh at State Institute of Rural Development at Itanagar on 19 January 2007. Thirty Fisheries Officials deputed by the Directorate of Fisheries, Govt. of Arunachal Pradesh attended the training on Responsible fishing and extension methods.

Smt. Varsha Joshi inaugurating the training at Itanagar

Training on FRP sheathing of low cost wood canoes

A demonstration cum training programme on FRP sheathing of low cost wood canoes was held at Guwahati, Assam during 15 October to 11 November 2006. Three 'Bengali type' wooden fishing canoes of 8.0 m, 9.6 m and 12 m made of easily available low cost woods such as 'Poma' and 'Pine' were constructed and sheathed with FRP. The completed

canoes were handed over to the Department of Fisheries, Assam which was later given to fishermen for operation.

Fabrication and training on Improved gill nets and collapsible fish traps

For conducting TOT programmes on Improved gill nets and collapsible fish traps at Manipur, net webbings and other accessories for 450 units of improved gill nets and SS frames and accessories for 90 collapsible fish traps were purchased. After fabrication, five units of improved gill nets and one collapsible fish trap will be given to each fisherman trained, and it is proposed to train about 90 fishermen during the year 2007. Two training programmes were conducted at Imphal West and Moirang (near Loktak lake), Manipur during 23-27 March, 2007 on Fabrication of improved gillnets and collapsible fish traps.

Fabrication, installation and training on Community Fish Smoking Kilns

The quality assessment made at Burla Research Centre on commercial smoke cured freshwater fish and shellfish revealed that major portion of the samples are charred and unfit for human consumption. The samples contained not only broken pieces of product which accumulate as waste but also unwanted material such as mud particles and charred (small) pieces of wood, twigs of trees and often stones. The physical, bacteriological, biochemical and sensory characteristics of the products are very poor. The shelf life of product is less than three weeks beyond which insect infestation, mould growth and offensive odours are major spoilage characters one encounters in these products. After years of efforts, Burla Research Centre came out with 'Community Fish Smoking Kiln' popularly called 'CoFiSmKi'. The purpose is to generate sustainable income and to meet protein requirements of rural poor in lean or off fishing seasons.

The demand for good quality smoke cured fish is more in NEH states and there were demands from the Dept. of Fisheries, Manipur to install improved fish smoking kilns developed by CIFT. A good quality product not only fetches high price but also longer shelf life. A product of good quality will be helpful in meeting animal protein requirement in interior places like Manipur especially during lean/off-seasons of fish catch. In this regard, smoked fish product act as an alternative source of income, thus helping in improving socio-economic conditions of poor fishermen in Manipur.

With the above considerations, materials required for the fabrication of five Community Fish Smoking Kilns (CoFiSmKi) were procured and for the benefit of fishermen, the villages suitable in Manipur state were selected. The erection of Community Fish Smoking Kilns and training of fishermen were also done.

CoFiSmKi installed at Komlakhong, Manipur

Outreach Programmes

Cochin

An outreach training programme on Fish processing and production of value added fish products was held at Aryad, Alapuzha district during 23-27 February 2006. Twenty participants attended the programme.

A training programme on Harvest and post harvest technology of fish was organized at Department of Aquaculture, Barkatullah University, Bhopal during 7-9 March 2006. The programme was inaugurated by Dr. K.G. Ramachandran Nair, HOD, FP, CIFT in a function presided over by Prof. R.S. Sirohi, Vice Chancellor, Barkatullah University. The practical and theory classes were on the topics such

as fishing gears for reservoirs and inland waters, microbial flora of fish and spoilage at different conditions and packaging of fish and fish products, value addition in fish processing industry, status of fish processing in India, HACCP in fish processing, fish byproducts and waste utilization and fresh fish handling and distribution. The programme was well attended by teaching faculty and students of the University.

A CIFT-TED demonstration-cum-training was conducted at Sakthikulangara, Kollam district on 17 March 2006, in collaboration with MPEDA. About 40 trawler fishermen and operators attended the function during which 43 CIFT-TED were distributed.

A training programme on Preparation of value added fish products and dried and ready to eat fish products such as fish pickle, fish cutlets, fish fingers, fish balls, fish flakes etc. was conducted at Malampuzha, Palakkad district on 27 and 28 June 2006. The programme sponsored by the Deputy Director of Fisheries, Malampuzha was for the benefit of 'Kudumbasree' units (Self Help Groups) in and around Malampuzha. The members of five Kudumbasree units who took training intend to start a production unit with financial support from State Fisheries Department.

Training in progress at Malampuzha

A training programme on Fish processing, sponsored by Gandhi Smaraka Seva Kendram, Alapuzha was conducted at Arthunkal during 19-21 July 2006. The participants were representatives of Self Help Groups. They were given training on value added products such as fresh fish for local distribution, dried fish and ready to eat fish products like fish pickle, fish cutlet, fish flakes etc. Twenty participants attended the programme. Another programme on Production of value added fish products was conducted at Azheekal, Alappad village during 28-30 August 2006. The programme jointly conducted by CIFT and Centre for Environmental Studies of Mata Amrithanandamayi Charitable Trust, Quilon was for the benefit of coastal fisherwomen Self Help Groups.

Visakhapatnam

Awareness programme on the Importance of fish aggregating systems for conservation, resource enhancement and rehabilitation of fishery resources was conducted at Induvanipalem and Kothapalem villages in Srikakulam district on 27 and 28 October 2006. On the post harvest technology front, hygienic handling of fish and value added fish products were explained.

Training programme at Pudimadaka, Vishakapatnam

Burla

A training-cum-demonstration on Hygienic preparation of smoke-cured freshwater fishes and prawns and Eco-friendly fishing gear for sustainable fisheries was held at Sapnai, Sambalpur district on 20 and 21 February 2006. Three fishermen and a woman participated in the programme.

The Community Fish Smoking Kiln built at the

village was formally inaugurated by Shri Vishal Gagan, IAS, District Magistrate and Collector, Sambalpur and keys of the kiln were handed over to the Secretary of the Women Self Help Group. About 300 fishermen and women participated in the programme.

The next programme was on Preparation of value added products from freshwater fishes and prawns and Use of eco-friendly fishing gears for sustainable fisheries held at Barkote, Deogarh district during 6 to 8 March 2006, for the benefit of 32 fishermen, all belonging to ST category.

Training programme at Barkote in progress

Similar programmes were also held at Thebra, Jharsuguda district on 17 and 18 March 2006. Community Fish Smoking Kiln built for the benefit of fishermen community of Thebra was inaugurated by Deputy Director of Fisheries, Orissa and the keys were handed over to the Secretary of Women Self Help Group.

As part of village adoption programme, two remote fishing villages viz., Kurumkel and Rampaluga were surveyed to observe changes, developments and further technological needs on 27 and 28 April 2006, respectively. In Kurumkel, the need observed is raised cemented platform for drying and removal of excess moisture from smoke cured fish. Fabrication of two Community Fish Smoking Kilns that could be portable to different locations for the SHG women groups of Barkote, Deogarh, Orissa was taken up with new design.

As follow-up, technological needs in four fishing hamlets viz., Sapnai, Rampaluga, Thebra and Pujaripali (Jampali) were assessed and minor operational problems associated with all the Community Fish Smoking Kilns were attended. In all the four fishing villages, lemon saplings were distributed to cater the future Vitamin C requirements. Lemon was one of the major ingredients in the preparation of smoked fish curry.

Another training cum demonstration on Hygienic preparation of smoke cured freshwater fishes and prawns and Eco-friendly fishing gear for sustainable fisheries was conducted at Jhikimikisahi, Deogarh district during 22-23 July 2006. One smoking kiln was inaugurated by the District Collector, Deogarh, Orissa and keys of the kiln were handed over to the Secretary of Self Help Group of the village. In Jhikimikisahi, smoke curing of fish was demonstrated during 30-31 August 2006. Personal hygiene aspects were also demonstrated employing Palm Impression Technique.

Work was also initiated to install four Community Fish Smoking Kilns at left dyke villages of Hirakud reservoir viz., Mohammadpur, Sonutikara, Balbuspur and Jugipalli in Orissa. In this project, DRDA, Sambalpur had sponsored the funds required for the fabrication and demonstration programmes of Community Fish Smoking Kilns.

The Centre organized a three-day workshop on Recent advances in harvest, post harvest handling and extension methods in freshwater fisheries during the period 18-20 September 2006. The workshop was intended mainly for field extension officers of Fisheries Department of Bargarh, Sambalpur and Jharsuguda districts of Orissa. The workshop was inaugurated by Shri Vishal Gagan, IAS, District Collector and Magistrate. In his inaugural address, Shri Gagan stressed on the need for overcoming the problems associated with post harvest losses in handling of fish. Keynote address was delivered by Dr. S. Balasubramaniam, HOD, EIS, CIFT. The speakers of the session were Shri Julius Lakra, OAS, PD, DRDA, Sambalpur Shri G.B. Parida, DDF (Northern Zone) and Shri M.P. Ramesan, Scientist (SG), CIFT.

Shri Vishal Gagan, IAS inaugurating the workshop

A total of 21 officers of Department of Fisheries, belonging to three districts participated in the programme. During the workshop, the participants were exposed to latest developments in fish harvesting methods, reasons for fish stock depletion in impounded waters such as reservoirs, the remedial measures, value addition to fish viz., smoke curing, pickle preparation, trends in quality control, fish borne health hazards and preventive measures, and extension methodologies which could be used for popularizing the various innovations among the clients in Orissa state. On the last day of the workshop, the participants were taken to Hirakud reservoir as a part of field visit in which they were taught experimental fishing and different kinds of gear operated for harvesting fish. At the end of the programme a feed-back session was held.

Veraval

Training programmes on Hygienic handling of fish and Popularization of GPS and fish finder were conducted on-board private vessels. The programmes were carried out in collaboration with MPEDA, Veraval. Scientists discussed the importance of hygienic handling and demonstrated different techniques. Palm Impression Technique was also demonstrated on-board.

General Information

Training Programmes Conducted

Sl. No.	Subject	No. trained / Beneficiary	Venue and Date
1.	Chemical quality analysis of seafood products	1	Cochin 15 December 2005 – 2 January 2006
2.	Biogenic amines in seafoods determination by HPLC	1	Cochin 1 January – 25 March 2006
3.	Laboratory techniques for microbiological examination of seafood	1	Cochin 2-13 January 2006
4.	Seafood quality assurance	1	Cochin 5 January – 25 March 2006
5.	Proteolytic and lipolytic bacteria in fish	1	Cochin 6 January – 6 June 2006
6.	Fish processing technology	9 students	Veraval 16-25 January 2006
7.	Laboratory techniques for microbiological examination of seafood	8	Cochin 16-28 January 2006
8.	Improved fish processing techniques	20 fishermen	Cochin 23-27 January 2006
9.	Fish processing	7	Cochin 23 January – 4 February 2006
10.	Water analysis including heavy metals and pesticides	1	Cochin 13-18 February 2006
11.	Fish processing	2	Cochin 13-25 February 2006
12.	Analytical techniques in Biochemistry	2	Cochin 13-25 February 22006
13.	Fish processing	1	Cochin 16 February 2006
14.	Antibiotic reside/heavy metal analysis	1	Cochin 20 February – 13 March 2006
15.	Production of value added fish products	30 members from SHG's	Arthunkal, Alappuzha 21-22 February 2006
16.	Production of good quality dried fish	1	Cochin 22-25 February 2006
17.	Production of value added fish products	2	Cochin 28 February – 3 March 2006

HACCP concepts

Techniques in biochemical analysis

Seafood quality assurance

Trainees from Nagaland

Trainees from Annamalai University

Trainees from Calicut University

Sl. No.	Subject	No. trained / Beneficiary	Venue and Date
18.	Production of value added fishery products and fish canning	1	Cochin 28 February – 4 March 2006
19.	Modern analytical techniques in Biochemistry	2	Cochin 6-18 March 2006
20.	Fish processing technology	1	Cochin 6-18 March 2006
21.	Harvest and post harvest technology of fish	43	Barkatullah University, Bhopal 7-9 March 2006
22.	Demonstration of ELISA and PCR tests	16	Cochin 9 March 2006
23.	Histamine analysis	1	Cochin 14-15 March 2006
24.	Instrumentation techniques	2	Cochin 15 March – 15 April 2006
25.	Demonstration of PCR and ELISA tests	19	Cochin 16 March 2006
26.	CIFT-TED	40 trawler fishermen and operators	Kollam 17 March 2006
27.	HACCP concepts	13	Cochin 22-25 March 2006
28.	Fish handling, processing and value addition of fish	6	Cochin 25-28 March 2006
29.	Production of prawn and fish wafers	1	Cochin 28 March 2006
30.	Microbial quality evaluation of fishery products	3	Cochin 3-22 April 2006
31.	Occurrence of bacteria of public health significance in fish from different aquatic environments	1	Cochin 3 April – 30 June 2006
32.	Testing of packaging materials used in fishery products and seafood quality assurance	4	Cochin 24 April – 20 May 2006
33.	Laboratory techniques for microbiological examination of seafoods	1	Cochin 25 April – 12 May 2006
34.	Fish processing technology	1	Cochin 1-20 May 2006
35.	Lipolytic enzymes from bacteria isolated from *Rastrelliger kangurta* (Mackerel)	1	Cochin 1 May - 19 June 2006

Detection of Bacteria

Water analysis

Preparation of value added fish products

Fish processing technology

Solar drying of fish

Fish drying with LPG back up

Sl. No.	Subject	No. trained / Beneficiary	Venue and Date
36.	Operation and maintenance of eco-friendly solar fish dryers	4	Cochin 2-6 May 2006
37.	Fish processing technology	2	Cochin 5-19 May 2006
38.	HACCP concepts	7	Cochin 8-11 May 2006
39.	Isolation and identification of bacteria present in *Nemepterus japonicus* (Kilimeen) from Arabian sea	1	Cochin 8 May - 12 June 2006
40.	Fish oil analysis	2	Cochin 9-23 May 2006
41.	Molecular techniques for detection of WSSV	1	Cochin 15-19 May 2006
42.	Isolation and identification of *Listeria monocytogenes* from seafood	1	Veraval 15-20 May 2006
43.	HPLC techniques	1	Cochin 22-27 May 2006
44.	Electropheretic techniques	1	Cochin 22-27 May 2006
45.	Fish processing technology	4	Cochin 23 May - 4 June 2006
46.	HACCP concepts	13	Cochin 5-9 June 2006
47.	Bacteriological techniques for analysis of fish and fish products	8	Cochin 8-15 June 2006
48.	Laboratory techniques for Microbiological examination of seafoods	1	Cochin 12-24 June 2006
49.	Preparation of fish and prawn pickle	3	Cochin 22-23 June 2006
50.	Fish processing technology	2	Cochin 12 June - 3 July 2006
51.	Packaging of fish and fishery products	1	Cochin 12 June - 3 July 2006
52.	Preparation of different value added fish products	15 Representatives from 5 SHG's	Malampuzha 27-28 June 2006
53.	Biochemical analytical techniques	1	Cochin 27 June - 11 July 2006
54.	Detection and enumeration of bacteria of public health significance in fresh fish	1	Cochin 3-7 July 2006

Sl. No.	Subject	No. trained / Beneficiary	Venue and Date
55.	Bacteria of public health significance and their proteolytic and lypolytic activity	1	Cochin 3-31 July 2006
56.	HACCP concepts	1	Cochin 10-13 July 2006
57.	Water analysis	1	Cochin 17-29 July 2006
58.	Handling and processing of ready to cook fish products	20 members from SHG's	Arthungal, Alappuzha 19-21 July 2006
59.	Detection and enumeration of bacteria of public health significance in fresh fish	1	Cochin 30-31 July 2006
60.	HACCP concepts	1	Cochin 7-10 August 2006
61.	Fish canning, value added products and quality control in fish processing plants	14 technicians from Lakshadweep	Cochin 22-24 August 2006
62.	Value addition of fish	11 Members of SHG's	Azheekal, Quilon 28-30 August 2006
63.	HACCP concepts	1	Cochin 28-31 August 2006
64.	Techniques in biochemical analysis	6	Cochin 30 August - 2 September 2006
65.	Analysis of major nutrients in selected species of fish	1	Cochin 2-15 September 2006
66.	Quality assurance in fish and fishery products	2	Veraval 11-23 September 2006
67.	HACCP concepts	10	Cochin 18-21 September 2006
68.	Seafood quality assurance	26	Cochin 18-30 September 2006
69.	Bacteriological techniques for analysis of fish and fishery products	2	Cochin 18-30 September 2006
70.	Hygienic and sanitary methods for dry fish processing and packing	1	Cochin 25-26 September 2006
71.	Techniques for microbiological analysis	6	Cochin 25-27 September 2006
72.	HACCP concepts	20	Cochin 25-28 September 2006
73.	Laboratory techniques for Microbiological examination of seafoods	1	Cochin 9-20 October 2006

Sl. No.	Subject	No. trained / Beneficiary	Venue and Date
74.	Extraction and concentration of flavour from fresh prawn shell waste	5	Cochin 3-31 October 2006
75.	Quality control aspects of fish	3 Officials from Govt. of Nagaland	Cochin 16-28 October 2006
76.	Laboratory techniques for microbiological examination of seafood	2	Visakhapatnam 16-31 October 2006
77.	HACCP concepts	3	Cochin 17-20 October 2006
78.	Techniques in microbial biotechnology for fisheries	2	Cochin 30 October - 3 November 2006
79.	Bacteriological techniques for analysis of fish and fishery products	2	Cochin 13-25 November 2006
80.	Bacteriological techniques for analysis of fish and fishery products	1	Cochin 20 November - 2 December 2006
81.	Canning of fish and fishery products	1	Cochin 27 November - 4 December 2006
82.	Production of value added fishery products	28 SHG members	Aryad, Alappuzha 28-30 November 2006
83.	HACCP concepts	3	Cochin 1-5 December 2006
84.	Value added products	5	Visakhapatnam 4 December 2006
85.	Value added products	5	Visakhapatnam 6 December 2006
86.	Value added products	5	Visakhapatnam 8 December 2006
87.	Fish processing and solar drying techniques	20	Cochin 11-16 December 2006
88.	Techniques in biochemical analysis	1	Cochin 11-21 December 2006
89.	Bacteriological techniques for analysis of fish and fishery products	3	Cochin 11-23 December 2006
90.	HACCP concepts	32	Cochin 16-20 December 2006
91.	Production of value added fish products	27 SHG members	Pattanakkad 19-21 December 2006

International training programme under the TCS of Colombo Plan

- Training on 'Development of fish and shrimp based value added products' was conducted at CIFT, Cochin under the TCS of Colombo Plan during 18-30 September, 2006. Shri H.S. Hathrusinghe, Quality Control Officer, Department of Fisheries and Aquatic Resources of Sri Lanka participated in the programme.
- Training on 'Laboratory course on the Biochemical evaluation of fish and fishery products' was conducted at CIFT, Cochin under the TCS of Colombo Plan during 3 October – 10 November, 2006. Ms. Noora Jaleel, Project Officer, Ministry of Fisheries, Agriculture and Marine Resources, Maldives participated in the programme.

Shri Hathrusinghe undergoing training

Dr. Devadasan handing over certificate to Ms. Noora Jaleel

Technologies Assessed and Transferred

- Designs of wooden fishing vessels in the size range of 7.6 m – 15.2 m
- Development and popularization of designs of steel fishing vessels of size 15.5 m LOA, 20 m LOA and fuel efficient vessel of 18 m LOA
- Design of Aluminium craft for inshore waters and FRP pole and line fishing vessels for Lakshadweep
- Substitution of wooden boats by FRP canoes and treated rubber wood canoes for use in backwaters and near-shore waters
- Dual preservative treatment for low valued species of timbers for boat construction
- Painting schedules for Aluminium-Magnesium alloy and FRP sheathing for underwater hulls of fishing vessels
- Antifouling and anticorrosive paints for protection of fishing craft
- Mercury free anodes for cathodic protection of fishing craft
- Protective coating for cast iron propeller
- Specifications for different types of synthetic materials for fabrication of different types of fishing gear
- Designs of different types of fishing gear such as trawls for demersal, pelagic and semi-pelagic applications, gill nets, purse seines and traps for exploitation of the different fishery

resources

- Otter boards of different sizes and designs to suit demersal trawl fishing operations and variable depth fishing
- V-form steel otter boards for demersal trawls
- Combination wire rope for deep sea fishing
- By-catch reduction devices such as square mesh codend and fish eye for reducing catch of juveniles and young ones, in shrimp trawls
- Turtle Excluder Device (TED) for conservation of marine turtles
- Designs of dryers such as tunnel dryer, rotary fish meal dryer, electrical fish dryer and solar dryer with LPG/electrical back up.
- Designs of deep fat fryer and cutlet moulding machine
- Fuel efficient propeller for fishing vessels and other fuel saving devices such as propeller nozzle
- Stainless steel tilting kettle for processing plants
- Oil fryer for battered and breaded products
- Meat bone separator for removal of bone including pin bones from rohu
- Electronic instruments for application in fishing technology, fish processing technology, aquaculture, marine environmental monitoring, agricultural investigations etc.
- Improved methods for freezing, freeze drying, canning, drying and curing of different types of fish and shellfish
- An improved method for production of dried prawns
- Methods for production of quality dried fish products with attractive appearance and long storage life
- Hygienic drying of anchoviella
- Method for economic utilization of low grade fish and conversion of fish wastes into useful by-products
- Methods for production of value added products such as wafers, pickles and soup powder from fish/shellfish
- Methods for the production of value added products such as fish balls, ready-to-cook and fry products, battered and breaded products from marine and freshwater fishes
- Ready-to-use isinglass from fish maws
- Methods for extraction of Chitin/Chitosan from prawn shell waste and their application in textile and poultry industry and in the medical field
- Pilot plant for production of Chitosan
- Method for extraction of shark fin rays and processing shark cartilage
- High gel strength agar from sea weeds
- Method for isolation of squalene from shark liver oil for use in cosmetics
- Improved packaging materials for transportation and storage of fish
- Production of retort pouch packed fish products
- Specific requirements in setting up fish processing plants
- Cleaning schedules for fish processing establishments and boat decks and preparation of deodorant and antiseptic ointment
- Chlorine level indicator paper for instant reading of chlorine level in water used in fish processing plants
- Specifications for various types of seafood, process water and ice
- Procedure for implementation of HACCP
- Design of energy efficient treatment plant for effluent water from processing plants
- Collagen - Chitosan film from fish skin, bone and air bladder for treatment of burns and as

a barrier material in guided tissue regeneration (GTR) in dentistry

- Fine grade absorbable surgical sutures from fish gut
- Method for preparation of n-3 polyunsaturated fatty acid (PUFA) concentrates from fish oils
- An 18 h depuration method to eradicate pathogenic bacteria and grit from bivalves, especially clams and mussels
- Bacteriological culture media for 1) direct detection and enumeration of the potent spoiler bacterium *Alteromonas putrefaciens*, and 2) estimation of total plate count of cured/semi-preserved/salted fishery products by preventing swarming of *Bacillus* sp.
- Device for drawing uniform samples from frozen fish blocks for microbiological evaluation
- Polymerase Chain Reaction (PCR) technique for detection of white spot disease syndrome in farmed shrimp

Outreach Programmes Conducted

Exhibitions

The Institute participated in the following exhibitions during the period:

- Exhibition held on the occasion of 93rd Indian Science Congress organized by Acharya N.G. Ranga Agricultural University at Rajendranagar, Hyderabad (3-7 January, 2006)
- All Kerala Exhibition organized by MES Keveeyam College in connection with their Silver Jubilee Celebrations at Valanchery, Kerala (13-22 January, 2006)
- India International Aqua Show-2006 - Exhibition of ornamental fishes and accessories, organized by the Department of Fisheries, Kerala at Cochin (2-7 February, 2006)
- India International Seafood Show-2006, organized by Marine Products Export Development Authority (MPEDA) and the Seafood Exporters Association of India (SEAI) at Kolkata (3-5 February, 2006)
- Exhibition held in connection with All India Seminar on Advances in agro-processing and rural empowerment, organized by The Institution of Engineers (India), West Bengal State Centre at Kolkata (17-18 February, 2006)
- Exhibition organized as a part of National Seminar on 'Sustainability of seafood production: reflections, alternatives and environmental control', organized by the Society for Indian Ocean Studies at NIO, Goa (23-24 February, 2006)
- Agro-Biotech 2006 - Exhibition held on the occasion of International Conference on Biotechnology for sustainable agriculture and agri-industry, at Visakhapatnam (9-11 March, 2006)
- North East Agri Expo - 2006, organized by the Ministry of Agriculture, Govt. of India, Confederation of Indian Industries and Govt. of Nagaland at Dimapur, Nagaland (27-31 March, 2006)
- 'Organic Kerala - 2006' - Exhibition at Ernakulam (19-22 April, 2006)
- 'Mitraniketan Golden Jubilee Expo-2006' organized on the occasion of Golden Jubilee Celebrations at Mitraniketan, Thiruvananthapuram (14-17 August, 2006)
- Exhibition held during the inauguration of National Fisheries Development Board (NFDB) at Acharya N.G. Ranga Agricultural University at Rajendranagar, Hyderabad (9 September, 2006)
- 'Aqua Ornamentals - 2006' - Exhibition organized by Sree Narayana College, Nattika, Thrissur (15-19 September, 2006)

Dr. Mangala Rai, DG, ICAR visiting CIFT stall in Indian Science Congress exhibition

Shri Neiphiu Rio, Hon. Chief Minister, Govt. of Nagaland and Shri Sharad Pawar, Hon. Minister of Agriculture, Govt. of India visiting fisheries stall at NE Agri Expo

Justice Rajan signing visitor's book at CIFT stall in NFDB exhibition

Shri Mohamed Fareeduddin, Minister of Fisheries, Govt. of A.P. visiting CIFT stall at NFDB exhibition

Visitors at India International Seafood Show

CIFT stall at Karshika Mela - 2007 at Thodupuzha

- 'Swasraya Bharath - 2006' - Exhibition held in connection with National Self Reliance Week Celebrations organized by Swadeshi Science Movement, Kerala at Ernakulam (11-17 October, 2006)
- 'Jubilee Expo - 2006 - All India Science, Arts & Culture Exhibition' held during the Golden Jubilee Celebrations of Christ College, Irinjalakkuda, Kerala (6-10 November, 2006)
- 'Millennium Development Goals Exhibition' held on the occasion of Global Forum in Agricultural Research (GFAR) Conference organized by Department of Agricultural Research and Education, Ministry of Agriculture and ICAR at New Delhi (8-11 November, 2006)
- Exhibition held during International Symposium on 'Sustainable fisheries development for food and health security' organised at College of Fisheries, Mangalore (20-21 December, 2006)
- 'Karshika Mela - 2007' exhibition organized by Gandhiji Study Centre at Thodupuzha (26 December 2006 – 7 January 2007)

Replies to technical queries and correspondence

Technical queries received from the various categories of clients such as fish processors, technologists, entrepreneurs, Self Help Groups, government organisations and fisherfolk were attended and the queries were related to the topics such as harvest and post harvest technology of fish, organisation of training programmes and payment of fees, technical guidance, analytical testing services, assistance under technology transfer programmes etc. About 600 such queries were attended during the year.

Production of video films

The following two video films were produced during the period:

- VCD- Training Video Series-1: HACCP in food processing plants
- VCD- Training Video Series-2: The pre-requisite programme - GMP & SSOP

Radio Talks

The following radio talks were given by the Scientists of the Institute:

- Dr. B. Madhusudana Rao, Scientist (Senior Scale) - Steps to be taken to improve fish quality, AIR, Visakhapatnam on 1 August 2006 (in Telugu)
- Dr. G. Rajeswari, Senior Scientist - Selectivity of trawl nets, AIR, Visakhapatnam on 6 August 2006 (in Telugu)

Agricultural Technology Information Centre

Arrangements were made for the visitors like students, technologists, officials and other stakeholders from the industry. Various priced publications and value added fishery products were sold through ATIC. Non-priced publications were also distributed to the interested visitors. Various technical queries received were answered. Analytical samples were received at ATIC and test reports were sent after analyses. The significant visitors during the period include:

- A group of fisherwomen from the Tsunami-affected areas of Nagapattinam district in Tamil Nadu who visited the Institute on 7 June 2006. The visit was sponsored by 'SCOPE' - a Non Governmental Organization based at Trichy, Tamil Nadu.
- A group of 80 fishermen under the 'Kolleru Lake Restoration Programme' in Andhra Pradesh along with five officials from Dept. of Fisheries, Govt. of Andhra Pradesh who visited the Institute on 28 June 2006.

Both the groups were explained about the various research and developmental activities in the field of fishing and fish processing technologies. They were exposed to the various low cost post harvest

VIP's at the ATIC

Visitors at ATIC being entertained

technologies, which could help them in additional income generation. The visitors showed keen interest in knowing about the eco-friendly solar fish dryers developed at the Institute.

Awards/Recognitions

CIFT, Cochin bagged the prestigious Rajarshi Tandon Award - 2005-06 for the best Official Laguage Implementation among ICAR Institutes. The award was received by Dr. K. Devadasan, Director and Dr. C. Jessy Joseph, Asst. Director (OL) from Dr. Mangala Rai, DG, ICAR, New Delhi. The Institute is receiving this award for the third time.

Receiving the Rajarshi Tandon award from DG, ICAR

Dr. P.N. Joshi, Principal Scientist and Head, Engineering Division received the Kerala State Energy Conservation Commendation Certificate - 2006 instituted by Energy Management Centre, an autonomous Institution under Govt. of Kerala. The award was presented to Dr. Joshi by Shri A.K. Balan, Hon'ble Minister for Electricity, Govt. of Kerala on 15 December, 2006, the National Energy Conservation Day. The award in the category, Research and Innovation was for the novel invention of 'An energy efficient eco-friendly solar fish dryer with LPG backup'.

Dr. P.N. Joshi receiving the award from Shri A.K. Balan, Kerala state Minister

The Society of Fisheries Technologists (India) Award for the Best Scientific Paper published in the

Journal 'Fishery Technology' during the year 2005 was presented to Dr. Leela Edwin, Dr. Saly N. Thomas and Dr. B. Meenakumari for their paper entitled, 'Utilization of rubber wood for fishing canoe construction'. The researchers have developed a novel method for utilization of rubber wood for construction of durable fishing canoes after upgrading it by chemical preservative treatment.

ICAR Sports: The Institute participated in the ICAR Inter Zonal Sports Tournaments held at Kolkata during 27 October to 2 November 2006. In the tournaments Smt. M.V. Valsala of CIFT emerged as women Athletic Champion. She stood first in 100 m Sprint, 200 m Sprint, Long jump and second in Javelin Throw. Smt. Tessy Rony of CIFT was the winner in Chess and runner up in 100 m Sprint.

Dr. Leela Edwin receiving the award from Dr. K. Devadasan

Smt. Valsala with her catch

Analytical Services

The Head Quarters and Research Centres of the Institute undertook testing of samples of different types of raw materials and products received from various organizations, State and Central Govt. Departments and entrepreneurs and issued reports on their quality. The samples tested included fresh and frozen fish and shellfish products, by-products, prawn larvae from hatcheries, swabs from processing tables and workers' hands, chemicals, salt, water, ice, packaging materials etc. Type testing of marine diesel engines was also carried out and performance certificates were issued to the concerned manufacturers in addition to calibration of mercury, alcohol and digital thermometers received from different fish processing plants and the industry. About 1100 samples were tested in the different laboratories of the Institute during the year.

Patents Obtained/Filed/Under Filing

Patents obtained

- Antifouling paints for ship bottom – *A.G.G.K. Pillai, K. Ravindran & R. Balasubramanyan*
- Production of absorbable surgical sutures from fish gut collagen – *M.K. Mukundan, P.D. Antony & K. Devadasan*

Application for patents at various stages of filing

- Development of collagen based membrane for periodontal application – *M.K. Mukundan, Suseela Mathew & T.V. Sankar*
- Fibreglass sheathed rubber wood canoe - *Leela Edwin & B. Meenakumari*
- Fishing canoes from treated rubber wood -

Leela Edwin, Saly N. Thomas & B. Menakumari

- Shelf stable fish sausages in indigenous synthetic casings - *C.N. Ravishankar, T.K. Srinivasa Gopal, K.G. Ramachandran Nair & K. Devadasan*
- Ready-to-serve pearl spot moilee in retortable poches - *T.K. Srinivasa Gopal, C.N. Ravishankar, K.G. Ramachandran Nair & K. Devadasan*
- Process for the production of high bulk density Chitosan - *K.G. Ramachandran Nair, George Ninan & P.T. Mathew*
- Mesh gauges: A devise for easy measurement of fishing net mesh size - *U. Sreedhar*
- A package of practice for improving the bacterial quality and food safety of farmed freshwater scampi (*Macrobrachium rosenbergii*) - *K.V. Lalitha & P.K. Surendran*
- Production of edible fish powder from small bony fish by thermal processing using perforated Aluminium trays – *A.K. Chattopadhyay, B. Madhusudana Rao, Sibsankar Gupta & R. Chakraborti*
- Rapid test kit for identification of white spot disease and stress in shrimps - *Suseela Mathew, K. Ashok Kumar, R. Anandan, P.G. Viswanathan Nair & K. Devadasan*
- A process for the production of high purity Glucosamine hydrocholoride from shrimp shell waste - *K.G. Ramachandran Nair, K.A. Martin Xavier & K. Devadasan*
- Isolation of squalene from shark liver oil - *T.K. Thankappan*
- A shell bead nucleus production system - *P.N. Joshi*
- A molluscan shell cutting system - *P.N. Joshi*
- Micro algae concentration monitor - *K. Vijayabharathi*
- A tunnel fish dryer – *P.N. Joshi*
- Water activity meter - *K. Vijayabharathi*
- Effluent treatment system for seafood processing plants – *M.K. Mukundan, K. Ashok Kumar & M. Nasser*
- Package of practices for pathogen free chilled fish for export - *M.K. Mukundan, K. Ashok Kumar, P.R.G. Varma & Francis Thomas*
- Collapsible fish trap - *M.P. Remesan, P. Pravin, P. George Mathai & B. Meenakumari*
- Collapsible lobster trap - *P. Pravin & B. Meenakumari*

Interaction and Linkages

Local institutions in the area other than ICAR Institutes

- Marine Products Export Development Authority
- Export Inspection Agency
- Naval, Physical and Oceanographic Laboratory
- Fishery Survey of India
- National Institute of Oceanography
- Central Institute of Fisheries Nautical Engineering and Training
- Matsyafed
- Integrated Fisheries Project
- Kerala State Pollution Control Board

National Institutes and Agricultural Universities

- Kerala Agricultural University
- Ministry of Agriculture
- Ministry of Food Processing Industries
- Dept. of Ocean Development
- Dept. of Biotechnology

- Dept. of Science and Technology
- Dept. of Electronics
- Indian Institute of Technology, Chennai/ Kharagpur
- State Fisheries Departments
- Union Territory of Lakshadweep
- Kerala Water Authority
- ICAR Institutes
- Science and Technology Entrepreneurship Development Project (STED)
- Bureau of Indian Standards
- Industries Department, Andaman & Nicobar Administration
- Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
- College of Fisheries, Mangalore

International Institutions

- Natural Resources Institute (NRI), U.K.
- Food and Agriculture Organization (FAO), Rome
- Bay of Bengal Programme (BOBP)
- Asia Pacific Fisheries Commission (APFC)
- University of Bristol, U.K.
- INFOFISH

Extension and Development Agencies

- Central Social Welfare Board
- Kannur District SC/ST Women Industrial Fish Products Manufacturing Co-operative Society Ltd.
- South Indian Federation of Fishermen Societies (SIFFS), Thiruvananthapuram
- Amala Mahila Samajam, Puthuvypu, Cochin
- AFPRD, Hyderabad
- Kanyakumari District Fishermen Sangam's Federation
- Madonna Rural Development Society, Kumarakom
- Centre for Research and Training in Poverty Alleviation and Women Welfare (CRATPAW), Cochin
- Centre for Management Development, Thiruvananthapuram
- Bharat Sevak Samaj, Thiruvananthapuram
- Small Industries Development Bank of India (SIDBI)
- Matsya Mahila Vedi, Chellanam
- Alleppey Diocesan Charitable and Social Welfare Society, Alappuzha
- Vanitha Matsya Thozhilali Bank, Neendakara
- Kerala Industrial and Technical Consultancy Organisation (KITCO)
- Avani Agro Society, North Paravur, Ernakulam
- Common Facility Service Centre, Changanacherry
- Kerala State Women's Development Corporation Ltd., Thiruvananthapuram
- Chellanam Panchayat SC/ST Co-operative Society
- Fishermen Youth Welfare Association, Gangavaram, A.P.
- Development Action through Self Help Network (DARSHN)
- Agency for Development of Aquaculture in Kerala (ADAK)

Technical guidance/Consultancy

Technical guidance/consultancy on various topics related to the fisheries industry were offered to interested entrepreneurs as shown below:

Name of the party	Consultancy offered/taken-up
M/s Forstar Instafoods Division of Forstar Frozen Foods Pvt. Ltd. Taloja, Navi Mumbai - 410 208	Renewal for consultancy relating to HACCP implementation and certification of their fish curry packing unit
M/s Sara Spices Kizhakkambalam, Aluva - 683 562	Renewal for consultancy relating to HACCP implementation and certification of their fish curry packing unit
M/s South Indian Federation of Fishermen Societies, Karamana, Thiruvananthapuram - 695 002	Consultancy for setting up fish auction centres and fish chilling units in Kanyakumari and Nagai areas
M/s Kerala Livestock Development Board Ltd. Thiruvananthapuram - 695 004	Technical guidance and consultancy relating to HACCP certification of the Sperm Station at Dhoni and Kulathupuzha units
M/s Cyriac Elias Voluntary Association Ceva Bhavan, Cochin - 682 011	Consultancy and assistance relating to checking up of FRP boats in project areas
Corporation of Cochin Cochin	Consultancy for modernization of fish markets at Chambakkara, Palluruthy and Polakandam
Cochin Port Trust Cochin	Consultancy for environment impact assessment due to ship traffic in the backwaters of Cochin

Dr. Ani S. Das, MD, KLDB receiving HACCP certificate from the Director, CIFT

Committees

Grievance Cell

Chairman

Dr. K. Devadasan, Director, CIFT

Members

1. Dr. K.G. Ramachandran Nair, Acting Head, Division of FP
2. Senior Administrative Officer
3. Asst. Finance and Accounts Officer
4. Dr. T.K. Thankappan, Principal Scientist
5. Shri P.A. Josi Augustine, TO (T-5)
6. Shri P. Mani, UDC
7. Shri T.A. Gopalakrishnan, Bearer (Auxiliary)
8. Shri V. Deepak Vin, SSG II

Nominated Member Secretary

Smt. M.A. Prasanna, Asst. Admn. Officer, CIFT

Research Advisory Committee

Chairman

Dr. K. Gopakumar
Former DDG (Fisheries), ICAR
28/863, Cheruparambath Road
Cochin - 682 020

Members

1. Prof. P.K. Salian
   Former Director of Instructions
   C/o Shri Rakesh Salian
   301 Kristal Amber Apartment
   7th Main-14th Cross
   B.T.M. 2nd Stage, Bangalore - 560 076
2. Dr. T.S.G. Iyer
   Former HOD,
   Fish Processing, CIFT
   Patteri Madh
   Boys High School Road
   Tripunithura - 682 301

RAC members inspecting fish dryers

3. Dr. R.P. Kachroo
   Former ADG (Engineering), ICAR
   303 D.K. Railbow Chuna Bhatty
   Kolar Road, Bhopal - 462 016 (MP)
4. Dr. Anil Kumar Tyagi
   Professor
   Department of Biochemistry
   South Delhi Campus
   Delhi University, Delhi
5. Prof. B.P.N. Singh, FIE, FNAAG
   A-1555, Indira Nagar
   Lucknow - 226 016

Member Secretary

Dr. B. Meenakumari, HOD, FT, CIFT

Management Committee

Chairman

Dr. K. Devadasan, Director, CIFT

Members

1. Dr. M.P. Dileep
   Project Director
   Kerala Reservoir Fisheries Development Project
   Fisheries Complex
   Dr. Salim Ali Road
   Cochin - 682 018

2. Director of Fisheries
   Govt. of Tamil Nadu
   Administrative Office Buildings
   DMS Complex
   Teynampet, Chennai - 600 006
3. Dr. D.D. Namboodiri,
   Dean, Faculty of Fisheries
   Kerala Agricultural University
   College of Fisheries
   Panangad P.O.
   Cochin - 682 506
4. Dr. A.D. Diwan,
   Asst. Director General (M. Fy.)
   ICAR, Krishi Anusandhan Bhavan II
   Pusa Gate, New Delhi -110 012
5. Shri Lal Phanindra Bhushan Pal
   Vill & Post Ahra, Dist. Basti
   Uttar Pradesh
6. Shri S. Somnath Pillai
   TC 13/287(4), ENS Nagar
   Pattoor, Vanchiyoor P.O.
   Thiruvananthapuram
7. Senior Finance & Accounts Officer
   CMFRI, Cochin - 682 014
8. Dr. Nirmala Thampuran
   HOD, MFB, CIFT
9. Dr. P.N. Joshi
   HOD, Engineering, CIFT
10. Dr. P.T. Mathew
    Principal Scientist,
    FP Division, CIFT
11. Dr. R. Sathiadas
    Principal Scientist &
    HOD, SEETID, CMFRI, Cochin - 682 018

Member Secretary

Senior Administrative Officer, CIFT

Institute Joint Staff Council

Chairman

Dr. K. Devadasan, Director, CIFT

Members (Official side)

1. Dr. K.G. Ramachandran Nair, Acting HOD, FP
2. Dr. P.G. Viswanathan Nair, Acting HOD, B&N
3. Dr. B. Meenakumari, HOD, FT
4. Shri A.C. Joseph, Principal Scientist
5. Shri K.S. Sreekumaran, AF&AO

Secretary (Official Side)

Shri K.P.S. Gautam, SAO

Members (Staff Side)

1. Shri K.U. Sheikh, TO (T-5)
2. Shri V.S. Ambasuthan, UDC
3. Shri K. Das, UDC
4. Shri C.D. Parameswaran, SSG-III
5. Shri T.D. Bijoy, SSG-II

Secretary (Staff Side)

Shri P.S. Nobi, T-1-3

Participation in Training Programmes

Sl. No.	Name(s) of participant(s)	Training attended	Venue and Date
1.	Shri V.K. Siddique	Operation and maintenance of pumps and compressors	KSPC, Cochin 19-20 January 2006
2.	Dr. P. Pravin	Disaster management in fisheries and aquaculture	NIPM, New Delhi 29 January - 3 February 2006
3.	Dr. T.K. Srinivasa Gopal (As resource person)	Recent developments in food additives and ingredients	NDRI, Karnal 29 March 2006
4.	Shri V. Radhakrishnan Nair	Introduction to GIS and its applications	NRSA, Hyderabad 3-28 April 2006
5.	Dr. P.T. Mathew Dr. T.V. Shankar	Laboratory accreditation under IS/ISO IEC 17025:2005 standard	New Delhi 2-3 May 2006
6.	Dr. S. Sanjeev	Internal Auditory training on ISO 22005:2005	CII, Bangalore 5-6 June 2006
7.	Dr. M.K. Mukundan	Value chains	TNAU, Coimbatore 5-9 June 2006
8.	Dr. S. Balasubramaniam Dr. Nikita Gopal Dr. S. Ashaletha	Methods of impact assessment of fisheries research	CMFRI, Cochin 3-4 July 2006
9.	Smt. K. Usha	Communication skills	ISTM, New Delhi 17-19 July 2006
10.	Shri M. Ajit Peter Kum. A. Sreeja	Wood biodegradation and preservation	IWST, Bangalore 17-21 July 2006
11.	Dr. S.K. Panda Shri V.R. Madhu	Data warehousing and data mining	ASCI, Hyderabad 24-28 July 2006
12.	Dr. R. Raghu Prakash	GIS based decision support systems for sustainable agriculture	NAARM, Hyderabad 5-25 August 2006
13.	Shri J. Charles Jeeva	Participatory impact monitoring and evaluation of agriculture and rural development programmes	Zonal Coordinating Unit, ICAR ToT Projects, Bangalore 17-26 August 2006
14.	Shri S.S. Gupta (As resource person)	Codex principles of food hygiene and application of HACCP in marine sector	Visakhapatnam 28 August 2006
15.	Shri Nimit Joshi	Geographical information system	NRSA, Hyderabad 28 August - 22 September 2006

Sl. No.	Name(s) of participant(s)	Training attended	Venue and Date
16.	Dr. R. Badonia (As Chief Guest)	Value addition	Veraval 25-26 September 2006
17.	Dr. G. Usha Rani	Instrumental methods of analysis	CUSAT, Cochin 9-13 October 2006
18.	Dr. Leela Edwin Smt. K.G. Sasikala Kum. A. Sreeja Shri M. Ajit Peter	Microscopic analysis of rubber wood	RRII, Kottayam 16-20 October 2006
19.	Smt. Usha Bhagirathan	Microscopic analysis	RRII, Kottayam 16-20 October 2006
20.	Shri Jones Varkey	Current scenario of Indian snack foods and breakfast foods	CFTRI, Mysore 6-11 November 2006
21.	Dr. S. Ashaletha	Extension research methodology: Basics to advances	CRRI, Cuttack 6-27 November 2006
22.	Shri M.S. Bhatkar	Improving administrative, official and financial management	NAARM, Hyderabad 8-15 November 2006
23.	Dr. P. Pravin	Managing video production	NAARM, Hyderabad 12-23 December 2006

Visits Abroad

Dr. B. Meenakumari, Head, Fishing Technology Division attended the First Meeting of Chlorophyll Pilot Study (the extended Antares network) held at Plymouth Marine Laboratory, Plymouth, UK during 18-22 September, 2006 under the auspecious of Partnership for Observing Global Oceans (POGO).

The workshop focused on the ecosystem and social benefits to humanity and also to send a common message to Global Earth Observation (GEO) from the ocean community. The workshop also proposed to develop ecosystem matrices to quantify concepts and to apply them serially to detect whether the ecosystem is modified in any significant way by perturbations such as climate change or over-fishing.

Dr. Meenakumari with foreign collegues at Plymouth Marine Laboratory, UK

Participation in Symposia/Seminars/Workshops etc.

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
1.	Dr. B. Meenakumari Shri V.R. Madhu Shri Nimit Joshi	National workshop on Space applications for mankind	VSSC, Thiruvananthapuram 2-4 January 2006
2.	Shri P. Muhammed Ashraf Shri Baiju John Shri Gipson Edapazhom	National workshop on Advanced techniques for corrosion studies	Alagappa Univeristy, Karaikudi 5-7 January 2006
3.	Kum. O.K. Sindhu Kum. Roswin James	National seminar on Trends in molecular biotechnology	Aquinas College, Cochin 12 January 2006
4.	Dr. K.G. Ramachandran Nair	Brain storming meeting on Employment opportunities in farm and non-farm sector through technological intervention with emphasis on primary value addition	CFTRI, Mysore 14 January 2006
5.	Dr. K. Devadasan	Meeting of Directors' of Fisheries Institutes	Chennai 16 January 2006
6.	Smt. J. Bindu Smt. K.K. Asha	Seminar on Mycotoxin estimation	Cochin 17 January 2006
7.	Dr. K. Devadasan	Interface meeting on agriculture transformation through public-private partnership	New Delhi 18 January 2006
8.	Dr. G. Rajeswari (As resource person)	TED awareness programme	Visakhapatnam 20 January 2006
9.	Dr. A.R.S. Menon	Inter Media Publicity Co-ordination Committee Meeting	Thiruvananthapuram 20 January 2006
10.	Smt. Sangita D. Gaikwad	Seminar on Water budgeting	CIFE, Mumbai 27 January 2006
11.	Dr. Toms C. Joseph	Workshop on Biotechnology tools in animal science	SH College, Cochin 2 February 2006
12.	Shri S.S. Gupta (As resource person)	National workshop on Post harvesting methods and domestic fish marketing opportunities	SIFT, Kakinada 3-4 February 2006
13.	Dr. S. Balasubramainam Dr. A.R.S. Menon	International Education Meet - 2006	Cochin 4-7 February 2006
14.	Dr. M.R. Boopendranath	International seminar on Ornamental fish breeding, farming and trade	Cochin 5-6 February 2006

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
15.	Shri K. George Joseph (As Chief Guest)	Seminar on Practical impacts of Microbiology	MAMO College, Manassery, Calicut 6 February 2006
16.	Dr. P.N. Joshi	International congress on Renewable energy	Hyderabad 9-11 February 2006
17.	Kum. O.K. Sindhu	International workshop on Molecular techniques in aquaculture and seafood safety	College of Fisheries, Mangalore 13-17 February 2006
18.	Dr. S. Balasubramaiam	National workshop on Planning and management of agricultural extension training	NASC, New Delhi 14-15 February 2006
19.	Dr. Nikita Gopal	Stake holder consultation workshop on Agriculture, non-agricultural market access negotiations	Cochin 17 February 2006
20.	Dr. P.T. Mathew Shri J.K. Bandyopadhyay Shri A.K. Panigrahi Shri P.M. Pattanaik	Seminar on Advances in agro-processing and rural empowerment	Kolkata 17-18 February 2006
21.	Dr. K. Sobha (As faculty)	Hindi workshop	Cochin Shipyard, Cochin 20 February 2006
22.	Dr. M.R. Boopendranath Dr. C.N. Ravishankar Dr. Saly N. Thomas Dr. V. Geethalakshmi Shri S. Santhosh	National seminar on Sustainability of seafood productions: Reflections, alternatives and environmental control	NIO, Goa 23-24 February 2006
23.	Dr. A.R.S. Menon	Inter Media Publicity Co-ordination Committee Meeting	Thiruvananthapuram 24 February 2006
24.	Shri Rakesh Kumar	National workshop on Biomodeling, Biosensors and Bio-MEMS	I. I. Sc., Bangalore 28 February - 2 March 2006
25.	Dr. T.K. Srinivasa Gopal	Seminar on Food texture analysis and cooking viscometry	UAS, Bangalore 3 March 2006
26.	Dr. R. Raghu Prakash (As resource person)	TED awareness programme	Sankarpur, Dhiga & Jalda 7-9 March 2006
27.	Dr. G. Rajeswari	Regional Committee meeting of MPEDA	FSI, Visakhapatnam 7 March 2006 & 17 March 2006

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
28.	Shri George Ninan Dr. R. Anandan	National seminar on Analytical Chemistry: Calibration of analytical instruments	Mumbai 17-18 March 2006
29.	Dr. S. Balasubramaniam	ICAR Fisheries Research Institutes Nodal Officer's Meeting	Imphal, Manipur 20 March 2006
30.	Dr. M.M. Prasad	Seminar on Role of livestock and fisheries in poverty reduction in NER (North East: Emerging horizons in agribusiness)	Dimapur, Nagaland 27-31 March 2006
31.	Dr. M.M. Prasad	Seminar on Need for quality assurances in mithun meat intended for commercial use	NRC on Mithun, Jhorapani 1 April 2006
32.	Dr. K. Devadasan (As Chief Guest)	Launching of IS/ISO 22000: 2005 food safety management system certification scheme	BIS, Cochin 4 April 2006
33.	Dr. S. Balasubramaniam	Workshop on Training need assessment under Tsunami Emergency Assistance Project (TEAP)	CMD, Thiruvananthapuram 7 April 2006
34.	Dr. B. Meenakumari	12th Meeting of the Textile Division of Bureau of Indian Standards	New Delhi 7 April 2006
35.	Dr. K. Devadasan Dr. P.K. Surendran	Meeting of the Directors' of Fisheries Institutes and PI's of Network project on National risk assessment programme for fish and shellfish products for domestic and international market	NRCCWF, Bhimtal 15-16 April 2006
36.	Dr. A.R.S. Menon	Workshop on Right to Information Act-2005	NAARM, Hyderabad 18-19 April 2006
37.	Dr. S. Balasubramaniam	Workshop on Impact assessment of fisheries research in India	NAARM, Hyderabad 20-22 April 2006
38.	Dr. B. Meenakumari	Meterology, Oceanography Programme Meeting	SAC, Ahmedabad 25 April 2006
39.	Dr. A.R.S. Menon	Inter Media Publicity Co-ordination Committee Meeting	Thiruvananthapuram 26 April 2006
40.	Dr. B. Meenakumari	Ocean Sat II Meeting	SAC, Ahamedabad 26-27 April 2006
41.	Dr. S. Ashaletha	National seminar on Bharateeya heritage in Engineering and Technology	I.I.Sc., Bangalore 11-13 May 2006
42.	Dr. P.T. Mathew	3rd Meeting of sub group committee on fisheries and fish technology	TIFAC, New Delhi 15 May 2006

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
43.	Shri Santhosh Alex	Town Official Language Implementation Committee Meeting	Visakhapatnam 19 May 2006
44.	Dr. B. Meenakumari	Meeting on expert consultation to prioritize areas in fisheries for technology interventions for implementation of projects by TIFAC	TIFAC, New Delhi 25 May 2006
45.	Dr. T.K. Srinivasa Gopal	Conference on Packaging for safety of foods	ILSI, Pune 25 May 2006
46.	Dr. K.G. Ramachandran Nair Dr. P.N. Joshi	Meeting on Tsunami Emergency Assistance Livelihood Programmes	Thiruvananthapuram 5 June 2006
47.	Dr. Jose Joseph (As resource person)	Entrepreneurship development programme	Cochin 8 June 2006
48.	Shri L. Anburajan	Workshop on Microbial Biotechnology	University of Madras, Chennai 19-23 June 2006
49.	Dr. K. Sobha (As resource person)	Hindi workshop	Coconut Development Board, Cochin 20 June 2006
50.	Dr. S. Ashaletha	National conference on Women Scientists/Technocrats - Opportunities and challenges	St. Theresa's College, Cochin 23-25 June 2006
51.	Smt. T. Silaja	Workshop on Building institutional repositories using D space	UC College, Aluva 24 June 2006
52.	Dr. B. Meenakumari	First meeting of the working group on fisheries for the Eleventh Five Year Plan (2007-2012)	NASC, New Delhi 26 June 2006
53.	Dr. S. Balasubramaniam	72nd Meeting of the Expert Committee for the schemes of DST	DST, New Delhi 29-30 June 2006
54.	Dr. Nirmala Thampuran Dr. B. Meenakumari Dr. P.T. Lakshmanan Dr. P. Pravin	International conference on Marine hazards and opportunities	FICCI, Chennai 3-5 July 2006
55.	Dr. B. Meenakumari	Round table conference on Deep sea fishing in India-Policy issues and way ahead	National Maritime Foundation, New Delhi 6 July 2006

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
56.	Dr. B. Meenakumari Dr. P. Pravin Smt. Usha Bhagirathan	Workshop on Impact of bottom trawling benthic communities	CUSAT, Cochin 7 July 2006
57.	Dr. K.G. Ramachandran Nair	Meeting of Kerala State Fisheries Department to formulate programme for overall development of fisheries in Kerala in five years	Thiruvananthapuram 15 July 2006
58.	Dr. A.R.S. Menon	Workshop on Maintenance of Personal Management Information System network (PERMIS net) and launching of Intelligent Reporting System (IRS)	NASC, New Delhi 21-22 July 2006
59.	Dr. K.G. Ramachandran Nair Dr. M.K. Mukundan Dr. M.R. Boopendranath Dr. P.T. Lakshmanan Dr. P.T. Mathew Dr. P. Pravin Dr. Leela Edwin	Workshop on Sustainable fisheries development	CMFRI, Cochin 22-23 July 2006
60.	Smt. Usha Bhagirathan	Workshop on Introduction to the study of meiofaune	Annamalai University, Parangipettai 24-26 July 2006
61.	Dr. A.R.S. Menon	Inter Media Publicity Co-ordination Committee Meeting	Thiruvananthapuram 31 July 2006
62.	Dr. M.M. Prasad	Workshop on Improving personality profile and human communication in organizations	NAARM, Hyderabad 1-5 August 2006
63.	Dr. K.G. Ramachandran Nair	State level consultation meet on fisheries development	NABARD, Thiruvananthapuram 8 August 2006
64.	Shri U. Sreedhar	Third technical advisory committee meeting of FORV Sagar Sampada	Tuticorin 9-10 August 2006
65.	Dr. Leela Edwin	Validation workshop on Methodology for planning in fisheries sector	CMD, Thiruvananthapuram 10 August 2006
66.	Dr. M.K. Mukundan	South Asian regional seminar on Food safety management systems	BIS, New Delhi 10-11 August 2006

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
67.	Dr. S. Ashaletha	National seminar held in connection with Golden Jubilee Expo-2006	KVK, Mitraniketan, Thiruvananthapuram 15 August 2006
68.	Dr. B. Meenakumari	Workshop on Potential Fishing Zone (PFZ) mission - Present status and improvements	INCOIS, Hyderabad 18 August 2006
69.	Dr. M.R. Boopendranath Shri A.C. Joseph (As resource persons)	Workshop on Issues and possibilities for revival and remedies to the traditional fisheries sector	Kattoor, Alappuzha 19 August 2006
70.	Dr. G.R. Unnithan	Meeting of 11th Plan working group on fisheries	CIFRI, Barackpore 21 August 2006
71.	Dr. T.K. Srinivasa Gopal	Workshop on Technology and equipments for processing and quality assurance of foods	NDRI, Karnal 23-24 August 2006
72.	Dr. G. Rajeswari	Regional Committee Meeting of MPEDA	CIFNET, Visakhapatnam 31 August 2006
73.	Dr. P.T. Mathew	Workshop on Vision 2015 - Strategies and action plan for food processing industries	Calicut 2 September 2006
74.	Shri Santhosh Alex	Town Official Language Implementation Committee Meeting	Visakhapatnam 8 September 2006
75.	Dr. C.N. Ravishankar	73rd Expert committee meeting on Science and Society	DST, New Delhi 11-14 September 2006
76.	Dr. B. Meenakumari Dr. Saly N. Thomas	10th Meeting of Textile materials for marine/fishing purposes sectional committee TX 18	CIFNET, Cochin 12 September 2006
77.	Dr. K. Devadasan	Sectional committee meeting of fisheries scientists for the year 2006	NAAS, New Delhi 12-15 September 2006
78.	Dr. M.K. Mukundan Dr. P.T. Lakshamanan Dr. P.T. Mathew Dr. S. Sanjeev Dr. T.V. Sankar (As resource persons)	Workshop on Seafood safety and quality assurance	Cochin 14-15 September 2006
79.	Dr. Suseela Mathew Dr. R. Anandan	Workshop on Clinical research and management	IFCR, Cochin 15-17 September 2006
80.	Dr. K. Sobha (As resource person)	Hindi workshop	EIA, Cochin 19 September 2006

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
81.	Shri U. Sreedhar	Workshop on Technology needs of the aquaculture industry with special reference to Andhra Pradesh	Kakinada 20 September 2006
82.	Dr. Toms C. Joseph Shri Rakesh Kumar	Meeting of scientists on Priorities in Biotechnology research in fisheries and aquaculture during XI Plan	NRCWF, Bhimtal 22-23 September 2006
83.	Dr. P.T. Mathew	Workshop on Vision 2015 - Strategies and action plan for food process industries	KINFRA, Calicut 25 September 2006
84.	Dr. R. Badonia (As resource person)	Workshop on Value added fishery products	Veraval 25-26 September 2006
85.	Dr. S. Balasubramaniam Dr. G.R. Unnithan Dr. Nikita Gopal	Meeting of the social scientists on Priorities in social science research in fisheries and aquaculture during XI Plan	NASC, New Delhi 26-27 September 2006
86.	Dr. K. Sobha (As resource person)	Hindi workshop	NPOL, Cochin 4 October 2006
87.	Dr. P.T. Mathew	Indo-US workshop on Nanotechnology in advanced drug delivery	NIPR, SAS Nagar, Panjab 4-6 October 2006
88.	Shri U. Sreedhar	Regional workshop on Marine fishery resources of upper east coast of India	Balasore 12 October 2006
89.	Dr. C.N. Ravishankar	Expert committee meeting on Science and Society	DST, New Delhi 12-13 October 2006
90.	Dr. K. Devadasan Dr. K.G. Ramachandran Nair	4th Meeting of sub group committee on fisheries and fish technology of TIFAC, New Delhi	CMFRI, Cochin 13 October 2006
91.	Shri A.C. Joseph	Better utilization of bycatch	Kollam 27 October 2006
92.	Dr. G. Rajeswari	Meeting on Diversification of trawls into semi-pelagic fishing	Visakhapatnam 30 October 2006
93.	Dr. Toms C. Joseph	National seminar on Biosciences (Bions 06)	IG College, Kothamangalam 31 October 2006
94.	Shri Rakesh Kumar Shri Mukund Mohan Kum. Dhanya Ramachandran Shri L. Anburajan	7th Asia Pacific Marine Biotechnology Conference	NIO, Cochin 2-5 November 2006
95.	Dr. K. Devadasan	Director's Conference of ICAR Institutes	ICAR, New Delhi 3-4 November 2006

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
96.	Dr. T.K. Srinivasa Gopal (As resource person)	12th Technology Summit & Technology Platform and Seminar on Food and marine technologies	CII, New Delhi 6-7 November 2006
97.	Shri P. Muhammed Ashraf	International conference on Recent advances in marine antifouling technology	NIOT, Chennai 6-8 November 2006
98.	Dr. M.R. Boopendranath (As invited speaker)	National seminar on Marine biology: Advances and prospects	CUSAT, Cochin 10 November 2006
99.	Dr. P.T. Lakshmanan	Meeting on NAIP	CIBA, Chennai 13-14 November 2006
100.	Dr. M.K. Mukundan Dr. K.G. Ramachandran Nair Dr. M.R. Boopendranath Dr. T.K. Srinivasa Gopal Dr. Jose Jospeh Dr. P.T. Lakshmanan Shri A.C. Joseph Shri P.K. Vijayan Dr. Leela Edwin DR. T.V. Shankar Dr. C.N. Ravishankar Dr. Saly N. Thomas Dr. K. Ashok Kumar Shri A.A. Zynudheen Shri George Ninan Smt. J. Bindu (As resource persons)	Refresher course on Modern approaches in fisheries science	CUSAT, Cochin 25 October- 15 November 2006
101.	Dr. M.R. Boopendranath	Round table discussion on Better fisheries management measures in Kerala fisheries	SIFFS, Kollam 22 November 2006
102.	Dr. A.R.S. Menon	Inter Media Publicity Co-ordination Committee Meeting	Thiruvananthapuram 29 November 2006
103.	Dr. S. Ashaletha Shri J. Charles Jeeva	National seminar on Extension strategies for fostering knowledge centric agricultural growth	Puducherry 2-3 December 2006
104.	Shri Santhosh Alex	Town Official Language Implementation Committee Meeting	Visakhapatnam 16-17 December 2006

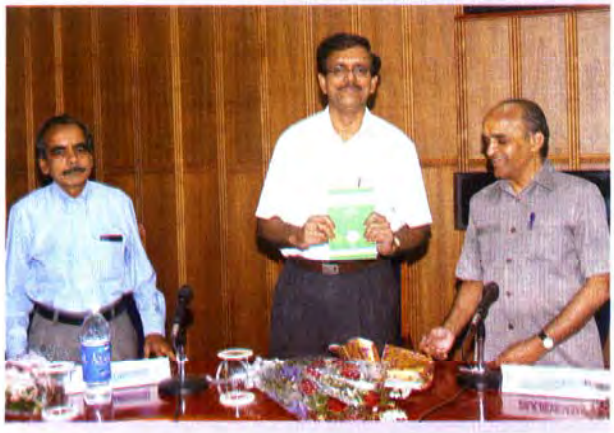
Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
105.	Dr. M.K. Mukundan Dr. M.R. Boopendranath Dr. Jose Joseph Dr. V. Geethalakshmi Shri V. Radhakrishnan Nair Dr. A.R.S. Menon Dr. C. Jessy Joseph	Seminar on Contribution of science and technology in the development of Kerala	CUSAT, Cochin 19-20 December 2006
106.	Dr. K.G. Ramachandran Nair Dr. P.T. Mathew	Seminar on Fisheries development of Kerala	Edacochin 22 December 2006

Special Days and Events

National Science Week

The National Science Week was celebrated at the Head Quarters and Research Centres through a series of activities to popularize science based issues especially on fisheries technological subjects such as fish processing, value addition, quality control of seafoods, microbiological tests and related areas.

In this connection, a training programme on 'Fish processing and production of value added fish products' was conducted at Arthunkal, a coastal village in Alappuzha district for the benefit of 30 people. On 25th February a special function was organized at CIFT, Cochin. Shri G. Mohan Kumar, IAS, Chairman, MPEDA was the Chief Guest and Dr. K. Devadasan, Director, CIFT presided over the function. On the occasion, the Chief Guest also released the second edition of CIFT publication on 'Laboratory manual on Microbiological examination of seafood'. Dr. D.D. Namboodiri, Dean, College of Fisheries, Panangad offered felicitations.



Shri Mohankumar releasing the publication

The Visakhapatnam Centre observed National Science Day on 28th February. The Centre was kept open to the students as well as the general public to visit its laboratories for a period of fortnight.

Shri A.K. Chatopadhyay, Principal Scientist with students

The Burla Research Centre observed the day on 28th February. About 100 students from local schools participated. Lectures were delivered on the

importance of nurturing nature for better future.

Dr. M.M. Prasad, SIC addressing the students

At the Mumbai Centre, various activities were arranged on 22nd March for increasing awareness about preservation of nature and specially for sustained fisheries development. The programme included lecture cum training to fish processing workers from 'Hirawati International', APMC, Vashi.

Visitors being explained

The Veraval Centre observed the day on 9th March. The laboratories of the Centre were kept open for the public. Dr. D.I. Khasim, SIC of the Centre delivered a lecture on the importance of conservation which was followed by a power point presentation and a film on responsible fisheries. On 13th March a special programme was arranged at the Fisheries Harbour, Veraval. Popular lecture in local Gujarati language on responsible fishing operations and various conservation aspects were delivered.

School children visiting the laboratories

International Women's Day

International Women's Day was observed at Head Quarters on 8th March. Dr. Vijayalakshmi Menon, former Director of the Health Services, Govt. of Kerala was the Chief Guest of the day. She gave a talk on 'The problems of women in this era'.

Dr. Vijayalakshmi Menon delivering the talk

National Technology Day

National Technology Day was celebrated at Cochin on 30th May at St. George Parish Hall, South Chellanam in Ernakulam district. The programme sponsored by Kerala State Council for Science, Technology and Environment, Thiruvananthapuram was inaugurated by Shri K.D. Prasad, President, Chellanam Grama Panchanyat. Scientists of the

Institute gave talks on various topics for the benefit of about 60 fishermen and women. A short film on silage production was also screened followed by an 'interactive session'.

Dr. K. Devadasan, Director, CIFT gives presidential address

World Environment Day

World Environment Day was celebrated on 5 June. Dr. T.S.G. Iyer, Vice President, Food Safety Solutions International, Cochin delivered a talk on 'HACCP aspects of food products'. As part of the celebrations a field day was also conducted in the coastal village of Chellanam. Saplings of orchard trees were distributed to the women folk of Self Help Groups.

Field day at Chellanam

Release of Book 'Fishtoons'

A book on cartoons on fisheries and aquaculture authorized by Dr. P. Pravin, Senior Scientist, CIFT has been published by Fishing Chimes, Visakhapatnam. The book was released on 10th July on the occasion of the National Fish Farmer's Day jointly organized by CIFRI, Kolkata and Fishing Chimes Jayasree Charitable Trust, Visakhapatnam.

Dr. Pravin receiving a memento from Dr. K.K. Vass, Director, CIFRI

Coastal Zone Management Training

Two training camps were held during 18 to 21 July and 25 to 28 July at Chellanam Field Centre premises of CIFT, Cochin. The training programmes formed part of the ongoing project on 'Action research on community based coastal zone management with specific involvement of women'. The camps focused more on the creation of employment opportunities for women group members through the production of value added fish

Participants and faculty of training camp

products such as pickles, cutlets, and dried fish and the production of milk based products such as chocolates, ice cream, milk halwa etc.

Fish Farmers Day

Fish Farmers Day was celebrated at Cochin on 12 July. A one day training programme was organized on the occasion, covering the areas such as 'Food safety and good aquaculture practices', 'Disease management in shrimp farming' and 'Fish nutrition'.

Dr. K. Devadasan inaugurating the Fish Farmer's Day celebrations

Ward Level Workshops

As part of the DST funded project, four ward level workshops for validating the coastal zone management plan were held at Chellanam during 19 and 27 October and 18 and 25 November. Each workshop comprised of an inaugural session followed by the technical session, which included presentation of ward level coastal zone management plan and group discussion. Under the project, a draft coastal zone management plan for the villages was prepared based on the project work and discussions.

Ward Level Workshop in progress

Golden Jubilee Logo Released

The Institute is celebrating its Golden Jubilee in the year 2007. As part of the celebrations a series of activities are planned. Monthly talks by eminent persons on subjects of interest to agricultural scientists will be organized. Industry-Institute interface meetings for better mutual help and co-operation are also planned. Scientific seminars on different aspects of fishery technology will be organized and exhibitions and awareness programmes will be conducted in different parts of the country. The logo of the Golden Jubilee Celebrations was officially released by the worshipful Mayor of Cochin Corporation, Prof. Mercy Williams on 18 November, Dr. K. Devadasan, Director, CIFT presided over the meeting.

Prof. Mercy Williams speaking after the logo release

Keel Laid for New Research Vessel

CIFT is constructing a 17.5 m OAL steel research vessel. The 'Keel Laying Ceremony' of the vessel was held on 12 October. The breadth and depth of the vessel are 5.75 m and 3.0 m respectively. This vessel will have facility for carrying out research activities in trawling and long lining. The vessel costing about

Rs.2.5 crores is being built by Kerala Shipping and Inland Navigation Corporation. The keel of the vessel was laid by Dr. S. Ayyappan, Deputy Director General (Fy.), ICAR, New Delhi in a simple function held at the boat yard of KSINC. Dr. K. Devadasan, Director, CIFT presided over the meeting.

Dr. S. Ayyappan, DDG (Fy.), ICAR laying the keel of the ship

Team Visits

The National Accreditation Board of Laboratories (NABL) team visited the Institute on 11 and 12 November. Necessary arrangements were done to explain the activities regarding the receipt of samples for analysis, preparation of test reports, dispatch and documentation of reports.

The National Academy of Agricultural Sciences (NAAS) Committee headed by Dr. S.D. Tripathi, former Director, CIFE, Mumbai visited the Institute during the period 5 - 9 December, to evaluate the achievements of the Institute during the X plan period as a part of the planning process for the XI plan. The Committee also visited the Visakhapatnam and Burla Research Centres of CIFT during the period 27 to 30 December.

NAAS committee with the Director and Heads of Divisions

World Food Day

The Institute observed World Food Day on 16 October to mark the anniversary of the founding of FAO in 1945. Dr. K. Devadasan, Director, CIFT presided over the meeting. Dr. M.K. Mukundan, HOD, QAM, CIFT delivered a scientific talk on the theme 'Food security and safety'.

Inspection by NABL team

Dr. M.K. Mukundan delivering the talk

Women in Agriculture Day

'Women in Agriculture Day' was observed at Kandakadavu SC/ST Co-operative Soceity at Kandakadavu fishing village in Ernakulam district on 4 December. Dr. S. Balasubramanaiam, HOD, EIS, CIFT presided over the function. Lectures on hygienic handling and preservation of fish were delivered. Preparation of value added fishery products were also demonstrated. More than 75 women from Self Help Groups participated in the programme.

Inauguration of Women in agriculture day celebrations

Administration

The Administration Section deals with recruitment, service and policy matters, discipline, staff welfare, land and building, procurement of stores, budget expenditure, settlement of claims etc.

During the period under report, the following Committees met for the purposes as shown below:

1. Departmental Promotion Committee : 3 times
2. Departmental Selection Committee : 3 times
3. Assessment Committee : 6 times
4. Career Advancement Committee : 4 times
5. ACP Committee : 2 times
6. Selection test : 5 times

Staff position as on 31 December 2006

Category	Sanctioned	Filled
Scientific	101	63
Technical	140	125
Administrative	90	84
Supporting	85	78
Auxiliary	6	6
Total	**422**	**356**

Cases considered by the Departmental Promotion Committee

Category	Promotion	Declaration of probation & Confirmation	Granting ACP
Scientific	4 cases	Nil	NA
Technical	14 cases	Nil	NA
Administrative	4 cases	4	8
Supporting	1 case	5	1
Auxiliary	Nil	Nil	NA

Technical Section

The Technical Section monitored the following technical matters of the Institute during the reported period:

Compilation of Research Project Programmes document

The Research Project Programmes of the Institute for the year 2006-07 comprising of new projects, ongoing projects and summary of concluded projects were compiled as per the recommendations of the Project Advisory Committee and Research Advisory Committee and brought out for distribution to all HODs, SICs and Principal Investigators. During the period a total of 20 in-house projects were under operation.

Preparation and submission of technical reports

Monthly reports on the important activities of the Institute, significant research findings, training programmes, seminars/symposia/workshops etc. conducted and attended by the staff, important policy decisions taken, information on new projects/ programmes initiated, visit of officers abroad and visit of foreign delegates to the Institute, details of extension activities etc. were compiled and sent to ICAR regularly for inclusion in the ICAR monthly report to the Cabinet Secretariat.

Submission of quarterly and half yearly feedback to DG, ICAR

Quarterly reports on targets and achievements of plan/non-plan expenditure, outstanding advances, infrastructural works carried out, research/ development/technology and human resource development, extension activities and target for the following quarter are regularly compiled and furnished to ICAR.

The quarterly out-put, out-come report of all the fisheries research Institutes under ICAR like CIFT, Cochin, CMFRI, Cochin, CIBA, Chennai, CIFE, Mumbai, CIFA, Bhubaneshwar, NRC on Cold Water Fisheries, Bhimtal and NBFGRI, Lucknow were collected, compiled and forwarded to DG's Office.

Further, six monthly targets and achievements of all the individual scientists of the Institute were furnished to the Council for the periods ending January-June and July-December 2006. Six monthly performance monitoring reports of the Institute were also furnished to the Council in time.

Publication of scientific papers

The scientific papers including research notes, popular articles etc. for publication in journals and papers meant for presentation at symposia/seminars etc. received from scientists for approval of the Director were arranged to be presented before the Scrutiny Committee and approval of the recommended papers communicated. During the period the Scrutiny Committee met five times and a total of 25 research/review papers were recommended for publication/presentation in various seminars, symposia etc.

Participation of scientists in seminars/symposia/ workshops/short term training courses etc.

Requests for participation of scientists in various seminars, symposia, workshops and short term training courses were processed and papers routed through the Section.

Staff Research Council

Arrangements were made for conducting the Staff Research Council meeting to review the progress achieved in the ongoing research projects of the Institute for the year 2005-06 and to discuss the research project proposals for the year 2006-07. Dr. A.D. Diwan, ADG (M. Fy.), ICAR, attended the meeting as Council's representative. Shri A.C. Joseph, Principal Scientist, acted as Member Secretary of the SRC.

Updating project files

Project Leaders' files of all ongoing research projects of the Institute were maintained up-to-date by collecting the consolidated Quarterly/Annual/ Final reports from the concerned Principal Investigators for the relevant periods.

Publication of newsletter and other reports

Four issues of Fish Technology Newsletter (bilingual) were published during the period. Besides, the Institute Annual Report 2005-06 and Research Highlights 2005-06 were also brought out. Further, the inaugural issue of 'Fisheries Policy Update', a half yearly publication was also brought out.

PERMISnet

The Technical Section helps in the maintenance of Personal Management Information System network of ICAR. The personal biodata of each and every staff member is computerized and updated every month and forwarded to IASRI, New Delhi through online.

Other technical matters

The Section continued to answer queries on various technical matters received from other organizations and individuals. Matters related to awards/fellowships/tour reports of scientists and other staffs were regularly monitored. Further, material for ICAR News, ICAR Reporter, Agri-News, Fishing Chimes, MPEDA Newsletter, Seafood News and the like were forwarded regularly, many of which have been published.

The Hindi translation work of the entire Institute is entertained by the Section.

The entire publicity related and extension oriented activities of the Institute are being regularly presented in the monthly meeting of Inter Media Publicity Coordination Committee of Ministry of Information and Broadcasting, Govt. of India.

The Technical Section also functions as the Office for implementing Right to Information Act-2005 at the Institute, besides Intellectual Property Rights and Patents. During the period a total of six applications were received under RTIA and all were entertained after collecting prescribed fees and were disposed in time.

Library

The CIFT Library is fully automated and it caters to the information requirements of the researchers and students in the fisheries field. With a collection of 10,693 books, 5,623 bound journals and 340 CD-ROMs, the Library extends borrowing privileges to the students, scientists and staff of CIFT.

Acquisition

The Library acquired 330 books during the period under report. Fourty six foreign and 34 Indian scientific periodicals have been subscribed. International Databases like ASFA (Aquatic Science Fisheries Abstracts), FSTA (Food Science and Technology Abstracts), Fish and Fisheries World Wide (NISC-F&FWW), Food and Human Nutrition (AGRIS-FHN) and Indian Standards on CD-ROM have also been acquired.

Services

During the year 4208 bonafide readers visited the Library and 823 books were issued and retrieved. CD-ROM based literature search service has been provided. Issues of Current Contents were brought out monthly. The Library in association with NIO, Goa continued to act as a national input centre of ASFA database. Reprographic Unit of the Library supplied copies of 98,936 pages of documents on requisition.

Library at Headquarters

Post Graduate Programme

Scientist-In-charge : Dr. Jose Joseph, Principal Scientist
Member, P.G. Cell : Dr. T.V. Sankar, Senior Scientist

M.F.Sc. students of 2004-2006 batch have appeared for the final examination in August 2006. The Overall Grade Point Average secured by them are given below:

Kum. Trincy Rose Johns	:	8.26
Shri Abbas A. Rahim	:	8.02
Kum. B. Sanitha	:	8.53
Kum. V.R. Devi	:	8.75
Shri T. Obulesu	:	F
Kum. P. Manja Jose	:	8.45

Kum. V.R. Devi received the gold medal for the best student in Post Harvest Technology. The 2005-2007 batch M.F.Sc. students joined CIFT in March 2006 for their Second Semester after completing their First Semester at CIFE Mumbai. After completing their Second Semester in August 2005, they did their dissertation from September 2006 to February 2007. The area of research, and major advisor/guide of each student are as follows:

Name of student	Topic of research	Major advisor/Guide
Kum. Madona T. Thachil	Effect of α-tocopherol in preventing peroxidation of PUFA in young and aged albino rats	Dr. Suseela Mathew
Kum. L. Manjusha	Studies on bacteriological methods for the detection of antibacterial substances in fish and fishery products	Dr. S. Sanjeev
Shri Pankaj Kishore	Distribution of pathogenic *Yersinia* spp. in seafoods and their characterization	Dr. K.V. Lalitha
Kum. A. Rajeena Maimoon	Effect of natural antioxidants on the quality and storage stability of freeze dried coated fish balls	Shri A.C. Joseph
Shri K. Shashidar	Development of ready-to-serve fortified shrimp soup in retortable pouches	Dr. C.N. Ravishankar

The following Ph. D. scholars of 2003-2006 batch have submitted their thesis. The details of their thesis are given below:

Name of student	Topic of research	Name of the guide
Kum. K.H. Sabeena Farveen	Biochemical studies on the cardioprotective effect of squalene on experimentally induced myocardial infarction in rats	Dr. R. Anandan
Shri Arun Kumar Mallick	Retort pouch processing of Indian White Shrimp (*Feneropenaeus indicus*) using flexible packaging materials	Dr. T.K. Srinivasa Gopal

Shri Arun Kumar Mallick, Shri A. Surendra Raj and Shri A.A. Zynudheen completed their Ph. D work. Shri C.O. Mohan and Kum. Sneha Susan Simon of 2004-2007 Ph. D. batch appeared for the qualifying examination and are in the final stage of their work.

The area of work and the names of the Chairman of 2005-2008 batch Ph. D. students are given below:

Name of student	Topic of research	Name of the Chairman
Kum. S. Tanuja	Pathogenic Vibrios in cultured shrimp and farm environs	Dr. Nirmala Thampuran
Shri I.P. Lakshmisha	Lipid oxidation and lipid-protein interaction in seafood	Dr. T.V. Sankar

Shri K.A. Martin Xavier and Shri C.S. Shine Kumar have been awarded Ph. D. degree during January 2007.

Scientific Talk

Mr. Bundit Chokesanguan, Head, Information and Extension Division, Southeast Asian Fisheries Development Centre (SEAFDEC), Thailand gave a talk on "Responsible fishing techniques and safety at sea" at CIFT, Cochin on 7th February.

Mr. Bundit Chokesanguan giving the talk

Representation in Committees

The following officials represented the Institute in various Committees/Board panels etc. in different capacities:

Dr. K. Devadasan, Director

As Expert Member

- Agricultural Services Recruitment Board

As Member

- Academic Council of CIFE, Mumbai
- Senate of Cochin University of Science and Technology, Cochin
- Extension Council of CIFE, Mumbai
- Governing Body of National Institute of Fisheries Administration and Management, Ernakulam
- Forum of Fisheries Professionals, Visakhapatnam

As Fellow

- National Academy of Agricultural Sciences (NAAS), New Delhi

Dr. M.K. Mukundan, Head, Quality Assurance & Management Division

As Principal Member

- Supervisory Audit Team for approving seafood

exports to EU

- Bureau of Indian Standards Sectional Committee for formulation of standards for fishery products
- Bureau of Indian Standards Sectional Committee for formulation of standards for sanitation and hygiene in food processing units

As Member

- PRMC, TIFAC, New Delhi

Dr. S. Balasubramaniam, Head, Extension, Information & Statistics Division

As Member

- High level committee on extension and training constituted by MPEDA

Dr. P.N Joshi, Head, Engineering Division

As Member

- Committee constituted by MPEDA, Cochin for technical scrutiny of subsidy schemes to modernize the seafood processing industry in India

Dr. Nirmala Thmapuran, Head, Microbiology, Fermentation & Biotechnology Division

As Member

- Inter Departmental Panel of EIC of India, New Delhi

Dr. B. Meenakumari, Head, Fishing Technology Division

As Principal Member

- Textile materials for marine fishing purpose: Sectional committee TX 18, Bureau of Indian Standards, New Delhi
- Expert Committee to look into the result and impact of trawl ban and conservation of existing fisheries wealth, Govt. of Kerala

Dr. K.G. Ramachandran Nair, Acting Head, Fish Processing Division

As Member

- Departmental Promotion Committee, CMFRI, Cochin
- Committee for approval of M. Sc. Food Science, M.G. University, Kottayam

Dr. P.G. Viswanathan Nair, Acting Head, Biochemistry & Nutrition Division

As Member

- Committee constituted by APEDA, New Delhi for purchase of advanced equipments for various laboratories
- Committee for modernization of Livestock products Inspection Laboratory, Cochin, Dept. of Animal Husbandry, Govt. of Kerala

Shri S.S. Gupta, Scientist-in-Charge, Visakhapatnam Research Centre

As Member

- Inter Departmental Panel of experts for approval of fish processing plants in Andhra Pradesh, Orissa and West Bengal for export to EU

Dr. R. Badonia, Scientist-in-Charge, Veraval Research Centre

As Chairman

- Nagar Rajya Bhasha Karyanavayan Samiti (TOLIC), Veraval of the Dept. of Official Language

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Consultative group of Porbandar base of Fisheries Survey of India
- Board of Studies, Junagadh Agricultural University, Junagadh

Shri K. George Joseph, Principal Scientist

As Member

- Technical Consultative Committee, TIFAC

Panel, Planning Board, Calicut dist.

- Inter Departmental Panel of experts for approval of fish processing plants for export to EU

Dr. P.T. Mathew, Principal Scientist

As Member

- Board of Studies in Food Technology in University of Calicut, Calicut

Dr. T.K. Srinivasa Gopal, Principal Scientist

As Member

- Tender technical committee constituted for the purchase of fish boxes for the Tsunami affected fishermen in Tamil Nadu coast
- Collaborative project by MPEDA, CIFT and IFP on Upgradation of seafood packaging
- Assessment Committee for scientists, CFTRI, Mysore

Shri A.C. Joseph, Principal Scientist

As Member

- Supervisory Audit Team, Govt. of India for approval of fish processing establishments for export to EU
- Committee constituted by MPEDA, Cochin for scrutinizing applications for releasing subsidy for flake/chip/tube ice making machines and refrigerated trucks/insulated transport containers

Dr. Jose Joseph, Principal Scientist

As Member

- Committee constituted by MPEDA, Cochin for scrutinizing applications for releasing subsidy for large cold storages

Shri P.K. Vijayan, Principal Scientist

As Member

- Staff Selection Committee of MPEDA, Cochin

Dr. P.T. Lakshmanan, Principal Scientist

As Member

- Supervisory Audit Team for approving seafood export to EU
- Inter Departmental Panel of experts of EIA for approval of seafood processing plants for EU

Dr. S. Sanjeev, Principal Scientist

As Member

- Inter Departmental Panel of experts of EIA for approval of seafood processing plants for EU
- Expert Group on Export of live bivalve mollusks constituted by EIC of India
- Assessment Board for the approval of technologists of MPEDA at Cochin and Chennai

Shri K.P. Antony, Principal Scientist

As Member

- Inter Departmental Panel of experts of EIA for approval of seafood processing plants for EU
- Assessment Board for the approval of technologists of MPEDA at Cochin and Chennai

Shri M. Nasser, Principal Scientist

As Member

- Transport Engineering Division Council, Bureau of Indian Standards, New Delhi
- Inland Harbour Crafts and Fishing Vessel Sectional Committee, Bureau of Indian Standards, New Delhi.
- Marine Engineering and Safety Aids Sectional Committee, Bureau of Indian Standards, New Delhi
- Multi-disciplinary team, State Planning Board, Govt. of Kerala for review of long pending infrastructure projects in fisheries sector

Dr. K.V. Lalitha, Principal Scientist

As Member

- Inter Departmental Panel of EIC of India, New Delhi

Dr. M.R. Boopendranath, Principal Scientist

As Member

- Commission of experts constituted by Govt. of Kerala to study ecological/environmental impact of dredging at Vaduthala Kayal and Vaikom Kayal in Vembanad backwaters
- Committee for Career Advancement Programme, Kerala Agricultural University, Thrissur

Dr. D.I. Khasim, Principal Scientist

As Alternate Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU

Dr. C.N. Ravishankar, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Collaborative project by MPEDA, CIFT and IFP on Upgradation of seafood packaging
- Expert Committee on Science and Society of DST, New Delhi

Dr. K. Ashok Kumar, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Assessment Board for the approval of technologists at MPEDA, Cochin and Chennai

Dr. Saly N. Thomas, Senior Scientist

As Alternate Memebr

- Textile material for marine fishing purpose: Sectional committee TX 18, Bureau of Indian Standards, New Delhi

Shri S.P. Damle, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Regional Committee of MPEDA for evaluation of assistance in acquisition of GPS, Fish Finder, Radio telephone and Fish holds to fishermen of Mumbai

Shri George Ninan, Scientist (Sr. Scale)

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Committee for financial aid for setting up of modern ice plants constituted by MPEDA, Cochin

Dr. B. Madhusudana Rao, Scientist (Sr. Scale)

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU

Shri V.R. Madhu, Scientist

As Member

- Regional Committee of MPEDA for evaluation of assistance in acquisition of GPS, Fish Finder, VHF and Fish holds onboard mechanized fishing vessels

Dr. L.N. Murthy, Scientist

As Alternate Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU

Dr. A.R. S. Menon, Technical Officer (T9)

As Member

- Inter Media Publicity Coordination Committee (Kerala), Ministry of Information and Broadcasting

Shri M.V. Baiju, Technical Officer (T7-8)

As Member

- Committee for conversion of trawlers to tuna long liners subsidy scheme of MPEDA, Cochin

Visitors

The following are some of the dignitaries who visited the Institute during the year:

- Shri Abdullah Kamaludeen, Hon'ble Minister of Fisheries and Agriculture, Maldives and Shri Fathin Hameed, Deputy Minister and two Senior Officials of the Ministry of Agriculture, Maldives (CIFT, Cochin on 2 February 2006)

Shri Abdulla Kamaludeen, Maldives Minister visiting fish processing laboratory

- Parliament Committee headed by Shri Kunwar Sarwa Raj Singh (Visakhapatnam Research Centre on 7 February 2006)

Dr. S. Ayyappan, DDG (Fy.), ICAR, New Delhi, welcoming the Shri Kunwar Sarwa Raj Singh

- A five member delegation from Ivory Coast (CIFT, Cochin on 28 April 2006)

Deligates from Ivory Coast along with Director, CIFT and Dr. P.N. Joshi, HOD, Engg. in front of solar dryer

- Dr. S.N. Puri, Vice Chancellor, Central Agricultural University, Imphal, Manipur (CIFT, Cochin on 27 October 2006)
- The NABL Team (CIFT, Cochin on 11-12 November 2006)
- The National Academy of Agricultural Sciences (NAAS) Committee headed by Dr. S.D. Tripathi, former Director, CIFE, Mumbai and Dr. V. Venugopal, former Head of Division, BARC, Mumbai, Prof. B. Shamsunder, Dept. of Fish Processing Technology, College of Fisheries, Mangalore and Prof. Rintu Banerjee, IIT, Kharagpur as members (CIFT, Cochin during 5-9 December and Visakhapatnam and Burla Research Centres during 27-30 December 2006)
- Prof. Mercy Williams, Worshipful Mayor of Cochin Corporation (CIFT, Cochin on 18 November 2006)

On-going Research Projects

Institute Projects

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
1.	Studies on post-harvest aspects of freshwater fish in Orissa-adjoining states and NEH region	Shri J.K. Bandyo-padhyay	Burla & Cochin	Burla Cochin	Dr. M.M. Prasad Dr. T.V. Sankar
2.	Development and application of appropriate processing techno-logies for better utilization of marine and freshwater fishery resources of Gujarat	Dr. R. Badonia	Veraval		Dr. D.I. Khasim Dr. L.N. Murthy
3.	Studies on biodeterioration and material up gradation for marine application	Dr. Saly N. Thomas	Cochin		Dr. Leela Edwin Shri P. Muhamed Ashraf
4.	Genomic investigations on aquatic and fish microorganisms and development of molecular diagnostic methods for pathogens	Dr. Nirmala Thampuran	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. Toms C. Joseph Shri Rakesh Kumar Dr. K.V. Lalitha Dr. Sanjoy Das Dr. B. Madhusudhan Rao
5.	Improvement and value addition of traditional fish products	Dr. K.G. Rama-chandran Nair	Cochin		Shri P. Ravindra-nathan Nair Shri P.K. Vijayan Shri K. George Joseph
6.	Development of value added products from freshwater fish and their preservation	Dr. Jose Joseph	Cochin		Shri A.C.Mathew Shri George Ninan Smt. J. Bindu Dr. K.V. Lalitha Dr. T.V. Sankar Shri P.K. Vijayan
7.	Development of high value products from fish and fish processing waste	Dr. P.T. Mathew	Cochin		Dr. K.G. Rama-chandran Nair Dr. T.K. Thankappan Smt. R. Thankamma Shri George Ninan Shri A.A. Zynudheen Shri Rakesh Kumar Dr. R. Anandan

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
8.	Isolation, identification and characterization of natural bioactive substances of therapeutical importance from Indian waters	Dr. P.G. Viswa-nathan Nair	Cochin		Dr. T.V. Sankar Dr. K. Ashok Kumar Dr. Suseela Mathew Dr. R. Anandan Shri Rakesh Kumar Smt. K.K. Asha
9.	Studies on the sanitation and hygiene requirement in fishing boats, fish landing centres, transport and domestic markets for hazard control	Dr. M.K. Mukundan	Cochin		Shri V. Muralee-dharan Dr. P.T. Lakshmanan Dr. S. Sanjeev Shri K.P. Antony Dr. K. Ashok Kumar Dr. D. Muthuchelvan
10.	Statistical and econometric evaluation of production and marketing of sea food products	Dr. G.R. Unnithan	Cochin		Dr. Nikita Gopal Dr. V. Geethalakshmi Shri V. Radha-krishnan Nair
11.	Modern technologies for packaging of fish and fishery products	Dr. T.K. Srinivasa Gopal	Cochin		Shri P. Ravindra-nathan Nair Dr. C.N. Ravishankar Shri A.C. Joseph Dr. K.V. Lalitha Smt. J. Bindu
12.	Development of add-on protruding bows for small fishing vessels to reduce fuel consumption	Shri M. Nasser	Cochin		
13.	Chemical and microbiological evaluation of marine and inland fish and fishery products of Maharashtra	Shri S.P. Damle	Mumbai		
14.	Improvements and standardiz-ation of traditional fishing systems with special reference to reservoirs	Dr. P. Pravin	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. B. Meenakumari Shri M.P. Ramesan Dr. V. Geethalakshmi Dr. G. Rajeswari Dr. R. Raghu Prakash Shri U. Sreedhar
15.	Investigations on responsible trawl systems for mechanized sector	Dr. M. R. Boopendra-nath	Cochin, Veraval & Visakha-patnam	Cochin	Dr. P. Pravin Dr. Leela Edwin Dr. Saly N. Thomas Shri M.P. Remasan

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
				Veraval Visakha-patanam	Dr. S.K. Panda Shri V.R. Madhu Dr. G. Rajeswari Dr. R. Raghu Prakash Shri U. Sreedhar
16.	Pathogenic and commensal microflora of the capture and culture fisheries in relation to food and environmental safety	Dr. Nirmala Thampuran	Cochin		Dr. K.V. Lalitha Dr. Toms C. Joseph Shri Rakesh Kumar Dr. R. Anandan
17.	Studies on evaluation of technology transfer and associated variables	Dr. S. Bala-subramaniam	Cochin		Dr. S. Ashaletha Shri J. Charles Jeeva
18.	Development of instruments for fishing industry	Smt. K. Vijaya-bharathi	Cochin		Shri M. Nasser Dr. K. Ashok Kumar
19.	Design and development of energy efficient renewable fish dryers and smoking kilns	Dr. P.N. Joshi	Cochin		Shri K. George Joseph Dr. P.T. Lakshmanan
20.	Studies on processing parameters and indices of fish and fishery resources and products specific to the Gujarat region	Dr. R. Badonia	Veraval		Dr. D.I. Khasim Dr. L.N. Murthy

ICAR Ad-hoc Projects

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
21.	Bycatch reduction devices for selective shrimp trawling	Dr. M.R. Boopendra-nath	Cochin		Dr. P. Pravin Shri S. Sabu* Shri T.R. Gibin Kumar*
22.	Impact of Copper Chrome Arsenic (CCA) wood preservative on the aquatic environment	Dr. Leela Edwin	Cochin		Kum. A. Sreeja* Shri M. Ajith Peter*
23.	Standardization of fishing gear materials and fishing accessories	Dr. Saly N. Thomas	Cochin		Shri C. Kalidas* Shri Gipson Edappazham*
24.	Improved fishing craft and gear for NEH region	Dr. P. Pravin	Cochin & Guwahati	Guwahati	Dr. Puhar Daimari* Shri Bipul Kakati*

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
25.	Development of eco-friendly technologies for the production of biodegradable membranes from chitosan	Dr. P.T. Mathew	Cochin		Dr. T.K. Thankappan Smt. R. Thankamma Dr. C.N. Ravishankar Smt. T.K. Sini* Shri S. Santhosh*
26.	Suitability of polymer coated tin free steel cans for canning fish and fish products	Dr. C.N. Ravishankar	Cochin		Dr. T.K. Srinivasa Gopal Shri. P.K. Vijayan Smt. J. Bindu Shri P.G. Sreenath* Shri Abhilash*
27.	Functional properties of protein from marine, brackish water, freshwater and deep sea fish of India	Dr. T.V. Sankar	Cochin		Dr. R. Anandan Shri Mukund Mohan* Kum. Dhanya Ramachandran*
28.	Development of extruded products utilizing low value fishes	Dr. T.K. Srinivasa Gopal	Cochin		Dr. K.G. Rama-chandran Nair Dr. C.N. Ravishanker Shri C.K. Kamalakanth* Shri Jones Varkey*
29.	Identification and characteri-zation of bacterial genes imparting osmo-tolerance and their validation in plants	Dr. Toms C. Joseph	Cochin		Dr. Nirmala Thampuran Shri L. Anburajan*
30.	Development of gene constructs for producing WSSV resistant Penaied shrimp and its validation in shrimp cell culture systems	Dr. Toms C. Joseph	Cochin		Kum. Roswin James*
31.	Chemical residue management in farmed and wild fish and shellfish of India	Dr. P.T. Lakshmanan	Cochin		Kum. K.M. Swapna* Shri R. Rajesh*
32.	Assessing the impact of fisheries research in India	Dr. S. Bala-subramaniam	Cochin		Dr. Nikita Gopal Dr. S. Ashaletha
33.	Investigations on the effect of bottom trawling on the benthic fauna of Saurashtra coast, Gujarat	Dr. B. Meenakumari	Cochin & Veraval	Cochin Veraval	Smt. Usha Bhagirathan* Shri Deepak Kumar* Shri T. Vaghela*
34.	Resource assessment and biology of deep sea fishing along the continental slope of Indian EEZ	Dr. P.G. Viswa-nathan Nair	Cochin Visakha patnam	Visakha patnam	Shri U. Sreedhar

Space Application Centre Project

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
35.	Application of remote sensing and GIS for marine fisheries resource management	Dr. B. Meena-kumari	Cochin & Veraval	Veraval	Shri Nimit D. Joshi*

Network Project

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
36.	National risk assessment programme for fish and fish products of domestic and internal market	Dr. P.K. Surendran Dr. Nirmala Thampuran	Cochin Veraval & Visakha patnam	Cochin Veraval Visakha patnam	Dr. P.G. Viswanathan Nair Dr. T.V. Sanker Dr. Nirmala Thampuran Kum. O.K. Sindhu* Dr. R. Badonia Dr. B. Madhusudana Rao Kum. G. Padmaja*

Department of Science and Technology Project

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
37.	Action research on coastal zone management with special involvement of women	Dr. S. Bala-subramaniam	Cochin		Dr. P. Pravin Dr. Nikita Gopal

Senior Research Fellow *

Papers Published in Refereed Journals

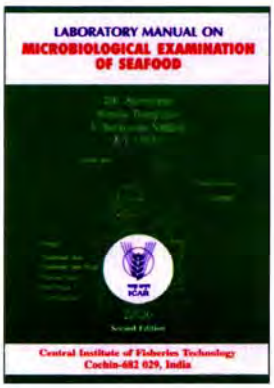
- Ansar Ali, Sudhir, B. & Srinivasa Gopal, T.K. (2006) – Effect of rotation on the heat penetration characteristics of thermal processed tuna in retort pouches – *Intl. J. Food Sci. & Technol.* **41**: 215-219.
- Charles Jeeva J., Balasubramaniam, S. & Krishna Srinath (2006) – Training needs and associated variables of fisheries officials in Kerala and Andhra Pradesh – *Fish. Technol.* **43** (1): 107-114.
- Charles Jeeva J., Imam Khasim, D., Krishna Srinath, Unnithan, G.R., Trinadha Rao, M., Murthy, K.L.N., Bathla, H.V.L. & Tauqueer Ahmad (2006) – Harvest losses at various resources of inland fisheries – *Fish. Technol.* **43** (2): 218-223.
- Dhanya Ramachandran, Mukund Mohan & Sankar, T.V., (2006) – Physicochemical characteristics of muscle proteins from Barracuda *(Sphyraena jello)* of different weight groups – *Food Science & Technol.* (Published online).
- Farvin, K.H.S., Anandan, R., Kumar, S.H.S., Shiny, K.S., Mathew, S., Sankar, T.V., & Viswanathan Nair, P.G. (2006) – Protective effect of squalene against isoproterenol-induced myocardial infarction in rats – *J. Med. Food.* **9**: 531-536.
- Jyothirmayee Sahoo & Prasad, M.M. (2006) – Ecosystem approach to fisheries: Implementation and impediments, *In*: Fish and fisheries: Conservation and sustainable development, (Eds.) Rekha, R.G., Patil, R.B. & Rodrigues, M.D.C., APH Publishing Corporation, New Delhi, pp: 121-146.
- Kumar, R., Surendran, P.K. (2006) – Antibacterial activity of shrimp chitosan against *Escherichia coli, Salmonella* and *Pseudomonas aeruginosa* isolated from seafood - *Fish. Technol.* **43**(1): 79-84.
- Lalitha, K.V. & Surendran, P.K. (2006) – Microbial quality of farmed freshwater Scampi (*Macrobrachium rosenbergii*) - *J. Aquatic Food Products Technol.* **14**: 39-50.
- Lalitha, K.V. & Surendran, P.K. (2006) – Isolation and characterization of *Shewanella putrefaciens* from farm reared freshwater prawn and farm environment – *Fish. Technol.* **43**(1): 85-92.
- Lalitha, K.V. & Surendran, P.K. (2006) – Seafood-borne bacterial pathogens – *Fish. Technol.* **43**(2): 118-137.
- Lalitha, K.V. & Surendran, P.K. (2006) – Microbial changes in farm reared freshwater prawn (*Macrobrachium rosenbergii* de Mann) in ice. *Food Control.* **17**: 802-807
- Leela Edwin & Muhamed Ashraf, P. (2006) – Assessment of biodetreioration or rubber wood exposed to field conditions – *Intl. Biodetrioration & Biodegradation* **57**(1): 31-36.
- Leela Edwin, Ajit Peter, M., Meenakumari, B. & Muhamed Ashraf, P. (2006) – Leaching of Chromated Copper Arsenate (CCA) wood preservative into the aquatic environment – A review – *Fish. Technol.* **43**(1): 1-6.
- Leema Jose, Manju, S., Kamalakanth, C.K., Srinivasa Gopal, T.K., Ravishankar, C.N. & Ashok Kumar, K. (2006) – Nucleotide degradation of Pearl spot during modified atmosphere

storage - *Fish. Technol.* **43**(2): 162-167.

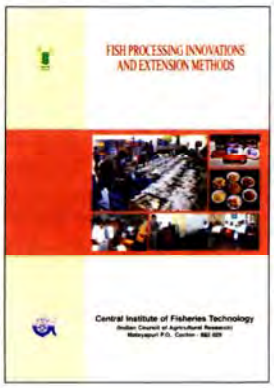
- Madhusudana Rao, B., Gupta, S.S., & Surendran, P.K. (2006) – Microbial quality of post-tsunami sea food of the Visakhapatnam coast – *Fish. Technol.* **43**(2): 192-197.
- Mallick, A.K., Srinivasa Gopal, T.K., Ravishankar, C.N. & Vijayan, P.K. (2006) – Polymer coated tin free steel cans for thermal processing of fish – *Fish. Technol.* **43**(1): 47-58.
- Mallick, A.K., Srinivasa Gopal, T.K., Ravishankar, C.N. & Vijayan, P.K. (2006) – Canning of Rohu in North Indian style curry medium using polyester coated tin free steel cans – *Food Sci. & Technol. Intl.* **12**(6): 539-545.
- Mohan, C.O., Ravishankar, C.N., Bindu, J., Geethalakshmi, V. & Srinivasa Gopal, T.K. (2006) – Effect of thermal processing on texture and subjective sensory characteristics of prawn kuruma in retortable pouches and aluminium cans – *J. Food Sci.* **71**(6): 1-5.
- Muhamed Ashraf, P., Leela Edwin & Meenakumari, B. (2006) – Studies on the seasonal changes of phosphorous in the marine environments off Cochin – *Environment Intl.* **32**(2): 159-164.
- Mukund Mohan, Dhanya Ramachandran & Sankar, T.V. (2006) – Functional properties of Rohu *(Labeo rohita)* proteins during iced storage – *Food Res. Intl.* **39** : 847-854.
- Nirmala Thampuran, Sreeganga, K. & Surendran, P.K. (2006) – Effect of chlorine ion on the survival of *Vibrio cholerae* of shrimp. *Fish. Technol.* **43**(2): 180-186.
- Prasad M.M, & Bandyopadhyay, J.K. (2006) – Poverty alleviation in small scale fishing communities: A review, *In:* Fish and fisheries: Conservation and sustainable development, (Eds.) Rekha, R.G., Patil, R.B.. & Rodrigues, M.D. APH Publishing Corporation, New Delhi, pp. 179-200.
- Saly N. Thomas & Hridayanathan, C. (2006) – Design and general characteristics of marine gill nets of Kerala – *Fish. Technol.* **43**(1): 1-6.
- Saly N. Thomas & Hridayanathan, C. (2006) – The effect of natural sunlight on the strength of polyamide 6 multifilament and mono-filament fishing net matyerials – *Fisheries Res.* **81**(2-3): 326-330.
- Sankar, T.V., Zynudheen, A.A., Anandan, R. & Viswanathan Nair, P.G. (2006) – Distribution of organochlorine pesticides and heavy metal residues in fish and shellfish from Calicut region, Kerala, India – *Chemosphere* **65**: 583-590.
- Santhosh, S., Sini, T.K., Mathew, P.T. & Ananadan, R. (2006) – Effect of chitosan supplementation as anti tubercular drugs induced hepto toxicity in rats – *Toxicology* **219**: 53-59.
- Sheela Immanuel, Kanagasabapathy, K. & Balasubramaniam, S. (2006) – An analysis of the linkages between fishermen and extension personnel in marine fisheries in Kerala. *Fish. Techol.* **43**(2): 230-235.
- Sindhu, O.K. & Surendran, P.K. (2006) – Enterotoxigenicity of coagulase positive and negative *Staphylococcus* species isolated from fish and fishery products. *Fish. Technol.* **43**(2): 186-192.
- Vijayan, V. & Baiju, M.V. (2006) – Net drag estimate of 18.0 m pelagic trawl through calculated twine area in comparison to projected monotype values by model studies - *Fish. Technol.* **43**(1): 37-40.

Publications Brought Out

- Laboratory manual on Microbiological examination of seafood edited by P.K. Surendran, Nirmala Thampuran, V. Narayanan Nambiar and K.V. Lalitha



- Training course mannual on Fish processing innovations and extension methods edited by S. Balasubramaniam, K.G. Ramachandran Nair and J. Charles Jeeva



- Electronic instrumentation technology developed in CIFT by P.N. Joshi, K. Vijayabharathi and T.K. Sivadas

- Fisheries policy update edited by G.R. Unnithan, Nikita Gopal and A.R.S. Menon

List of Personnel in CIFT

(as on 31 December 2006)

Managerial Personnel

Director : Dr. K. Devadasan

Heads/Acting Heads of Division		
Quality Assurance & Management Division	:	Dr. M.K. Mukundan, Principal Scientist
Engineering Division	:	Dr. P.N. Joshi, Principal Scientist
Extension Information & Statistics Division	:	Dr. S. Balasubramaniam, Principal Scientist
Microbiology, Fermentation & Biotechnology Division	:	Dr. Nirmala Thampuran, Principal Scientist
Fishing Technology Division	:	Dr. B. Meenakumari, Principal Scientist
Fish Processing Division (Acting)	:	Dr. K.G. Ramachandran Nair, Principal Scientist
Biochemistry & Nutrition Division (Acting)	:	Dr. P.G. Viswanathan Nair, Principal Scientist

Scientist-Incharge of Research Centre		
Veraval Research Centre	:	Dr. Rajendra Badonia, Principal Scientist
Visakhapatnam Research Centre	:	Shri Sibsankar Gupta, Principal Scientist
Burla Research Centre	:	Dr. M.M. Prasad, Senior Scientist
Mumbai Research Centre	:	Shri S.P. Damle, Senior Scientist
Administrative & Accounts		
Senior Administrative Officer	:	Shri K.P.S. Gautam
Assistant Finance & Accounts Officer	:	Shri K.S. Sreekumaran

Other Personnel

HEADQUARTERS, COCHIN

Scientific Personnel

Principal Scientist

1. Dr. P.T. Mathew
2. Dr. T.K. Srinivasa Gopal
3. Shri A.C. Joseph
4. Dr. Jose Joseph
5. Shri P.K. Vijayan
6. Dr. T.K. Thankappan
7. Shri K. George Joseph
8. Dr. M.R. Boopendranath
9. Dr. P.T. Lakshmanan
10. Dr. S. Sanjeev
11. Shri P. Ravindranathan Nair
12. Smt. K. Vijayabharathy
13. Dr. G.R. Unnithan
14. Dr. K.V. Lalitha
15. Shri K.P. Antony
16. Shri M. Nasser

Senior Scientist

1. Dr. Leela Edwin
2. Dr. C.N. Ravishankar
3. Dr. K. Asok Kumar
4. Dr. T.V. Sankar
5. Dr. Saly N. Thomas
6. Dr. P. Pravin
7. Dr. V. Geethalakshmi

Scientist (Selection Grade)

1. Smt. R. Thankamma
2. Dr. Suseela Mathew
3. Shri M.P. Ramesan

Scientist (Senior Scale)

1. Smt. J. Bindu
2. Shri P. Muhamed Ashraf
3. Dr. Nikita Gopal
4. Shri George Ninan
5. Shri A.A. Zynudheen
6. Dr. Toms C. Joseph
7. Dr. R. Anandan
8. Dr. S. Ashaletha
9. Shri V. Radhakrishnan Nair
10. Shri J. Charles Jeeva
11. Shri Rakesh Kumar

Scientist

1. Dr. D. Muthuchelvan
2. Smt. K.K. Asha
3. Dr. Sanjoy Das

Technical Personnel

T-9 (Technical Officer)

1. Shri K.J. Francis Xavier
2. Dr. A.R.S. Menon

T (7-8) (Technical Officer)

1. Shri M.V. Baiju

T-6 (Technical Officer)

1. Shri C.R. Gokulan

T-5 (Technical Officer)

1. Shri P.T Sebastian
2. Shri N.M. Vasu
3. Shri V. Gopalakrishna Pillai
4. Shri G. Ratnakaran Nair
5. Smt. K.B. Beena
6. Dr. K. Sobha
7. Shri E.K. Balakrishnan
8. Smt. K. Sarasamma
9. Smt. P.K. Shyma
10. Dr. M. Baiju
11. Dr. G. Usha Rani
12. Shri Jose Kalathil
13. Shri K.B. Thilakan
14. Shri P. Bahuleyan
15. Smt. K.K. Sumathy
16. Shri P.A. Josi Augustine
17. Smt. Tara Karupalli
18. Smt. M.K. Sreelekha
19. Smt. T. Silaja
20. Shri K.B. Thampi Pillai
21. Smt. V.C. Mary
22. Shri P. Feroz Khan
23. Shri T.N. Sukumaran
24. Shri T.R. Sreekumaran
25. Shri D. Padmanabhan
26. Shri K.P. Vijayan
27. Shri C. Rajendran
28. Shri M.K. Asokan
29. Shri K.D. Jos
30. Smt. M. Rekha

T-4

1. Shri B. Ganesan : Animal House Keeper
2. Smt. K.G. Sasikala : Junior Laboratory Assistant
3. Smt. K.K. Kala : Technical Assistant
4. Shri Sibasis Guha : Photographer-cum-Artist
5. Shri P.S. Babu : Senior Field Assistant
6. Shri V.N. Dileepkumar : Engine Driver
7. Shri P. Shankar : Hindi Translator
8. Smt. Ancy Sebastian : Technical Assistant
9. Shri G. Omanakuttan Nair : Junior Laboratory Assistant

10.	Smt. G. Remani	:	Junior Laboratory Assistant
11.	Shri P.N. Sudhakaran	:	Net Making Supervisor
12.	Shri Aravind S. Kalangutkar	:	Senior Field Assistant
13.	Smt. K.P. Leelamma	:	Junior Laboratory Assistant
14.	Shri P.S. Raman Namboodiri	:	Junior Laboratory Assistant
15.	Shri A.A. Kunjappan	:	Field Assistant
16.	Shri A.K. Unnikrishnan	:	Cook
17.	Shri Arockia Sami	:	Deckhand

T-II-3

1.	Shri K.K. Narayanan	:	Boilerman
2.	Shri P.T. Viswambharan	:	Electrician

T-3

1.	Shri T. Gangadharan	:	Senior Laboratory Assistant
2.	Smt. P.K. Geetha	:	Junior Laboratory Assistant
3.	Shri C. Subash Chandran Nair	:	Projector Operator
4.	Smt. P.A. Jaya	:	Junior Laboratory Assistant

T-I-3

1.	Shri Tomy Rebellow	:	Boilerman
2.	Smt. K.S. Mythri	:	Junior Laboratory Assistant
3.	Shri P.S. Nobi	:	Net Making Supervisor

T-2

1.	Shri T. Mathai	:	Junior Laboratory Assistant
2.	Smt. N. Lekha	:	Junior Laboratory Assistant
3.	Shri R.N. Sahoo	:	Driver (Launch)
4.	Shri P.N. Sukumaran Nair	:	Field Assistant
5.	Shri P.D. Padmaraj	:	Junior Laboratory Assistant
6.	Shri N. Sunil	:	Plant Attendant
7.	Shri Sajith K. Jose	:	Draughtsman
8.	Shri P.V. Sajeevan	:	Draughtsman
9.	Smt. M.V. Valsala	:	Field Assistant
10.	Shri V.K. Siddique	:	Refrigeration Mechanic
11.	Shri G. Gopakumar	:	Carpenter

12.	Shri R. Rangaswamy	:	Driver
13.	Shri V.A. Sudhakaran	:	Plumber
14.	Shri Umesh D. Aroskar	:	Driver
15.	Shri T.P. Balakrishnan	:	Driver
16.	Shri K.V. Mohanan	:	Driver
17.	Shri K. Nakulan	:	Driver
18.	Shri T.B. Assisse Francis	:	Driver
19.	Shri K.S. Babu	:	Turner
20.	Smt. Bindu Joseph	:	Media Assistant
21.	Smt. N.C. Shyla	:	Field Assistant
22.	Shri C.K. Suresh	:	Machine Operator
23.	Shri N. Krishnan	:	Junior Laboratory Assistant
24.	Shri V.T. Sadanandan	:	Junior Laboratory Assistant
25.	Shri K.D. Santhosh	:	Junior Laboratory Assistant
26.	Shri K. Dinesh Prabhu	:	Plant Attendant
27.	Smt. Tessy Rony	:	Field Assistant
28.	Shri P.A. Shanmughan	:	Tindal
29.	Shri P.S. Sunil Kumar	:	Driver

T-1

1.	Shri T. Jijoy	:	Junior Laboratory Assistant
2.	Shri K.C. Anish Kumar	:	Junior Laboratory Assistant
3.	Shri K.A. Martin Xavier	:	Filed Assistant

Administrative Personnel

1.	Smt. K. Usha	:	Administrative Officer
2.	Shri R. Anil Kumar	:	Asst. Admn. Officer
3.	Shri A. George Joseph	:	Asst. Admn. Officer
4.	Smt. M.A. Prasanna	:	Asst. Admn. Officer
5.	Shri P.K. Sreedharan	:	Asst. Admn. Officer
6.	Dr. C. Jessy Joseph	:	Asst. Director (Official Language)
7.	Shri K. Ravindran	:	Private Secretary
8.	Shri P.P. Anil Kumar	:	Jr. Accounts Officer

Assistant

1. Smt. C.G. Marykutty
2. Smt. K.R. Gita Rani
3. Smt. N. Prabhavathy Amma
4. Smt. Pushpalatha Viswambharan
5. Shri T.M. Ramaraj
6. Smt. M. Jully
7. Shri Y. Philipose
8. Shri R. Viswanathan
9. Smt. T.K. Susannamma
10. Smt. K. Gracy
11. Shri P. Krishna Kumar
12. Shri K.P. Velayudhan
13. Smt. P.C. Kamalakshy
14. Shri P.V. Venugopalan
15. Smt. N.I. Mary
16. Shri K.B. Sabukuttan
17. Smt. M.S. Susanna
18. Smt. T.D. Usheem
19. Shri P.K. Thomas
20. Smt. P.K. Thankamma

Personal Assistant

1. Smt. R. Vasantha
2. Smt. V.P. Vijayakumari
3. Shri P.K. Raghu
4. Smt. S. Kamalamma
5. Smt. N. Leena
6. Shri K.V. Mathai
7. Shri R.D. Goswamy
8. Shri T. Viswanathan

Stenographer Grade - III

1. Smt. Anitha K. John

Upper Division Clerk

1. Smt. A.A. Cousallia
2. Shri K.K. Sasi
3. Shri P. Padmanabhan
4. Smt. A.R. Kamalam
5. Smt. T.K. Shyma
6. Shri V.S. Ambasudhan
7. Smt. V.S. Aleyamma
8. Smt. G.N. Sarada
9. Shri C.K. Sukumaran
10. Smt. Lillykutty George
11. Shri P.K. Somasekharan Nair
12. Shri P. Mani
13. Smt. Jaya Das
14. Shri P. Bhaskaran
15. Smt. K. Renuka
16. Smt. P.R. Mini
17. Smt. V.K. Raji
18. Shri M.N. Vinodh Kumar
19. Shri K. Das
20. Shri T.N. Shaji
21. Smt. A.R. Raji
22. Smt. E. Jyothilekshmy

Lower Division Clerk

1. Smt. Shiji John
2. Shri P.G. David
3. Shri Santhosh Mohan

Cook

1. Shri V. Ramachandran

Supporting Personnel

Supporting Staff Grade IV

1. Shri T.V. Manoharan

2. Shri M.R. Bharathan
3. Shri K.N. Mukundan
4. Shri P. Gopalakrishnan
5. Shri K.B. Bhaskaran
6. Shri P.R. Unnikrishna Panicker

Supporting Staff Grade III

1. Shri A.R. John
2. Shri P.A. Sivan
3. Shri. C.D. Parameswaran
4. Smt. C.G. Radhamoney
5. Shri E. Damodaran

Supporting Staff Grade II

1. Shri P.P. George
2. Shri P.V. Raju
3. Shri A.V. Chandrasekharan
4. Shri M.M. Radhakrishnan
5. Shri K.K. Karthikeyan
6. Smt. C. Ammini
7. Smt. P. Ammalu
8. Shri M.N. Sreedharan
9. Smt. U.K. Bhanumathy
10. Shri T.K. Rajappan
11. Shri. P. Rajeev
12. Shri M.T. Udayakumar
13. Smt. P.T. Mary Vinitha
14. Shri O.P. Radhakrishnan
15. Shri P. Raghavan
16. Shri T.M. Balan
17. Shri V. Deepak Vin
18. Shri T.D. Bijoy

Supporting Staff Grade I

1. Shri K.R. Rajasaravanan
2. Shri P.N. Nikhil Das
3. Shri A. Vinod
4. Shri K.S. Ajith

Auxilary Personnel

1. Shri. M.T. Mani : Cook
2. Shri K.C. Mohanan : Tea Maker
3. Shri T.A. Gopalakrishnan : Bearer
4. Shri M.V. Rajan : Bearer

VERAVAL RESEARCH CENTRE

Scientific Personnel

Scientist

1. Dr. L.N. Murthy
2. Shri V.R.Madhu
3. Dr. S.K. Panda

Technical Personnel

T-6 (Technical Officer)

1. Shri J.B. Paradwa
2. Shri K.U. Dholia

T-5 (Technical Officer)

1. Shri Thomas Teles
2. Shri K.U. Sheikh

T-4

1. Shri K.C. Gopalan

T-3

1. Shri G.M. Vaghela

T-2

1. Shri H.V. Pungera
2. Shri G. Kingsely
3. Shri S.H. Ummer Bhai

Administrative Personnel

Assistant

1. Shri M.M. Damodara
2. Shri S.B. Purohit

Upper Division Clerk

1. Shri D.P. Parmar

Lower Division Clerk

1. Shri Arockia Shaji

Supporting Personnel

Supporting Staff Grade IV

1. Shri P.A.G.A. Rehman

Supporting Staff Grade III

1. Shri B.M.A. Khokhar
2. Shri D.B. Chudasama
3. Shri K. J. Damor

Supporting Staff Grade II

1. Smt. Gangaben Naren Chorwadi
2. Shri D.K. Viram
3. Shri J.B. Malamdi
4. Shri R.N. Gosai
5. Shri A.M. Vala
6. Shri M.K. Kana
7. Smt. Harshaban A. Joshi
8. Shri N.K. Masani
9. Smt. Pushpaben P. Chudasama
10. Smt. Motiben K. Fofandi

Supporting Staff Grade I

1. Shri K. Thinakaran
2. Shri D. Ramesh Kumar

Auxiliary Personnel

1. Shri J. K. Khodidas : Wash Boy
2. Smt. Veena Sreedhar Narkar : Coffee/Tea Maker

VISAKHAPATNAM RESEARCH CENTRE

Scientific Personnel

Principal Scientist

1. Dr. D. Imam Khasim Saheb
2. Shri A.K. Chattopadhyay
3. Dr. Rupshankar Chakraborti

Senior Scientist

1. Dr. G. Rajeswari

Scientist (Senior Scale)

1. Shri U. Sreedhar
2. Dr. R. Raghu Prakash
3. Dr. B. Madhusudana Rao

Technical Personnel

T-7-8 (Technical Officer)

1. Shri M.S. Kumar

T-6 (Technical Officer)

1. Shri V.V. Ramakrishna

T-5 (Technical Officer)

1. Shri C. Srihari Babu
2. Shri K.V.S.S.S.K. Harnath
3. Shri U. Alagumalai

T-4

1. Shri Santhosh Alex
2. Shri K. Prakasa Rao
3. Shri N. Venkata Rao

T-3

1. Shri M. Venkateswara Rao
2. Shri P. Radhakrishna

T-1

1. Shri V. Kamaraju

Administrative Personnel

Assistant Administrative Officer

1. Shri G.C. Adhikari

Assistant

1. Smt. B. Hemalatha

Personal Assistant

1. Smt. D.A.L. Satyanarayanamma
2. Shri Trilochan Rout

Upper Division Clerk

1. Shri Y. Kanakaraju
2. Shri G. Chinna Rao

Lower Division Clerk

1. Shri Appa Rao

Supporting Personnel

Supporting Staff Grade - IV

1. Shri Orilika Heman
2. Shri C. Kamaraju

Supporting Staff Grade - III

1. Shri B. Sivanadham
2. Shri K. Appa Rao
3. Shri S. Chakram
4. Shri V.V. Ramana

Supporting Staff Grade - II

1. Shri G. Bhushanam

Supporting Staff Grade - I

1. Shri M.S. Prabhakara Rao
2. Smt. Nalla Naveena
3. Shri P. Ramakrishna
4. Smt Neelima Besra

BURLA RESEARCH CENTRE

Scientific Personnel

Senior Scientist

1. Shri J.K. Bandyopadhyay

Technical Personnel

T-6 (Technical Officer)

1. Shri B. Pradhan

T-5 (Technical Officer)

1. Shri B.K. Panda
2. Shri A.K. Panigrahi
3. Shri P.M. Pattanayak

T-4

1. Shri Kirtan Kisan
2. Shri Damodar Rout
3. Shri A.K. Naik

T-2

1. Shri H.S. Bag

T-1

1. Shri Surjananda Dishri

Administrative Personnel

Assistant

1. Shri Udekar Pandey

Upper Division Clerk

1. Shri L.N. Badi
2. Shri Premlal Panda

Lower Division Clerk

1. Shri K.C. Naik

Supporting Personnel

Supporting Staff Grade IV

1. Shri Santhosh Banchor
2. Shri Satrughan Seth

Supporting Staff Grade III

1. Shri B.N. Guru
2. Shri Jaisingh Oram
3. Shri S.N. Mirdha
4. Shri G.B. Mahanandia
5. Shri D.L. Pattanaik

Supporting Staff Grade II

1. Shri T.N. Banchor
2. Shri S.N. Dash
3. Shri B.K. Deo
4. Shri Nande Oram
5. Shri Sanyasi Ganik

Supporting Staff Grade I

1. Smt. Gyananetri Nag
2. Shri Amit Vengaraj
3. Shri S.K. Mehar

MUMBAI RESEARCH CENTRE

Scientific Personnel

Senior Scientist

1. Shri S.P. Damle

Technical Personnel

T-6 (Technical Officer)

1. Smt. Sangeetha D. Gaikwad
2. Smt. Triveni Gopal Adiga

T-5 (Technical Officer)

1. Shri P.S. Gadankush

T-1

1. Shri P.B. Bait
2. Shri T.A. Waghmare

Administrative Personnel

Assistant Administrative Officer

1. Shri M.S. Bhatkar

Assistant

1. Smt. Smitha K. Shirishkar

Upper Division Clerk

1. Shri A.N. Agawane

Supporting Personnel

Supporting Staff Grade III

1. Shri B.M. Ghare
2. Shri C.B. Kolvalkar
3. Shri V.S. Salvi