ISSN 0972-0667 Annual Report - CIFT

Annual Report
2003 - 04

Central Institute of Fisheries Technology
(Indian Council of Agricultural Research)
Matsyapuri P.O. , Cochin – 682 029

Annual Report

2003 - 2004

Central Institute of Fisheries Technology
(Indian Council of Agricultural Research)
Matsyapuri P.O., Cochin - 682 029

Published by	**Dr. K. Devadasan** Director, CIFT
Compilation, editing & layout	**Mary Thomas** **Dr. A.R.S. Menon**
Photography & cover design	**Sibasis Guha** **Dr. Nikita Gopal**
Secretarial assistance	**K.V. Mathai** **V.P. Vijayakumari**
Official Language	**Dr. K. Sobha** **P. Shankar**
Printers	M/s Bethesda Printers Edappally, Cochin – 21

Cover: Top: I to r - Cuttlefish waste, Cuttlefish, Silage-rice bran mixture
Bottom: Loading gill net for operation at Lakshadweep

Contents

Preface 1
Introduction 3
Organogram 4
Executive Summary 6
Budget details 7
A quick glace at past achievements 8
Research Achievements 9
- Headquarters, Cochin 9
- Veraval Research Centre 40
- Visakhapatnam Research Centre 43
- Burla Research Centre 48
- Hoshangabad Research Centere 52
- Mumbai Research Centre 53
- Calicut Research Centre 55

Transfer of Technology Programmes 58
Training Programmes Conducted 59
Technologies Assessed and Transferred 67
Outreach Programmes 68
Analytical Services 69
PG Programmes in Post Harvest Technology 69
Awards/Degrees/Recognitions 70
Interaction and Linkages 71
On-going Research Projects 72
Technical Guidance/ Consultancy 73
Committees 74
Visits Abroad 75
ICAR Sports 75
Participation in Training Programmes 76
Participation in Symposia/Seminars/Workshops etc. 78
Special Days and Events 84
Administration 88
Technical Section 89
Official Language Implementation 90
Scientific/Technical Talks 90
Library 91
Representation in Committees 91
Visitors 94
Publications 95
List of Personnel in CIFT 102

Preface

2003-2004 was a tough and turbulent year for Indian fisheries. The export oriented fish processing industry which is even now mainly dependent on shrimp, saw catches from the capture sector stagnating. Aquaculture was in doldrums due to disease problems in many parts of the country. Competitions from other South-Eastern countries have also become tough. On top of all these, the importing countries have made their quality standards stricter and more stringent. Many new contaminants have entered the list of parameters to be checked for quality evaluation and more are on the way. Antibiotics, stilbenes, steroids, PCBs etc. at ppb level have become reasons for rejection. In this rather not so pleasant scenario, CIFT has the satisfaction that it could do considerable work to help this premier foreign exchange earning industry. This annual report of the Institute is an attempt to summarise these activities, for the information of all. It also helps the Institute to review the work in its totality enabling us to identify the gaps and to plan our future activities properly.

The Institute has been successful to a considerable extent, in making the fish processors aware of the vast internal market for processed and ready-to-serve fishery products. The vagaries of the export market and unreasonably stringent quality standards introduced by the importing countries have also forced them to turn more to the internal market, especially the vast affluent metropolitan markets. With increase in the number of working housewives, demand for ready-to-serve products has increased. Non-resident Indians in different parts of the world, whether in Gulf countries, Europe or America, also are eager to get ready-to-eat fish curries prepared according to their respective regional recipes which in due course will serve to ensure a good export market for these products. As a result, factories are coming up in different parts of the country for the production of such products, with technology from CIFT. This is bringing about a silent but significant revolution in the fish consumption pattern in the country. The much needed diversification to reduce over dependence on shrimp and foreign markets is beginning. Finfishes, especially fresh water fishes, are fast becoming prized catches. The Institute is happy to play the critical lead role in this transformation in keeping with its past tradition when it had guided and lead the industry in all the decisive turns it took in its chequered history.

The traditional sector, both in fishing and fish processing, in different parts of the country, received special attention in the research and transfer of technology programmes of the Institute. Fresh water fisheries, especially in the North Eastern Regions, is also a priority area. Fibreglass moulded artisanal fishing canoes, popularized in this region by CIFT, is well accepted. Boat builders in different NEH states have been trained in this technology to ensure availability of maintenance-free boats at affordable price. As a result of CIFT's work, chemically treated rubber wood has become a substitute for traditional costly woods for boat building. This ensures a better market for the under-utilized rubber wood. It also makes inexpensive good wood available for boat building.

This benefits the rubber farmer and the artisanal fishermen in the South West coast and in the NEH, sparing costly wood and forests, and saving the environment from deforestation.

Squid wastes from seafood processing plants dumped in residential areas have been causing environmental degradation and is a public nuisance in many parts. A very simple process developed by the CIFT to convert these wastes into a pleasant smelling high protein cattle/poultry feed has generated a lot of interest. It literally generates wealth from waste, saves the environment and brings relief to the local population.

Food safety has been, as in previous years, a major concern for the industry. Monitoring the quality of processed products in the light of new EU standards necessitated highly sophisticated instruments. The industry and aquaculture farmers were given all help in monitoring antibiotic residues, pesticide residues, heavy metals, PCBs, pathogenic bacteria etc. in farmed shrimp.

Extensive training programmes were conducted in different parts of the country for the benefit of farmers, traditional fishermen, technologists and fish processors. The M. F.Sc. and Ph. D. programmes in Fish Processing Technology continued successfully during the year also.

In collaboration with the Society of Fisheries Technologists (India), the Institute conducted a one day seminar on the Status and future of fisheries in Gujarat, in which distinguished persons in the field participated. The proceedings of the seminar were brought out in the form of a book 'Sustainable fisheries development – Focus on Gujarat' which was appreciated by the Govt. of Gujarat. This is the beginning of a series of such seminars focusing attention on fisheries in all major states. A book on 'Seafood safety' was also released jointly by CIFT and SOFT (I) which has been well received by the industry.

The foregoing is a brief summary of the main activities of the Institute during the year 2003-04. The Institute welcomes suggestions, if any, for improving its research and development programmes for better service to the fisheries industry.

(Dr. K.Devadasan)
Director

Kochi
June 2004

The **Central Institute of Fisheries Technology** (named at the time of its inception as Central Fisheries Technological 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 Agriculture with a small nucleus of staff for research work in fishing craft and gear. Other divisions which subsequently was expanded into a research institute to carry out multidisciplinary research in harvest and post harvest technology of fish soon followed. The administrative control of the Institute was brought under the Indian Council of Agricultural Research from 1 October, 1967.

The Institute is the only national center 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), Mumbai (Maharashtra), Calicut (Kerla) and Hoshangabad (Madhya Pradesh).

Mandate

The various works of the Institute are carried out as per the mandate assigned to it as shown below

- To evolve innovative and cost-effective technologies for fish harvest
- To develop and standardise 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 popularise the innovations for overall development of the fisheries industry

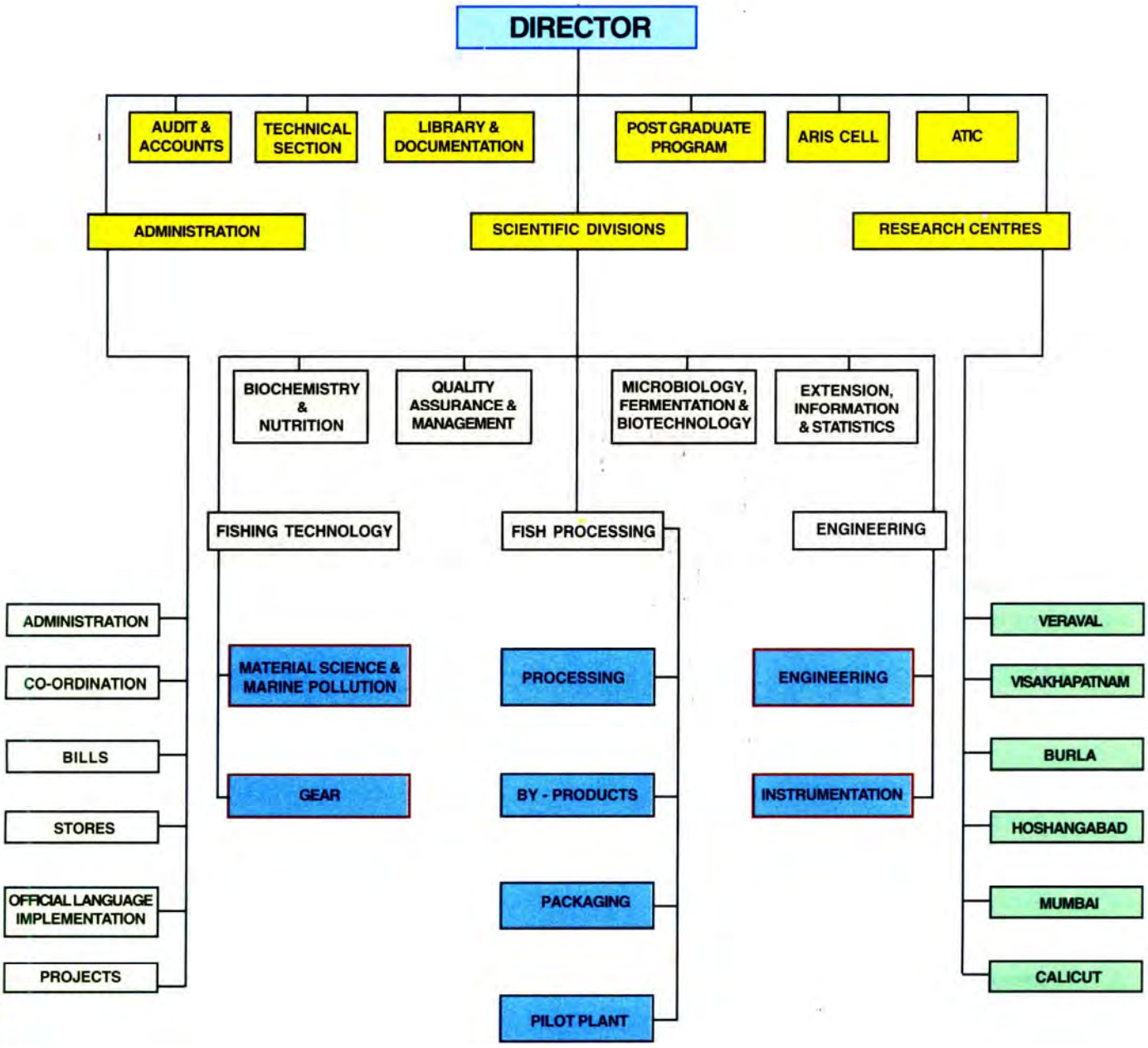
Organisational set-up

The Institute is headed by the Director with whom all administrative and financial powers of the Institute are vested. Research management is carried out with the help of Heads of Divisions. The Director is assisted by a Senior Administrative Officer, Administrative Officer and Asst. Administrative Officers for dealing with matters relating to general administration and Assistant Finance and Accounts Officers for looking after the financial and accounting aspects as also internal audit of the Institute. A Technical Officer attends to the technical matters including those connected with research projects handled by the Institute. Official Language Implementation Section is headed by the Assistant Director (Official Language).

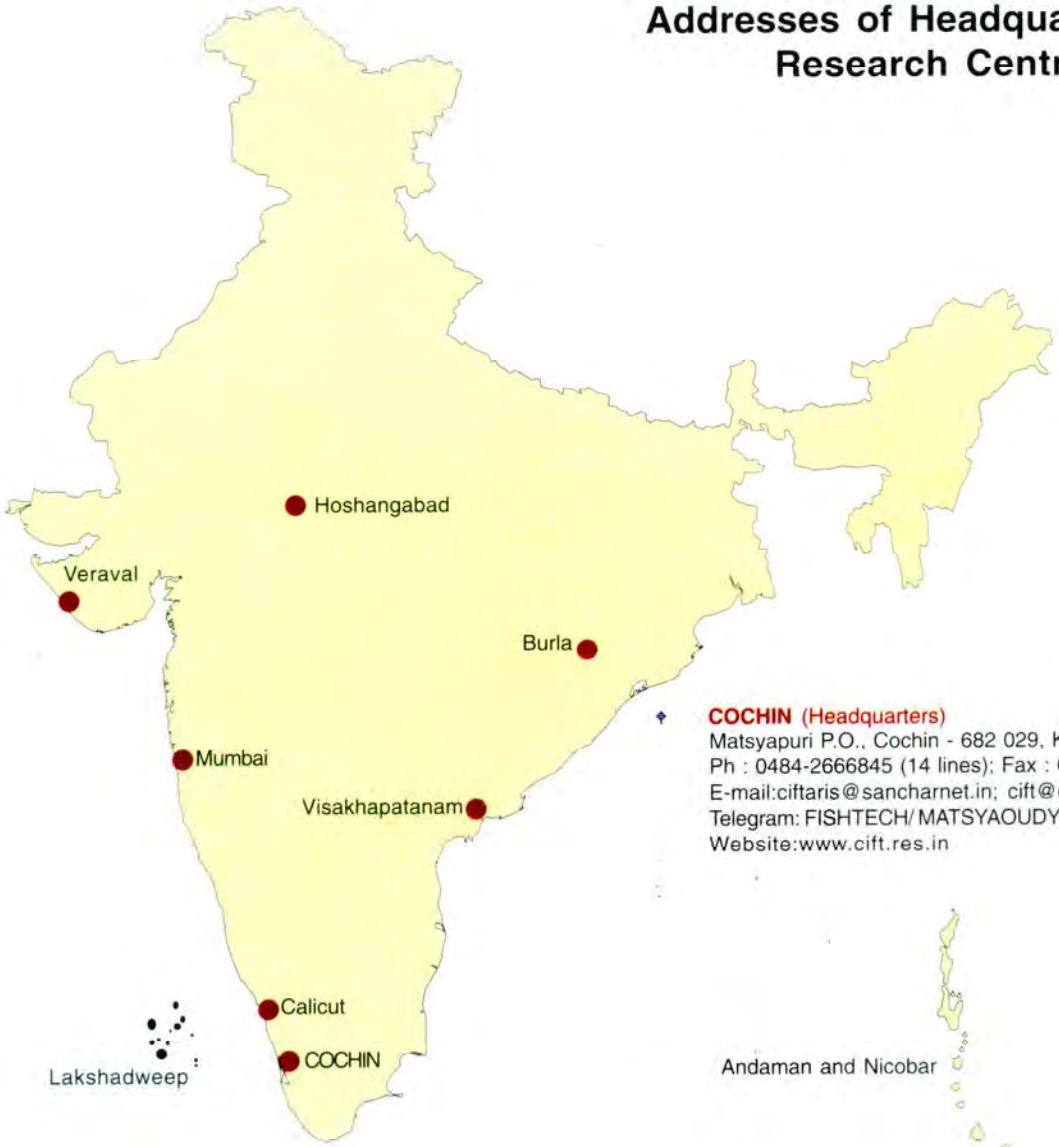
The research work is carried out by the following Research Divisions:

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

Organogram


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

Addresses of Headquarters and Research Centres



COCHIN (Headquarters)
Matsyapuri P.O., Cochin - 682 029, Kerala
Ph : 0484-2666845 (14 lines); Fax : 091 - 484 - 2668212
E-mail:ciftaris@sancharnet.in; cift@ciftmail.org
Telegram: FISHTECH/ MATSYAOUDYOGIKI
Website:www.cift.res.in

Veraval
Research Centre of CIFT
Matsya Bahavan
Bhidia Plot, Veraval - 362 269, Gujarat
Ph : 02876 - 231297; Fax : 02876 - 231576
E-mail: ciftvrc@vsnl.net.in
Telegram: FISHTECH/MATSYAOUDYOGIKI

Visakhapatanam
Research Centre of CIFT
Ocean View Layout
Pandurangapuram, Andhra University P.O.
Visakhapatanam - 530 003, Andhra Pradesh
Ph : 0891 - 2567040/ 2567856; Fax : 0891 - 2567040
E-mail: cift@itpvis.ap.nic.in
Telegram: FISHTECH/MATSYAOUDYOGIKI

Burla
Research Centre of CIFT
Burla - 768 017, Sambalpur Dist, Orissa
Ph : 0663 - 2430419; Fax : 0663 - 2430419
Telegram: FISHTECH/MATSYAOUDYOGIKI

Mumbai
Research Centre of CIFT
CIDCO Administrative Bldg., (Ground Floor)
Sector - I, Vashi, Navi Mumbai - 400 703, Maharashtra
Ph : 022 - 27826017; Fax : 022 - 27827413
E-mail: ciftmum@bom.nic.in
Telegram: FISHTECH/FISHPROCESSS (FT)

Calicut
Research Centre of CIFT
Beach Road, West Hill
Calicut - 673 005, Kerala
Ph : 0495 - 2380627
E-mail: ciftkoz@ker.nic.in; koz_rcofcift@sancharnet.in
Telegram: FISHTECH/MATSYAOUDYOGIKI

Hoshangabad
Research Centre of CIFT
Near Harijan Chatravas, Ananda Nagar
Hoshangabad - 461 001, Madhya Pradesh
Ph : 07574 - 251117; Fax : 07574 - 251117
Telegram: FISHTECH/ MATSYAOUDYOGIKI

Executive Summary

- A fibreglass reinforced plastic (FRP) sheathed rubber wood canoe was constructed and given for experimental fishing to artisanal fishermen.
- A mesh-measuring gauge was designed and fabricated for measuring mesh size of various netting materials up to of 150 mm.
- Monoline fishing (long lining) was introduced in the reservoirs (Hirakud reservoir) for the first time.
- 30 mm square mesh cod end were seen efficient in elimination of juveniles from trawls in inshore waters.
- Chondroitin sulphate was extracted from shark cartilage and purified.
- Pure carrageenan was prepared from *Euchemia cottoni*.
- Fish sauce was prepared from the low fatty fish waste.
- Cephalopod processing waste was used for the preparation of silage.
- Storage life of salted sardines is increased by giving the samples a dip treatment in ginger/turmeric extract before salting.
- Battered and breaded fish nuggets were developed from threadfin bream (*Nemipterus japonicus*).
- Standardised the preparation of chilly fish with ingredients possessing nutraceutical properties.
- Formulated fish kuruma using seer fish by modifying the recipe for chicken kuruma.
- Standardised methods for preparation of a number of value added, ready-to-serve products from black tilapia (*Oreochromis mossambicus)*.
- Process conditions for the preparation of surimi from fresh and iced tilapia under different washing conditions were standardised.
- Standardised processing and storage conditions for ready-to-serve sardine curry, clam meat masala, mussel masala, prawn manchurian and a traditional product from anchovy in retort pouches.
- Dried fish had enhanced storage life when packed in laminate pouches under vacuum.
- Standardised packaging materials for packing prawn and fish wafers.
- A simple process was developed to utilize seasonal surplus catch of low value, less marketable small bony fish as nutritionally rich, edible fish powder without de-boning the fish.
- Defatted fish powder exerted significant antilipidemic effect in experimental rats.
- Fish feed ingredients of animal origin were found superior in nutritional quality compared to the ingredients derived from plants with respect to the proportion of essential amino acids and n-3 polyunsaturated fatty acids.
- Commercial trials of a 50000 litre per day capacity effluent treatment plant constructed by M/s. Abad Fisheries, Cochin under CIFT guidance were successfully completed.
- A survey of about 200 samples of fish and shell fish, mainly from Kerala coast, consisting of coral fishes, crab, bi-valves etc. revealed that Indian seafood are free from Paralytic Shellfish Poison.
- Developed a simple and rapid colorimetric method for quantitative evaluation of sulphate residue. A rapid colorimetric method was also developed for screening of seafood for antibiotic residues.
- A LC-MS-MS method for analysis of different antibiotics was standardised.
- A nucleotide based method (K-value) was established for quality evaluation of *Macrobrachium rosenbergii*.
- An improved microbiological assay method was developed for the detection of bacterial inhibitors from seafood.

- Design was prepared of an eco-friendly fish drier. A multi channel thermometer with five channels was also developed for use in the drier.
- Designed and developed a polishing system for removing the sharp edges from cubical cut pieces of molluscan shells, a bead pre-forming machine to make the corner ground shell beads into near spherical shape and a bead-rounding machine to produce exact spherical shaped shell beads.
- Developed a portable Environmental Data Acquisition System for monitoring environmental parameters.
- Developed an indigenous electronic counter for measurement of concentration of micro algae *Tetraselmis*.
- About 70% of the traditional fishermen respondents had only medium level awareness (50% score) of the hygienic fish handling practices to be used in the fish landing centres.
- The fuel consumption by the mechanised crafts operated at Cochin region during 2002 - 03 was estimated at 37,482 KL and for Kerala state as a whole, at 97,204 KL.
- Results of the economic evaluation of 18 m steel trawler of CIFT design, under commercial operations, indicated that operational profit was 47.5% of the operating cost.
- Various technologies developed were transferred to different sections of the clientele through training, consultancy and extension programmes.

Statement showing budget allocation and actual expenditure for the year 2003 - 2004

(Rs. in lakhs)

Particulars	Non Plan			Plan		
Budget Head	Budget Estimate	Revised Estimate	Expenditure	Budget Estimate	Revised Estimate	Expenditure
Establishment Charges	670.30	644.70	644.49	3.00	-	-
O.T.A.	0.40	0.40	0.40	-	-	-
T.A.	7.70	10.00	10.00	13.75	13.75	13.74
Other charges including equipments, works & repair	86.60	130.90	130.65	323.25	326.25	326.21
NEH	-	-	-	10.00	8.00	7.98
Total	**765.00**	**786.00**	**785.54**	**350.00**	**348.00**	**347.93**

A quick glance at past achievements

Sustainable utilization of the marine and inland resources is one of the main aims of the activities of the Institute for which extensive surveys have been conducted by the Institute along the entire area from the North-West to North-East coast of the country on-board the DOD owned research vessel *Sagar Sampada*. Specialized nets such as high speed demersal trawl, hybrid trawl, high opening trawl and semi-pelagic trawl, to name a few, have been designed for operation from this vessel. A large number of designs of various types of gear such as gill nets, purse seines, lines and traps have also been developed for exploitation of fishery resources. Development of a combination wire rope for deep sea fishing, design and popularization of Turtle Excluder Device, square mesh cod end for conservation of juveniles and V-form steel otter board for increased efficiency are other notable achievements of the Institute.

In addition to developing designs of mechanized wooden fishing vessels in the size range 7.67 – 15.25 m OAL, the Institute embarked upon designing large resource – specific vessels of 20 m OAL and above, in order to meet the ever increasing demand for exploiting the deep sea waters of the country. Fibreglass reinforced plastic (FRP) and treated rubber wood canoes for use in backwaters and near-shore waters are recent contributions. Painting schedules and methods have been developed for protection of fishing crafts. Designs of fuel efficient steel fishing vessels have also been developed and commercialized.

The Institute also developed a number of electronic equipments for monitoring in commercial fisheries, research as well as environmental studies. Some of them are trawl depth meter, solar processing monitor, environmental data acquisition system, freezer temperature monitor, warp load meter, salinity temperature meter, elephant draft power monitor and micro algae concentration monitor.

Different types of dryers for hygienic drying of fish and shell fish have been developed. Latest of these are the PVC solar dryer for dehydration of prawns and the through flow cross circulation hot air dryer. The PVC dryer, besides being inexpensive and easy to fabricate, is ideal for an individual fisherman family. Development of design of an effluent treatment plant is yet another notable contribution. A high speed rotary cutting machine for making cubical shaped molluscan shell beads of various sizes also deserves mention.

Chlorination of water using Sodium Hypochlorite is normally practised to reduce bacterial contamination. CIFT has developed a chlorine level indicator paper called 'Cloritest' for instant reading of chlorine level in process water. Other products developed for the fish processing industry are antiseptic ointment for use by prawn handlers and deodorant for masking the foul odour emanating from processing plants. A recent contribution to this field is a palm impression technique developed to popularize hygiene and sanitation practices among fish handlers.

To meet the new demands for products and processing techniques, emphasis was shifted from block freezing of fish and shell fish to the development of individual quick frozen products like battered and breaded products, including fish fingers, fish cutlets and fish sticks. A number of packagings for various types of fish products including synthetic edible casings for fish sausage as well as technologies for transportation of live fish and shell fish have also been developed at the Institute.

Some of the important value-added products developed by CIFT, which are in demand at present within the country and abroad, are fish wafers, fish soup powder, fish pickles and hygienically dried fish. Shark fin rays is a very expensive commodity, process for extraction of which has been developed at the Institute. Another value added product developed is fish curry processed in flexible pouches which can remain at room temperature without any change for over a year. Process details for retort pouch packing of a variety of other products such as fried mussel and prawn manchurian also deserve mention. Other items developed include masmin prepared by repeated smoking of tuna fillets and squalene obtained from oils of certain species of sharks. Process has also been developed and commercialized for processing shark cartilage.

Suitable media for culture of different types of bacteria and methods for their enumeration and isolation have been developed and a PCR technique perfected for detection of white spot disease and yellow head disease viruses in farmed shrimp. An ELISA method was standardised for the detection of antibiotic residues in seafood.

The CIFT has successfully developed pharmacological products from fish waste, a noteworthy one being absorbable surgical sutures from fish gut collagen. Field trials with the product have been very encouraging. Two other important products from fish waste developed by the Institute are chitin and chitosan, which have been adopted both in the national and international levels. Collagen-chitosan membrane is another product which has found a place in periodontal applications.

Transfer of technology through technical consultancy programmes is a major activity of the Institute. Many entrepreneurs have benefited by the services rendered by the Institute leading to establishment of a number of processing units for fish waste utilization and improvement in fish catch. Outreach programmes such as conduct of training courses and field level extension programmes targeting the weaker sections of the community and rural women have been organized. The Agricultural Technology Information Centre (ATIC) has started functioning at the Institute. Technology transfer programmes for the NEH region have also started earnestly.

Research Achievements

Headquarters, Cochin

Fishing Technology Division

Research projects handled

Title of the project	**Optimization and upgradation of traditional fishing systems for inland and marine sector**
Principal Investigator	Shri. P. Pravin
Location of project	Cochin & Veraval
Co-investigators at Cochin	Dr. B. Meenakumari, Shri. P. George Mathai, Dr. Saly N. Thomas, Shri. M. P. Remesan & Dr. S.K. Panda
Title of the project	**Studies on material protection and marine pollution**
Principal Investigator	Dr. Leela Edwin
Location of project	Cochin,Visakhapatnam & Veraval
Co-investigators at Cochin	Dr. Saly N.Thomas & Shri. P. Muhamed Ashraf
Title of the project	**Exploration of potential fishery zones (PFZ) of major reservoir systems**
Principal Investigator	Dr. B. Meenakumari
Location of project	Cochin & Burla
Title of the project	**Development studies on responsible trawl systems**
Principal Investigator	Dr. M.R. Boopendranath
Location of project	Cochin, Veraval & Visakhapatnam
Co-investigators at Cochin	Shri. P. George Mathai, Shri. V. Vijayan, Shri. P. Pravin, Shri. M.P. Remesan & Dr. S.K. Panda
Title of the project	**Harvest technology and catch composition of deep-sea fishery resources in the Indian EEC (DOD project)**
Principal Investigator	Dr. B. Meenakumari
Location of project	Cochin
Sr. Research Fellows	Smt. Sally Simon & Smt. Latha Unnikrishnan
Title of the project	**Validation of IRS P4 OCM data with demersal fisheries (Collaborative project)**
Principal Investigator	Dr. B. Meenakumari
Location of project	Cochin & Veraval

Chief findings

- A fibreglass reinforced plastic (FRP) sheathed rubber wood canoe (length 6.05 m, breadth 0.77 m, and depth 0.39 m) was constructed and given for experimental fishing to artisanal fishermen.
- Rubber wood panels treated with copper creosote, arsenical creosote and dual preservative, subjected to soil burial test and weathering test did not show significant reduction in compressive stress after five years of exposure.
- When fouling growth was taken as an index to find out the effect of wood preservatives on the epibiota, it was seen that CCA (Copper-Chrome-Arsenic) dual preservative and Cypermethrin Creosote mixture did not have any detrimental effect on the growth of fouling organisms.

- Cyclic loading experiments on PA monofilament of 1.5 mm diameter subjected to repeated stress for 10, 20, 30, 60, 100 and 180 cycles under load of 5 and 10 g/tex showed that the strained specimens had a lower rate of elongation as the cycles increased.
- Analyses of hydrocarbon content in the backwaters of South Kerala show that higher concentrations of hydrocarbon occurred during the months of July and August.
- Separator trawl studies indicated differential behaviour and sorting of catch components within the trawl system.
- Silver pomfret (*Pampus argenteus*) formed 18.10% of the catch profile of semi-pelagic trawl system.
- Monoline fishing (long lining) was introduced in the reservoirs (Hirakud reservoir) for the first time.

Report of work done

Material Science & Marine Pollution

FRP coated rubber wood canoe

A FRP coated rubber wood canoe was constructed as a further study on the preservative treated rubber wood canoe which showed good performance. The canoe had a LOA of 6.05 m, breadth 0.77 m and depth 0.39 m. There were five cross planks of 2 cm thickness and 25 frames of 5 cm thickness.

The rubber wood planks were first given dip treatment with 2% CCA for 10 minutes. On stabilization of moisture content, the planks were kept immersed in 7.5 % CCA solution for seven days and then air seasoned. The planks were placed end to end and the edges held together by sealing with cotton and putty. Two layers of chopped strand mat with alternating layers of resin were used for covering the planks, which were sandered smooth, prior to coating. The increased number of ribs helped in holding the planks together.

The notable features of this craft were the use of FRP sheathing, minimal use of preservatives, avoiding stitching of planks as done conventionally, the use of increased number of hull frames and reduction in the thickness of the planks. The canoe is expected to have greater durability and prolonged service. The canoe was handed over to the fishermen of Kannur for experimental fishing through the district office, Matsyafed at a function organized at Mapila Bay, Kannur on 4 November 2003.

Handing over of FRP coated rubber wood canoe

Performance of rubber wood canoes

The two treated rubber wood canoes, which were built during the previous year and subjected to field trials, are being operated by fishermen of the Fishermen Co-operative Societies at Chellanam and Kumbalam. The canoes are periodically being monitored for cracking, decay, physical damage, termite attack or change in colour. The canoes have not shown any signs of biodeterioration and are in sound condition even after fourteen months of operation.

Field studies of treated rubber wood panels

Rubber wood panels of size 50 x 50 x 200 mm treated with three types of preservatives viz. Copper Creosote, Arsenical Creosote and dual preservative and subjected to weathering test and grave yard test for five years in the Institute premises were tested for compression parallel to grain. The results show that there was no significant reduction in strength due to field exposure.

Studies on wood preservation using synthetic pyrethroids

Rubber wood panels of size 50 x 50 x 200 mm, 50 x 50 x 150 mm and 30 x 30 x 500 mm treated with CCA, Cypermethrin Creosote mixture and dual preservative (CCA and Creosote) were exposed in seawater to study their comparative effectiveness against biodeterioration. Control panels were found to be infested with borers while treated panels were free from biodeterioration at the end of two years of exposure.

Effect of preservatives on strength of ropes used for stitching planks

The effect of CCA, Creosote and dual treatment on the strength of polypropylene ropes used for construction of plank built canoes was studied. The ropes of 4 mm dia were kept immersed in Creosote and CCA separately for fifteen days. One set of CCA treated samples were kept immersed in Creosote solution for fifteen days more. The ropes were dried and tested in the UTM for tensile strength. It was found that there was no significant difference in the maximum load or break strain due to the treatment.

Studies on the environmental implication of biodeterioration control measures

Study on the impact of biodeterioration control measures on the environment was continued taking fouling growth as the index. The test samples treated with chemical preservatives i.e., CCA, dual and Cypermethrin and exposed to estuarine conditions were observed periodically for fouling growth on the treated samples in comparison with control. The results showed that the fouling growth on the treated samples was almost equal to untreated control panels. Results at the end of 24 months exposure showed that treatments did not have detrimental toxic effect on epibiota as the fouling growth on control and treated panels did not show much difference.

Photodegradation of gear materials

Weathering studies of gear materials viz., polyamide (PA) monofilament and PA multifilament under simulated conditions in the Xenotest were continued. The samples were retrieved after 216, 240, 264, 288 and 312 h of exposure and were tested for loss in breaking strength.

The results showed that PA monofilament samples of 0.16, 0.20, 0.23 and 0.32 mm diameter lost 13.64, 12.03, 6.93 and 9.40% of the strength respectively after 312 h of exposure. The average loss in strength for monofilament was 10.49%. PA multifilament samples viz., 210 x 1 x 2 lost 43.73.8% of the original strength.

Effect of cyclic loading on gear materials

To study the effect of repeated stress under different loads on the strength properties of gear materials, the cyclic loading test was carried out. Polyamide monofilament of 1.5 mm dia were subjected to repeated stress for 10, 20, 30, 60, 100 and 180 cycles under loads of 5 and 10 g. tex $^{-1}$. The breaking strength and corresponding elongation after removal of the load was measured. The strained specimens showed a lower rate of elongation as the cycles increased.

Studies on hydrocarbon and heavy metal pollution of the backwaters of South Kerala

Results of analysis of hydrocarbon content in the backwaters of South Kerala showed that the monsoon months recorded high hydrocarbon content. Veli in Thiruvananthapuram recorded 15.3-24.2 ppm during these months (Fig 1).

Water samples from the backwaters were analysed for heavy metals like Cd, Cr, Cu, Mn, Ni, Pb, V, Zn, Sb, Se, and As. The concentrations of these elements were well below the tolerance limit for freshwater fish culture as per prescribed standards (Fig 2).

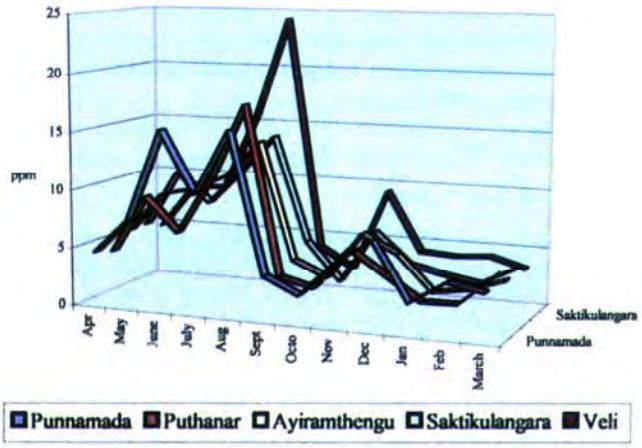


Fig 1. Variation of hydrocarbon content in five backwater sources of South Kerala

Studies on deterioration of polymer composites under marine and atmospheric environments

Studies were conducted to evaluate the degradation of fibreglass under marine and atmospheric conditions. The degradation was monitored using electrochemical impedance spectroscopy. Fibreglass panels were exposed in the Cochin estuary and sampled every month.

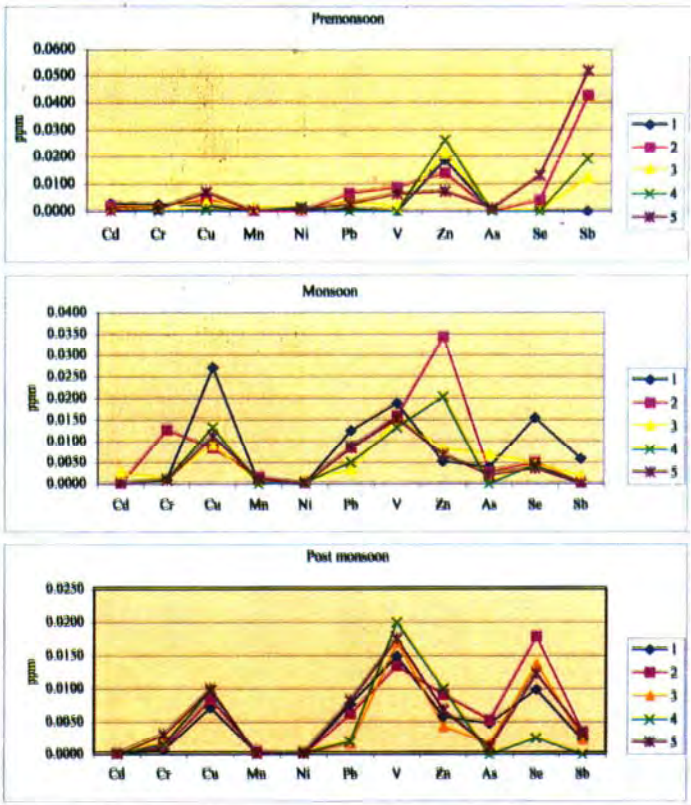


Fig 2. Variation of trace metals in different seasons and stations.
1: Punnamada,2:Thottappalli, 3:Ayiramthengu, 4: Saktikulangara and 5:Veli

The panels exposed to atmospheric conditions had significant reduction in polarization resistance (5.07×10^7) after one year compared to fresh samples indicating the slow degradation in fibreglass.

Fishing Gear

Separator trawl studies

A 31 m trawl with horizontal separator panel and dual cod ends rigged with V-form otter boards was operated in order to study the fish behaviour and sorting effect on demersal trawl resources. Sixteen per cent of the total catch was obtained in the upper segment of the trawl leading to upper cod end and 84% in the lower cod end. A pronounced sorting effect with respect to different species between upper and lower segment of the trawl was observed.

Operation of separator trawl

Semi-pelagic trawl system

Operations were conducted using semi-pelagic trawl system (18 m 8P and 23.4 m 6E semi-pelagic trawls with 1350x1000 mm suberkrub otter boards), in order to study the catch characterization. Catch profile of semi-pelagic trawl was mainly constituted by *Pampus argenteus* (18.10%), *Sardinella longiceps* (11.01%), sea turtle (*Lepidochelys olivaceae*) (5.48%), crabs (unspecified) (5.40%) and *Rastrelliger kanagurta* (5.20%).

A good catch of silver pomfrets (*Pampus argenteus*) obtained using 18m 8P semi - pelagic trawl system rigged with suberkrub otter boards

Development of fishing gear and techniques for harvesting reservoir fishery resources

Under the programme on fishing gear and techniques for harvesting reservoir fishery resources, trammel net was introduced in Hirakud Reservoir for catching small fishes and weed fishes. Monoline fishing (long lining) was introduced for the first time in the reservoir. Mesh sizes for catching pelagic and column fishes of the Hirakud Reservoir were standardised. Attempts were also made to educate the fishermen/tribals in the conservation of fishery resources.

Field trials of gill nets and monolines

Under the project, optimization and upgradation of traditional fishing system in inland and marine sectors, pelagic gill nets and monolines were field-tested. Field trials were carried out at Lakshadweep with 20 units of PA and PE gill nets of different mesh sizes ranging from 100 mm to 200 mm. Fishing operations were carried out on board two fishing vessels LACFISH-4 and LACFISH-6 of Lakshadweep Fisheries Department. Fishing was carried out off Kavaratti for five days and off Agatti island for nine days. Fishing was also carried out during night using set lines and gill nets.

Field trials at Lakshadweep

Operation of set lines for rocky fishes was quite encouraging. Few local fishermen have been identified with the help of Lakshadweep Department of Fisheries for operating the experimental gear at Agatti island. Nets were rigged and arrangements made for field trials with PA and PE gill nets and monolines at Kavaratti, Agatti and Suheli islands of Lakshadweep.

Field trials with large mesh PA and PE gill nets is being carried out with the help of private fishermen at Kannur through Matsyafed. The rigging of the PE net was optimized for the local conditions.

Design and operation of lobster traps

Collapsible lobster traps were designed and 20 numbers fabricated. Twelve numbers of collapsible traps (four each for each village) were given to selected fishermen of Enayam, Kadiapatnam and Muttom fishing villages of Kanyakumari district for field trials. Twenty of the CIFT designed modern lobster traps were also distributed among the traditional lobster fishermen of Enayam fishing village, under the MPEDA Project 'Participatory management and conservation of lobster resources'. In addition, forty numbers of lobster traps with escape gap were fabricated and distributed at Kadiapatnam among the traditional lobster fishermen.

Traditional inland fishing gears

A preliminary study of the traditional fishing craft and gear of Brahmaputra river in Assam was conducted during the period. Details were collected from fish landing centres of Nagoan, Dhubri and Kamrup districts of central, lower north east and lower north west regions of Brahmaputra river respectively. Information was also gathered on the traditional fishing craft and gear of Itanagar, Arunachal Pradesh.

Exploration of Potential Fishing Zones (PFZ) of major reservoirs

Time series satellite data collected from NRSA were analyzed with Erdas Imagine 8.6 Software and geometric corrections made. Classification of the data, preparing layer stacking and preparing sedimentation boundaries were also carried out.

Physico-chemical studies of water from nine selected stations of Hirakud reservoir were carried out for use in Geographical Information System in finding Potential Fishing Zones and thematic layers prepared for physico-chemical parameters.

Harvest technology and catch composition of deep sea fishery resources of Indian EEZ

The DOD funded project on 'Harvest technology and catch composition of deep sea fishery resources of Indian EEZ' was completed and the final report submitted. The thrust areas of the project were the development of target specific trawls, standardization of selective devices in the trawls for offshore waters, provision of square mesh panels of appropriate mesh size for the escapement of juveniles and sub-adults for reducing the quantum of by-catch, particularly young ones, and the introduction of square mesh panels in the existing commercial trawl nets. A brief summary of the project is given below.

Ten cruises were undertaken onboard FORV *Sagar Sampada* during the tenure of the project and fishing operations were carried out in the east and west coast of India. A total of 261 fishing operations were carried out spanning a period of 277.2 h in ten cruises.

Two hundred and seven fishing operations covering an area between Lat 7°-22° N and Long 65°-83° E in the east and west coast were made during the six exclusive cruises from February 2000 to February 2003. HSDT-II (Fish version), HSDT-II (Crustacean version), 51 m Long Wing Semi-pelagic Trawl, 33.7m Mega Mesh Trawl (midwater trawl), High Opening Trawl, Hybrid Trawl, and Expo-model net were tested.

Two new midwater trawls developed indigenously, viz. 47 m four seam midwater trawl and 50 m midwater trawl were also field tested. A total of 55784 kg of fish, crustaceans and cephalopod resources were obtained in ten cruises, with an average catch rate of 201.2 kg/h. Two hundred and five species were identified from all the cruises undertaken. Gear-wise catch composition showed that the HSDT II Crustacean version landed the highest catch amounting to 18160 kg while HSDT II Fish version landed 17,993 kg.

Ocean colour monitoring programme

IRS – P4 OCM Validation programme carried out by CIFT and Space Application Centre (SAC), Ahmedabad was completed and the final report submitted.

Recognizing ocean features such as water colour, turbidity, sea state, size and direction of waves and wind patterns, temperature variations over sea surface etc. can be efficiently used to formulate fishing strategies. The analysis for validating the IRS-P4 OCM chlorophyll images with the actual sea truth data by CIFT and SAC was carried out in two phases. In the first phase, the data collected from boats operating off Munambam, Kerala from February to May 2000 were analyzed, along with the data collected by departmental vessel *Sagarkripa*. For the second phase, the data analyzed were collected from the mechanized boats engaged in demersal trawling operating from Veraval port, Gujarat. The analysis clearly showed correlation with areas of high chlorophyll gradient and good catches and in almost all images where no chlorophyll gradients were seen, catches were either average or poor. This type of geo-referenced catch data from commercial fishermen can be of immense use in establishing that satellite prediction is a useful tool in reducing searching time.

Fish Processing Division

Research projects handled

Title of the project	**Development of value added fishery by-products**
Principal Investigator	Dr. T.K. Thankappan
Location of project	Cochin
Co-investigators	Dr. K.G. Ramachandran Nair, Dr. P.T. Mathew, Smt. R. Thankamma, Shri. Rakesh Kumar, Dr. R. Anandan & Shri. George Ninan
Title of the project	**Environmental friendly feed for ornamental fishes (egg layers, live bearers and nest builders) utilizing fishery waste**
Principal Investigator	Dr. P.T. Mathew
Location of project	Cochin
Co-investigators	Dr. K.G. Ramachandran Nair, Dr. Suseela Jose* & Dr. M.V. Mohan*
Title of the project	**Development of eco-friendly technologies for the production of water soluble derivatives of chitin/chitosan and the production of biodegradable membranes from chitosan (Ad-hoc project)**
Principal Investigator	Dr. P.T. Mathew
Location of project	Cochin
Co-investigators	Dr. T.K. Thankappan, Smt. R. Thankamma & Dr. C.N. Ravishankar
Sr. Research Fellows	Kum. T.K. Sini & Shri. S. Santhosh
Title of the project	**Development of value added products from low cost fish and processing waste from fish and shell fish (NATP)**
Principal Investigator	Dr. K.G. Ramachandran Nair
Location of project	Cochin
Co-investigators	Dr. P.T. Mathew & Shri. A.C. Joseph,
Sr. Research Fellows	Shri. Umesh A. Prabhu & Shri. Martin Xavier
Title of the project	**Processing and product development from by-catch and deep sea fishes**
Principal Investigator	Shri. P.K. Vijayan
Location of project	Cochin & Calicut
Co-investigators at Cochin	Shri. A.C. Joseph & Dr. Jose Joseph
Title of the project	**Handling, processing and preservation of fresh water fish with special emphasis on transportation and improvement in traditional preservation techniques**
Principal Investigator	Dr. Jose Joseph
Location of project	Cochin
Co-investigators	Shri. George Ninan, Smt. J. Bindu & Shri. V. Radhakrishnan Nair
Title of the project	**Development of technology for processing fish and fishery products in appropriate packaging materials**
Principal Investigator	Dr. T.K. Srinivasa Gopal
Location of project	Cochin
Co-investigators	Shri. T.S. Unnikrishnan Nair, Shri P.R. Nair, Shri P.K.Vijayan, Dr. C.N. Ravishankar., Shri. A.V. Shenoy, Shri V.N. Nambiar, Smt. J. Bindu, Smt. R. Thankamma & Shri. A.A. Zynudheen

Title of the project	**Development and popularization of modern technologies for production of convenience foods from fish (NATP)**
Principal Investigator	Dr. T.K. Srinivasa Gopal
Co- Principal Investigator	Shri. A.C. Joseph
Location of project	Cochin
Co-investigators	Shri. P.K. Vijayan, Dr. C.N. Ravishankar, Smt. J. Bindu & Dr. K.V. Lalitha
Sr. Research Fellows	Smt. Leema Jose, Shri. C.K. Kamalakanth & Shri. C.K. Abdul Asees
Title of the project	**Development of technology for processing fish and fish products in aluminium cans and flexible pouches (Ad-hoc project)**
Principal Investigator	Dr. T.K. Srinivasa Gopal
Location of project	Cochin
Co-investigator	Shri. P.K. Vijayan
Sr. Research Fellows	Shri. A. Ansar Ali & Shri. B. Sudhir

** Fisheries College, Panangad*

Chief findings

- Protein was extracted from prawn shell and crab shell using enzymatic and chemical methods and the quality parameters compared.
- Chitosan of various quality parameters was prepared.
- Chondroitin Sulphate was extracted from shark cartilage and purified.
- Hydrolysate was prepared from shell protein and its nutritional studies carried out.
- Purified glucosamine hydrochloride was prepared and the anti-ulcer activity of the compound was studied using white albino rats.
- Pure carrageenan was prepared from *Euchemia cottoni.*
- Feed incorporated with carrot pigments and beet root pigments are found good for feeding platty, an ornamental fish.
- Anti bacterial property of chitosan solution in *E. coli* culture was studied. Chitosan was found to reduce the growth of *E. coli.*
- Squalene shark meat was utilized for the preparation of value added products.
- Fish sauce was prepared from the low fatty fish waste.
- Cephalopod processing waste was used for the preparation of silage.
- Deproteinisation of prawn shell was done by using biotechnological method.
- Water soluble derivative of chitin, viz. carboxymethyl chitin, was prepared and purified.
- Battered and breaded fish nuggets were developed from threadfin bream (*Nemipterus japonicus*).
- Light salted and smoked products were prepared from thread fin bream. Calcium propionate treatment enhanced the shelf life beyond five months.
- Developed high quality salted sardine with good keeping quality.
- Standardised the preparation of chilly fish with ingredients possessing nutraceutical properties.
- Formulated fish kuruma using seer fish by modifying the recipe for chicken kuruma. The product had good frozen storage characteristics.
- Mango pulp at 60% level had good preservative action on cured fish products.
- Standardised methods for preparation of a number of value added, ready-to-serve products from black tilapia (*Oreochromis mossambicus)* viz., fish moilee, chilly fish, spiced fish mince, fish balls and fish cutlets. All these products had a high quality shelf life of six months at -20^{0} C.

- Process conditions for the preparation of surimi from fresh and iced tilapia under different washing conditions were standardized. The rheological properties of the surimi, particularly the gel strength, are comparable to those of surimi prepared from marine species.
- *Macrobrachium rosenbergii* had a shelf life of twelve days in ice. The high quality shelf life was retained up to three days.
- Cured and dried tilapia treated with sodium benzoate packed in PEST/PE pouches in air and vacuum retained the quality for more than nine months. The samples were free from fungal and halophilic attack.
- Ready-to-serve tuna in oil, mackerel curry and rohu curry processed in tin free steel cans had a shelf life of 12 months at ambient temperature.
- Packaging under vacuum enhanced the storage stability of shark chutney powder.
- Storage stability of dried fish can be enhanced by packing in laminated pouches under vacuum.
- Preliminary studies have indicated that ready-to-serve smoked tuna fillets can be processed in retort pouches and stored for a long period at ambient temperature.
- Standardised packaging materials for packing prawn and fish wafers.
- Studies on indigenous retortable pouches for packing fish products were completed. The physical properties of the pouches were found to be within the limits prescribed in the National Standards.
- The pouches were found suitable for processing several fish products.
- Standardisation of processing and storage conditions were completed. The products could be kept in good condition for more than one year at ambient temperature.
- The indigenous pouches were as good as imported pouches for the thermal processing of fish products.
- Indigenous aluminium cans were found to be suitable for the thermal processing of fish products.
- Standardisation of F_o value and cook value for various fish products was completed.
- Studies on Modified Atmospheric Packaging (MAP) of pearl spot, prawn, rohu and seer fish were completed and ideal gas compositions for enhancing shelf life standardised.

Report of work done

Fish products and by products from fish and shell fish

Different enzymes were used for deproteinisation of prawn shell waste and the yield of hydrolysate obtained by deproteinisation compared using chemical methods.

For preparing different quality chitosan, deacetylation was carried out at controlled temperature.

Powdered shark bone was subjected to papain treatment and the resulting residue was treated with cystine buffer. It was dialysed and then dried. Chondroitin Sulphate prepared was analysed for quality parameters.

Glucosamine hydrochloride was fed to white albino rats for finding out the anti-ulcer activity. Ulcer was induced in the animals and 100 mg/kg/day glucosamine hydrochloride was orally given to the animals for 45 days. The prior oral administration of glucosamine hydrochloride significantly prevented the induction of ulcer in the animals. Chitosan and adipic acid mixture was found to be water soluble and white in colour. This was stable even after keeping for three months without losing viscosity. Chitosan was produced strictly under cold conditions in all stages. Product obtained was highly viscous and hence of high molecular weight.

Semi processed carrageenan prepared from *Euchemea cottoni* was further purified by treating with rectified spirit and drying. Solubility, clarity, viscosity and gel strength was compared with commercial samples of carrageenan.

Antibacterial property of chitosan, against *Escherichia coli* was ascertained. Studies were carried out with three different concentrations of chitosan, viz. 0.05%, 0.25% and 5% containing 100ml PBS. The studies revealed the antibacterial activity of chitosan.

Isinglass was prepared from air bladders of rohu. Dried air bladder was soaked in ice cold water at 0-5°C for 12 hrs. It was minced, dried and powdered. Isinglass thus prepared had viscosity of 20 mpa at pH 3.6 and was completely soluble in water. Addition of small quantity of tartaric acid served to enhance the quality of the product.

Ornamental fish feed

Three feeds containing about 30% protein were formulated. Ingredients of these feeds were incorporated with one per cent carrot mix, beetroot mix and a natural dye mix. The feeds were then extruded and dried and the biochemical and amino acid compositions determined. The feeds were fed to fingerlings of platty (*Xiphophores maculates*).

Environmental parameters such as pH, temperature, dissolved oxygen etc. were determined. Colour of the fish was determined after 6 months of feeding using Lovibond Tintometer. Carrot mix and beetroot mix imparted more colour to the fish. Growth rate was also more in fishes fed with these feeds.

Development of value added products from low cost fish and processing waste from fish and shell fish (NATP)

Cuttle fish processing waste from processing factories was collected and analysed for proximate composition. It had 82-85% moisture, 12-15% protein, 1-2% fat and 1.2% ash. The material was also analysed for its heavy metal content. The waste was converted to silage by mixing with 3-5% formic acid and maintained at pH 4. Effect of pH on the rate of liquefaction of silage was studied. Silage was acceptable even after storage for one year. The silage was mixed with rice bran and dried and fed to piglets, quail and calves. The product is recommended for effective use as feed. Growth rate is also more than that of controlled commercial feed.

Cuttle fish processing waste

Silage - rice bran mixture

The process of preparation of glucosamine hydrochloride requires huge quantities of concentrated hydrochloric acid. A new method has been developed to reduce the use of the concentrated acid to 2/3 of that required in the original method. Various solvents were also tried for the purification of glucosamine hydrochloride.

Pigs being fed silage incorporated feed

Eco-friendly technologies for the production of water soluble derivatives of chitin and biodegradable membranes from chitosan (Ad-hoc project)

Carboxymethyl chitin from prawn shell was prepared at three different alkali concentrations, 50, 55 and 60% and their properties studied. Different strains of lactic acid bacteria were isolated from prawn shell, fish etc.

Standardisation of glucose concentration for the fermentation of shell waste was continued. Different concentrations of glucose were tried for fermentation of shell using Lactobacillus strain and its fermentation ability checked by measuring the acid produced. Deproteinisation and demineralization ability of Lactobacillus strains was checked by protein analysis.

Glucosamine Sulphate preparation was standardized. Different concentrations of Sulphuric acid were used for the preparation. Time of reaction and time of precipitation were recorded. For elucidating the quality of the product, the sulphate and chloride contents were determined. FTIR spectroscopic measurement was also carried out.

Development of coated products

Battered and breaded fish nuggets were developed from threadfin bream *(Nemipterus japonicus)*. The product showed satisfactory physical and organoleptic characteristics even after 5 months of storage at –20°C. Biochemical characteristics did not indicate any appreciable change during the period of storage.

Improvements in traditional salting of sardine

The effect of treatments by incorporating antioxidants such as ascorbic acid, ginger extract and turmeric extract either alone or in combination followed by salting of sardine is being investigated. Storage study of the treated sardine for 2 months showed that the combined effect of ascorbic acid, ginger and turmeric extract improved the quality of the cured product significantly.

Development of consumer friendly dried/smoked/ fermented fish products

Light salted and smoked fish was prepared from *Nemipterus japonicus*. After a dip treatment in 10% brine, the fish was smoked for 2, 3, 4 and 5 h respectively followed by drying in an electrical drier at 50°C till the a_w stabilized at 0.65. The 3 h smoked samples showed better organoleptic qualities. The 4 and 5 h smoked samples had high smoke flavour and were brownish in colour.

The storage studies of smoked fish treated with and without Calcium propionate showed that the samples without Calcium propionate treatment remained in acceptable condition for only 3 months and thereafter developed fungal growth irrespective of smoke treatment. There was no fungal growth in Calcium propionate treated samples. The a_w during storage was 0.73.

Development of ethnic fish curry formulations and study on the quality changes during heat processing and frozen storage

Fish kuruma was prepared using seer fish by making modification in the recipe for the preparation of chicken kuruma. Frozen storage study of the product showed high quality shelf life of 3 months at –20°C.

Development of fish based formulations with nutraceutical values

Method of preparation of chilly fish with mint leaves was standardised. The product with improved taste remained in good condition even after 12 months of storage.

Ready-to-serve fish curry

Development of value added products from tilapia

Spiced fish mince: Spiced fish mince is a South East Asian product, which is mainly used as a flavouring agent for rice preparations. The product was prepared from fillets. The fillets were cooked and mixed thoroughly with salt and spices, pressed, dried and ground. It was then packed in PE laminate cast PP pouches and kept in ambient conditions for sensory evaluation and storage studies. The product remained in good condition even after four months of storage.

Chilly fish: Fish mince mixed with additives, partially frozen and cut into small cubes was used for the preparation of chilly fish. It was then packed in PE laminate cast PP pouches. The product had a high quality shelf life of four months at -20 ° C.

Fish cutlets and fish balls: These were prepared from the mince. Fresh products were rated high in sensory evaluation. The product packed in PE laminate cast PP pouches and kept at - 20° C remained in good condition even after six months of storage.

Fish cutlets

Fish moilee: Prepared from fresh tilapia, 250 gm each of the product was packed in PEST/CPP pouches and stored at –20° C in a deep freezer. No significant change was observed after six months of storage.

Studies on the properties of surimi from fresh and iced tilapia under different washing conditions were continued to standardize the process. The rheological property of the surimi, particularly the gel strength, is comparable to surimi prepared from other marine species.

Edible fish powder was prepared from tilapia and from two marine species, viz., threadfin bream (*Nemipterus* sp.) and jew fish (*Johnius* sp.). The quality of the products was comparable. The powder prepared from tilapia had the highest protein content.

Light and intensely smoked products were prepared from tilapia in a Kerre's smoke kiln. Samples after drying were stored at ambient temperature under vacuum and in air to study the shelf life of the product. No changes in sensory, chemical and physical characteristics were noticed after three months of storage.

Curing and drying studies of fresh and chill stored tilapia were conducted. The samples treated with Sodium benzoate had a longer shelf life (more than nine months) than the untreated samples.

Iced and frozen storage studies of scampi (*Macrobrachium rosenbergii)* were undertaken during the period and different types of value added products like battered and breaded butterfly shrimp and fan tail shrimp prepared.

Analysis of seventeen different smoked and dried fish samples from the north east region was carried out during this period. The samples were collected from the Jagirod dry fish market near Guwahati. Chemical and sensory analysis showed that the quality was very poor compared to dried products available in the local markets of Cochin.

Studies on the marketing of freshwater fish from farms and reservoirs in Kerala were carried out. It was observed that the cost of production of freshwater fish in Kerala farms was almost double than that of farms in Andhra Pradesh.

Packaging

Trials on preparation of ready-to-eat clam in retort pouches were conducted. Different recipes were tried out and the best one standardized. Grey clams (*Villorita cyprinoids*) were prepared as per standard recipe and vacuum packed in retortable pouches. These samples were retorted to a F_o value of 8. The clams were found to have undergone non-enzymatic browning, with no significant change in texture or flavour. Trials were again conducted by giving different treatments like i) dipping in 0.3% Potassium metabisulphite solution, ii) adding 0.2% Malic acid, and iii) addition of red food colour, to reduce browning. Samples prepared by adding Malic acid gave the most favorable results. This may be due to the fact that the Malic acid helped in reducing the pH of the product, thus reducing the browning. Large-scale production of clam, as per the recipe standardized, was carried out. Samples were prepared and retorted in an over pressure autoclave. The samples have been found to be commercially sterile and are being subjected to storage studies. They were found to be in excellent condition after nine months of storage.

Studies on the processing of clam meat in thermoform containers were also conducted. The samples were prepared as per standard recipe and filled in high-density polyethylene containers. 75% vacuum was applied and the containers were heat sealed for 3 seconds using a co-extruded film. The samples were retort processed at 121°C for 40 minutes. It has been observed that the product remained in excellent condition. Further studies are being continued.

Fresh mussels procured from Calicut were used for preparation of the samples. The curry medium was prepared using fried grated coconut. The other ingredients included green chilly, chilly powder, turmeric powder, potato, tomato, garam masala mix, curry leaves etc. The mussels were flash fried before adding to the curry medium. 90 g of mussel meat and about 130 g of curry medium was packed in the pouches, the pouches heat sealed after steam flushing and retorted in the over pressure autoclave to a F_o of 8.2. The processed pouches were stored at room temperature for storage studies. The samples stored at room temperature for 6 months were analysed for changes in various quality parameters. They were found to be in good condition with regard to all sensory attributes.

A traditional recipe from anchovies was standardized. Ingredients like grated coconut, tamarind, onions, green chillies and salt were used for the preparation. The samples were then packed in retortable pouches and retorted in the over pressure autoclave to a F_o of 8. The processed pouches were stored at ambient temperature and periodically tested for different biochemical and organoleptic characteristics. The samples were found to be in excellent condition even after 6 months.

Process conditions for the preparation of prawn manchurian in retortable pouches were standardized. The product was prepared and processed in over pressure autoclave at 121°C to a F_o value of 6 and cook value of 63 min. and stored at ambient temperature for storage studies. Samples were drawn regularly for assessing the storage life. After storage for 12 months at room temperature, the product had very good acceptability with regard to all sensory attributes.

Storage studies of ready-to-serve sardine curry in retortable pouches were completed. Sardine curry pouches were processed at 121°C in an over pressure autoclave to a F_o value of 9 and cook value of 92 min. A total process time of 47 minutes was sufficient to get a product of desired texture. The product was acceptable for a period of 12 months at room temperature.

Standardisation of processing conditions and storage studies for several other ready-to-serve fish products in retortable pouches, such as tuna in oil, seer fish moli, rohu curry, Punjabi style fish curry, Kashmiri fish curry, Bengali fish curry, Oriya fish curry, North East fish curry and Goan fish curry, was also completed. The products could be kept in good condition for more than one year at ambient temperature.

Studies on suitability of tin free steel (TFS) cans for processing fish products was undertaken. Rohu curry was packed in TFS cans and processed at 121°C to a F_o value of 7.65 and cook value of 95 min. Total process time was around 65 minutes. The cans were stored at room temperature for shelf life studies. After storing for 9 months it was observed that the product had good acceptability. The product could be stored in good condition for 12 months at ambient temperature.

Tuna in oil, packed and processed in TFS cans, were also studied for changes in the quality parameters during storage at room temperature. The products were acceptable even after 12 months of storage at room temperature.

Similarly, mackerel curry packed in polyester coated TFS cans remained in good condition for 12 months of storage at room temperature and showed good sensory characteristics.

Shark chutney was prepared from dry shark purchased from the market. Minced shark meat was utilized for the purpose. The other ingredients used in the preparation were onions, green chillies, chilly powder and oil. The product was packed in 12µ polyester/118µ LD-HD co-extruded pouch under air and vacuum and stored at ambient temperature. After three months of storage, the air packed samples were rejected due to growth of fungus. Vacuum packed samples remained in acceptable condition up to a period of 5 months.

Storage stability studies of commercial dried shark samples brought from the market were initiated. The dried

samples were packed in 12µ PEST/300 gauge LDPE laminate pouches under air and vacuum. Market samples without further drying spoiled after one month of storage. Samples, which were further dried and packed in air, could be kept in good condition only for 6 months and were rejected after 6 months due to spoilage. Vacuum packed samples were acceptable for a period of 10 months.

Smoked fish was prepared using fresh mackerel purchased from the market. The fish was pretreated in 10% brine solution for one hour, before drying. Partially dried fish was then smoked in a smoke kiln, using sawdust and coconut husk. The fish was then dried again and packed in LDPE pouch. Growth of fungus was noticed after one month, due to the high moisture content of the final product.

Preliminary studies for standardizing smoked tuna fillets in retort pouches were initiated. Tuna fillets were dipped in brine, smoked and processed at 121°C to a F_0 value of 9. The product had good acceptability. It was observed that the smoked samples remained in good condition even after 3 months.

Prawn wafers with round shape were prepared by blending prawn meat with 0.1% polyphosphate along with tapioca starch, corn starch and salt. After mincing, the paste was stuffed into synthetic casings and cooked for 30 min in boiling water. The cooked meat was kept in the refrigerator for 12 hrs and sliced using mechanical slicer. The wafers were then dried in a drier for 4 hrs at 45°C. The dried wafers were stored for shelf life studies. After 6 months of storage they were fried in edible oil. The fried product exhibited good swelling property and had good acceptability. Storage studies are being continued.

Storage studies of fish wafers packed in 250 gauge LDPE and PEST/LDPE pouches are being continued. Even after five months of storage, the wafers were in good condition. The taste, colour and flavour were found to be good. Storage studies are being continued.

Ribbonfish samples collected from Puthiyappa harbour, were dried in two lots, one without salt and the other after salt curing for one day. After drying, the samples were analysed for chemical, physical and microbiological parameters. Samples were also packed in CO_2 with controls packed in air for storage study at room temperature. After storing for 6 months, the samples packed in CO_2 were found to be superior in quality compared to air packed samples.

The F_0 value and cook value for various fish products was standardised. The F_0 value for tuna was $F_0$10 and for mackerel and sardine, F_0 9. For attaining the same F_0 value, retort pouch (20 x17 cms) was found to have a lower process time compared to 8 oz aluminium cans (301 x 206).

In the case of fish products packed in aluminium cans and flexible pouches, reduction in process time could be achieved by subjecting the cage of the retort to different rotational speeds. For both tuna and mackerel, there was significant reduction in process time up to 2 rpm. After that, reduction in process time was found to decrease.

In retort pouch processed products, significant reduction in process time was achieved compared to aluminium cans for the same F_0 value and with the same rotation speed.

Studies were completed on Modified Atmospheric Packaging (MAP) of pearl spot, prawn, rohu and seer fish and the following gas compositions ideal for enhancing shelf life of the various fishes, standardized:

- A gas composition of 40% CO_2, 30% O_2 and 30% N_2 for prawn with a shelf life of 18 days under MAP and 11 days for air (control) packs.
- A gas composition of 50% CO_2 and 50% O_2 for pearl spot with a shelf life of 30 days under MAP and 14 days for air (control) packs
- A gas composition of 70% CO_2 and 30% O_2 for seer fish with a shelf life of 30 days under MAP and 14 days for air (control) packs
- A gas composition of 40% CO_2, 30% O_2 and 30% N_2 for rohu with a shelf life of 28 days under MAP and 18 days for air (control) packs

Extension activities

Popularisation of ready-to-serve fish products suitable for different regions was undertaken. Recipes specific to Punjab, Goa and NEH region were standardised and popularised among people of the respective regions through the following organisations:

- Marine Products Export Development Authority, Cochin
- Punjab Agricultural University, Ludhiana
- College of Fisheries, Agarthala
- Govt. Polytechnic, Goa
- Institute of Hotel Management & Catering, Goa

Test marketing of seer fish moli, pearl spot moli, fried mussel etc. was undertaken in collaboration with MPEDA in various national and international fairs.

Biochemistry & Nutrition Division

Research projects handled

Title of the project	**Isolation and utilization of bioactive substances from aquatic sources**
Principal Investigator	Dr. P.G.Viswanathan Nair
Location of project	Cochin
Co-investigators	Dr. T.V. Sankar, Dr. R. Anandan & Smt. K.K. Asha
Title of the project	**Toxicity induced stress on the metabolism of fish and distribution of toxic contaminants in fish and shell fish**
Principal Investigator	Dr. T.V. Sankar
Location of project	Cochin
Co-investigators	Dr. R. Anandan, Smt. K.K. Asha & Shri. A.A. Zynudheen
Title of the project	**Isolation and characterization of fish lipases for commercial applications**
Principal Investigator	Dr. R. Anandan
Location of project	Cochin
Co-investigator	Dr. T.V. Sankar
Sr. Research Fellows	Shri. S. Hari Senthil Kumar & Kum. K.S. Shiny
Title of the project	**Nutrition and pathology in mariculture (NATP)**
Principal Investigator	Dr. P.G. Viswanathan Nair
Location of project	Cochin
Co-investigator	Dr. R. Anandan
Sr. Research Fellow	Kum O. Kavitha

Chief findings

- Defatted fish powder exerted significant antilipidemic effect in experimental rats.
- Dietary PUFA was found to reduce the alloxan-induced alterations in protein metabolism in experimental animals.
- Dietary PUFA also controlled the lipid levels in liver tissue and serum of experimental diabetic rats.
- Notable differences were observed between fish feed ingredients of plant and animal origin with respect to the proportion of essential amino acids and n-3 polyunsaturated fatty acids ($C_{20:5}$ n3 and $C_{22:6}$ n3), indicating that ingredients of animal origin were superior in nutritional quality as compared to the ingredients derived from plants.
- Experiments showed changes in the sarcoplasmic and myofibrillar protein in fish exposed to varying concentrations of Monocrotophos. There were alterations in the oxidative and detoxifying enzymes as well.
- Antibiotic residues, namely Nitrofurazone, Chloramphenicol, Tetracycline, Oxytetracycline and Chlorotetracycline were not detected in the fish samples collected from various fish farms in and around Kochi.
- About 50% of the fish samples collected from Cochin harbour contained op-DDE, 33% contained Heptachlor and less than 10% of the samples contained pp DDT, pp DDD, op DDT, Heptachlor Epoxide, Aldrin and BHCs. The levels were within the permitted limits.
- Among poly aromatic hydrocarbons (PAH), naphthalene was the most common PAH found in all the samples collected from Cochin harbour constituting 60-90% (of total PAH) in some of the samples. The levels were within the permitted limits.
- Cd, Pb, Cu, Ni, Zn, Co and Mn were the common heavy metals noticed in the samples collected from Cochin harbour but were within limits.

Report of work done

Antilipidemic effect of defatted fish powder in experimental rats

The level of total lipid was lower in plasma of rats fed on defatted fish powder (178 mg/dl) as compared to that of casein-fed animals (192mg/dl). There was no significant difference in the level of total cholesterol in all three groups of animals. But the level of HDL cholesterol was higher (25.4mg/dl) in fish protein-fed animals when compared to casein-fed group (20.7mg/dl). These results indicate the antilipidemic effect of defatted fish powder. Similarly, levels of LDL cholesterol were lower when the source of dietary protein was defatted fish powder.

Effect of polyunsaturated fatty acids supplementation on protein metabolism in experimental diabetic rats

The effect of polyunsaturated fatty acids (PUFA) on experimentally induced diabetes in rats was studied. Supplementation of PUFA at 2% of the diet significantly reduced the Alloxan-induced hyperglycemic condition by maintaining the blood glucose concentration at near normal level (Fig. 3 & 4). The possible beneficial effect of PUFA on protein metabolism was also evident from reduction noticed in degradation of plasma and tissue protein content and normal activities of enzymes involved in protein metabolism such as arginase, alanine transaminase and aspartate transaminase. Significant decline in blood urea level was also observed in PUFA supplemented diabetic rats. PUFA also exerted significant anabolic effect by maintaining the levels of body weight and different tissue weight at near normalcy. However the potential utility of PUFA as an antidiabetogenic agent is to be investigated in more detail.

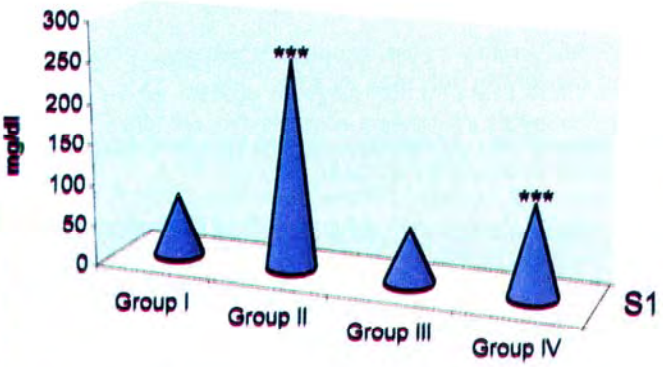


Fig.3 Level of blood glucose in normal and experimental groups of rats

Group I- Control; Group II- Diabetic; Group III- PUFA; Group IV- PUFA + Diabetic

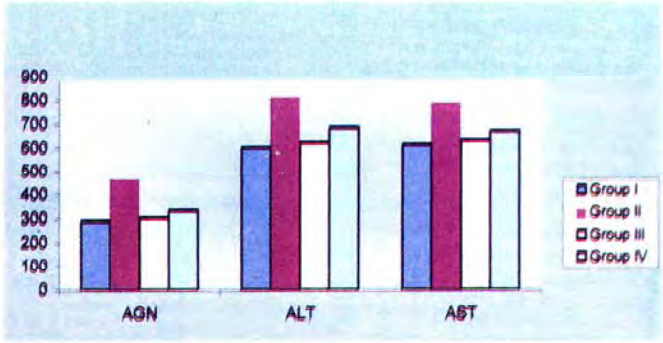


Fig.4 Activities of Arginase (AGN), Alanin amino transferase(ALT) and Aspartate amino transferase (AST) in liver tissue of normal and experimental groups of rats

The activities of the enzymes are expressed as follows: arginase. μ mol urea formed/h/mg protein; alanine transaminase and aspartate transaminase, n mol pyruvate liberated/h/mg protein

Effect of dietary supplementation of PUFA on lipid levels in experimental diabetic rats

Polyunsaturated fatty acids were supplemented at 2% level in the diet of control and Alloxan-induced diabetic groups of male albino rats to study their effect on the lipid levels in serum and various tissues of these animals. Accumulation of lipid was observed in the liver of Alloxan-induced diabetic rats and dietary PUFA brought about a decrease in the total lipid, total cholesterol and triglyceride levels, counteracting the effect of Alloxan-induced increase observed in these parameters (Fig 5 & 6). It was also noted that PUFA supplementation in the diet of Alloxan-induced diabetic rats brought down the levels of total cholesterol and triglyceride in the serum. The concentration of HDL cholesterol was enhanced and that of LDL cholesterol was reduced by PUFA supplementation. This observation is of significance because of the fact that high LDL cholesterol is a known risk factor for conditions like coronary heart disease and artherosclerosis, which are known diabetic complications.

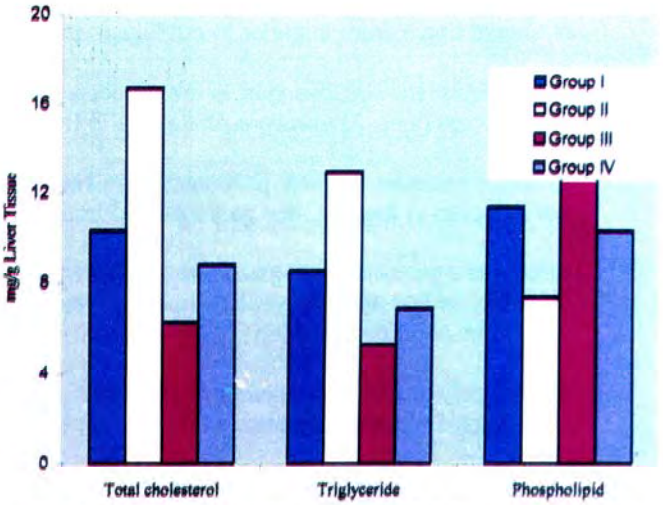


Fig.5 Effect of PUFA on lipid parameters in liver of control and diabetes-Induced rats

Values are expressed as mean ± SD for five animals in each group

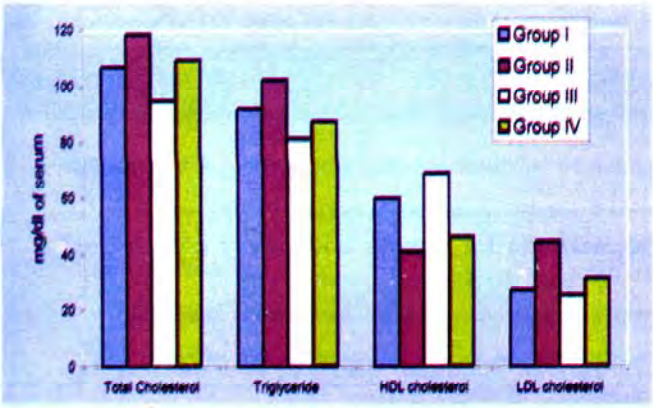


Fig.6 Levels of total, HDL and LDL cholesterol and triglyceride in serum of normal and diabetes - induced rats

Values are expressed as mean ± SD for five animals in each group

Antibiotics in fish

Fish collected from eight culture farms in and around Cochin were screened for antibiotic residues namely Nitrofurazone, Chloramphenicol, Tetracycline, Oxytetracycline and Chlorotetracycline. Antibiotic residues were not detected in these samples. Commercial samples when analyzed showed presence of certain antibiotics in some cases.

Pesticide residue

Eighteen samples of fish were analysed for organochlorine pesticide residues, polyaromatic hydrocarbons and heavy metals. About 50% of the samples contained op-DDE (range 29-128 ppb), 33% contained Heptachlor and less than 10% of the samples contained pp DDT, pp DDD, op DDT, Heptachlor epoxide, Aldrin and BHCs. However, the concentrations of pesticides were within the permitted limit.

Poly Aromatic Hydrocarbons (PAH)

The samples were analysed for PAH by HPLC and it was found that naphthalene was the most common PAH found in all the samples constituting 60-90% of total PAH in some of the samples. Acenaphthelene, naphthalene, fluorine, phenanthrene, anthracene, fluoranthene, benzo-a-anthracene, benzo-b-fluoranthene, chrycene and benzo-k-fluoranthene residues were the other PAHs detected in the fish samples. Fluorene and phenanthrene were present in about 70% of the samples followed by benzo-b-fluoranthene in about 55% of the samples. Among the fishes, *T. mystax* had the highest concentration of the PAH.

Heavy metals

Cadmium (Cd) and Cobalt (Co) were found to be present at levels below 0.05 ppm in all samples. Lead (Pb) was present to the extent of 2 to 3 ppm in Giant Threvally (*C. ignobilis*) while in other samples, the content was 1 ppm or below. Marlin (*Istiophorus gladius*), jew fish (*Otolithus argenteus*) and kalava (*Epinephelus diacanthus*) were found to contain Mn at 3.0 ppm level, while it was below 1ppm in all other samples. The essential elements Cu and Zn were found at higher concentrations in the samples when compared to other heavy metals. The presence of these heavy metals might be due to increased metabolic requirement of the animals. But all the samples analyzed were found to contain the toxic heavy metals at levels below the permitted limits, indicating that fish samples from Cochin area were good for consumption with respect to heavy metal content.

Toxicological studies with Monocrotophos

Exposure of rohu (average weight about 100g) to varying concentration of Monocrotophos has shown that the pesticide influences the protein content and composition of the tissue (Fig.7). There was significant increase in total protein content of the tissue when the environmental concentration of Monocrotophos was 1 ppm. Protein content gradually decreased on increasing the pesticide concentration of water. The trend was the same in the case of myofibrillar protein also. There were alterations in the activities of oxidative and detoxifying enzymes as well.

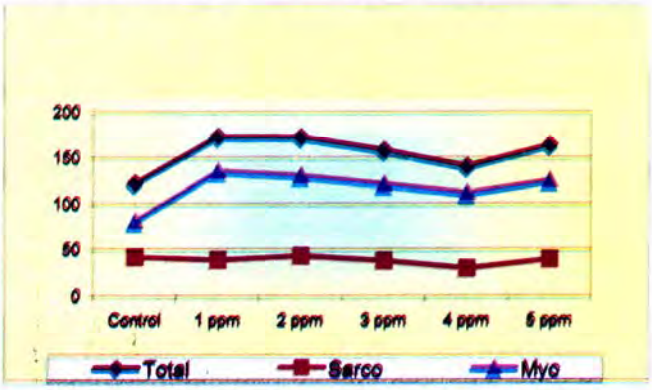


Fig.7 Changes in protein on exposure to different concentrations of Monocrotophos

Isolation, characterization and immobilization of fish lipase for commercial applications

The activity of fish lipases was determined in the hepatopancreas and intestine of rohu, sardine, mackerel and mullet fish samples. The lipase activity was found to be higher in the hepatopancreas and intestine of rohu fish samples as compared to that of other fish samples. In rohu, lipase activity was 1328 IU/mg protein, while sardine, mackerel and mullet fish samples contained 1035, 879 and 823 IU/mg protein respectively. In hepatopancreas, it was 2875 (rohu), 1965 (sardine), 1600 (mackerel) and 1578 (mullet) IU/mg protein. However, the specificity of these fish lipases on saturated and unsaturated fatty acid may be varying for which analysis has to be carried out.

Nutrition and pathology in mariculture (NATP)

Nutrient composition of commonly used fish feed ingredients and commercial fish feeds was studied. Results showed that there were wide variations in the composition. Availability of essential nutrients like essential amino acids and polyunsaturated fatty acids was better in feed ingredients of animal origin. Many of the feed samples available commercially were not nutritionally balanced. Protein content varied widely, ranging from 22.4 to 46.9%.

Quality Assurance & Management Division

Research projects handled

Title of the project	**Development of improved methods for quality and safety of fish and fishery products**
Principal Investigator	Dr. M.K. Mukundan
Location of project	Cochin & Mumbai
Co-investigators at Cochin	Shri. P.R.G. Varma, Dr. Francis Thomas, Shri. V. Muraleedharan, Dr. P.T. Lakshmanan, Dr. S. Sanjeev & Shri. K.P. Antony
Title of the project	**Studies on incidence of toxic principles and parasites in seafood (Ad-hoc project)**
Principal Investigator	Dr. M.K. Mukundan
Location of project	Cochin
Co-investigators	Dr. K. Ashok Kumar, Dr. P.T. Lakshmanan, Dr. C. P. Gopinath* & Dr.V. Kripa*

**CMFRI, Cochin*

Chief findings

- Successfully completed commercial trial of 50,000 litre per day effluent treatment plant constructed by M/s. Abad Fisheries, Cochin with CIFT consultancy. The plant is currently in full swing operation.
- Evaluation of 160 factory samples for export consisting of fish, shell fish and cephalopods indicated that the Indian seafood was free from common pathogens like *Vibrio cholerae* and *Listeria monocytogenes*.
- The pathogen *Salmonella* was detected in 1% of the samples.
- An estimated 10% of the samples showed the presence of *Staphylococcus aureus* but within the tolerance limit of 100 cfu/g.
- Microbiological quality of the products from National Standards and EU approved plants remained the same.
- Of the 85 samples examined for antibacterial substances, 28% were found positive, out of which about 4% was positive for Chloramphenicol.
- Monitoring of the heavy metal residues, lead, cadmium and mercury showed that the content of these metals in all the marine products for export were far below toxic levels.
- Fishes such as sardine, mackerel, pomfret and seer fish were free from detectable levels of lead.
- The brackishwater species of pearl spot and mullet showed significant levels of lead contamination.
- A study on size grade and heavy metal content showed a positive correlation in tilapia for mercury, whereas other elements like cadmium, lead and copper did not show any correlation between the level of metal residue and size grade.
- A survey on about 200 samples of fish and shell fish, mainly from Kerala coast, consisting of coral fishes, crab, bivalves etc. revealed that Indian seafoods were free from Paralytic Shellfish Poison.
- Only 2% of the samples showed the presence of Diarrhetic Shellfish Poison but all the samples showed concentrations much lower than 20mg/100 which is the tolerance limit.
- Survey of algal blooms as well as samples collected monthly from selected locations along Kerala coast revealed that the Kerala coast was free from PSP producing algae.
- Developed a simple and rapid colorimetric method for quantitative evaluation of sulphate residue.
- Formulated a rapid method for colorimetric estimation of phosphate residue above tolerance limit.

- A blueprint for rapid detection of antibiotic residue using a biochemical reaction of a bacterium was worked out.
- Preliminary studies to minimise the problem of squid ink in effluent treatment system using electric field was successful.
- A nucleotide based method (K-value) was established for quality evaluation of *Macrobrachium rosenbergii*.
- Developed a modified medium for detection of pathogenic *E. coli, which* was found to be very efficient for detection of *E. coli* 0.157.

Report of work done

Studies on effluent treatment and waste minimization

Based on the studies on the nature of effluent from seafood processing plants, a design was developed of an energy efficient effluent treatment plant. The plant was designed taking into consideration levels of parameters such as BOD, COD, oil and grease, pH, total dissolved solids, total suspended solids and chlorine in the effluent so as to bring it below the limits prescribed by Pollution Control Board. The essential components of the system established at M/s. Abad Fisheries, Kochangadi, Kerala, with CIFT consultancy are:

a. A screen filter having a pore size of 0.1 mm to remove the solid particles from the raw effluent.

b. An effluent sump for collecting and stabilizing the flow of effluent.

c. An effluent pump for regulating flow of effluent to holding tanks.

d. A plug flow mixer, which aspirates alum at the rate of 0.2 to 0.3% and mixes it for precipitation and coagulation of suspended as well as dissolved solids. This unit totally eliminates the need of a dosing and mixing tank, thereby saving space and investment.

e. Settling tanks (2 nos) for holding the alum dosed effluent for 24 hours to enable the settling of coagulated suspended material. These tanks are also equipped with surface skimmer, which effectively removes floating grease and oil.

f. A trickling filter, which is an aerobic biological filter, for the decomposition of remaining dissolved nutrients into carbon dioxide and water.

g. A chlorine doser to remove excessive bacterial load.

h. A dechlorinizing channel to remove residual chlorine.

The system can handle an effluent load of 50,000 litres per day. The operation of the plant was found to be successful.

Studies on microbiological quality of fish and fishery products for export

A total of 102 samples were collected from different seafood processing plants exporting their products to EU countries. The samples collected comprised of frozen shrimps (HL, PD, PUD, PC), frozen cuttlefish and squid, frozen octopus, frozen crab and frozen fish fillets. In general, the microbial quality of the samples was satisfactory as given in various standards. *E. coli* was present in some samples, but within limits. *Staphylococcus aureus* was present in about 10% samples and in all cases the count was within limits. All the samples were free from *Vibrio cholerae* and *Listeria monocytogenes*. *Salmonella* was present in one sample of frozen cut crab. Similar results were obtained for products from plants operating as per National Standards.

A modified medium was developed for the detection of pathogenic *Escherichia coli* and it was found very efficient for the detection of *E. coli* 0157 from fish and fishery products.

PSP and DSP in fish and fishery products

Samples of mussels, oysters, clam, water and soil were collected on a monthly basis from selected stations viz. Thalassery, Dhalavapuram, Calicut, Cochin, Sakthikulangara and Vizhinjam in the Kerala coast for the study of toxigenic micro algae producing PSP and DSP. Although two algal blooms were reported, no toxin producing algae could be detected. The water sample from Vizhinjam bay collected in the month of September 2003 answered positive for diarrhetic shell fish poison. *Dinophysis caudate* was the causative dinoflagellate. Samples collected from a bloom seen in CMFRI farm at Dhalavapuram were identified as *Dunalliella salina*. The same was cultured and analysed for PSP and DSP. Though reported to be toxic for the spat, no PSP or DSP was detected. *Paphia* collected from Dhalavapuram farm was also analysed and found to be negative for PSP and DSP.

Studies on minimizing benzopyrene in smoked products

Effect of various smoking conditions on the incidence of the chemical hazard benzopyrene in the smoked product was studied. Lowering of the temperature inside the kiln and maintaining it at 60 -70°C for the smoking duration of 30-60 minutes reduced the benzopyrene content to less than the permissible limit of 0.002 ppm. Dampening the fuel by moistening saw dust to about 50% moisture content also aided the reduction of benzopyrene.

Traditional masmin was found to contain benzopyrene, a suspected carcinogen, above limit, i.e. 0.002 ppm. To bring it down below tolerance limit, the above procedure was effective.

Studies on the heavy metal residues

The levels of heavy metals like Pb, Cd, As, Hg etc. were monitored in 36 samples of various fishery products like Cephalopods (squid and cuttlefish), frozen shrimp and fish. Mercury content was quite low in all the products and were much below 0.1ppm or nil. The level of lead (Pb) in

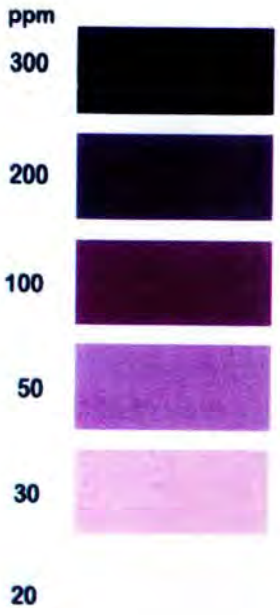
various fishery products were in the range of nil to 1.618 ppm. Level of Cd was insignificantly low in all these products.

Monitoring of residual SO_2 in prawn products

The levels of residual SO_2 were monitored in 18 samples of freeze dried shrimp and 10 samples of frozen PD/PUD shrimp in order to assess the safety of the material for human consumption. In freeze dried products, the residual SO_2 varied from 0 to 0.14 ppm and in frozen products, the level was around 5 ppm.

Development of suitable rapid test methods for sulphite and phosphate residues in prawn

A quantitative test strip for the estimation of sulphite residues in prawn muscle was developed. Standardisation of the test strip is in progress. The method consists of impregnating the test strip with potassium iodate and starch solution and cutting into small strips. The sulphite residue extracted in water or any suitable solvent is tested with the strip paper. Intense violet/blue colour develops on the filter paper; the intensity of the colour can be compared/matched with standard colour of known strength and SO_2 level estimated. Similarly, another test strip was developed for residual polyphosphate in prawn.



Quantitative test strip for Metabisulphite - Standard Colour Chart

Occurrence of antibacterial substances

Seventy six samples consisting of frozen prawns, frozen surimi, IQF blanched shrimps and food additives meant for export and rejected by the importing countries were tested for the presence of bacterial inhibitory substances. ATCC bacterial cultures, viz. *Bacillus subtilis* and *Micrococcus luteus* were used for the test. Thirty one samples (40.1%) were found positive in bacterial inhibitor test.

One consignment of frozen surimi exported by M/s.Gadre Marine Exports, Ratnagiri to Japan was detained suspecting the presence of bacterial inhibitory substances. The surimi sample was evaluated for the presence of bacterial inhibitory substances by using Four Plate Method and found free of the substance. The Ministry of Health, Labour and Welfare, Japan approved the test methodology, result etc. and cleared the detained consignment in August, 2003. The Institute received an appreciation letter from MPEDA for the timely help to clear the above said consignment.

Evaluation of K value for freshwater prawn

Using live *Macrobrachium rosenbergii*, the K value was evaluated for determining its freshness. Storage studies in ice were conducted and K value was used to determine its freshness, in comparison with organoleptic assessment. It was found that K value can be effectively used as objective chemical index for evaluating the freshness of *M. rosenbergii*. The study also revealed that a K value of 30 can be rated as very good and 50 as good for *M. rosenbergii*.

Improvement of quality of marinated products

Assessment of the quality of marinating underutilized fish was conducted. Variations in the acid-brine concentration of the pickle medium were found to affect the sensory quality and shelf stability of the product. Mould growth was seen on the surface layer of the samples having 0.5% acid and 7% salt (pH 3.07) after 12 days storage at ambient conditions. In 1.5% acid + 7% salt medium, no mould growth was seen even after 45 days. Culinary preparation of the marinades into different styles suggested that the pH may be limited to 4-4.5 for optimum consumer acceptability.

Studies on development of rapid methods for detection of antibiotic residues

A procedure was formulated for rapid detection of antibiotic residues using a biochemical reaction of the microorganism *Bacillus luteus*. Preliminary studies to evaluate presence of 5 to 100 ppb levels of Chloramphenicol were successful. Further studies on the efficiency and standardization of the method are in progress.

Microbiology, Fermentation & Biotechnology Division

Research projects handled

Title of the project	**Investigations on prevalence of microbial hazards in fish and fishery environments and development of methods for their control**
Principal Investigator	Dr. P.K. Surendran
Location of project	Cochin
Co-investigators	Dr. Nirmala Thampuran, Shri. V. Narayanan Nambiar, Dr. K. V. Lalitha, Dr. Toms C. Joseph & Shri. Rakesh Kumar
Title of the project	**Microbial ecology, seafood safety and molecular methods for detection of pathogens and toxins**
Principal Investigator	Dr. Nirmala Thampuran
Location of project	Cochin
Co-investigators	Dr. P.K Surendran, Shri. V. Narayanan Nambiar, Dr. K. V. Lalitha, Dr. Toms C. Joseph, Shri. Rakesh Kumar & Dr. Sanjoy Das
Title of the project	**In-service training programme in molecular biology for Fisheries Scientists (DBT project)**
Principal Investigator	Dr. P.K Surendran
Location of project	Cochin
Co-investigators	Dr. Nirmala Thampuran, Dr.Toms C. Joseph & Shri. Rakesh Kumar
Title of the project	**National risk assessment programme for fish and fish products for domestic and international markets (Network project)**
Principal Investigator	Dr. P.K. Surendran
Location of project	Cochin, Veraval & Visakhapatnam
Co-investigator	Dr. Nirmala Thampuran
Sr. Research Fellow	Kum. O.K. Sindhu
Title of the project	**International referral laboratory of fisheries technology (NATP)**
Principal Investigator	Dr. M.K. Mukundan
Location of project	Cochin
Co-investigators	Dr. P.K. Surendran
Sr. Research Fellow	Smt. K. Sreeganga

Chief findings

- A rapid colorimetric method was developed for screening of seafood for antibiotic residues. Method is under trial for fixing the quantitative minimum detection level.
- An improved microbiological assay method was developed for the detection of bacterial inhibitors from seafood. This method has the added advantage of excluding the possibility of false positives.
- Out of 717 samples of seafood consisting of farmed shrimps and processed shrimps tested, 11 farmed shrimp samples and 3 processed shrimp samples were found positive for antibiotic residues. Also, 13 samples contained bacterial inhibitors other than antibiotics.
- Enteropathogenic *E. coli* could not be detected in fresh fish from landing centers, local fish markets and also in frozen fish from retail outlets in and around Cochin city. However, beta hemolytic activity was noticed in a small percentage of the isolates.
- The genes encoding for cholera toxin and virulence (ctx A, tcp A and tcp I) were noticed in the environmental isolates of non O1 *V. cholerae* strains. This observation indicates chances of a possible health hazard to humans from environmental isolates of *V. cholerae* non O1.

- *Plessiomonas shigelloides*, an emerging pathogen, was detected in the whole meat of the farmed crab *Scylla serrata* and also from the farm mud.
- The post larvae (PL) and the surrounding hatchery water registered a very high count of *Vibrios* and *Aeromonas*. However, no correlation could be observed with the higher counts of these bacteria and incidence of WSSV in the PL.
- *Clostridium botulinum* type B was isolated from pearl spot (*Etroplus suratensis*) and farmed crab *Scylla serrata* from Ernakulam district.
- Farmed freshwater prawns *M. rosenbergii* collected from Kottayam and Alappuzha districts in Kerala harboured very high microbial load, in the range of 10^6- 10^7 cfu/g. Microflora on the surface of prawn revealed a preponderance of gram negative bacteria, mainly of the genus *Aeromonas* and family Enterobacteriaceae.
- Microflora associated with farmed crab *Scylla serrata* and farm water collected from Vypeen in Ernakulam district, Kerala were dominated by gram negative bacteria. Enterobacteriaceae and generae *Aeromonas* and *Vibrio* were isolated from both, water and crab samples.
- A survey indicated that there is high prevalence of WSSV (27%) in post larvae of tiger prawns from hatcheries of Kerala. Prevalence of Monodon Baculo Virus (MBV) was also seen in post larval samples from hatcheries, ranging from 50-80%.
- Aquatic *Pseudomonas, P. cepacia,* harbored three small plasmids (circular DNA) of 3.8 kb, 2.1 kb & <2.0 kb respectively; but other *Pseudomonas* spp. from brackish water did not carry any plasmids.

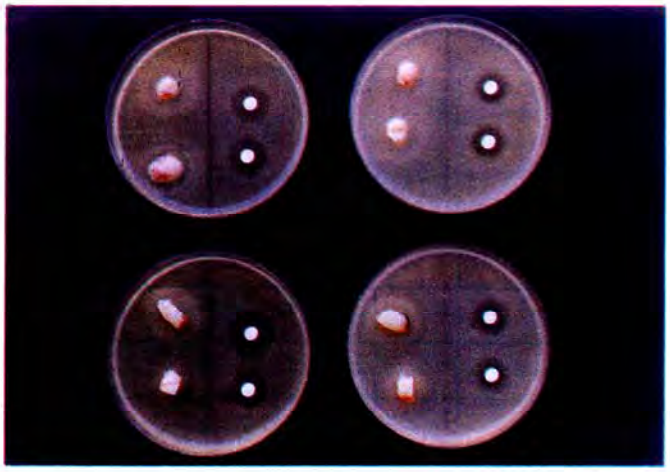
Report of work done

Antibiotic residues in farmed shrimp and processed fishery products

A total of 717 shrimp samples, consisting of 587 samples collected from aquaculture farms, 187 processed shrimp samples from seafood factories and 11 shrimp feed samples were tested for antibiotic residues, namely Chloramphenicol, Oxolinic acid, Tetracycline, Oxytetracycline, Furazolidone, Nalidixic acid, Neomycin and Trimethoprim. ELISA method was employed in the case of Chloramphenicol, with a detection limit of 0.1 ppb and microbiological assay method of AOAC, with a detection limit of 0.1 ppm was used for the rest of the antibiotics. Ten farmed shrimp samples tested positive for antibiotics. Three frozen shrimp samples contained Chloramphenicol at levels between 0.1 and 0.2 ppb, while 11 commercially processed shrimp samples contained bacterial inhibitors other than antibiotics. In most cases, the bacterial inhibitors were found to be chlorine residues.

Investigations for development of a rapid microbiological screening method for detection of a consortium of 8 antibiotics commonly encountered in farmed shrimps are in progress. A rapid colorimetric method has already been worked out. The method is based on the ability of the antibiotic residues to interfere with the growth and metabolism of test bacteria. The method is under intensive trial using various levels of antibiotics. The sensitivity level is also being worked out.

The conventional microbiological method (Four Plate Test) used for detection of bacterial inhibitors in seafood is based on the method used in meat industry, where the susceptible bacteria is exposed to the inhibitor diffusing out of the tissue sample planted on the seeded plate. It has the innate disadvantage of giving false results, because of the interference from the tissue exudates. Investigations were therefore undertaken to improve the testing method. An improved assay method has now been developed to detect the bacterial inhibitors in seafood. The improved method has the advantage of excluding false results. The method will also help in differentiating between bacterial inhibition due to antibiotics and due to those preservatives which are not antibiotics.



Improved Four Plate Technique to detect bacterial inhibitors in seafood

Enteropathogenic *E. coli* O157: H7 in fish

From the 36 samples of fresh fish comprising of sardine, mackerel, pearl spot, *Arius* sp and prawn purchased from five retail markets in Cochin, 56 presumptive colonies of Enteropathogenic *E. coli* were isolated. Ability of the isolates to produce labile toxin was tested by Reverse Passive Latex Agglutination (RPLA) test. None of the isolates was capable of producing the labile toxin. The hemolytic activity of the isolates tested against human blood indicated beta-hemolytic activity in 7% of the isolates. Lysine and ornithine decarboxylase activity was noted in 12 of the isolates

(6%). Even though a few isolates showed a negative reaction for MUG (Methyl Umbeliferyl beta-Glucuronide) on latex agglutination with specific antibody, *E. coli* O157: H7 was not seen to be present. It can be derived that although entero-hemolytic strains of *E. coli* O157: H7 (EHEC) were not detected during this survey, hemolytic *E. coli* are present in fish samples and they can be considered as variant of the EHEC. Hence, monitoring of environmental strains of *E. coli* is imperative .

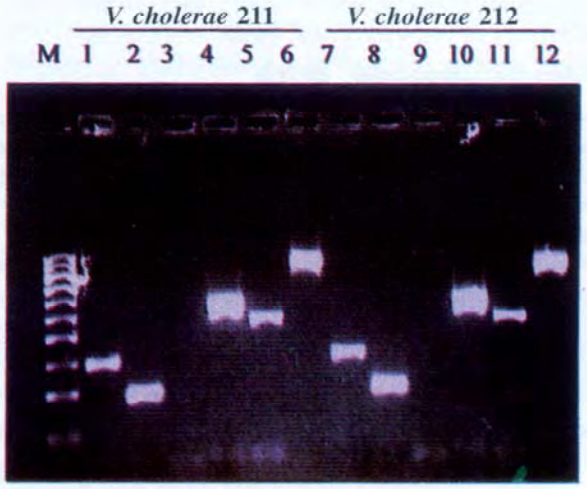
MUG negative hemolytic *E. coli* from fresh fish

Studies on pathogenic Vibrios

The factors associated with production of cholera toxin (ctxA) and virulence (tcpA & tcpI) were screened in clinical and environmental isolates of *V. cholerae* O1 and *V. cholerae* non-O1 by PCR method. The genes encoding for cholera toxin and virulence were noticed in the environmental isolates of non O1 *V. cholerae*. Amplification of genes targeted to serotypes and biotypes of environmental Vibrios used in the study showed that the *V. cholerae* strains were El Tor. But none of the strains tested harboured the genes specific for *V. cholerae* serogroup O139. The finding that environmental isolates of *V. cholerae* non-O1 carried the ctxA, tcpA and tcp I genes has implications on our environmental hygiene and sanitational practices.

Studies were undertaken on the sensitivity of important pathogenic *Vibrio* spp. namely *Vibrio alginolyticus, V. harveyi, V. mimicus, V. parahaemolyticus* and V. *vulnificus* to elevated temperatures of 45, 50, 55 ,60 and 65°C in trypticase soy broth. At 50°C, all the test cultures except *V. mimicus* were killed within 7.5 min. *V. mimicus* survived for 2.5 min at 55°C. *V. harveyi* was the most susceptible among the Vibrios tested.

During sanitary sampling of farmed crabs *(Scylla serrata*) from aquaculture farms in Kumbalangi, Cochin, the claw meat was found to carry a higher Vibrio count (2.7×10^3/g), while in the crab body meat it was only 950/g. In the surrounding water, the Vibrio count was < 100 /ml and in the bottom mud, 900 / g. *V. cholerae* was isolated from the crab body surface as well as mud, while *V. parahaemolyticus* was detected in whole body meat. Other pathogenic Vibrios namely, *V. mimicus* and *V. alginolyticus* were also found on the crab.



Amplicons showing the Vibrio serotype specific and toxigenic genes. Lane M: 1000bp ladder marker; Lane 1,7: amplification of *V. cholerae* specific region (300bp); Lane 2,8: amplifications of serotype *V. cholerae* O1 specific region (190bp); Lane 3,9: amplifications of serotype *V. cholerae* O139 specific region; Lane 4,10: amplifications of cholerae toxins enzymatic subunit (ctxA) specific region (564bp; Lane 5, 11: amplifications of toxin-coregulated pilus (tcpA) specific region (453bp); Lane 6,12: amplifications of regulatory protein gene (tcpI) specific region (862bp)

Studies on *Plessiomonas* and *Aeromonas* species in fish/shell fish farms and environs

Plessiomonas shigelloides was detected in the whole body meat of the crab *Scylla serrata* and also from the farm bottom mud. *Aeromonas* count was found to be 3.6×10^3/g in the crab claw meat, while in the whole crab body meat, it was 1.3×10^4/g and in the farm water, 3.4×10^3 /ml.

Water and post larvae (PL) samples from four hatcheries in central Kerala were monitored for *Vibrios* and *Aeromonas* and White Spot Syndrome Virus (WSSV). The mean *Aeromonas* count for water was 4.4×10^3 /ml and that of PL, 4.7×10^5 / g. The isolated *Aeromonas* cultures were identified as *Aeromonas caviae* and atypical *A. hydrophila, V. alginolyticus, V. campbelli, V. splendidus* and *V. pelagius* were also detected occasionally. No correlation was found between these counts and detection of WSSV.

Hygienic status of seafood in landing centres and fish markets in Cochin

A total of 300 samples of fresh and frozen fish were analyzed for hygienic microbial parameters. Fresh samples comprised of 26 different species of fish and 24 frozen samples. It was found that 72% of the fresh fish samples and 77.5% of frozen samples were of poor microbial quality, as they exceeded the maximum permissible bacterial count limit of 10^5 /g. Moreover, 21.6% of the fresh fish samples and 32% of frozen fish samples showed a very high total plate

count (TPC) of 10^7–10^8/g. *E. coli* counts of more than 20/g were noted in 72.3 % of the fresh fish samples and 71.3% of frozen fish samples of which 47.6 % fresh fish and 46% of frozen fish samples had *E. coli* counts beyond 100/g, indicating possibility of faecal contamination. The study indicated that there was urgent need for introducing hygienic practices in the fish landing and retailing places in Cochin.

Studies on *Salmonella* in fish

A total of 300 samples, comprising of 26 different species of fresh fish and 24 species of frozen fish from retail outlets and fish landing places in Cochin were examined for *Salmonella* serotypes. *Salmonella* was detected in 17.3% of fresh fish samples and 6.35 frozen samples. Among the different varieties of fish, *Pampus argenteus* showed maximum contamination (37.5%) by *Salmonella*, followed by *Etroplus suratensis*. There was no correlation between *Salmonella* contamination and counts of indicator microorganisms.

Distribution of *C. botulinum* in fish and shell fish

A total of 18 samples of frozen crab and eight samples of fish were examined for the presence of the toxigenic anaerobe, *Clostridium botulinum*. *C. botulinum* type B toxin was detected in seven crab and one fish sample. Forty presumptive *C. botulinum* cultures were isolated from the positive frozen crab samples for further characterization. Only eight cultures were toxigenic. Also, samples of fish (*Mugil cephalus* and *Etroplus suratensis*) were examined for *Clostridium botulinum*. *C. botulinum* type B toxin was detected in pearl spot (*Etroplus suratensis*).

Incidence of *C. botulinum* was also studied in farmed crab samples and farm water and mud, from two farms located at Kumbalangi and Vypeen, in Ernakulam district. Toxigenic *C. botulinum* type B was found to be present in the farmed crabs.

Detection of *C. botulinum* by PCR method

A Polymerase Chain Reaction (PCR) based method bas been standardized for the detection and confirmation of *Clostridium botulinum* type B, isolated from fish and crab samples. After cell wall lysis by treatment with lysozyme, DNA was extracted by two different methods. In the first method, proteinase K was added to remove proteins, followed by addition of sodium dodecyl sulphate solution. The extracted DNA was purified with phenol-chloroform-isoamyl alcohol mixture. In the second method, alkaline lysis was employed. The concentration of the DNA recovered was determined by running the DNA preparations in agarose gel. The purified DNA from type B formed the template for PCR amplification. Analysis of PCR products is in progress.

Microbiological changes during handling and chilled storage of the farmed freshwater prawn *Macrobrachium rosenbergii* and identification of spoilers

The total aerobic bacterial population on the farmed freshwater prawn *M. rosenbergii* collected from the farms located at Vayalar in Alappuzha district of Kerala was found to be in the range of 10^6 to 10^7/g of whole prawn and 10^5 to10^6/g of headless prawn. Faecal streptococcal counts ranged from 10^4 to 10^5/g .

Qualitative analysis of the microflora on the surface and in the intestine of farmed *M. rosenbergii* revealed a preponderance of gram negative bacteria. Gram negative bacteria on the surface of prawn were composed mostly of Enterobacteriaceae, *Vibrio*, *Aeromonas*, *Acinetobacter* and *Moraxella*. Gram positive bacteria accounted for 20-25% of the total microbial population and were represented by *Bacillus* and *Micrococcus*. Gram negative bacteria belonging to the genera *Aeromonas*, *Vibrio* and *Pseudomonas* were predominant in the intestine. Among Gram positives, *Bacillus* and *Corynebacterium* were predominant in the intestine. In addition, *Arthrobacter* and *Micrococcus* were also isolated in smaller numbers.

Microbial changes taking place in farmed *M. rosenbergii* during various stages of processing viz., as whole, headless, peeled and deveined were investigated. The microbial counts in the head region and intestine portions were the highest. The TPC of whole prawn was 7.041 log cfu/g. Deheading of prawns reduced total aerobic bacterial counts by 75%. Deheading and deveining process reduced the microbial load by 93-96%. In *S. aureus*, faecal coliforms, *E. coli* and *C. perfringens* counts, the reduction was about 60%. However, the counts of faecal Streptococci increased in proportion. During the deheading and deveining process, more than 90% reduction was noticed in the numbers of faecal coliforms and *E. coli*. However, such reductions in microbial load are not adequate to bring their levels within the TPC limit of 500,000/g. stipulated by USFDA.

Chlorine treatment of the deheaded shrimp by dipping in 10 ppm chlorinated water for 15 min. reduced the total bacterial counts by 99.9 % and the faecal streptococcal counts by 94. Even then, the reduction brought about by chlorine treatment was not sufficient to keep their levels within the stipulated limit.

Microbiology of farmed crab (*Scylla serrata*)

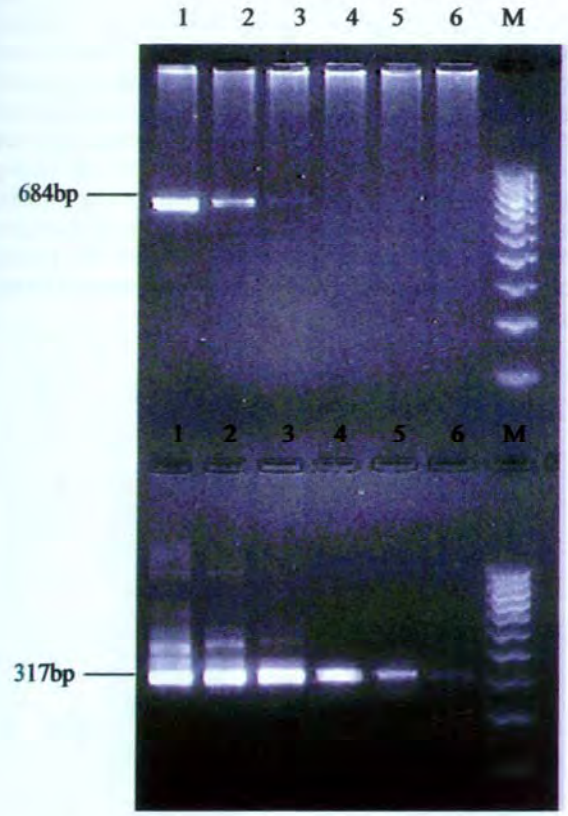
Microflora associated with the crab, *Scylla serrata*, and mud and water from farms located at Vypeen and Kumbalangi in Ernakulam district were studied quantitatively and qualitatively. Total bacterial counts were in the range of 10^5 to 10^6 and 10^4 to 10^5 cfu/g respectively for whole crab and claw meat. The levels of TPC of whole crab were higher than that of farm water. In addition, hydrogen sulphide producers, total coliforms, faecal coliforms, *E. coli*, Staphylococci, faecal Streptococci and *C. perfringens* were estimated.

Microflora associated with crab, *Scylla serrata* and water collected from the farm located at Vypeen were dominated by gram negative bacteria belonging to Enterobacteriaceae and generae *Aeromonas* and *Vibrio*. A small proportion of the flora consisted of gram positive bacteria, represented by *Bacillus*, *Micrococcus* and *Arthrobacter*.

Standardization of a nested PCR for detection of white spot syndrome virus

Penaeus monodon juveniles collected from a white spot syndrome outbreak in a culture pond at Ernakulam district, Kerala were used in the study. Total DNA was extracted from the pleopod by lysing the shrimp homogenate in a mixture of 0.025N NaOH and 0.0125% Sodium dodecyl sulphate (SDS). The samples were confirmed for the presence of white spot syndrome virus (WSSV) by using commercial WSSV test kit.

Two sets of nested PCR primers were designed from a region of WSSV genome sequence with primer 3.0, a primer-designing software by MIT, USA. The first primer set was selected from a WSSV sequence (NCBI Gene Bank Access No. U50928) with WSSV26F/27R as external primers that gave a 731 bp amplicon and WSSV24F/25R as the internal primer that gave a 302 bp amplicon. Another primer set was selected from a region of WSSV genome sequence (NCBI Gene Bank Access No.AF178572.1) with WSSV22F/23R and amplified as a 684bp product and the internal primers WSSV34F/35R amplified as a 317 bp product. The nested PCR was used for detection of WSSV. The reaction mixture was optimized with different concentration of primers (0.15µM, 0.3µM and 0.45µM), Taq DNA polymerase (0.9U, 1.8U and 3U), dNTPs (0.2mM, 0.4mM and 0.6mM) and $MgCl_2$ (1.5mM, 2mM and 2.5mM). In the first step, the maximum yield was obtained with 0.3µM of each primer, 0.2mM of each dNTP, 1.8U of Taq DNA Polymerase and 1.5mM of $MgCl_2$. In the nested PCR, the maximum yield was achieved with 0.3µM of each primer, 0.4mM of each dNTP, 1U of Taq DNA polymerase and 1.5mM of $MgCl_2$. Primer WSSV26F/27R and WSSV24F/25R were tested like the previous primer set. WSSV was serially diluted with negative shrimp sample (screened by commercial PCR kit) and assayed for its sensitivity from $6.8x10^5$ virions (500fg/µl) up to 5 virions (0.0036fg/µl). The detection limit for the first PCR was 6800 virions and for the nested PCR, 10 virions.



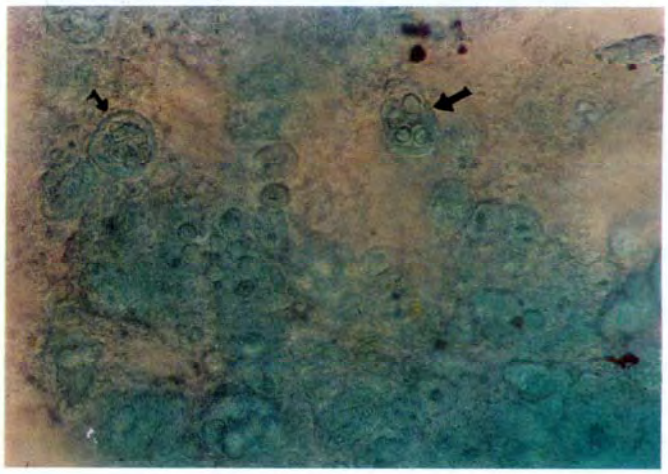
Sensitivity of quantified WSSV by serial dilution with WSSV negative shrimp sample. Lanes 1 - 6: Dilutions of WSSV ranging from 6.8 x 10^5 to 10 virions and Lane M, 100bp ladder marker. Top lanes are for first step PCR and bottom lanes for nested PCR

Screening of post larvae of shrimps for presence of WSSV

Ninety four post larval samples from different hatcheries tested positive by first step PCR while twenty four samples were positive only by nested PCR. These results indicate the high prevalence of WSSV among the post larvae supplied by the hatcheries to the farmers.

Screening of PL of shrimps for the presence of Monodon Baculo Virus (MBV)

Wet mount preparations of hepatopancreas from post larvae of *P. monodon* were stained with 0.05% malachite green and examined for the presence of spherical/polyhedral occlusion bodies/hypertrophied nucleus, characteristic of MBV infection. The prevalence of MBV occlusion bodies in post larvae from hatcheries ranged from 50-80% of the population in ten samples of post larvae tested.



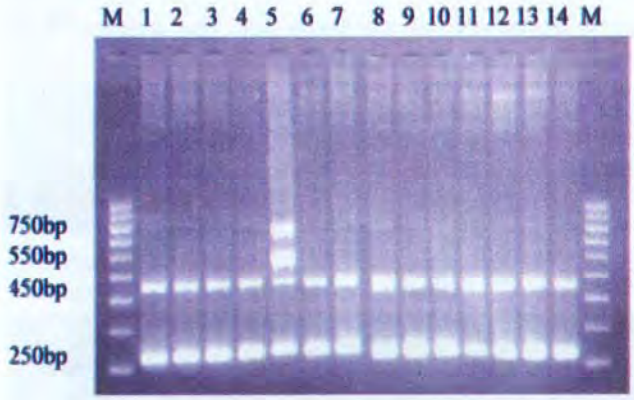
MBV occlusion bodies in the hepatopancreas of post larvae of *P. monodon*

DNA fingerprinting of *B. cereus* isolates using ITS PCR

Bacillus cereus is the pathogen that is ubiquitous in the environment and is established as a significant cause of human food-borne illness. Understanding the diversity within the species and relationships among this bacterium by a suitable discriminatory method would facilitate epidemiological and taxonomical studies. Several typing methods based on the analysis of bacterial DNA have been successfully applied to a wide variety of bacterial species. The 'internal transcribed spacers' (ITS) between 16S and

23S rDNA are frequently used as a molecular marker to identify microbial species and analyze the phylogenetic relationships between strains. In the present study, 18 *B. cereus* isolates were studied for genetic diversity by ITS typing by PCR.

B. cereus strains were isolated from aquatic environment by using standard cultural and biochemical methods. DNA was extracted from overnight grown cultures using phenol-chloroform method. The genomic DNA was quantified by spectrophotometer. ITS PCR was performed in 50µl reactions with 0.5µl of 1.25 U Taq polymerase, 5µl of 10x PCR reaction buffer, 1µl of mM each dNTP, 2µl of 2.5mM $MgCl_2$, 1µl of 0.3µM primer each and 2µl DNA. The primers used were S-D-Bact-1494-a-s-20 and reverse L-D-Bact-0035-a-A-15. The following temperature profile was used: initial denaturation at 94°C for 4 min, followed by 30 cycles each consisting of 94°C for 1 min, 55°C for 7 min and 72°C for 2 min with a final extension step at 72°C for 7 min .



ITS-PCR for DNA finger printing of *B.cereus*
Lanes M, 100bp ladder; 1-14 *B. cereus* isolates

Three fingerprint types were obtained from the eighteen strains tested. Two major bands of 250 bp and 450 bp size were common for all strains tested. Two strains BC07 and BC12 gave an extra band of 550 bp and one strain BC13 had an extra band of 750 bp.These results showed that in *B. cereus*, the 16S-23S ITS can be used in fingerprinting of the pathogen, but shows less discrimination.

Antibiogram and plasmid profile of aquatic Pseudomonas

The identified and confirmed strains of aquatic Pseudomonas were subjected to plasmid profile analysis by SDS - alkaline lysis, midi - preparation method followed by agarose gel electrophoresis. It was found that the strain of *Pseudomonas cepacia* harboured 3 bands of plasmid DNA running parallel to 3.8 kb, 2.1 kb and < 2 kb positions of the 1 kb standard markers. Plasmids DNA could not be detected in the tested strains of *P. aeruginosa, P. flouresenscens, P. putida, P. alcaligenes* and *P. pseudoalcaligenes.*

Young culture of *P. cepacia* were subjected to three sets of curing agents :- 1) bacterial cells incubated in lactose broth (LB) containing 3% SDS at 43°C 2) bacterial cells incubated in LB containing 1.5mg/ml acridine orange(AO) at 43.0°C, and 3) bacterial cells incubated in LB containing 100mg/ml ethidium bromide (EtBr) at 43 °C. After subjecting the cells to the curing agents, the cultures were streaked on TGA plates along with control and observations made on colony morphology. The apparently cured colonies were streaked on TGA slants and finally inoculated into LB for the isolation of the plasmid DNA. Cultures were assayed for plasmid curing after every 24 hr. The plasmid profile was assayed after subjecting to all three curing agents viz. SDS. AO and EtBr with elevated temperature (43°C) and it was found that plasmids were cured in all three sets of reactions. In case of SDS, two bands of plasmids were cured while in AO and EtBr reaction sets, all three plasmid bands were cured. The acridine orange and ethidium bromide were better curing agents than SDS at elevated temperatures.

A comparative study of antibiotic susceptibility of wild and cured strains using six antibiotics viz. Kanamycin, Chloramphenicol, Ampicillin, Tetracycline (30mg/disc each), Neomycin and Streptomycin (10mg/disc each) for wild cured strains of *P. cepacia* showed a marked difference in the antibiotic pattern of Kanamycin, Tetracycline and Neomycin. The wild strains of *P. cepacia* were resistant to these antibiotics whereas the cured strains were sensitive.

Transformation of plasmid in Pseudomonas

The transformation of plasmid DNA was performed into the cured strains of *P. cepacia* by standard method. The transformation was confirmed by the isolation and agarose gel electrophoresis of transformed plasmid. The plasmid profile of the transformed cells showed two bands of plasmid DNA as compared to wild strain that showed three bands of plasmid. The colony morphology of transformed strain was similar to wild strains i.e. mucoid, circular and raised, having smooth surface. The antibiotic susceptibility of transformed strain was also similar, showing resistance to Kanamycin, Tetracycline and Neomycin. The result showed that colony morphology and antibiotic resistance were plasmid based characters.

Cured plasmid DNA of
Pseudomonas cepacia

Transformation of plasmids, P-1 and P-2 in cured
Pseudomonas cepacia

In-service training programme in Molecular Biology for fisheries scientists (DBT project)

Two batches of 6 month's training programmes for Fisheries Scientists selected by CIFE, Mumbai were completed. The programme comprised of theory and practical classes, The trainees were given foundation courses in molecular biology. Thrust areas in Biotechnology like isolation of genomic and plasmid DNA,. agarose and SDS-PAGE electrophoresis for separation of proteins, DNA and RNA separation, use of restriction enzymes, transformation of competent *E. coli* and PCR were covered in the practical classes. They were assigned short research projects of about three months duration. The trainees also submitted well written dissertations as part of the programme.

National risk assessment programme for fish and fish products of domestic and international markets (Network project)

Fresh, frozen marine, brackish water and freshwater fish/shell fish from different parts of the state of Kerala were investigated for microbial hazards, viz. bacteria of public health significance like *Salmonella*, *Vibrio cholerae*, *V. parahaemolyticus*, *Staphylococcus aureus*, Group D *Streptococci*, *Listeria* and faecal coliforms including *E. coli*. Salmonella was detected in few of the frozen shrimp samples, while *Vibrio cholerae* (non O1) was detected in 6 out of 22 samples. *V. parahaemolyticus* was detected in three samples. A high incidence of *S. aureus*, *E. coli* and faecal Streptococci have also been observed.

International Referral Laboratory of fisheries technology (NATP)

The microbiology component under this project is validation studies on test methods for microbial quality of seafood. As part of studies on validation of the currently used methods of USFDA and EU, studies were initiated for evaluating the minimum detection level of *V. cholerae* in seafood and the minimum cell level required for detection of the bacterium by biochemical method estimated. Further studies are in progress.

Engineering Division

Research projects handled

Title of the project	**Design and development of eco-friendly fish dryers and indigenous electronic instruments for the Indian fisheries**
Principal Investigator	Dr. P.N. Joshi
Location of project	Cochin
Co-investigator	Smt. K. Vijayabharathi
Title of the project	**Mechanisation and production of pearl nucleus (NATP)**
Principal Investigator	Dr. P.N. Joshi
Location of project	Cochin
Sr. Research Fellows	Shri. K. Maheswaran & Shri. S. Saji Kumar

Chief findings

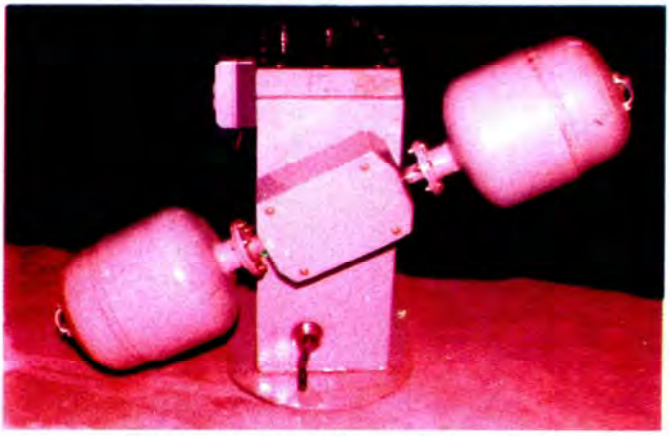
- Prepared design drawings of an eco-friendly fish drier.
- Designed and developed a polishing system for removal of sharp edges from cubical cut pieces of molluscan shells.
- Designed and developed a bead pre-forming machine to make the corner ground shell beads into near spherical shape.
- Developed a portable Environmental Data Acquisition System for monitoring environmental parameters.
- Designed and developed a navigational light control system for fishing vessels and installed the same in CIFT vessel *Sagar Sakthi*.
- Developed an indigenous electronic counter for measurement of concentration of micro algae *Tetraselmis*.
- Developed a multi channel thermometer with five channels for use in the eco-friendly fish drier.

Report of work done

Prepared the design drawings of an eco-friendly fish drier. This tent type fish drier is designed in such a way that it can be constructed easily using local materials available such as MS structural frames, aluminum sheets, wooden reapers, PVC films etc. Most of the items required for fabrication of the drier have been procured and fabrication of the drier is in progress.

Designed and developed a polishing pan for removal of sharp edges from the cubical cut pieces of molluscan shells. Rubber linings are provided inside the barrel to avoid corrosion of the material while using abrasives. The machine can be operated at 16 variable speeds ranging from 20 to 70 rpm.

Designed and developed a bead pre-forming machine to make the corner ground shell beads into near spherical shape. The machine consists of two circular plates in which the upper plate can be rotated at specific speeds by using motor drive mechanism whereas the bottom plate can be moved up and down through the main spindle to adjust the load on the shell beads. The top plate is provided with a specially designed rubber lining to give cushioning effect while rolling the non uniform shell beads over the bottom plate, which is embedded with a grinding medium to grind the uneven surfaces of shell beads into spherical shape.



Polishing mechanism for shell bead nucleus

A portable Data Acquisition System was developed for monitoring the environmental parameters namely water temperature, water salinity, air temperature, solar radiation, wind velocity, water level and relative humidity.

A navigational light control system for fishing vessels was developed and installed in the departmental vessel *Sagar Sakthi* for further trials.

An indigenous electronic counter was developed for measuring the cell concentration of algae of the species *Tetraselmis* in the range 0 – 5 millions/ml. This species of algae is a large green flagellate with a very high lipid level. It also contains natural amino acids that stimulate feeding in marine animals. It is used as an excellent feed for larval shrimp in shrimp hatcheries for increasing growth rates and as a standard feed for oysters, clams and mussels. Calibration of the instrument was carried out using the algae culture maintained at CMFRI, Cochin, by comparing with the reading of the haemocytometer. The data obtained was counter checked by enumerating the algae using the haemocytometer available in the MFB Division of CIFT.

Electronic counter for measuring cell concentration of algae

A multi channel thermometer with five temperature sensors was developed for measuring the temperature at different points inside the solar drier developed at CIFT.

Thirty sets of soil moisture sensors were fabricated and supplied to Central Institute of Agricultural Engineering Bhopal, for their research activities on payment basis.

Other activities

The following technical services were offered by the Division during the period:

* Fabrication of an electronic thermometer with special type of sensor for measurement of temperature inside cooked prawn for QAM Division
* Fabrication of two nos. time delay circuits for QAM Division after testing and calibration
* Fabrication of equipments, repair and maintenance works in the Engineering workshop
* Installation and testing of electronic instruments
* Repair and maintenance of refrigeration and air conditioning systems
* Preparation of an electrical design and estimate for the electrification of Director's Chamber, selection and procurement of electrical items, work supervision and work assessment
* Electrical design and estimate preparation, and selection of the light fittings for Conference hall, procurement of electrical items, work supervision and work assessment
* Instrumentation support for repairing Oxygen Generator maintained at B&N Division
* Testing and installation of 5KVA UPS in the Fish Processing Division
* Electrical design and estimate preparation, selection and procurement of electrical items, work supervision and work assessment for corridor of Conference Hall

The following resource generating works were also undertaken during the year:

* Type testing of different types of marine diesel engines and issue of certificates
* Calibration of mercury, alcohol and digital thermometers received from different fish processing plants and industry and issue of certificates
* Conductivity measurements of water samples as part of water quality analysis

Extension, Information & Statistics Division

Research projects handled

Title of the project	**A study on fish marketing and socio-economics of NEH region**
Principal Investigator	Dr. Krishna Srinath
Location of project	Cochin
Co-investigators	Smt. Mary Thomas & Shri. V. Radhakrishnan Nair
Title of the project	**Study on adoption of hygienic and disease preventive practices in small scale fisheries**
Principal Investigator	Dr. S. Balasubramaniam
Location of project	Cochin & Visakhapatnam
Co-investigators at Cochin	Dr. Krishna Srinath & Smt. Mary Thomas
Title of the project	**A study on the fuel utilization pattern by the fishing industry in India**
Principal Investigator	Dr. G.R. Unnithan
Location of project	Cochin
Co-investigators	Dr. Nikita Gopal & Shri. V. Radhakrishnan Nair
Title of the project	**Assessment of harvest and post harvest losses in fisheries – Marine fisheries (NATP)**
Co-Operating Centre Principal Investigator	Dr. Krishna Srinath
Co-Operating Centre Co-Principal Investigator	Dr. G.R. Unnithan
Location of project Co-Operating Centre	Cochin & Visakhapatnam
Co-investigators at Cochin	Dr. Nikita Gopal & Shri. V. Radhakrishnan Nair
Sr. Research Fellows	Smt. M.S. Mumtaz & Smt. K.A. Indu

Chief findings

- The data collected from pre-processing units revealed that the peeling shed owners were in the age group of 32 - 55 years and their educational level ranged from VIIth Std to Pre-University. Their experience in organizing peeling activities ranged from 7 - 35 years.
- On an average, six male workers, 48 female workers and two supervisors were employed in a peeling unit. The average number of days of peeling work in a year was 265.
- Most of the respondents (90%) were aware about fourteen hygienic practices to be followed in the pre-processing units. However, 50% of the respondents were not aware of the use of adequate rodent control measures.
- Hygienic practices such as use of fly proof netting for doors and windows, efficient system of waste disposal, adequate rodent control measures and use of recommended cleaning schedule were not adopted by about 40% of the respondents.
- The fish marketing personnel reported that facilities such as water, drainage channels, waste disposal facility and clean ground conditions were not available to about 85% respondents.
- Many of the hygienic practices viz. using clean containers, using clean water for washing, sorting of fish and using adequate ice were not adopted by the fish marketing personnel in the selected centres.
- About 70% of the traditional fishermen respondents had medium level of awareness (50% score) on the hygienic fish handling practices to be used in the fish landing centres.
- The aquaculturists in selected centres in Kerala had an average of 15 years of experience and the area of the fish farms was 12.5 acres.

- Most of the aquaculture respondents had implemented the practices such as the preparation of field, eradication of predators using mahua oilcake, stocking the pond with hatchery seeds, supplementary feeding with local feeds and water quality monitoring, but no standardized practice was observed.
- 90% of the aquaculture respondents from Alappuzha and Ernakulam districts reported the occurrence of diseases in their farms and the sources of infection were predicted as seeds, feeds and water pollution.
- The number of mechanised crafts operating on the Kerala coast was enumerated as 3,823 in 2003, of which 1,498 were below 40', 912 between 40 and 48' and 1,413 above 48' LOA.
- The fuel consumption by the mechanised crafts operated at Cochin region during 2002-03 was estimated at 37,482 KL and for Kerala state as a whole, at 97,204 KL.
- Results of the economic evaluation of 18 m steel trawler of CIFT design, under commercial operations, indicate that operational profit was 47.5% of the operating cost. The fuel consumption rate was 13 litres per hour and the vessel was found to be economically viable and fuel-efficient compared to similar class of vessels.
- The major wholesale market in Assam, namely Palton Bazaar, sold 42 tonnes of fresh fish including locally produced carps, and fresh fish varieties supplied by Andhra Pradesh and West Bengal.
- Jagirod Dry Fish Market - the biggest dry fish market in South East Asia, sold 210 tonnes of dry fish supplied mainly from Andhra Pradesh, West Bengal and Gujarat. Important varieties of fish supplied in the North Eastern region included major carps, Bombay duck, *Chana punctatus, Gadusia chapra, Puntius, Barillius* etc.
- The constraints in dry fish marketing involved difficulties and delay in transportation, loss of quantity due to long storage and improper infrastructure.

Report of work done

Adoption of hygienic fish handling practices in the fish pre-processing centres

Data were collected from 22 pre-processing units in Eramalloor, Ezhupunna and Chandiroor areas of Alappuzha district. Socio-personal factors such as age, education, experience, number of workers employed, number of days of work in a year, total investment and annual income were assessed. Extent of awareness and adoption of improved practices such as availability of drainage facilities, use of fly proof netting, use of adequate potable water for washing, use of soap and detergents, use of recommended cleaning schedule, personnel cleanliness, use of rodent control measures, etc. were evaluated among the respondents.

The data revealed that most of the respondents were aware of about fourteen hygienic practices to be followed in the pre-processing units. 50% of the respondents were not however aware about use of adequate rodent control measures. Further, the results revealed that some of the hygienic practices such as use of fly proof netting for doors and windows, efficient system of waste disposal and hygienic handling of ice were not adopted by about 40% of the respondents.

The data collected further revealed that twelve respondents availed financial assistance from MPEDA and banks. The average investment was Rs.33,000/- which was used for procuring pre-processing equipments. The peeling units that had not availed financial assistance were not properly equipped for adopting the hygienic practices. They had employed 35 workers/day, handled about 150 tonnes of fresh shrimp/year for an average 240 days of operation. The constraints in adoption of hygienic practices included:

- High investment and low profit
- Operational expenditure
- Workers not willing to follow improved practices
- Non-availability of skilled workers
- Seasonal nature of the activity and irregular supply of raw material
- No uniform implementation of hygienic practices; fear of commodity hygienically handled and pre-processed unhygienically getting mixed up at the destination
- Lack of policy to discourage homestead peeling
- Lack of finance for the maintenance of hygienic conditions

Adoption of hygienic fish handling practices in the fish markets

During the period, data were collected from 20 respondents in Champakkara, Piravom, Paravur and Mulakkulam fish markets in Ernakulam district. The data revealed that the marketing personnel were in the age group of 35 to 55 years with an average experience of 24 years. Infrastructural facilities such as clean water, drainage channels, cemented floor and clean ground conditions were available to about 83% respondents. About 40% of the respondents were not satisfied with the waste disposal facilities as they were thrown into the nearby backwater canals. Many of the hygienic practices such as using clean containers, using clean water for washing, sorting of fish and using adequate ice were not adopted by the fish marketing personnel.

Observations made at Saidapet fish market in Chennai and data collected from 12 fish stalls consisting of six each of fresh and dry fish stalls indicated that there was good

Use of plantain leaves for hygienic fish handling - a practice followed at Saidapet fish market in Chennai

awareness about the need for hygiene and sanitation. The market had separate toilet and potable water facility. Water was supplied at Rs.3/- per pot of 50 litres. Fish displayed on racks were kept on banana leaves which are easily available and easy to dispose.

Adoption of hygienic fish handling practices in the fish landing centres

During the period, data were collected from 15 traditional fishermen who operate their crafts in the fish landing centres such as Kathur, Anthakaranazhi and Chappakadavu in Alappuzha district. The age of the respondents varied from 40 to 60 years and the average investment on their fishing unit was Rs. 4.5 lakhs. About 70% of the respondents had obtained scores around 40 to 50% on awareness about the hygienic practices to be adopted in the fish landing centres. Financial problems, lack of transport facilities, water scarcity and lack of infrastructure facilities were found to be the constraints in the adoption of hygienic practices.

Hygiene and disease management practices in aquaculture

Data were collected from 30 respondents in Alappuzha and Ernakulam districts in Kerala and Nagapattanam, Tanjavur region in Tamil Nadu. The age of the respondents varied from 32-60 years and they had an average of 12 years of experience. Most of the respondents had adopted the practices such as preparation of field, eradication of predators using mahua oilcake, stocking the pond with hatchery seeds, supplementary feeding with local feeds and water quality monitoring. Organic manuring of the farms was reported by 30% of the respondents and another 30% had not used any manure. About 90% of the prawn farmers had reported the occurrence of virus diseases and the sources of infection were predicted as seeds, feeds and water pollution. As constraints, increased cost of farming, lack of technical guidance, lack of finance, risk due to mortality and lack of planning were reported by about 60% of the respondents.

From the data collected from Tanjavur – Nagapattanam area in Tamil Nadu, the following observations were made.

- WSSV affects the shrimp farms every season and farmers encountered considerable losses.
- Farms of 3 – 5 acres or above maintain reservoirs to provide treated water to the shrimp farms.
- The farmers have formed associations in different localities to promote group action in prawn farming aiming at disease prevention such as collective procurement of seed and implementation of disease prevention measures. The seed is PCR tested at brood stock, nauplii PL1, PL8 and at the time of lifting.
- Farmers followed the guidelines for shrimp farming provided by the Aquaculture Authority.
- The concept of pro-biotics was very well received but not well confirmed by the farmers. No standardized packages or practices was available for disease - free shrimp farming. Farmers depended on private companies marketing feed and pro-biotics including herbal products and who had their technicians employed at the farm sites. This resulted in increase in the cost of farming.
- The farmers reported that they had discontinued the use of banned antibiotics and drugs. MPEDA had played a major role in campaigning for this.
- The farmers felt that there was strong need to understand the claims made by the companies producing pro-biotics and other materials for water quality management and feed supplements. They were of the opinion that interventions from Institutes like CIFT through training and educational programmes are very essential.
- Introduction of *P. vannamei*, an exotic species, in some parts of the country had created anxiety among farmers.

Observation on the adoption of hygienic practices in a shrimp farm at Poompuhar

Study on fish marketing and socio-economics of NEH region

Visits were made to dry and fresh fish markets of Assam and Tripura and data collected from fresh and dry fish markets to study the fish marketing pattern in the NEH region. Paltan Bazar, a major fresh fish market in Assam, transacted 42 tonnes of fresh fish every week supplied mainly from Andhra Pradesh and West Bengal. The major varieties included Indian major carps and live catfish.

Jagirod Dry Fish Market, which operates for 6-7 months during the fair season, transacted about 210 tonnes of dry fish in a week. Dry fish arrived from West Bengal, Andhra Pradesh and Gujarat to the market and was supplied to all the North Eastern hill states. The important varieties of dry fish included Bombay duck, *Chana punctatus, Gadusia chapra, Puntius, Barilius* etc. A co-operative society functioned in the market which looked into the welfare activities. The constraints in the dry fish marketing involved difficulties and delay in transportation, loss of quantity due to long storage and improper infrastructure. A four percent CESS levied on fish coming from other states by Government of Assam led to increase in price and development of roadside markets in the periphery of the state, reducing the importance of Jagirod.

Visits were made to other major fish markets namely Battala, Gol Bazar, Lake Chowmung and Udaipur. Major supply of fish was from Andhra Pradesh, comprising major carps and Hilsa from Bangladesh. Seadal, an ethnic preparation of tribals of Tripura was also an important item supplied in the dry fish market. Data collection from the major fish markets of Tripura is in progress.

Study on the fuel utilisation pattern by the fishing industry in India

Under the study on the fuel consumption pattern, enumeration of the mechanised fishing crafts operating on the Kerala coast was carried out, as the category and size-wise information regarding the crafts was not available from secondary sources. The Kerala coast was divided into three regions, namely Quilon, Cochin and Calicut and physical counting of the crafts was performed under separate groups during the trawl ban period in 2003. The information on physical parameters of the crafts including LOA, breadth, depth, hp of engine, fuel tank capacity, fish hold capacity etc. were recorded and the data compiled. The data collection for the study on the fuel consumption pattern was completed for Kerala and the project has been extended to Veraval in Gujarat and Visakhapatnam in Andhra Pradesh. The fuel consumption by the mechanised crafts operated at Cochin region during 2002-03 was estimated at 37,482 KL and for Kerala state as a whole,at 97,204 KL.

The detailed economic evaluation of 18 m steel trawler of CIFT design was carried out based on data of 76 fishing trips. The average number of fishing days per trip was found to be 6.5 and the average number of days of operation per year was 248. The fuel consumption per trip was between 1200 and 1400 litres depending on the duration of operation.

Assessment of harvest and post harvest losses- Marine fisheries (NATP)

The compilation of data collected from different channels in the harvest and post harvest sector were completed and analysis of the data carried out at the lead centre IASRI, New Delhi. The losses were assessed, pooled over seasons, season-wise, viz. pre-monsoon, monsoon and post monsoon and with reference to the trawl ban, viz. pre-trawl ban, during trawl ban and post trawl ban. Estimates of percentage losses at harvest stage were made for large trawlers, other mechanised craft, motorised craft and traditional craft. Besides the above strata, post harvest loss percentages were estimated at market, vendor, pre-processing, processing, drying and household levels.

The major reasons for loss were seen to be retention of catch in net, attack by larger species and discard of juveniles and low value species in the harvest stage. While at the post harvest level, improper handling and transportation were the main reasons for loss, in addition to drying of sardine in large quantities for use as cattle feed and discard of low value species. Loss at the pre-processing and processing stage was generally low due to careful handling of the high value raw material. In the marketing sector, loss was mainly due to spoilage of the product as a result of improper handling, temperature and insect attack. Discard of fish due to lack of demand has also been recorded.

VERAVAL RESEARCH CENTRE

Research projects handled

Title of the project	**Development and application of appropriate processing technologies for better utilization of marine and freshwater fishery resources of Gujarat**
Principal Investigator	Dr. R. Badonia
Location of project	Veraval
Co-investigator	Dr. Arnab Sen
Title of the project	**Development studies on responsible trawl systems**
Principal Investigator	Dr. M.R. Boopendranath
Location of project	Cochin, Veraval & Visakhapatnam
Co-investigator at the Centre	Shri. U. Sreedhar
Title of the project	**Optimization and upgradation of traditional fishing systems for inland and marine sectors**
Principal Investigator	Shri. P. Pravin
Location of project	Cochin, Veraval & Visakhapatnam
Co-investigator at the Centre	Shri. U. Sreedhar
Title of the project	**Studies on material protection and marine pollution**
Principal Investigator	Dr. Leela Edwin
Location of project	Cochin, Veraval & Visakhapatnam
Co-investigator at the Centre	Shri. U. Sreedhar
Title of the project	**Validation of IRS P4 OCM data with demersal fisheries (Collaborative project)**
Principal Investigator	Dr. B. Meenakumari
Location of project	Cochin & Veraval
Co-investigator at the Centre	Shri. U. Sreedhar
Title of the project	**Development of value added products and by-products from low cost fish and processing waste from fish and shell fish (NATP)**
Principal Investigator	Dr. K.G. Ramachandran Nair
Co-Principal Investigator	Dr. R. Badonia
Location of project	Cochin, Veraval & Visakhapatnam
Title of the project	**National risk assessment programme for fish and fish products for domestic and international markets (Network project)**
Principal Investigator	Dr. P. K. Surendran
Location of project	Cochin, Visakhapatnam & Veraval
Co-investigator at the Centre	Dr. R. Badonia

Chief findings

- Trials carried out with 32 m large mesh demersal trawl, attached with 40 mm square mesh cod end showed more escapement of fishes (20.10%) as compared to 40 mm diamond mesh cod end (18.60%). The net was operated for 29 hrs, recording CPUE of 16.25 kgs/hr. Sciaenids, ribbonfish and shrimp were the main components of the catch.
- Experiments were conducted with trouser cod end having 40 mm square and diamond mesh legs attached to the 32 m large mesh demersal trawl. In square mesh cod end, 32.39 percentage of fishes had escaped as compared to 36.35% from the diamond mesh.

- A mesh-measuring gauge was designed and fabricated for measuring mesh size up to 150 mm of various nets. It was released by Shri. Vipul Mitra, IAS, the Commissioner of Fisheries, Gujarat, in a function held at Veraval. This gauge has proved to be very useful among fishermen and State Fisheries officials for monitoring mesh size.
- Standardization of LC-MS-MS method for analysis of different antibiotics was carried out. Analysis of Chloramphenicol was standardized quantifying a minimum of 0.1ng/gm (0.1ppb) in samples. Commercial samples are also being analyzed for testing of Chloramphenicol.
- Studies on the processing, quality and export potential of different fishes have revealed the export potential for frozen fillets of 'Koth'. The meat of barracuda, which has a characteristic taste and texture, is also seen to have good export market.
- Fermented and fortified fishmeal was prepared successfully in the laboratory. The product has average moisture content of 22%, 46% protein, 18% fat and 29% mineral content. It is attractive in colour and appearance, devoid of offensive and putrid odour, palatable to the poultry and animals and free from Salmonella. Many batches of fishmeal were prepared by fermentation technique for carrying out field trials. A pilot plant for production of the product is also being set up.

Report of work done

Fishing gear

Selectivity studies were conducted from the multipurpose fishing vessel *Sagarkripa* with a 32 m demersal trawl attached with 40 mm square and diamond mesh cod ends fitted with 10 mm cod end cover. The vessel expended 30.5 trawling hours. In the 40 mm square mesh cod end, 20.10% of fishes had escaped as compared to 18.60% from the 40 mm diamond cod end. The catches comprised mostly of Sciaenids and ribbonfish dominated by the species *Otolithes cuveiri* and *Lepturacanthus savala* followed by cuttle fish and lesser sardines.

Trials conducted with 32 m large mesh demersal trawl attached with 40 mm square mesh cod end showed more escapement of fishes (20.10%) when compared to the 40 mm diamond mesh cod end (18.60%). This net expended a total of 29 hrs, recording CPUE of 16.25 kgs/hr. Sciaenids (34.00%), followed by ribbonfish (21.00%) and shrimp dominated the catch.

A trouser cod end was designed and fabricated. One leg of the trouser cod end had 40 mm square meshes and the other leg had 40 mm diamond meshes. The cod end was covered with 10 mm mesh for collection of the species escaping. This cod end was attached to a 32 m large mesh demersal trawl and trials conducted. There was a total escapement of 32.39% of fishes from the square mesh cod end as compared to 36.35% from the diamond mesh cod end. Length frequency studies were carried out of the dominant species viz. *Trichurus savala, Otolithes rubber, O. cuveiri, Nibea albida* and *P. stylifera* from both the cod ends.

Fabrication of units of a multi mesh gill net was carried out at the request of the fishermen of Sutrapada fishing village. Various types of artificial lures were designed and hooks attached with these lures were distributed to the fishermen.

Troll lines with 5 and 4 No. Mustad hooks with artificial baits were fabricated. Five types of baits using various types of decorative material were tested along with mono lines and troll lines on board *Sagarkripa*.

Information on potential fishing zones (PFZ) received from SAC, Ahmedabad was disseminated to the fishermen of Veraval during this year also by translating it as approximate area and depth of operation with the help of hydrological data. Samples from a strong algal bloom observed on the Saurashtra coast were collected and the major group of planktons identified as *Noctiluca* sp., *Trichodesmium* sp., *Ceratium* sp., *Chaetoceros* sp., *Dinophysis* sp., *Eucampia cornuta* and *Rhizosolenix cylindrus*. The work on the project was completed and the final report submitted.

Fish processing

Standardization of LC-MS-MS method for analysis of different antibiotics was carried out. Analysis of Chloramphenicol was standardized quantifying a minimum of 0.1ng/gm (0.1ppb) in samples. Commercial samples are also being analyzed for testing of Chloramphenicol residues.

Saurida tumbil (lizard fish) samples were analysed for processing, quality and export potential. Fresh and dried samples were analysed for proximate composition and quality parameters. The common size was 30 cm in length and 300 g in weight. The yield of dried and trimmed product for export market is 17%. Present rate in the local market is in the range of 5-10/kg and in the export r[redacted]. From Veraval, 25-30 tonnes of dried fis[redacted]d in refrigerated containers every month.

Studies on processing, composition and marketing of *Otolithioides biauratus* (Koth) were carried out. The fish has moisture and fat content of 78% and 3% respectively and a protein content of 18%. The yield of fillet was noted to be around 45%. These are being exported in significant quantities from Veraval. The fresh maws from Koth are commercially important and fetch a price of Rs.500/-kg.

Samples of *Nemipterus japonicus* (pink perch) were analysed for evaluating processing and quality parameters. Heavy landings of the fish obtained during long fishing trips are processed as beheaded and gutted and given to surimi plants located in Veraval, Porbunder, Mumbai and Ratnagiri. The price of pink perch which earlier was Rs. 4-6/kg, has since gone up to Rs. 24/kg.

Samples of Surajbari prawn (*Metapenaeus kutchensis*) were analysed for proximate composition and yield during processing and cooking and organoleptic quality attributes. Good landings of this brackishwater prawn, particular to Gulf of Kutch, were noted. The price of prawn was Rs.15-25/kg.

Samples of cuttle fish, seer fish, ribbonfish, pomfrets, tuna, ghol and other varieties were analyzed for heavy metals, histamine and bacteriological quality parameters. The cadmium levels in different tissues of cuttle fish and other fishes ranged from 0.05 to 2.05 ppm. Whole squid samples contained more cadmium. In samples of frozen leather jacket, the level of lead was found to be 1.97 ppm and in 'Koth' fillets,1.69 ppm.

Tuna, seer fish, mackerel and perches were found to have potential for export in chilled condition as air cargo. The fish is packed with ice in sealed thermocole packing and air lifted from Rajkot to Mumbai and from Mumbai to Bangkok. Necessary technical guidance was provided to processors on this aspect.

Samples of surimi and crabsticks for export market were analysed for bacteriological quality. High T.P.C. and total Coliform count was noted. The samples were drawn from primary processing centres where pink perch is being beheaded and gutted and supplied to surimi plants. Most of the samples were of poor bacteriological quality.

Proximate composition of 37 fishmeal samples, including fermented fishmeal, was prepared successfully in the laboratory. The samples had an average moisture content of 22%, 46% protein, 1.8% fat and a mineral content of 29%. 25 kg of fishmeal was prepared by fermentation technique. It was attractive in colour and appearance, devoid of offensive and putrid odour and palatable to the poultry and animals. No Salmonella pathogen was detected.

VISAKHAPATNAM RESEARCH CENTRE

Research projects handled

Title of the project	**Studies on material protection and marine pollution**
Principal Investigator	Dr. Leela Edwin
Location of project	Cochin,Visakhapatnam & Veraval
Co-investigator at the Centre	Dr. R. Raghu Prakash
***Title* of the project**	**Development studies on responsible trawl systems**
Principal Investigator	Dr. M.R. Boopendranath
Location of project	Cochin, Visakhapatnam & Veraval
Co-investigators at the Centre	Dr. G. Rajeswari & Dr. R. Raghu Prakash
Title of the project	**Studies on environment friendly, high yielding semi-pelagic trawl for exploitation of fishery resources of east coast of India**
Principal Investigator	Dr. G. Rajeswari
Location of project	Visakhapatnam
Co-investigator	Dr. R. Raghu Prakash
Title of the project	**Technological studies on processing of freshwater and marine fish and shell fishes of east coast with special emphasis on product development and quality standards**
Principal Investigator	Shri. Sibsankar Gupta
Location of project	Visakhapatnam
Co-investigators	Dr. D. Imam Khasim Saheb, Shri. A. K. Chattopadhyay, Dr. R. Chakrabarti & Dr. B. Madhusudana Rao
Title of the project	**Study on the adoption of hygienic and disease preventive practices in small scale fisheries**
Principal Investigator	Dr. S. Balasubramaniam
Location of project	Cochin & Visakhapatnam
Co-investigator at the Centre	Shri. J. Charles Jeeva
Title of the project	**Assessment of harvest and post harvest losses in inland fisheries (NATP)**
Principal Investigator	Dr. H. V. L. Bathla, IASRI, New Delhi
Location of project	Cochin & Visakhapatnam
Co-operating Centre	
Principal Investigator	Dr. D. Imam Khasim Saheb
Co-operating Centre	
Co-Principal Investigators	Dr. Krishna Srinath, Dr. G. R. Unnithan & Shri. J. Charles Jeeva
Sr. Research Fellows	Shri. M. Trinadha Rao & Shri. K. L. N. Murthy
Title of the project	**Development of value added products and byproducts from low cost fish and processing wastes from fish and shell fish (NATP)**
Title of the sub-project	**Conversion of fish and shell fish processing wastes into livestock feed employing environmental friendly methods**
Principal Investigator	Dr. K. G. Ramachandran Nair
Location of project	Cochin, Visakhapatnam & Veraval
Co-operating Centre	
Principal Investigator	Dr. D. Imam Khasim Saheb
Co-operating Centre	
Co-Principal Investigator	Dr. B. Madhusudana Rao
Sr. Research Fellow	Shri. U. S. Jayaprakash Babu

Title of the project	**National risk assessment programme for fish and fish products for domestic and international markets (Network project)**
Nodal Officer	Dr. P. K. Surendran
Location of the Project	Cochin, Visakhapatnam & Veraval
Co-investigator at the Centre	Dr. B. Madhusudana Rao
Sr. Research Fellow	Kum. G. Padmaja
Title of the project	**Extraction of carotenoprotein and protein isolate from shrimp process waste: Development of an easy method and its scale-up (Ad-hoc project)**
Principal Investigator	Dr. R. Chakrabarti
Location of project	Visakhapatnam
Sr. Research Fellows	Shri. C. Madhu Babu & Shri. G. Raghu

Chief findings

- Trawl and cod end selectivity studies were undertaken. 30 mm square mesh cod end proved efficient in elimination of juveniles from trawls in inshore waters.
- Semi pelagic trawls were field tested and proved efficient in exploitation of off bottom fishes.
- Studies were conducted on *Mytilopsis sallei* to study the salinity tolerance. The salinity tolerance ranged from 0.083 % to 48%. *M. sallei* showed very high tolerance to copper and hydrogen peroxide.
- A simple process was developed to utilize seasonal surplus catch of low value, less marketable small bony fish as nutritionally rich, edible fish powder without de-boning the fish.
- Sodium tri polyphosphate (STPP) had better inhibitory effect on *Staphylococcus aureus* than on *Escherichia coli* and *Salmonella*.
- White Spot Syndrome Virus was detected in one sample of *Penaeus monodon* juvenile by 1st step PCR. One *P. monodon* juvenile and four *P. monodon* PL samples were negative in 1st step but positive in 2nd step PCR. Fourteen *P. monodon* PL samples, 8 *P. monodon* juveniles and one *Macrobrachium rosenbergii* samples tested negative for the presence of WSSV by 2 step PCR method.

Report of work done

Fishing Technology

Studies on material protection and marine pollution

The macro-foulers attached to the immersed panels showed growth of *Serpula vermicularis, Hydroides* sp., *Balanus amphitrite* and a few numbers of *Mytilopsis sallei*. There was no fouling pattern in the treated panels. Seasonal variation in macro-foulers was studied in Visakhapatnam. The macro-foulers mainly consisted of barnacles, bivalves and Serpulids. The list of different groups of foulers observed were; *Merciella enigmatica, Serpula vermicularis, Hydroides norvegica, Balanus amphitrite, B. tinitinnabulam, Chthamalus* sp., *Bagula neritina, Ostraea* sp., *Modiolus* sp., *Priomia* sp., *Mytilopsis sallei* and *Mytilus edulis*.

Hydrographical study was conducted in the harbour waters of Visakhapatnam. Salinity in the harbour area ranged from 28% - 30%. Dissolved oxygen values did not show much variation. Specimens of *Mytilopsis sallei*, an invasive marine fouler, were collected and acclimatisation was done for toxicity studies. Tissue samples were also collected for analysing the PHC burden in the tissues. Studies were conducted on *Mytilopsis sallei* to study the salinity tolerance. The salinity tolerance ranged from 0.083% to 48%. *M. sallei* showed very high tolerance to copper and hydrogen peroxide. Toxicity tests were conducted on *M. sallei* to study the tolerance to copper and hydrogen peroxide. Toxicity studies were conducted in four size groups of 0.5 cm, 1 cm, 1.5 cm and 2 cm. The 24 hrs LC_{50} values of *M. sallei* of size groups 0.5 cm, 1 cm, 1.5 cm and 2 cm to copper were 6.06 ppm, 5.75 ppm, 7.71 ppm and 5.48 ppm respectively. The 48 hrs LC_{50} values of *M. sallei* for the same size groups to copper were 2.39 ppm, 1.88 ppm, 1.23 ppm and 0.95 ppm, whereas, the 96 hrs LC_{50} values were 0.65 ppm, 0.85 ppm, 0.70 ppm and 0.58 ppm. The 24 hrs LC_{50} values of *M. sallei* of the size groups 0.5 cm, 1 cm, 1.5 cm and 2 cm to Hydrogen peroxide were 190.9 ppm, 233.1 ppm, 214.5 ppm and 198.2 ppm respectively. The 48 hrs LC_{50} values of *M. sallei* for the same size groups to Hydrogen peroxide were 65.15 ppm, 111.7 ppm, 98.17 ppm and 80.22 ppm, whereas, the 96 hrs LC_{50} values were 61.19 ppm, 55.5 ppm, 50.25 ppm and 54.15 ppm.

Development studies on responsible trawl systems

Studies were conducted on whole trawl selectivity by using 30 m demersal trawl at 25-40 m depth off Visakhapatnam. Morphometric data of trawl fishery and escaped fishes were recorded. Pelagic fishes like sardine and anchovies were seen to escape from the trawl bellies.

Fabrication of 30 mm, 35 mm and 40 mm square mesh cod ends was carried out for cod end selectivity studies.

Morphometric data of fish in cod end and cover cod end were recorded. Juveniles of *Platycephalus*, sardines, *Saurida* spp., anchovies, silver bellies and *Apogon* spp. escaped through square mesh cod end.

Environment friendly, high yielding semi-pelagic trawls

30 m semi-pelagic trawl was designed and fabricated and experimental fishing carried out with the trawl at 30-40 m depth. Field trials were conducted to evaluate the efficiency of the trawl. The C.P.U.E was found to be 60 kg/hr. The catch composition was mackerel (50%), ribbon fish (15%), silver bellies (15%), *Upeneus* spp. (10%), Carangids (5%) and Sciaenids (5%). Check-list of trawl resources of Visakhapatnam and trawl base was also prepared.

Fish Processing

Incidence of fungi in salted and dried fish

During the survey on the incidence of fungi in salted and dried fish samples collected from different markets of the upper Visakhapatnam coast, *Pencillium* sp. and *Aspergillus niger* were found to be common in the summer and the rainy season respectively. During the summer, the majority of samples collected remained free from visible fungal growth even after three months of storage at ambient temperature; but visible fungal growth appeared on the stored samples within one month after the beginning of the rainy season. The increase of moisture content, TVBN content and FFA content was noticed in all stored samples in the rainy season.

The monitoring of the presence of fungi in seawater was continued. The sensitivity of *Trichothecium* sp. isolated from seawater to Sodium Chloride was studied. Visible colonies appeared slowly on media containing 10% Sodium Chloride after 7 days at 28± 2 °C; but visible fungal growth was not noticed on media containing 14% Sodium Chloride even after 30 days at 28± 2 °C. A dip in 1% Potassium Sorbate for 2 hrs. prior to drying could control visible fungal growth in salted and dried rainbow sardine (*Dussumieria acuta*) for up to four months.

Monitoring of histamine in fish

During the monitoring of histamine level in muscle of little tuna (*Euthynnus affinis*), skipjack tuna (*Katsuwonus pelamis*), flying fish (*Cheilopogon cyanopterus*) and mullet (*Mugil cephalus*), it was found that the level of histamine in the muscle of acceptable fish varied from 2.4-19.5, 3.6-4.8,5.1-16.5 and 4.2-5.1 mg% respectively. All fish were acceptable up to 8 hrs. at ambient temperature. Skipjack tuna, flying fish and mullet were acceptable in ice up to 10, 11 and 13 days respectively. Slow increase in histamine and hypoxanthine levels in both the iced fish was noticed during storage; but the rapid increase of the same was in the muscle of fish stored at tropical ambient temperature. The histamine content in salted and pressed product from Carangids (*Atule mate*) and *Decapterus* sp. varied from 9.4 to 3.2 and 8.4 to 9.6 mg% respectively during storage of 45- 60 days at ambient temperature. The use of 0.2% Propionic acid during salting reduced histamine level in muscle to some extent.

Changes in *Catla catla* during frozen storage

During the frozen storage of *Catla catla* at 18±2°C for eight months, the loss of gel strength of the meat was observed to be from 370 to 180 g for 1 cm. thick disc. Hypoxanthine and total volatile base nitrogen content showed slow increasing trend.

Protein extract from crab shell waste

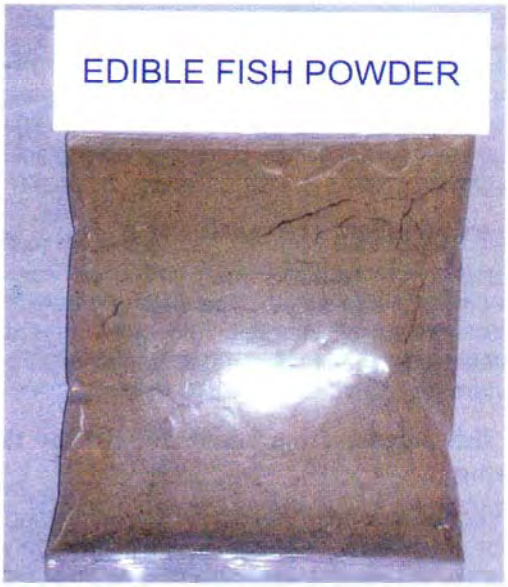
Protein was extracted from crab shell waste using different proteolytic enzymes. The yield of carotenoids rich protein cake was 4-5.5 percent. Slow loss of carotenoids was noticed during the storage of the cake at ambient temperature.

Edible fish powder from small size fish by thermal processing

Process has been developed for converting locally abundant small bony fish, e.g. silver bellies (mixture of *Leiognathus* sp.), mullets (mixture of *Liza* sp.) and lesser sardine (mixture of *Sardinella* sp.) to nutritionally rich edible fish powder without de-boning the fish. Small bony fish (dressed and beheaded) were processed under controlled thermal conditions (cooked under constant pressure for specified time in autoclave, depending on size of the fish) in order to soften the bones completely, remove fat partially and improve flavour, like canned product. Edible fish powder was developed utilizing the thermally processed fish with softened bones. The thermal processed fish was dried by mechanical drying/sun drying. Dried fish was made into powder in grinder and kept in polythene pouches for storage. Changes in biochemical and microbiological parameters were noted during storage and were found to be within acceptable limits.

The edible fish powder finds use as a fortifying agent to improve the food value and taste of different food items while cooking, which can help in mitigating malnutrition problem. The organoleptic acceptability of the products varied between 3 to 5 months when stored at room temperature. Faecal coliforms, *E. coli* and coagulase positive *Staphylococci* were not detected in the product during storage. The products

Fresh silver bellies (mixture of *Leiognathus* sp.) used for preparation of edible fish powder



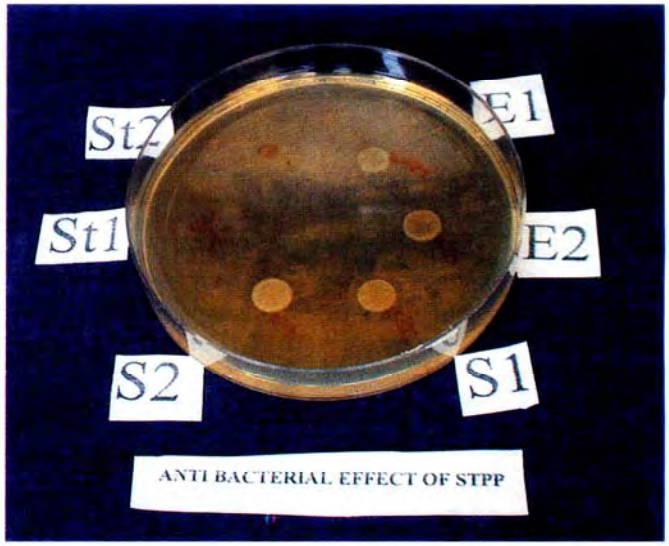
Edible fish powder prepared from silver bellies

were found to be a rich source of protein (62.52 to 69.77%), calcium (1113.00 to 2032.34 mg/100 g) and phosphorus (2141.74 to 2859.02 mg/100 g).

Incidence of pathogenic and toxigenic bacteria in fish, fishery products and fishery environment along the East coast and microbiology of freshwater fishes

Sodium tri polyphosphate (STPP) had better inhibitory effect on *Staphylococcus aureus* than on *Escherichia coli* and *Salmonella*. *S. aureus* strains were inhibited at 2% STPP level whereas, *E. coli* and *Salmonella* strains showed varying degree of susceptibility at higher levels (above 4%). Water sample showed 100% reduction in total Enterobacteriaceae count at 3% STPP and complete reduction in faecal Streptococci count at 5% STPP. A 4 log reduction in TPC at 37°C was observed at 4% STPP concentration but only 2 log reduction in TPC at 22°C was observed even at 6% STPP concentration. Antibacterial effect of STPP treated fish chunks was studied. Rohu (*Labeo rohita*) chunks dipped for 15 minutes in ice cold water containing STPP at 3% level showed an immediate reduction in TPC from 3.6 x 10^5 cfu/g to 5.3 x 10^4 cfu/g. However, on subsequent storage of chunks at refrigerated temperature, there was not much difference in the counts between control and treated chunks from the second day onwards.

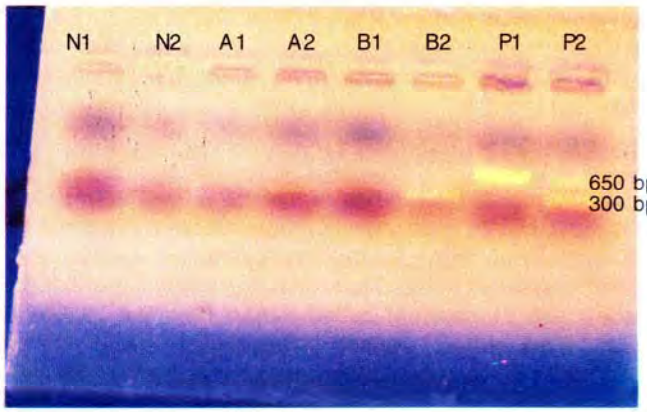
Sardines (*Sardinella* sp.), *Labeo rohita* and *Penaeus monodon* were found to be negative for the presence of *Salmonella*, *Vibrio cholerae* and *V. parahaemolyticus*. Coagulase positive *Staphylococci* were detected in one sample of *L. rohita* (20 cfu/g). *E. coli* (7/g) was detected in sardines. *E. coli* isolated from cultured freshwater fish (*L. rohita*) were tested for antibiotic resistance pattern. *E. coli* was found sensitive to Chloramphenicol, Ciprofloxacin, Co-trimoxazole and Norfloxacin and showed resistance to Niotrofurantoin. *E. coli* strains isolated from sardines were sensitive to Chloramphenicol, Ciprofloxacin, Co-trimoxazole and Norfloxacin but one strain was sensitive to Niotrofurantoin.



Sodium tri polyphosphate (STPP) incorporated at 2% level showing antibacterial effect on *Staphylococcus aureus*

Monitoring of White Spot Syndrome Virus (WSSV) in shrimps of Andhra Pradesh

Eighteen *Penaeus monodon* PL samples from shrimp hatcheries, 10 *P. monodon* juveniles from aquaculture farms and one sample of *Macrobrachium rosenbergii* collected from Godavari river were tested for the presence of WSSV by 2 step PCR. White Spot Syndrome Virus was detected in one sample of *P. monodon* juvenile by 1st step PCR. One *P. monodon* juvenile and 4 *P. monodon* PL samples were negative in 1st step but positive in 2nd step PCR. Fourteen *P. monodon* PL samples, 8 *P. monodon* juveniles and one *M. rosenbergii* were found negative for the presence of WSSV by 2nd step PCR method.



Monitoring of White Spot Syndrome Virus (WSSV) in *Penaeus monodon* post larvae by PCR method

N1 Negative control in 1st step	N2 Negative control in 2nd step
A1 PL sample negative in 1st step	A2 PL sample positive in 2nd step
B1 PL sample negative in 1st step	B2 PL sample positive in 2nd step
P1 Positive Control in 1st step	P2 Positive control in 2nd step

Adoption of hygienic and disease preventive practices in small scale fisheries

Preliminary field visits were made to the beach landing centres in Visakhapatnam district, Visakhapatnam fishing harbour and markets to find out the existing fish handling practices and disease preventive measures. Sampling methodology for the study was finalized and data collection work initiated. It could be observed from the preliminary field visits that, among the important parameters to be studied viz., awareness, adoption and impact of popularization efforts, the response was positive for most of the items of awareness and negative for actual adoption. Lack of infrastructure facilities like shelter, landing platforms, potable water, availability of ice and approach roads were expressed as constraints by majority of the respondents. The data collected among the fish/prawn farmers indicate the lack of contact with the extension agencies for technical guidance. Field visits and further data collection are in progress.

National risk assessment programme for fish and fish products for domestic and international markets (Network project)

Freshwater fish viz., Catla (*Catla catla*) and Rohu (*Labeo rohita*), freshwater prawn (*Macrobrachium rosenbergii*) and brackish water prawn (*Penaeus monodon*) were procured from aquaculture farms and internal markets and analysed for microbiological quality.

Extraction of carotenoprotein and protein isolate from shrimp process waste (Ad-hoc project)

The project work was started on 31st November, 2003. The biochemical composition of shrimp process waste is being studied in detail.

Assessment of harvest and post harvest losses in inland fisheries (NATP)

Scrutiny of data, data entry and statistical analysis of data were completed using the software provided by the lead centre, IASRI, New Delhi and the draft report prepared and sent to the Principal Investigator at IASRI, New Delhi. The critical stages, types, causes and extent of losses at harvest and post harvest levels have been identified for the various inland fishery resources, both culture and capture and marketing channels. This will be helpful in creating awareness regarding the losses among the fisher persons, planners, policy makers and administrators for planning and implementing loss reduction strategies.

Physical loss of fish due to faulty handling practices

Conversion of fish and shell fish processing wastes into livestock feed employing environmental friendly methods (NATP)

Underutilized fish and processing wastes were efficiently transformed into fish silage by formic acid treatment (acid silage) and *Lactobacillus plantarum* fermentation (fermented silage). Optimum formic acid level, molasses level and inoculum of *L. plantarum* were determined. Biochemical changes and microbiological quality of acid and fermented silages were analyzed. Stable fermented silage was reinoculated as starter culture to transform raw fish mince into silage. Livestock feed was prepared incorporating fish silage as animal protein source.

Fish ensilage (Biological silage) based livestock feed

Testing facility set up

A Polymerase Chain Reaction (PCR) testing facility was set up at the Centre for detection of white spot syndrome virus in cultured tiger prawn (*Penaeus monodon*), at present the country's most valuable aquaculture crop. This is by far the most effective method to screen brooders and post larvae at hatchery level and juveniles and adults at prawn farm level for the presence of the white spot syndrome virus. The Centre offers this facility to hatcheries and aquaculture farmers at moderate charges.

BURLA RESEARCH CENTRE

Research projects handled

Title of the project	**Exploration of potential fishing zones (PFZ) of major resevoir systems**
Principal Investigator	Dr. B. Meenakumari
Location of project	Cochin & Burla
Co-investigator at the Centre	Shri. Prem Kumar
Title of the project	**Studies on pollution of fish and fish curing environments of Orissa and NEH region**
Principal Investigator	Shri. J.K. Bandyopadhyay
Location of project	Burla
Co-investigators	Dr. M. M. Prasad & Dr. D. I. Khasim Saheb

Chief findings

- Trammel nets made of PP outer and nylon inner having mesh sizes of 50, 55 and 60 were found to be suitable for big sized carps like *Labeo rohita, Catla catla , S. silondia, L. fimbriatus* and *C. mrigala.*
- Monolines with hooks of numbers 15,16 and 17 were found suitable for exploiting catfishes of species *M. armatus, R. chrysea, M. gulio, M. seenghala, N. chitala* and *G. guiris.*
- Thematic layers of different physico-chemical parameters were prepared for modelling purposes.
- Product acceptability studies of marine dry/smoked fish in the Burla region showed 'Sole' as the most acceptable variety among five varieties tested.
- Quality evaluation of commercial freshwater smoked prawns indicate low quality, specially with respect to physical contaminants.
- High levels of lead, chromium and zinc were observed in commercial smoked freshwater fish.
- Abrupt reduction was seen in counts of mesophilic aerobic bacteria (7 to 3 log CFU/g), faecal Streptococci (6 to 1 log CFU/g) and Staphylococci (5 to 1 log CFU/g) during conversion of fresh fish to pickle/wafer (within 24 hours).

Report of work done

Fishing Technology

Trammel nets made of PP outer and nylon inner having seven different mesh sizes were tested in 197 fishing operations. A total of 12 fish species weighing 133.5 kg. were caught from these fishing operations. *L. rohita, C. catla, S. silondia, L. fimbriatus* and *C. mrigala* were the dominant species constituting 75 % of the catch. Nets having mesh sizes of 50, 55 and 60 showed better performance contributing to 58% of the total catch.

Gill nets made of high tenacity nylon monofilament having seven different mesh sizes were operated in 294 fishing operations. A total of 24 species of fish, weighing 566 kg. were caught from these nets. The catches comprised mainly of *S. silondia, E. vacha, C. mrigala, L. rohita* and *M. seenghala* (about 73% of the total catch) followed by *R. cotio, L. fimbriatus, L. calbasu, G. chapra, R. chrysea* and *C. catla.* Nets having mesh sizes 30, 35 and 40 contributed 61% of the total catch.

Two units of monoline consisting of 30 hooks of different numbers each were tested during 198 fishing operations. Small sized prawns and fishes were used as baits. A total of 20 fish species weighing 68 kg were caught from these monolines. The catches mainly comprised of *M. armatus, R. chrysea, M. gulio, M. seenghala, N. chitala, G. guiris* and *Anguilla bengalensis.* Catches from hooks of numbers 15,16 and 17 were found to constitute 59% of the total catch.

Observations and spatial analyses of Hirakud and Thangu reservoirs

Thangu reservoir on Harihar Jore, a tributary of Mahanadi river system, is a medium reservoir of Sambalpur district of Orissa. Total submerged area of the reservoir at full reservoir level (FRL) is 1800 hectares. Geographically, Thangu reservoir is situated in between 210 1'N to 210 5'N latitude and 830 59'E to 840 5'E longitude. Pipli Jore and Kusumi Jore are the other small rivers that fall into Thangu reservoir. Before constructing the dam, the reservoir area was a sparse forest area. The major portion of the reservoir bed is therefore covered with submerged trees.

Before construction of the dam, very few fishermen used to do fishing in Harihar Jore, but the number of fishermen gradually increased because they found fishing more profitable than agriculture. A Fishermen Co-operative Society is yet to be established in the region. Fishing has been adopted irrespective of caste. Presently there are about 200 fishermen families in 12 villages around the reservoir. Major Indian Carps is the major fishery, which is followed by catfishes and minor carps. Fishermen sell their fresh catches to the middlemen @ Rs. 20-30/-kg according to size and species. The small sized fishes are smoke dried and sold @ Rs. 70 to 100 per kg. Fishing for Catla is the major fishing activity due to the big size of the catch (1 to 22 kg). No closed season is observed. Instead, the fishermen go for fishing even in the rainy season when they get bigger sized carps. There is no mesh size regulation; mosquito nets to nets of 140 mm bar mesh size are in use. Dugout and plank built canoes built from a local wood, known as 'Donga' are used for fishing. Size of the boat varies from 5.50 to 8 m.

Periphery of the reservoir, up to a depth of 2-3 m. is littered with submerged weeds such as *Hydrilla, Chara* and *Vallisneria*. The colour of water of the reservoir is brownish due to the presence of organic matter. A good concentration of zooplanktons, *Moina* and *Daphnia,* was observed, which provide ideal food for zooplankton feeders such as Catla. The reservoir is shallow, the depth varying from 5 to 16 m. Dissolved Oxygen (DO) and free CO_2 do not have significant variation. DO varies from 5.2 to 6.8 ppm while CO_2 varies from 4 to 12 ppm. Water is rich in nutrients.

Time series spatial data were classified on land and in water. In December 1996, the area of water was found to be 324 hectares, which subsequently increased to 717 hectares in November 1999 and 1157 hectares in December 2002. The analyses show mixed pixels value of water and vegetation, which was confirmed during collecting field truth data. During the period under report, thematic layers were prepared for physico-chemical parameters of Thangu and Hirakud reservoirs. Experimental fishing with trammel nets of different mesh sizes ranging from 50 to 80 mm bar was conducted in 17 fishing operations in Hirakud reservoir. The catches were comprised mainly of *E. vacha* and *N. chitala.* Water samples were collected from different stations of Hirakud reservoir for hydrological studies.

Fish Processing

Product acceptability studies on dry/smoked fish samples

Studies carried out of five varieties of smoke cured marine fish received from Calicut Research Centre of CIFT for their acceptability among the smoked fresh water fish consumers and traders at Burla were completed.

Following is the descending order of the varieties for their acceptability, based on the mean scores.

Sl. No.	Product (smoked)	Scientific Name
1	Sole (III)	*Cyanoglossus* sp.
2	Ribbon fish (VI)	*Trichiurus* sp.
3	Anchovy (V)	*Anchoviella commersoni*
4	Oil sardine (I)	*Sardinella longiceps*
5	Mackerel (II)	*Rastrelliger kanagurta*

Rankings of the same variety of fish samples obtained for the previous study are shown in parentheses. The study was conducted on a 10 point hedonic scale which was as follows: Excellent-10 to 9, Very good-less than 9 to 7, Good-less than 7 to 5, Acceptable with reservations-less than 5 to 2, Unacceptable-less than 2. Twenty respondents, including traders and actual consumers were selected for the study. The respondents were provided with samples of all the five products for sensory evaluation. From the feedback it was observed that smoked sole was the most acceptable one whereas acceptability of smoked mackerel was the least. An important aspect of this study is the marked improvement in acceptance of the fish samples that scored significantly less in the first batch.

Quality of commercial smoke cured freshwater prawn harvested from Mahanadi river system and Hirakud reservoir

Smoke curing of fresh water prawn is an age-old practice prevalent in Western Orissa. This is one of the important sources of animal protein available to economically under-privileged people, specially those residing in hinterlands. The prawns are harvested from Mahanadi river system and Hirakud reservoir and are smoke cured in domestic kilns. The products in general are disposed off within a week.

Traditional smoke curing at Chaurasimal

Studies were carried out on different aspects of quality such as physical, biochemical, microbiological and sensory characteristics of commercial smoke cured prawns collected from different sources.

The bacteriological analyses of the smoked prawn samples revealed that the range and percentage of

occurrence of mesophilic aerobic bacteria, faecal Coliforms, faecal Streptococci, Staphylococci and coagulase positive Staphylococci is from 3.9 to 6 (100%), 2.78 to 5.9 (25%), 4.64 to 5.98 (33.33%), 4.20 to 6.72 (100%) and 4.36 to 4.78 (25%) log cycles per gram of the sample, respectively.

The samples had moisture content from 8.43 to 14.95% with an average of 9.59%, fat content from 3.88 to 7.96% with an average of 5.35%, total volatile nitrogen from 28.66 to 47.35 mg% with an average of 36.03 mg% and alpha amino nitrogen from 233.24 to 493.14 mg% with an average of 394.57 mg%. Among the samples screened, 41.66% was constituted by miscellaneous fish and 50% had unwanted materials. One sample showed insect infestation.

Sensory evaluation studies on a 10 point hedonic scale revealed that the scores ranged from 5.38 to 7.07.

This study indicates the need for improvement in quality of the product to enhance shelf life, to fetch better returns and improvement in socio economic condition of the primary producer.

Post harvest scenario of inland fisheries - A glance at needs of NEH region

Post harvest fisheries in inland sector are relatively virgin in comparison with marine sector and not much information is available on this aspect. The reasons could be that the production is not sufficient enough to meet the demand and hence, cultural preference is consuming the fish in fresh or iced condition. Assuming that 56% of the population includes fish in their diet, the country needs at least 6.2 million tonnes of fish. The present shortfall of fish production is about 0.8 million tonnes. In post harvest utilization of freshwater fish, apart from consuming fresh, product development and value addition depend mainly on demand for products such as 'Sidhal' that constitute the diet of more than 80% people of Manipur, a North Eastern state. The freshwater fish are cured for preparation of products such as smoked prawns and smoked and dried fish such as *Gadusia chapra*. The practices are common but are confined to hinterlands. As regards North Eastern Hill region, which is also a priority area, the needs of the region and suggestions for effecting improvement in the fisheries scenario in the region are being given due thrust.

Quality of commercial freshwater fish

Observations on the quality of commercial freshwater fish are given below:

Microbial Quality (Counts expressed as log CFU / g. of the sample)

Variety of fish	Mesophilic aerobes	Faecal Coliforms	Faecal Streptococci	Total Staphylococci	Coagulase positive Staphylococci
N. chitala	6.62	2.60	3.90	5.66	4.30
L. calbasu	5.90	2.60	5.78	3.87	3.78
S. silondia	7.92	2.60	4.00	3.60	2.30
L. mrigala	6.08	<1.00	3.78	4.29	3.90

Biochemical Quality

Variety of fish	Moisture (%)	Total Volatile Nitrogen mg%	Alpha amino nitrogen mg%	Peroxide value m eq/kg fat	Fat (%)
N. chitala	80.502	14.194	45.098	4.505	0.307
L. calbasu	80.166	11.961	59.028	4.509	-
S. silondia	79.816	14.199	64.562	2.329	0.462
L. mrigala	81.005	10.600	31.500	2.273	0.591

Suspected Salmonella were isolated from freshwater fish samples.

Bacteriological studies on fish pickle and fish wafers during storage

Bacteriological studies were carried out on both fish pickle and fish wafers during storage. The studies carried out so far indicate sudden and drastic reduction in count from fresh condition to pickle/wafer product. The mesophilic aerobic counts reduced from 7 to 3 log cycles/ g while faecal Streptococci, Staphylococci and coagulase positive counts reduced from 6, 5 and 4 log CFU/ g to less than one log CFU/ g respectively.

Quality of commercial smoke cured fish

The commercial smoked fish samples collected from interior markets were screened for bacteriological quality viz., mesophilic aerobic bacterial count, faecal Coliforms, faecal Streptococci, total Staphylococci, coagulase positive Staphylococci and Salmonella. The samples were also tested for moisture, fat, TVN, PV, alpha amino nitrogen and free fatty acids. A composite sample was made out of one variety of fish *Gadusia chapra* collected from different sources and mixed thoroughly for further analysis of bacteriological, physical, biochemical, nutritional and trace elements. The lead content in the sample was at hazardous level (34.66 ppm). And so was the case with zinc and chromium, which were at 157.50, and 122.20 ppm levels. Samples were free from pathogenic bacteria such as *E. coli* and Salmonella.

Comparative quality evaluation of commercial and controlled condition smoke cured *Rohtee cotio*

Comparative quality evaluation studies on smoke cured *Rohtee cotio* in controlled conditions and at commercial level obtained from Chaurasimal fishing village at Hirakud reservoir area were carried out during the period. The analytical studies included bacteriological, biochemical, physical and sensory evaluation.

Extension activities

Survey of fishing villages and fish markets

In the twin cities of Andhra Pradesh i.e. Secunderabad and Hyderabad, the dry fish markets viz. Monda Market, Ashok Nagar Market, Miralam Mandi and Begum Bazar were surveyed to assess the intra-country export of fish from the maritime states to the interior markets, general quality of fish, shelf life, transportation facilities and preservation methods adopted. In the freshwater wet fish market, potential areas of transfer of technologies such as preparation of fish pickles and wafers were identified in the absence of ice storage facilities and handling glut with a view to avoid disposal of fish at lower prices by value addition. On the basis of the survey conducted, enquiries of dry fish traders on quality and preservation aspects were clarified. Information was also gathered on facilities for conducting training-cum-demonstration programmes for the benefit of fishermen, fisherwomen and fish traders and the same passed on to the Commissioner of Fisheries, Gujarat.

Information on the technologies developed at CIFT, facilities for conducting training-cum-demonstration programmes and analysis of products was also passed on to the officials of the Department of Fisheries, Govt. of Jammu and Kashmir.

Dhama, a fishing village on the river Mahanadi under Maneswar block of Sambalpur district was surveyed to assess the socio-economic conditions of the fisher folk, varieties of fish harvested and post harvest handling and marketing of the fish. Nearly 250 fishermen families are active in this profession. This village has been identified as potential target for transfer of technology and to conduct training-cum-demonstration programmes.

Study of wet fish market in Pandu Bara Bazar, Guwahati (Assam)

In the wet fish market in Pandu Bara Bazar, Guwahati (Assam), type of fish marketed, quality and post harvest handling, especially during marketing, were assessed.

Wet fish market at Pandu Bara Bazar, Guwahati

Study of wholesale/retail wet fish markets of Cuttack (Orissa)

Pancha Mukhi Matsya Sangh, a fresh/marine water wholesale fish market, Cuttack (Orissa) was surveyed for variety of fish sold, source, hygienic conditions in the market, post harvest handling and transportation.

The retail fresh fish markets surveyed in Cuttack included Maa Basulaya Matsya Vyavasaya Sangh in Zobra and roadside makeshift stalls near Zobra Ring Road. Chaudhar Matsya Jeevi Cooperative Society was also visited for this purpose.

Special component plan and women component plan

As a part of the Special Component Plan and Women Component Plan under IXth Plan, the scientists visited the village Kurumkel adopted by CIFT Burla. The transfer of technology programme was initiated by demonstrating the use of insulated icebox for fish preservation. A GI icebox designed and fabricated by the Center was handed over to Shri. M. Bhaisal, member of Thebra P.F.C.S.

HOSHANGABAD RESEARCH CENTRE

Officer associated : Shri. Moka Swamy Kumar

Report of work done

Eight numbers of scientifically designed framed gill nets made of nylon multifilament yarn were supplied to the fishermen members of Tawa Matsya Sangh, Kesala, Hoshangabad District, Madhya Pradesh, on 16 March, 2003. Four of the gill nets were of specification 160 mm mesh bar and four, 180 mm mesh bar, of same twine size 210 x 2 x 3. Twenty two 5" dia. aluminium floats and equal number of iron rings as sinkers were also supplied to the fishermen.

The nets were distributed with the aim of collecting data from the fishermen in order to develop and standardize twine size and mesh size of eco-friendly fishing gears suitable for sustainable and effective exploitation of fishery resources of Tawa reservoir.

Fishing activities are suspended in all reservoirs of Madhya Pradesh, including Tawa, from 15th June to 15th August every year. During the year under report, a total number of 123 fishing days was observed and 129.750 kgs of fish harvested in both the nets. The fishery of Tawa reservoir was dominated by *Catla catla*, which constituted 80% of total landings.

A total of 36 numbers of *Catla* species weighing around 93 kgs were caught in both the nets (average weight 2.583 kgs). Out of this, 19 numbers were caught in 160 mm bar and 17 numbers in 180 mm. Though more number of the fish was caught in nets with 160 mm mesh bar, from the weight point of view, 51 kgs was recorded in 180 mm mesh bar, whereas it was only 42 kgs in case of 160 mm mesh bar.

Eleven numbers of *Cirrhinus mrigala* species were caught in both the nets and its weight recorded as 30.5 kgs. Excepting for one fish, which weighed 2.5 kg, caught in nets with 180 mm mesh bar, remaining ten numbers weighing 28 kgs was recorded in 160 mm net. Among the major carps, *Labeo rohita* was not seen caught in either of the nets on all the 123 days of fishing. Out of five numbers of *Mystus* species caught, four numbers were recorded in 180 mm net.

MUMBAI RESEARCH CENTRE

Research projects handled

Title of the project	**Development of improved methods for quality and safety of fish and fishery products**
Principal Investigator	Dr. M.K. Mukundan
Location of project	Cochin & Mumbai
Co-investigators at the Centre	Shri. D.K. Garg & Shri. S.P. Damle
Title of the project	**Chemical and microbiological evaluation of marine and inland fish and fishery products of Maharashtra**
Principal Investigator	Shri. D.K. Garg
Location of project	Mumbai
Co-investigator	Shri. S.P. Damle

Chief findings

- One hundred and forty two samples of frozen seafoods from processing units were screened for quality parameters and found to be free from pathogens like Salmonella, *V. cholerae, V. parahaemolyticus* and *Listeria monocytogenes.*
- Total bacterial count and TVN value was higher in fresh fish from retail markets compared to those from landing centres indicating poor handling and storage practice in the markets.
- High TBC and faecal Streptococci count was noticed in ice and water samples used in retail fish markets.
- Spoilage of dry fish was found to be rapid with increase in humidity.

Report of work done

Bacterial quality of seafoods from processing units

A total of 142 samples from EU and non EU approved units were analysed for their bacterial quality. The samples comprised of frozen cuttle fish, squids, prawns and different varieties of fin fish.

Pathogens like Salmonella, *V. cholerae*, *V.parahaemolyticus* and *L. monocytogenes* were not detected in any of the samples analysed. Three samples of frozen prawns contained higher values of Coliforms than the permissible limits.

Bacterial quality of water and ice from processing plants

Thirty two samples each of water and ice from processing plants were analysed for their microbiological quality. Out of these, TBC of more than 100/ml was noticed in three samples of water and five samples of ice. However pathogens were not detected in any of the samples.

Chemical and microbiological evaluation of fish products of Maharashtra

This study was taken up to evaluate the quality of fresh fish available to the consumer in Maharashtra. Two samples of freshwater fish and twelve different fresh fish samples of marine origin were collected from retail fish markets of Navi Mumbai and two landing centres in Mumbai. Quality of market samples was observed to be poor compared to those sampled from landing centres. High TVN value and total bacterial count as well as high count of faecal Streptococci was noticed in the market samples. This is indicative of poor handling and storage as well as inadequate icing in the retail outlets. The details are presented in the table below:

Tambusa, dhoma, mandeli and baga sampled from New Ferry Wharf Landing Centre were analysed for presence of trace metals like Cd, Pb and Zn. These metals were not detected in the edible meat portion.

Storage studies of dry fish from market

Dry fish samples of jawala (*Acetes* spp.), kardi (*Palaemon tenuipes*), modak *(Escuosa thorakata)*, bangda (*Rastrelliger kanagurta*), baga (*Trichiurus lepturus lepturus*) and mandeli (*Coilia dussumieri*) were procured from Dadar Dry Fish Market for quality and storage studies. The samples were stored in glass jars at ambient temperature. In case of salted bangda, the initial moisture content was 43.11% while in the rest it was less than 20%. Initial TVN values ranged between 94.8 mg% to 183.0 mg%. The samples were periodically examined for quality and insect infestation. At the end of twenty five weeks, heavy insect infestation by *Dermestes* spp. was noticed in dry ribbon fish. Entire edible meat was consumed by the insects leaving disintegrated skeletal bones and debris of dead insects and shell. The material emanated strong ammoniacal odour. Likewise, heavy infestation by *Nacrobia* spp. was noticed in modak with almost 70% of the edible portion consumed by the insects.

Sl. No.	Local Name	Source	Moisture %	TVBN mg%	TBC count/g	Faecal Streptococci
1.	Chorbombil	Vashi market	85.2	27.3	$>10^5$	$>10^2$
2.	Kateribangda	- do -	67.4	31.8	$>10^5$	$>10^2$
3.	Pedva	- do -	71.3	37.5	$>10^5$	$<10^2$
4.	Karkara	- do -	74.5	26.7	$<10^5$	$<10^2$
5.	Tambusa	New Ferry Wharf	75.7	15.2	$<10^4$	$<10^1$
6.	Dhoma	- do -	74.6	18.1	$<10^4$	$<10^1$
7.	Mandeli	- do -	68.8	23.2	$<10^4$	$<10^1$
8.	Baga	-do -	71.8	19.7	$<10^4$	$<10^1$
9.	Le[illegible]i	Vesave	77.4	16.1	$>10^4$	$<10^2$
10.	Rawas	- do -	74.6	11.2	$<10^4$	$<10^1$
11.	Bhing Pala	- do -	73.7	14.5	$<10^4$	$<10^1$
12.	Saundala	- do -	69.3	12.6	$<10^6$	$<10^2$
13.	*Catla catla*	Vashi	75.9	----	$>10^5$	$<10^2$
14.	Rohu	Belapur	77.1	----	$>10^5$	$>10^1$

Note: Salmonella and *V. cholerae* were not detected in any of the samples

Due to high humidity, insect infestation was followed by mites in all the samples, disintegrating the material into powdery mass. TVN values increased to 215 mg% in jawala and to 194 mg% in kardi. Both samples emitted strong ammoniacal odour. Oil was also seen oozing out from salted bangda, rendering the product unacceptable.

Bacterial quality of water and ice used in retail fish markets

Samples of water and ice used in fish retail market of Vashi and Belapur were analysed for bacterial quality. TBC of more than 100/ml was detected in all the samples. Faecal Streptococci count of 46/ml was detected from one sample of ice.

CALICUT RESEARCH CENTRE

Research projects handled

Title of the project	**Processing and product development from oceanic and deep-sea fishes**
Principal Investigator	Shri. P. K. Vijayan
Location of project	Cochin & Calicut
Co-investigators at the Centre	Shri. A.A. Zynudheen & Shri. K. George Joseph
Title of the project	**Toxicity induced stress on the metabolism of fish and distribution of toxic contaminants in fish and shell fish**
Principal Investigator	Dr. T. V. Sankar
Location of project	Cochin & Calicut
Co-investigator at the Centre	Shri. A. A. Zynudheen
Title of the project	**Development of technology for processing fish and fishery products in appropriate packaging materials**
Principal Investigator	Dr. T. K. Srinivasa Gopal
Location of project	Cochin & Calicut
Co-investigator at the Centre	Shri. A. A. Zynudheen

Chief findings

- Preservation of salted sardines is found to be augmented on giving the samples a dip treatment in ginger/turmeric extract before salting.
- Trials confirmed that shark meat pickle remains in very good condition for over eight months.
- 65.2% of the representative samples of packaged dry fish sold through supermarkets in Calicut city had moisture content above 25%. 91.3% of the samples analyzed had acid insoluble ash below 1%. TVB values were generally high with average at 207.68 mg%.
- Mycological profile of dried fish samples collected from Calicut Central Market revealed the presence of *Aspergillus* sp., *Rhizopus/Mucor* sp. and *Polypaecilum* sp.

Report of work done

Studies on effect of mango pulp as preservative

Fresh sole collected from the landing center was treated with raw mango pulp extract in varying concentrations and different quality parameters were estimated. It was observed that the sample treated with 40% and 60% solutions had better quality, whereas, samples treated with 100% solution became withery on drying. All the samples had better appearance when compared to control. Taste panel studies showed that samples treated with 60% extract had better taste.

Results of analysis:

Parameter	Control sample	Sample + 20% extract	Sample + 60% extract	Sample + 100% extract
Moisture(%)	12.26	10.88	08.04	-
Protein(%)	-	52.40	55.50	57.60
Fat(%)	10.83	09.20	11.60	-
TVBN(mg%)	49.91	66.16	83.49	-
FFA(%of Oleic acid)	04.25	05.64	04.92	-

Studies on fungi in dry fish

Thirty samples of dried fish brought to Calicut Central Market from different sources were collected and their quality estimated.

A total of 212 fungal cultures comprising *Aspergillus glaucus* group (53.30 %), *A. niger* (11.32 %), *Polypaecilum* sp. (14.62 %) and *Rhizopus/Mucor* (20.76 %) were isolated from the samples.

Distribution of toxic contaminants in fish and shell fish

Fish samples from Korappuzha river, Puthiyappa harbour, Chaliyar river, Purakkattiri river and freshwater fish from Peruvannamuzhi reservoir were collected and analysed for the presence of heavy metals, PAH and pesticide residues.

Packaging of fish and fish products

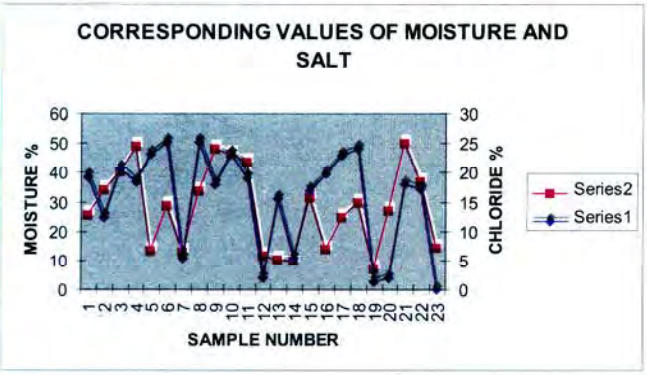
Effect of carbon dioxide on storage life of dry ribbon fish was studied. Two lots of ribbon fish samples were dried, one with salt and other without salt. From each lot, half of the sample was packed in carbon dioxide and a control was kept, which was packed in air. It was found that the sample packed in carbon dioxide had better keeping quality and better organoleptic as well as chemical qualities on storage at room temperature.

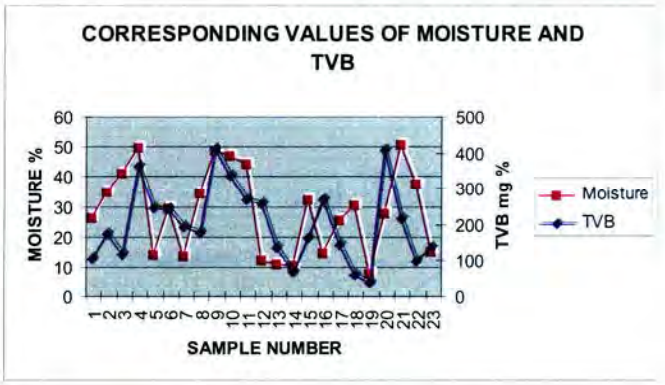
Packaged dry fish sold through supermarkets in Calicut city

Periodical collection of samples of salted/dried fish sold from various supermarkets in the city under different brand names and assessment of their quality was continued.

During the period, 23 samples as detailed below, were collected and analyzed for organoleptic, chemical, bacteriological and mycological parameters. These products were branded as: Grace Marine Foods, Cochin-5, Be Sea Foods, Calicut-20, C-Boat, Calicut-21, Alappat Food Products, Cochin-25, Venad Food Products, Kollam and Ocean Marine Foods, Cochin-5.

Sole	2	Jew Fish	1
Anchovies	2	*S. tumbil* (Bral)	1
Prawn	5	Mackerel	1
Shark	5	Pomfret	1
Silver Belly	4	Ray	1





Mycological characteristics

Type of fungi	Range of fungal load in the samples/g
Aspergillus sp.	0.10×10^2 - 1.10×10^3
Polypaecilum sp.	0.20×10^2 - 3.80×10^4
Penicillium sp.	Nil - 2.00×10^2
Rhizopus/Mucor	0.10×10^2 - 2.00×10^2

Improvements in traditional salting of sardine

Trials on hygienic salting of sardines were continued. The self-brine formed was allowed to drain off continuously while the top surface remained covered with salt. The samples remained in good condition for more than 45 days. The chemical and bacteriological characteristics of the samples were evaluated periodically.

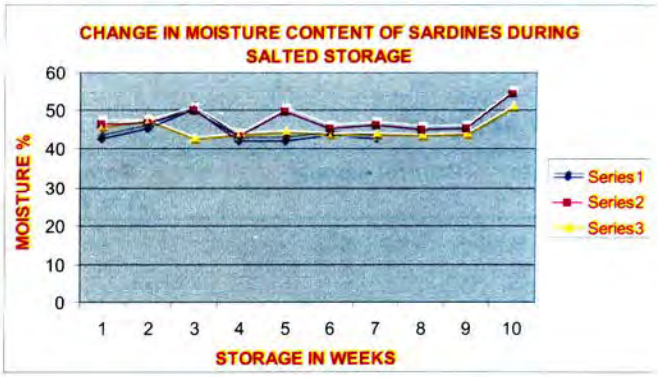
Three different trials were conducted:

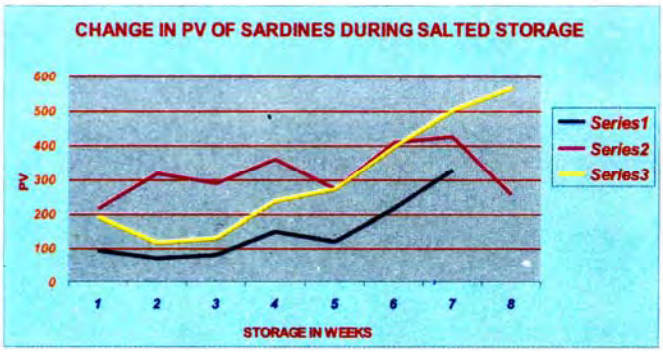
1) Incorporating Ascorbic acid in the ratio 1:2.

2) Incorporating fresh ginger extract at 2.5 % level in the dipping bath, before salting, in the ratio 1:2.

3) Incorporating turmeric extract at 2.5 % level in the dipping bath, before salting, in the ratio 1:2.

Typical chemical characteristics during salted storage were as follows:





(Values of PV are found to be lower in ascorbic acid treated samples. However, a steady upward trend is shown towards the end of the storage period. PV in ginger extract treated sample remains almost at a steady level throughout while that in turmeric extract treated samples, it shows a steady increase. TVB values were found to be lowest in samples treated with ginger extract).

Another experiment with four different trials was conducted as follows:

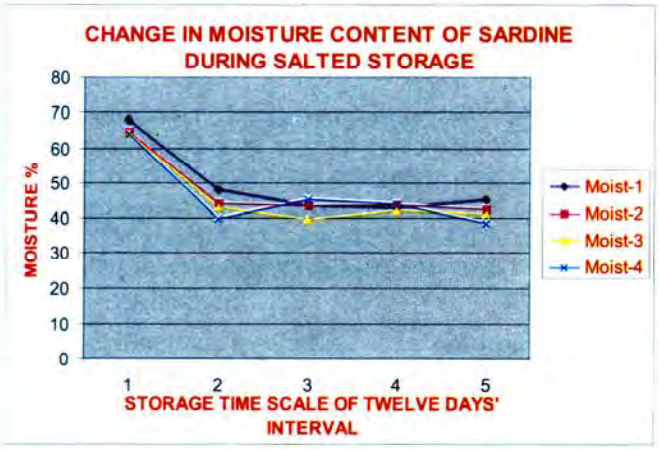
1) Incorporating 0.5 % Ascorbic acid as an antioxidant through dip-treatment (20 min.) of the dressed sardine before salting, in the ratio 1:2.

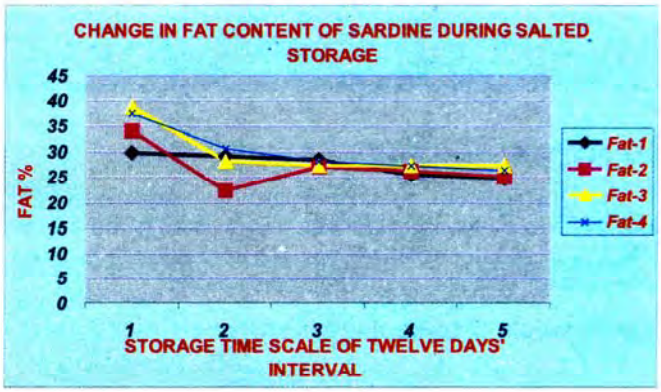
2) Incorporating fresh ginger extract at 2.5 % level in the bath for dip-treatment (20 min.) before salting, in the ratio 1:2.

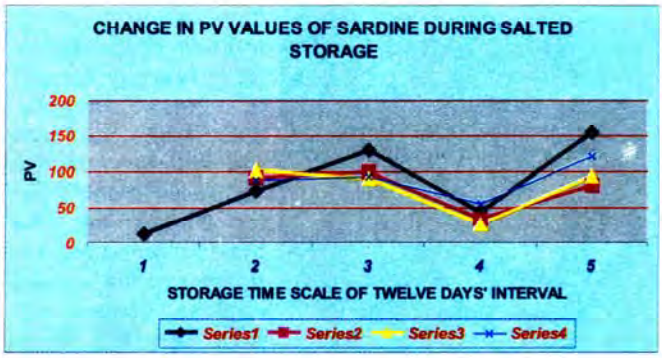
3) Incorporating turmeric extract at 2.5 % level in the bath for dip-treatment (20 min.) before salting, in the ratio 1:2.

4) Incorporating 0.2 % Ascorbic acid, 2 % ginger extract and 2 % turmeric extract in the bath for dip-treatment (20 min.) before salting, in the ratio 1:2.

Typical chemical characteristics of the samples are as follows:







(Moisture and fat contents of all the samples show similar trend during the storage while PV is lowest in samples treated with ginger extract and turmeric extract. Combined treatment, as well as Ascorbic acid treatment is not seen to be very effective).

Survey of mechanized fishing trawlers

Four major landing centers in Calicut district, namely, Beypore, Puthiyappa, Koilandy and Chombal, were surveyed for collection of data on fuel consumption. The work was carried out as part of the Project; 'Development of statistical models for evaluating the economic viability of mechanized fishing trawlers'.

Assessment of harvest and post-harvest losses - Marine Fisheries (NATP)

Data were collected on fishing craft operations based at Puthiyappa Fishing Harbour and also on fish curing activities at Puthiyappa and Vellayil curing centers and the data sent to the Principal Investigator on monthly basis.

The collection of data concluded by the end of February 2003.

Survey on fuel utilization pattern

Survey was carried out of the landing centers at Ponnani, Tirur, Beypore, Puthiyappa, Koilandy and Mahe in connection with the studies on the Project; 'A study on the fuel utilization pattern by the fishing industry in India' and data collected on the country crafts operating at these centers.

Transfer of Technology Programmes

ToT programmes at NEH

A training-cum-demonstration on fish processing and fish utilization was organized at Assam during the period 6-13 March 2003 in which 28 trainees consisting of fisheries development officials and NGOs participated.

Identification of technology needs

A tour was also undertaken to Tripura, Meghalaya, Assam and Sikkim during the period 16-26 September 2003 to finalise programmes on technology transfer in these regions, discussions held with the officials of the respective State Fisheries Department and the technologies for transfer at the various centres identified. Arrangements were made with CIFRI, Guwahati to print publications on some of the technologies developed in different languages such as Bengali, Assamese, Nepali and Khasi for distribution in the NEH region.

Fish being readied for salting-Training programme at Guwahati

On the basis of the discussions held with the concerned State Fisheries Dept. officials, a team from the Institute again visited Assam and Meghalaya and organised training programmes on preparation of value added products such as fish pickle, fish cutlet, fish fingers, fish balls and fish ensilage from fish waste.

The training programmes were conducted at Shillong in Meghalaya during 2-5 December 2003 and at Amranga, 35 kms away from Guwahati, Assam during 7-10 December 2003. Sixteen participants attended the training at Shillong and twenty eight at Amranga.

Visits were made to Jagirod Dry Fish Market at Assam, one of the biggest dry fish markets in South East Asia, to assess the quality of the products sold there.

Discussions were also carried out with the Joint Director, Dept. of Fisheries, Kolkata to work out possibilities for holding quality awareness training programmes in fish curing and production of good quality dry fish which will go a long way in improving the quality of dry fish at the production stage, thereby reducing to a great extent the percentage of inferior quality products reaching Jagirod market and other dry fish markets in NEH region.

A general view of the dry fish market at Jagirod, Assam

In addition to the above, officials from the States of Arunachal Pradesh, Assam, Meghalaya and Sikkim and students from the College of Fisheries, Central Agricultural University,Tripura were given training in Fisheries Technology in general at the Institute's Headquarters at Cochin during the year.

Interaction with dry fish traders - Dry fish market at Jagirod

Village adoption programmes

Periodic visits were made to the Sutrapada village near Veraval for technology transfer on improvement in fish handling practices, drying for internal and export market, sanitation and hygiene etc. Demonstration was carried out on rack drying of fish and improvement of quality of the dried fish. Technical literature in Gujarati was also distributed to the participants.

Project preparation

At a 'Focus a village' programme launched by the South Indian Bank for upliftment of the rural poor in connection with its Platinum Jubilee celebrations at Chellanam on 12 July 2003, the Institute assisted in preparation of two projects for the Matsya Mahila Vedi, a fisherwomen society, viz.

1. Fabrication of fishing nets
2. Utilization of fish waste

Training Programmes Conducted

Sl. No.	Subject	Participants	Venue and Date
1	Preparation of fish/prawn pickle	10 fisherwomen sponsored by Dist. Fishermen Youth Welfare Association (DFYWA), Pedagantyada	Moolapalem Fishermen Colony, Visakhapatnam 6 January 2003
2	Microbiological investigation methods	9 PG students	Cochin 6 January - 6 February 2003
3	Fisheries technology	10 students from College of Fisheries, Tripura	Cochin 28 January - 10 February 2003
4	Preparation of fish pickle	4	Cochin 29 January 2003
5	Rigging and mounting of PA and PE gill nets, rigging of monolines and handlines (in association with Fisheries Dept., Lakshadweep)	24 trainees from different islands of Lakshadweep	Kavaratti 5 - 14 February 2003 Agatti 10 - 27 March 2003 (details given elsewhere)
6	Harvest and post harvest technology of freshwater fish (organized by Burla Research Centre in collaboration with Agricultural Technology Management Agency (ATMA), Sambalpur & State Fisheries Dept., Govt. of Orissa)	40 fisherwomen and fish traders of Dhankauda Block of Sambalpur Dist.	Sambalpur, Orissa 17-19 February 2003
7	Packaging of ready-to-eat fish curry in retortable pouches	1 trainee from CRI, Kasauli, Himachal Pradesh	Cochin 18 -28 February 2003
8	Fish processing and marketing	About 20 members of Women Self Help Groups nominated by Gandhi Smaraka Gramaseva Kendram, Alleppey	S.L. Puram, Alappuzha Dist. 20-21 February 2003
9	Preparation of fish wafers	32 members of Fish Workers' Development Agency, Puthuvypu	Cochin 27 February 2003
10	Quality control	1	Cochin 1-4 March 2003
11	Fish pickling, scientific method of drying fish and use of fish waste as manure	28 fisheries officials sponsored by Directorate of Fisheries, Govt. of Assam	Guwahati, Assam 6 - 13 March 2003
12	Fisheries technology	7 fisheries officials from Arunachal Pradesh, Meghalaya and Assam	Cochin 11 - 21 March 2003
13	Preparation of fish/prawn pickle	35 fisherwomen and rural youth	Pedajalaripeta village, Visakhapatnam 15 March 2003
14	Preparation of fish/prawn pickle	35 members from sixteen Women Self Help Groups	Mangamaripeta, Visakhapatnam 18 March 2003

Sl. No.	Subject	Participants	Venue and Date
15	Processing of diverse products from mussel meat	49 ladies sponsored by Agency for Devt. of Aquaculture in Kerala (ADAK)	Calicut 19 - 21 March 2003
16	Value added products, quality improvement, sanitation and hygiene	Fishermen	Goghala and Vanakbara 21 - 22 March 2003
17	Fabrication of square mesh cod ends	20 fishermen from Relliveedhi and Jalaripeta villages	Visakhapatnam 25 - 29 March 2003 (details given elsewhere)
18	Post harvest fish handling and improved fish curing	20 women participants - belonging to fishermen community from West Hill, Thoppayil, Pallikkandy and Kallai Beach	Calicut 25 - 29 March 2003
19	Value added products, quality improvement, sanitation and hygiene	Fishermen	Jaffarabad 26 March 2003
20	PCR techniques for detection of WSSV in post larvae of shrimps	15 MPEDA trainees	Cochin 26 March 2003
21	Production of value added fish products	14 participants - sponsored by Nayarambalam Panchayat	Nayarambalam 26 - 28 March 2003
22	Use of multi-mesh gill nets; advances in line fishing and purse seining; use of artificial baits	Fishermen	Artisanal fishing villages - Sutrapada, Chorwad, Dhamlej, Miyani
23	Salting and drying of fish, reprocessing of commercial dry fish and value added products from fish and shell fish	8 women belonging to fishermen community (Sponsored by Malabar Federation of Fishermen Societies, West Hill, Calicut)	Calicut 3 - 5 April 2003
24	Fishery technology	1 official sponsored by Directorate of Fisheries, Sikkim	Cochin 16 - 26 April 2003
25	Quality control and identification of bacteria in fish and fishery products	1 participant sponsored by Livestock Products Inspecting Office, Ernakulam	Cochin 21 - 26 April 2003
26	Seafood quality assurance	3	Visakhapatnam 28 April - 12 May 2003
27	Preparation of fish/prawn pickle	2	Visakhapatnam 1 - 3 May 2003
28	Advanced microbiological and biotechnological methods	9	Cochin 5 May - 4 June 2003
29	Isolation and identification of pathogenic bacteria from foods	4	Cochin 5 - 31 May 2003
30	HACCP concepts	1	Cochin 12 - 17 May 2003
31	Isolation and identification of pathogenic bacteria from foods	2	Cochin 17 - 31 May 2003
32	Biochemical analysis of fish	3	Cochin 19 - 31 May 2003
33	PCR techniques for detection of WSSV in PL of shrimp	15 Trainees from MPEDA	Cochin 25 May 2003
34	Production of value added fish products	20 women sponsored by Gandhi Smaraka Gramaseva Kendram, S.L. Puram, Alappuzha	S.L. Puram, Alappuzha Dist. 28 - 29 May 2003

Processing of diverse products from mussel meat - at Calicut

Square mesh cod ends - at Visakhapatnam

Post harvest handling and improved fish curing - at Calicut

Inauguration of programme on Post harvest fish handling - at Calicut

Training on Post harvest fish handling in progress - at Calicut

Salting and drying of fish, reprocessing of commercial dry fish and value added products from fish and shell fish - at Calicut

Sl. No.	Subject	No. of participants	Venue and Date
35	Seafood quality assurance	11	Visakhapatnam 31 May - 13 June 2003
36	HACCP concepts	1	Cochin 2 - 6 June 2003
37	Biochemical analysis of fish	1	Cochin 2 - 13 June 2003
38	Fabrication and assembling of square mesh cod end (in collaboration with State Fisheries Dept.)		Veraval 12 - 13 June 2003
39	Seafood quality assurance	12	Cochin 16 - 27 June 2003
40	Use of electronic equipments in fishing (in collaboration with MPEDA)		Okha 16 June 2003
41	Use of electronic equipments in fishing (in collaboration with MPEDA)		Dwaraka 17 June 2003
42	Improved traditional fish processing methods	30 fisherwomen sponsored by DRDA, Srikakulam	TTDC, Etcherla, Srikakulam Dist. 9 - 10 July 2003 (details given elsewhere)
43	Preparation of fish/prawn pickle	1	Visakhapatnam 1 - 2 August 2003
44	Laboratory techniques for microbiological examination of fish and fishery products	9 SRFs selected under a Network project	Cochin 1 - 16 August 2003
45	Analysis of pesticides and heavy metals in fish and fishery products	5 SRFs selected under a Network project	Cochin 1 - 16 August 2003
46	Production of value added fish products	10 participants sponsored by Sandhya Devt. Society, Kodumpidy P.O., Pala, Kottayam	Cochin 21 - 22 August 2003
47	Biochemical analysis of fish	5	Cochin 22 - 26 August 2003
48	HACCP concepts	5	Cochin 27 August - 2 September 2003
49	Handling of fish and shellfish and preparation of value added fish products	25 coastal fisherwomen	Aroor 29 - 30 August 2003
50	Pickles from fish and shell fish	1	Calicut 2 - 4 September 2003
51	Salting and drying of fish and reprocessing of commercial dry fish	1	Calicut 2 - 4 September 2003
52	Dry fish processing	1	Visakhapatnam 8 - 10 September 2003
53	Laboratory techniques for microbiological examination of seafoods	6	Cochin 15 - 27 September 2003
54	Microbiological and ELISA methods for assay of antibiotic residues in seafood	2	Cochin 22 - 25 September 2003

Practical demonstration of framed gill net at Gobind Sagar

Seafood quality assurance - at Cochin

Production of value added fish products - at Cochin

Fabrication of square mesh cod end - at Kannur

Demonstration on value added products in Kasunda fishing village, Sambalpur Dist.

On board demonstration on fish harvest technology - at Burla

Sl. No.	Subject	No. of participants	Venue and Date
55	PCR techniques for detection of white spot syndrome virus in shrimp larvae	1	Cochin 23 - 24 September 2003
56	Microbiological analysis of seafoods	10 officials sponsored by Export Inspection Council, New Delhi	Cochin 20 - 25 October 2003
57	Seafood quality assurance	1 - sponsored by M/s.Sara Spices, Kizhakkambalam	Cochin 3 - 15 November 2003
58	Fabrication of square mesh cod end (in collaboration with Matsyafed Dist. Office, Kannur)	12 fishermen	Mapilla Bay, Kannur (Fishermen Training Centre) 4 - 5 November 2003
59	Salting and drying of fish and reprocessing of commercial dry fish	1	Calicut 26 - 28 November 2003
60	Fish harvest and post-harvest technology	Fishermen	Rengali & Kasunda fishing villages of Sambalpur Dist., Orissa 20 - 21 November 2003
61	Production of value added fish products and fish ensilage	16	Shillong 2 - 5 December 2003
62	Laboratory techniques for microbiological examination of seafoods	5	Visakhapatnam 3 - 18 December 2003
63	Processing ready-to-serve fish products in retortable pouches	Technologists from Forstar Frozen Products, Mumbai	Cochin One week in December 2003
64	Processing ready-to-serve fish products in retortable pouches	Technologists from M/s. Britto Exports, Chennai	Cochin One week in December 2003
65	Harvest and post-harvest technology aspects of freshwater fish	32 fishermen representing different blocks of the district	Balasore Dist., Himachal Pradesh 6 - 9 December 2003
66	Awareness on shrimp health management and related hazards of antibiotic residues in farmed shrimp	14 officials sponsored by Directorate of Fisheries, Govt. of Kerala	Cochin 8 - 9 December 2003
67	Production of value added fish products and fish ensilage	28	Amranga, Assam 7 - 10 December 2003
68	Seafood quality assurance	7	Cochin 8 - 20 December 2003
69	Salting and drying of fish and reprocessing of commercial dry fish	1	Calicut 10-12 December 2003
70	HACCP concepts	6 students	Visakhapatnam 15 - 22 December 2003
71	Demonstration on production of value added fish products	18 fisherpersons from Kochiwade fishing village	Mumbai 16 December 2003
72	Installation and operation of CIFT-TED in trawl nets (at meeting organized by MPEDA in collaboration with State Fisheries Dept. and Mechanised Fishing Boat Operators' Association)	35 trawler owners and operators	Sakthikulangara, Quilon 23 December 2003

Harvest and post harvest technology aspects of freshwater fish for fishermen of Himachal Pradesh - at Burla

Production of value added fish products - at Amranga, Assam

TED demonstration programme - at Kakadweep in West Bengal

Preparation of fish fingers - at Guwahati

Trainees of Assam with resource persons

Fisheries Technology - at Cochin

Orientation training programme

An orientation training programme for 14 SRFs under a Network Project `National Risk Assessment Programme for Fish and Fish Products for Domestic and International Markets' was inaugurated by Dr. K. Gopakumar, former DDG (Fy), ICAR on 2 August 2003. Dr. K. Devadasan, Director, CIFT presided over the function.

The programme is being implemented through seven Research Institutes of ICAR and Fisheries College, Mangalore and covers the States of Gujarat, Maharashtra, Karnataka and Kerala on the west coast, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal on the east coast and Uttar Pradesh. Hazards and risks in capture and culture of fish and shell fish from both marine and inland sources, with particular reference to the seafood exported to EU, USA and Japan will be investigated. Dr. P.K. Surendran, Head, Microbiology, Fermentation & Biotechnology is the Principal Investigatcr and National Nodal Officer of the project. Duration of the project is 3 years.

Island Development Programme

Training on diversified fishing methods at Lakshadweep

A training programme on diversified fishing methods - monolines and high sea gill nets - was imparted to 24 fishermen trainees from different islands viz., Kavaratti, Agatti, Minicoy, Kadamath, Kalpeni, Amini and Chetlet of Lakshadweep from 5 to 14 February 2003 at Kavaratti and from 10 to 27 March 2003 at Agatti. The programmes were organised under the auspices of Director of Fisheries, Lakshadweep on board their 32' vessels, LACFISH-4 and LACFISH-6. The training programme was inaugurated by Shri. Sandeep Kumar, Collector-cum-Development Commissioner, U.T. of Lakshadweep Administration. Shri. Benjamin Verghese, Director of Fisheries, Lakshadweep, stressed the importance of diversified fishing techniques in the islands.

Set long lines yielded good catch of perches and other varieties of coral fishes. A hooking rate of 50% was obtained. Nylon and HDPE gill nets of different mesh sizes were operated during the programme. Skipjack tuna was caught in both the gill nets having mesh size 120 mm. Hand lines were also operated using octopus baits. Fishing operation with hand lines also yielded good catches. Fishing experiments are to be continued at Lakshadweep during the ensuing fishing season.

Trainees of Agatti island

Training on square mesh cod ends

A training programme on 'Square mesh cod ends' was organized by the Institute under the NATP scheme at its Research Centre at Visakhapatnam from 25 to 29 March, 2003. A batch of 20 fishermen from Relliveedhi and Jalaripeta villages in Visakhapatnam district participated in the programme. Lectures were delivered by invited dignitaries on topics such as 'Deteriorating environment', 'Dwindling resources of sea', 'By-catch: commercially important species' and 'Importance and impact of using square mesh cod ends'. During the five days programme, practical demonstration was conducted and skill imparted on fabrication/mending and cutting pattern of various sizes of square mesh cod ends.

Training programme on improved traditional fish processing methods

A training programme on improved traditional fish processing methods for capacity building of fisherwomen under the Special Project on Development of Marine Fisheries, sponsored by DRDA, Srikakulam was conducted on 9 and 10 July 2003 at TTDC, Etcherla, Srikakulam District.

Theoretical and practical aspects of basic principles of general hygiene and sanitation, hygienic handling and storing of fish, curing and rack drying of fish were dealt in the local language. About thirty fisherwomen participated in the programme.

Training on improved traditional fish processing at Srikakulam

Foreign Training

Ms. Proserfina R. Reyno, Chief, Post Harvest Technology Section, Bureau of Fisheries & Aquatic Resources, Republic of Philippines, sponsored under Colombo Plan, was trained in HACCP concepts in seafood processing during the period 3 - 15 November 2003.

Ms. Proserfina R. Reyno undergoing training

Technologies Assessed and Transferred

- Designs of wooden fishing vessels in the size range of 7.6 m - 15.2 m
- Designs of steel fishing vessels of size 15.5 m, 20 m and 24 m OAL
- Design of an 18 m steel trawler, developed as part of the consultancy offered by Ministry of Agriculture, Govt. of India, provided to a private entrepreneur on trial basis. Construction of vessel completed with technical assistance of CIFT
- Designs 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 and formulation of indigenous preservatives for traditional fishing crafts
- Painting schedules for aluminium magnesium alloy and FRP sheathing for underwater hulls of fishing vessels
- Development of toxic wood plastic composites (TWPC)
- Antifouling and anticorrosive paints for protection of fishing crafts
- Mercury free anodes for cathodic protection of fishing crafts
- Protective coating for cast iron propeller
- Specifications for different types of synthetic materials for fabrication of different types of fishing gears
- Designs of different types of fishing gears 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 cod end and fish eye for reduction of by-catch, especially 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 and electrical fish dryer for cottage scale operation
- Designs of deep fat fryer, cutlet moulding machine, inboard/outboard drive, electro thermal smoke kiln, mechanized processing table and mechanical fish cleaner for sprats
- Fuel efficient propeller for fishing vessels
- Other fuel saving devices such as propeller nozzle
- Biogas plant from water hyacinth
- Fishing accessories including trawl winch, power-take-off clutch and gurdy
- Refrigerated sea water plant of 150 kg capacity
- Design of shark liver oil/fish oil plant to handle 1000 kg raw material per day
- Specific requirements in setting up fish processing plants
- 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 different types of fish and shell fish
- Hygienic drying of anchoviella on raised platform
- Cleaning schedules for fish processing establishments and boat decks and preparation of deodorant and antiseptic ointment
- 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/shell fish
- Ready-to-use isinglass from fish maws
- 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
- 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
- An 18 h depuration method to eradicate pathogenic bacteria and grit from bivalves, especially clams and mussels
- High gel strength agar from sea weeds
- Improved packaging materials for transportation and storage of fish
- Production of retort pouch packed fish products
- 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
- 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.
- Polymerase Chain Reaction (PCR) technique for detection of white spot disease syndrome in farmed shrimp
- Method for isolation of squalene from shark liver oil for use in cosmetics
- Method for preparation of n-3 polyunsaturated fatty acid concentrates from fish oils
- Device for drawing uniform samples from frozen fish blocks for microbiological evaluation

Outreach Programmes

Reply to technical queries

Queries received from various quarters of the country and abroad continued to be replied to. The queries received were mainly on topics related to training programmes, various aspects connected with fishing and fish processing, assistance in setting up production units etc.

Exhibitions

The Institute participated in the following exhibitions during the period:

- International Aqua Show 2003, Cochin, 29 December 2002 - 5 January 2003
- International Food Tech. - India 2003, Hyderabad, 1-4 February 2003
- First Indian Pearl Congress & Exposition, organized by CMFRI, Cochin, 5-8 February 2003
- Exhibition in connection with 48th Kisan Mela at Ankapalle, Visakhapatnam, 6-7 February 2003. The CIFT stall bagged the first prize
- India International Seafood Show, at Goa (organized by MPEDA & SEAI in association with Assn. of Indian Fishery Industries (AIFI) & Indian Shrimp Hatcheries Assn.), 7-9 February
- Exhibition in connection with Seminar on `Fishing and fish processing industries of Gujarat - Present status and future needs' at Veraval, 7 March 2003
- Exhibition held in connection with CHASIR BHET 2003 (Farmers' Meet 2003) held at Sambalpur, 3-5 April 2003
- Enterprises Kerala 2003 - Food Tech International Fair & Conference on Food Processing & Packaging, Thiruvananthapuram, 6-11 May 2003
- Exhibition in connection with International Symposium on Freshwater Prawns, Cochin, 21-23 August 2003
- Exhibition in connection with International Conference on Disease Management for Sustainable Fisheries, 2003 (ICON DMSF 2003), organized by Dept. of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram, 25-28 August 2003
- Exhibits sent to ICAR in connection with Ghana International Food & Agriculture Trade Fair (AFRIFEX-03), 11-17 November 2003
- Exhibition in connection with establishment of seafood quality monitoring faculty LC MS MS at Veraval Research Centre of CIFT and release of book `Sustainable fisheries development - Focus on Gujarat' by the Hon.Minister of State for Parliamentary Affairs & Tourism, GOI, Smt. Bhavanaben Chikhalia, 12 December 2003
- Exhibition in connection with launching of Kumbalangi Model Village Tourism Project at Kumbalangi, 26-28 December 2003

Radio talks

The following radio talks were broadcast during the period:

- Eco-friendly fishing (in Hindi) - Dr. K. Devadasan
- Trawling methods - Measures to be taken (in Telugu) - Dr. G. Rajeswari
- Fish - A nutritious food (in Hindi) - Dr. D. Imam Khasim

TV telecast

- Feature on fisherwomen - Dr. Krishna Srinath and Dr. Nikita Gopal

Dr. I.V. Sibba Rao, Vice-Chancellor, ANGRAU visiting the CIFT stall at 48th Kisan Mela

Shri. D. Veerabadhra Rao, former Minister & MLA, Anakapalle, visiting the CIFT stall at 48th Kisan Mela

Analytical Services

The Institute undertook testing samples of different types of raw materials and products received from various organisations, State and Central Govt. departments and entrepreneurs and issued reports on their quality. The samples tested during the year both at its Headquarters and Research Centres included fresh and frozen fish and shell fish products, by-products, salt, water, ice, packaging materials, prawn larvae from hatcheries, swabs from processing tables and workers' hands, chemicals, etc. A total of 2166 samples were tested during the year, besides twelve marine diesel engines. Calibration of 68 mercury, alcohol and digital thermometers was also carried out.

Postgraduate Programme in Post Harvest Technology

Officer-in-Charge : Dr. Jose Joseph
Member, P.G. Cell : Dr. T.V. Sankar
Personal Assistant : Shri. R.D. Goswami

All the 2001-2003 batch M.F.Sc. Post Harvest Technology students passed the examinations conducted in August 2003 by scoring an OGPA more than 8. The outgoing students are:

Shri. R. Yathavamoorthi
Kum. K. H. Sabeena Farvin
Shri. Subhasis Sil
Shri. Arun Kumar Mallick
Shri. A. Surendraraj

Shri. Subhasis Sil received the best student award.

The M.F.Sc. 2002-2004 batch students started their dissertation work in September 2003. The names of the students, area of research, name of the Guide and division to which each student is attached are given below:

Name of student	Title of research	Name of Guide & Division
1. Shri. F. Parthiban	Changes in the functional properties of tilapia myofibrillar protein during ice storage	Dr. T. V. Sankar, Biochemistry & Nutrition Division
2. Shri. S. Prasanna	Effect of high temperature processing on process time and quality factors in oil sardine (*Sardinella longiceps*) packed in oil and brine in polymer coated tin free steel can (TFS-Can)	Shri. P.K. Vijayan, Fish Processing Division
3. Kum. Sneha S. Simon	Studies on incidence of enterotoxigenic *Staphylococcus aureus* in fishery products and its antibiotic sensitivity	Dr. S. Sanjeev, Quality Assurance & Management Division
4. Shri. C.O. Mohan	Thermal processing of ready-to-serve 'prawn kuruma' in retortable pouches and aluminium cans	Dr. C.N. Ravishankar, Fish Processing Division
5. Shri. B. D. Kiran	Occurrence and spoilage potential of *Aeromonas* sp. in fresh fish and fishery products	Dr. Nirmala Thampuran, Microbiology, Fermentation & Biotechnology Division

The first batch of Ph. D. (2001-2004 batch) students are in their final semester and most of the students have completed more than 90% of their research work. Particulars of area of research, name of the Guide and division to which the students are attached are given below:

Name of student	Title of research	Name of Guide & Division
1. Shri. Jyotiranjan Nayak	Studies on the role of PUFA on transplantable tumor regression in mice model	Dr. P.G.Viswanathan Nair, Biochemistry & Nutrition Division
2. Smt. M. Rajalakshmi	Application of chitosan in fish processing	Dr. P.T. Mathew, Fish Processing Division
3. Shri. P. Yesudhason	Effect of modified atmosphere packaging on the shelf life of fish	Dr. T.K. Srinivasa Gopal, Fish Processing Division

4. Smt. Suseela Mathew	Influence of different protein sources, growth promoters, immuno-stimulants and attractants on diet digestibility and growth in cultured shrimp	Dr. K. Devadasan, Biochemistry & Nutrition Division
5. Shri. Patange Surendra	Studies on bacterial decarboxylase activity associated with spoilage of fish	Dr. M.K. Mukundan, Quality Assurance & Management Division

Two students of the above batch, viz. Shri. S. Thippeswami and Smt. K. Rekha Devi, left the Ph. D. programme temporarily. Shri. S. Thippeswami received a Swedish Fellowship for one year to work on fish ensilage at the Chalmers University of Technology, Gothenburg, Sweden while Smt. Rekha Devi joined the ARS.

Classes for the 2002-2005 batch Ph.D. students started from April 2003 onwards on the topics shown against their names.

Name of student	Title of research	Name of Guide & Division
Shri. C.S. Shine Kumar	Studies on the application of chitosan in clarification and purification of water	Dr. K.G.Ramachandran Nair, Fish Processing Division
Shri. Jiten Sarma	Studies on the effect of cryoprotectants in freshwater fish surimi during frozen storage.	Dr. Jose Joseph, Fish Processing Division

The following M. F. Sc. 2003-2005 and Ph. D. 2003-2006 batch students joined CIFT during the period:

M. F. Sc.

Shri. Chintu M. Raju
Kum. S. Tanuja
Shri. K.V. Anoop
Shri. I.P. Lakshmisha

Ph. D.

Kum. K.H. Sabeena Farvin
Shri. A.A. Zynudheen
Shri. A. Surendra Raj
Shri. Arun Kumar Mallick

Awards/Degrees/Recognitions

- Panjab Rao Deshmukh Woman Agricultural Scientist Award - 2002 instituted by ICAR, was conferred on **Dr. B. Meenakumari**, Head, Fishing Technology Division.

Dr. Rajnath Singh, Union Minister for Agriculture, presenting the woman scientist award to Dr. B. Meenakumari

- **Smt. K. Sobha,** T-5 was awarded Ph. D. in Official Language on the topic 'An analytical study of fisheries scientific and technical terminology in official language' from Sree Sankaracharya University of Sanskrit, Kalady.
- **Dr. M.M. Prasad,** Sr. Scientist received 'Outstanding' ranking in category of other than Hindi speaking states for presentation of paper 'Jalkrishi main sukshmajiviyon ki bhumika' (Role of micro-organisms in aquaculture) at National Seminar in Official Language on Aquatic environment and fisheries: Problems and solutions - CIFRI, Barrackpore, 23-24 February 2003.
- Poster entitled 'Study of variation in properties of chitosan prepared from squid pen and shrimp shell at different alkali concentrations' by **Santhosh, S., Sini, T.K.** and **Mathew, P.T.** bagged the third prize in the area of Animal Products at the 5th International Food Convention, IFCON 2003, held at Mysore during 5-8 December 2003.
- **Dr. M.K. Mukundan,** Head, Quality Assurance and Management Division and **Dr. K. Ashok Kumar,** Scientist (Sr. Scale) were certified as ISO 14000 Lead Auditors by Bureau of Indian Standards and Marsdon International, U.K. for auditing industrial units for compliance with ISO 14000.

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

- Agricultural Universities
- Ministry of Agriculture
- Ministry of Food Processing Industries
- Department of Ocean Development
- Department of Biotechnology
- Department of Science and Technology
- Department 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 Admn.

International Institutions

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

Extension and Development agencies

- Central Social Welfare Board
- Kannur Dist. SC/ST Women Industrial Fish Products Manufacturing Co-op. Society Ltd.
- South Indian Federation of Fishermen Societies, Trivandrum (SIFFS)
- Amala Mahila Samajam, Puthuvypu, Cochin
- AFPRD, Hyderabad
- Kanyakumari Dist. Fishermen Sangam's Federation
- Madonna Rural Development Society, Kumarakom
- Centre for Research and Training in Poverty Alleviation and Women Welfare (CRATPAW)
- Centre for Management Development, Trivandrum
- Bharat Sevak Samaj, Trivandrum
- Small Industries Development Bank of India (SIDBI)
- Matsya Mahila Vedi, Chellanam
- Alleppey Diocesan Charitable and Social Welfare Society, Alleppey
- 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 Corpn. Ltd., Trivandrum
- Chellanam Panchayat SC/ST Co-op. Society
- Fishermen Youth Welfare Association, Gangavaram, A.P.
- Development Action thRough Self Help Network (DARSHN)
- Agency for Development of Aquaculture in Kerala (ADAK)

On-going Research Projects

Institute Projects

1. Processing and product development from oceanic and deep sea fishes
2. Handling, processing and preservation of freshwater fish with special emphasis on transportation and improvement in traditional preservation techniques
3. Development of value added fishery by-products
4. Development and application of appropriate processing technologies for better utilization of marine and fresh water fishery resources of Gujarat
5. Technological studies on processing of freshwater and marine fish and shell fishes of east coast with special emphasis on product development and quality standards
6. Development of technology for processing fish and fishery products in appropriate packaging materials
7. Development of technology for packaging materials
8. Optimization of upgradation of traditional fishing system for inland and marine section
9. Studies on environment friendly high yielding semi pelagic trawls for exploitation of fishery resources of east coast
10. A study on fish marketing and socio-economics of NEH region
11. A study on the fuel utilization pattern by the fishing industry in India
12. Studies on materials protection and marine pollution
13. Environmental friendly feed for ornamental fishes (egg layers, live bearers and nest builders)
14. Isolation and utilization of bioactive substances from aquatic resources
15. Development of improved methods for quality and safety of fish and fishery products
16. Exploration of potential fishing zones (PFZ) of major reservoir systems
17. Toxicity induced stress on the metabolism of fish and distribution of toxic contaminants in fish and shell fish
18. Study on adoption of hygienic and disease preventive practices in small scale fisheries
19. Microbial ecology, seafood safety and molecular methods for pathogens and toxins
20. Post harvest technologies of freshwater fish in Orissa, adjoining states and NEH region
21. Chemical and microbiological evaluation of marine and inland fish and fishery products of Maharashtra
22. Design and development of eco-friendly fish dryers and indigenous electronic instruments for the Indian fisheries

ICAR Ad-hoc Projects

23. Isolation, characterization and immobilization of fish lipases for commercial applications
24. Development of eco-friendly technologies for the production of water soluble derivatives of chitin and biodegradable membranes from chitosan
25. Extraction of carotenoprotein and protein isolate from shrimp process waste-Development of an easy method and its scale up
26. Development of technology for processing fish and fish products in aluminium cans and flexible pouches
27. Studies on incidence of toxic principles and parasites in seafood

Department of Biotechnology Project

28. National risk assessment programme for fish and fish products for domestic and international markets - Microbiological and chemical risk assessment of marine and farmed fish and shell fish from the west and east coast of India

NATP

29. Development of value added products from low cost fish and procesing waste from fish and shell fish
30. Nutrition and pathology in Mariculture (Lead Centre - CMFRI)
31. International referral laboratory of fisheries technology
32. Mechanization and production of pearl nucleus (Sub project under NATP on Breeding and culture of pear loysters and production of pearls) (Lead Centre-CMFRI)
33. Assessment of harvest and post harvest losses in fisheries- Marine and inland fisheries (Lead Centre-IASRI)

Collaborative Project

34. Validation of IRS P4 OCM data with demersal fisheries (CIFT & SAC, Ahmedabad)

Externally Funded Project

35. Harvest technology and catch composition of deep sea fishery resources in the Indian EEZ (DOD funded)

Technical Guidance/Consultancy

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

Name of party	Consultancy offered/taken-up
M/s Forstar Frozen Foods P. Ltd., Mumbai	Production of ready-to-serve fish curry in retortable pouches
M/s Britto Exports, Chennai	Production of ready-to-serve fish curry in retortable pouches
M/s tqs International, Cochin	Technical advice and assistance relating to HACCP certification for fisheries and other food industries
M/s Sara Spices, Kizhakkambalam	HACCP implementation for fish curry and curry powder packing unit
M/s Abad Fisheries, Cochin	Setting up of 50,000 litre/day capacity effluent treatment plant
Name of party	**Technical guidance given**
Chellanam Panchayat SC/ST Services Co-op. Society	Technology for production of shrimp feed
M/s Sara Spices, Kizhakkambalam	Fresh fish quality evaluation
Kerala State Fisheries Department	Establishment of a diagnostic PCR laboratory at North Parur

Assistance relating to HACCP certification being handed over to M/s tqs International

Technology transfer on production of ready-to-serve fish curry to M/s Britto Exports

Committees

Grievance Cell

Chairman : Dr. K. Devadasan, Director, CIFT

Members

1. Dr. M.K. Mukundan,
   Acting Head, Division of QAM
2. Sr. Administrative Officer
3. Asst. Finance and Accounts Officer
4. Dr. T. K. Thankappan, Principal Scientist
5. Shri. P. A. Josi Augustine, T-4 (Technical)
6. Shri. R. Viswanathan, Assistant (Administrative)
7. Shri. T. A. Gopalakrishnan, Bearer (Auxiliary)
8. Shri. C. D. Parameswaran, SSG-III (Supporting)

Nominated Member Secretary

Shri. A. George Joseph, Asst. Admn. Officer

Research Advisory Committee

The Research Advisory Committee with the following members met on 10 July 2003.

Chairman

Prof N. Balakrishnan Nair
Retd. Chairman,
Dept. of Science and Technology
(Govt. of Kerala), Thiruvananthapuram

Members

1. Dr. Bongirwar
   Head, Dept. of Food Technology
   BARC, Mumbai
2. Shri. P.V. Prabhu,
   Retd. Principal Scientist, CIFT, Cochin
3. Dr. R. K. Baisya
   Professor,
   Dept. of Management Studies
   IIT, Hauz Khaz, New Delhi
4. Shri.Y. Sree Krishna,
   Retd. Principal Scientist,
   P.101, Vijay Park, Near Jangid Complex
   Meera Road (E), Maharashtra-401 102

Member Secretary

Dr. P. K. Surendran, Head, Division of MFB

Management Committee

The Committee met once on 20 March 2003.

Chairman : Dr. K. Devadasan, Director, CIFT

Members

1. Director of Fisheries
   Govt. of Kerala, Vikas Bhavan
   IVth Floor, Thiruvananthapuram-695 003
2. Director of Fisheries
   Govt. of Karnataka, Mahaveer Complex
   K.G. Road, Bangalore -9, Karnataka
3. Dr. D.D. Namboodiri,
   Dean,
   Faculty of Fisheries,
   Kerala Agricultural University,
   College of Fisheries,
   Panangad P.O., Kochi-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. Sunil Kumar Choudhry
   Narayani Bhavan
   Anugrah Narayan Road, Murarpur
   Gaya-893 001, Madhya Pradesh
6. Sr. Finance & Accounts Officer,
   CMFRI, Cochin-682 014
7. Dr. M.K. Mukundan,
   Acting Head, Division of QAM
8. Dr. K.G. Ramachandran Nair,
   Head, Division of F.P.
9. Dr. B. Meenakumari,
   Head, Division of F.T.
10. Dr. P.G. Viswanathan Nair,
    Head, Division of B&N

Member Secretary

Sr. Administrative Officer, CIFT, Cochin

Institute Joint Staff Council

Chairman : Dr. K. Devadasan, Director, CIFT

Members (Official Side)

1. Dr. M.K. Mukundan, Acting Head, QAM
2. Dr. Nirmala Thampuran, Principal Scientist
3. Dr. M.R. Boopendranath, Principal Scientist
4. Shri. Ravi Kumar, Sr. Administrative Officer
5. Shri. H. Ganesha, AF&AcO

Secretary (Official Side)

Shri. A. C.Joseph, Principal Scientist

Members (Staff Side)

1. Shri. C. Srihari Babu, Technical Officer (T-5)
2. Shri. P.S. Nobi, T-1-3
3. Shri. K. Das, LDC
4. Shri. V.S. Ambasuthan, UDC
5. Shri. M.M. Radhakrishnan, SSG-II
6. Smt. C.G. Radhamony, SSG-II

Secretary (Staff Side)

Shri. M.K. Kuttikrishnan Nair, Technical Officer (T-5)

Project Advisory Committee

Chairman : Dr. M.K. Mukundan, Acting Head, QAM / Dr. P.K. Surendran, Head, MFB

Members

1. Dr. K.G. Ramachandran Nair, Head, Division of F.P.
2. Dr. B. Meenakumari, Head, Division of F.T.
3. Dr. P.G. Viswanathan Nair, Head, Division of B&N
4. Dr. P.N. Joshi, Acting Head, Division of Engineering

Member Secretary

Dr. Krishna Srinath, Acting Head, Division of EIS

Visits Abroad

Dr. T.K. Srinivasa Gopal, Principal Scientist, Fish Processing Division, underwent training at the Department of Food Science, University of McGill, Canada, on modified atmosphere packaging (MAP) of fish during the period 20 February - 20 May 2003. He carried out studies on MAP of salmon steaks. The study has shown that salmon steaks stored under modified atmosphere containing 60% CO_2 and 40% nitrogen can be kept for a period of 19 days compared to 12 days in air. The extension of shelf life is due to minimal physical and chemical changes in MAP packs compared to air packed samples.

Dr. T.K. Srinivasa Gopal measuring the headspace gas in MAP salmon samples using MOCON Oxygen and Carbon dioxide analyser

ICAR Sports

The Institute participated in the ICAR Sports Tournament, Zone III held at Secunderabad during 3-7 November 2003. Smt. M.V. Valsala, the lone woman participant of the CIFT contingent, bagged the individual championship. She stood first in all the events in which she took part, viz. 100m race, 200m race, long jump and javelin throw.

Smt. M.V. Valsala receiving the individual championship trophy from Dr. Hegde, Director, CRIDA

Participation in Training Programmes

Sl. No.	Name(s) of participant(s)	Training attended	Venue and Date
1	Dr. G. Rajeswari (as faculty)	TED popularization/ demonstration programme (organized by MPEDA in collaboration with Dept. of Fisheries, Govt. of Orissa)	Dhamara, Astarang and Paradip in Orissa 13 - 17 March 2003
2	Dr. Krishna Srinath	Coastal zone management (organized by Dept. of Ocean Engg., Indian Institute of Technology, Chennai)	Chennai 17-19 March 2003
3	Dr. G. Rajeswari Dr. R. Raghu Prakash (as faculty)	Awareness programme on Diversification of crafts and gears in the mechanised fishing industry (organized by Dept. of Fisheries, Govt. of Andhra Pradesh)	Visakhapatnam 11 May 2003
4	Dr. R. Badonia Shri. U. Sreedhar	Development and management of coastal bio-resources	Veraval 20 - 22 May 2003
5	Shri. K. George Joseph (as faculty)	Mussel harvesting (organized by Agency for Development of Aquaculture, Kerala (ADAK), Calicut)	Korapuzha, Calicut 1 June 2003
6	Shri. S.P. Damle (as faculty)	Training for pre-processing and processing workers	MPEDA, Mumbai
7	Dr. G. Rajeswari Dr. R. Raghu Prakash (as faculty)	Awareness programme on Fish aggregating devices for the fishermen of Nellore district (organized by a NGO)	Visakhapatnam 4 June 2003
8	Shri. A. George Joseph	Improving administrative efficiency and financial management	NAARM, Hyderabad 17-24 June 2003
9	Dr. M.M. Prasad	HPLC-MS-MS	23 - 28 June 2003
10	Dr. B. Meenakumari, Dr. M.R. Boopendranath, Dr. Leela Edwin, Dr. Saly N. Thomas, Shri. P. Pravin, Shri. Prem Kumar, Shri. P. Muhamed Ashraf Shri. M. Baiju	Training in ERDAS 8 - 6 software used for geo-referencing, image processing and modelling	Cochin 30 June - 3 July 2003
11	Shri. B.K. Pradhan	Bathymetry system for hydrographic studies	Hirakud 2 July 2003
12	Dr. Toms C. Joseph (as faculty)	Ornamental freshwater fish breeding and rearing	Vallarpadam 4 July 2003
13	Shri. Prem Kumar	ERDAS IMAGING (Software on Remote sensing)	Cochin 1 - 5 August 2003

Sl. No.	Name(s) of participant(s)	Training attended	Venue and Date
14	Dr. Krishna Srinath (as faculty)	Gender issues and self development (organized by Income Tax Department, Cochin)	Cochin 5 August 2003
15	Shri. Sibasis Guha	Advances in videography and photography	NAARM, Hyderabad 26 August - 5 September 2003
16	Shri. Sibsankar Gupta Shri. A.K. Chattopadhyay Dr. B. Madhusudana Rao (as faculty)	Refresher training course for MPEDA officials (organized by MPEDA)	Visakhapatnam 27 - 28 August 2003
17	Dr. Krishna Srinath (as resource person)	Empowerment of fisherwomen (organized by CMFRI)	Aroor 28 August 2003
18	Shri. George Ninan Smt. J. Bindu (as faculty)	Handling of fish and shell fish and preparation of value added fish products (NAT programme of CMFRI)	Aroor 29 - 30 August 2003
19	Dr. M.K. Mukundan Dr. K. Ashok Kumar	ISO 14000 EMS Audit (organized by Marsdon International, U.K. and Bureau of Indian Standards)	Cochin 1 - 5 September 2003
20	Dr. R. Raghu Prakash (as faculty)	Demonstration on TED (organized by MPEDA)	Kakadweep and Digha (West Bengal) 16 - 17 October 2003
21	Smt. K.K. Asha Shri. Rakesh Kumar	Winter School on Recent advances in mariculture, genetics and biotechnology	CMFRI, Cochin 4 - 24 November 2003
22	Dr. T.K. Srinivasa Gopal	Recent developments in meat science and technology	Mysore November 2003
23	Dr. Toms C. Joseph	Agrobacterium mediated transformation	NRC on Plant Biotechnology, New Delhi 19 November - 6 December 2003
24	Dr. G.R. Unnithan (as resource person)	Marketing of crab - domestic and export (organized by MPEDA)	Cochin 5 December 2003
25	Shri. Prem Kumar	GIS application in agriculture	NAARM, Hyderabad 15 - 24 December 2003
26	Dr. P.K. Surendran	NABL accessor training course (organized by Dept. of Science & Technology)	CIPHET, Bhubaneswar 22 - 26 December 2003

Participation in Symposia/Seminars/Workshops etc.

Sl. No.	Name(s) of participant(s)	Symposia/seminar etc. attended	Venue and Date
1	Shri. A.C. Joseph	Entrepreneurship program (organised by Evangelical Social Action Forum, Trichur)	Trichur 2 January 2003
2	Shri. Sibsankar Gupta Dr. D. Imam Khasim	Meet on Globalization and EU standards - Impact on poor (organized by Coastal Management)	Visakhapatnam 23 - 24 January 2003
3	Dr. G.R. Unnithan Dr. Nikita Gopal	Identification of new research issues in the research front with respect to marine fisheries (in Hindi)	CMFRI, Cochin 30 - 31 January 2003
4	Dr. P.N. Joshi Shri. P. Muhamed Ashraf Shri. V.S. Manoj Shri. K.S. Maheswaran	First Indian Pearl Congress	CMFRI, Cochin 5-8 February 2003
5	Dr. P.T. Lakshmanan (as faculty)	Seminar on Recent advances in Chemistry and Biosciences (Sponsored by Sacred Heart College, Thevara)	Cochin 14 - 15 February 2003
6	Dr. M.K. Mukundan	Workshop on Food safety (organized by Confederation of Indian Industry on Food Safety)	Cochin 18 February 2003
7	Dr. R. Anandan	International Conference on Alternatives to the use of animals in research and education	New Delhi 18 - 20 February 2003
8	Shri. George Ninan Shri. M.S. Kumar	Workshop on Fishery management in lentic water systems - Stocking of reservoir with fish seed (organized by CIFRI, Barrackpore)	Jabalpur 19 - 20 February 2003
9	Shri. Sibsankar Gupta	Workshop on Implementation of welfare and development projects through NGOs with assistance of CAPART (organized by Dept. of Fisheries, Govt. of Andhra Pradesh)	Visakhapatnam 20 February 2003
10	Dr. K. Sobha (as faculty)	Workshop on Official language rules and regulations and administrative drafting	Spices Board, Cochin 20 - 21 February 2003
11	Dr. M.M. Prasad	Seminar on Aquatic environment and fisheries - Problems and solutions (in Hindi)	CIFRI, Barrackpore 23 - 24 February 2003
12	Shri. Sibsankar Gupta	Workshop on Development of Marine Fisheries of Orissa (organized by Fishery Survey of India, Visakhapatnam)	Gopalpur, Orissa 25 February 2003
13	Dr. P.T. Lakshmanan (as faculty)	Workshop on HACCP and SQS 2000 (sponsored by Confederation of Indian Industries)	Cochin 26 February 2003

Sl. No.	Name(s) of participant(s)	Symposia/seminar etc. attended	Venue and Date
14	Dr. B. Meenakumari	User Interaction Meet of National Remote Sensing Agency (organized by National Remote Sensing Agency, Hyderabad)	Hyderabad 26 - 27 February 2003
15	Shri. George Ninan Shri. P. Muhamed Ashraf	Seminar on Nuclear technology and safety: Expanding horizons (organized by Indian Institute of Chemical Engineers - Cochin Chapter and Dept. of Atomic Energy)	Cochin 27 February 2003
16	Shri. Sibsankar Gupta Dr. D. Imam Khasim Dr. R. Chakrabarti	Workshop on Controlling blowfly infestation in traditionally processed fish in Andhra Pradesh (organized by Integrated Coastal Management)	Kakinada 4 March 2003
17	Dr. B. Meenakumari Dr. P.T. Mathew Shri. P. George Mathai Shri. P. Pravin Shri. U. Sreedhar	Seminar on Fishing and fish processing industries of Gujarat - Present status and future needs (organized by CIFT and SOFT(I))	Veraval 7 March 2003
18	Shri. K. Santhosh Alex	Seminar on Harivansh Rai Bachen and his literary works (in Hindi)	Visakhapatnam 8 March 2003
19	Kum. O. Kavitha	National Conference on Aquaculture nutrition	CMFRI, Cochin 12 - 14 March 2003
20	Dr. K.G. Ramachandran Nair	Review Workshop of NATP Coastal Agro Ecosystems	CTCRI, Trivandrum 17 - 18 March 2003
21	Dr. Krishna Srinath	Workshop on Coastal Zone Management	IIT, Chennai 17 - 19 March 2003
22	Shri. S.S. Gupta Shri. K. Santhosh Alex	National Seminar on 'Hindi sahitya mein yudh ki prasangiktha'	Visakhapatnam 17 - 19 March 2003
23	Dr. Jessy Joseph Shri. P. Shankar Smt. G.N. Sarada	All India Official Language Seminar (conducted by Cochin Refineries)	Cochin 27 - 28 March 2003
24	Dr. K.V. Lalitha Dr. Toms C. Joseph Shri. Rakesh Kumar	National Seminar on Current trends in biotechnology and future prospects	CUSAT 4 - 5 April 2003
25	Dr. M.K. Mukundan Dr. K.G. Ramachandran Nair Dr. P.T. Mathew Shri. A.C. Joseph	Seminar on Resource generation from seafood waste	Aroor 30 April 2003
26	Smt. R. Thankamma	National Convention on Sexual harassment and gender justice (conducted by National Institute of Public Administration, Bangalore)	Bangalore 2 - 3 May 2003
27	Shri. A.C. Joseph	International Seminar on Food processing and packaging	Trivandrum 8 May 2003
28	Dr. Krishna Srinath	Seminar on Technology of and for the common man (organized by Swadeshi Science Movement)	CUSAT, Cochin 13 May 2003

Sl. No.	Name(s) of participant(s)	Symposia/seminar etc. attended	Venue and Date
29	Dr. R. Badonia Shri. U. Sreedhar	Workshop on Cluster-based project for upgradation and development of fish processing units	Ahmedabad 30 May 2003
30	Shri. K.P. Antony	Workshop on Marine fishery resources of Kerala (organized by Fishery Survey of India)	Ponnani 5 June 2003
31	Dr. P.K. Surendran	Workshop on Shrimp disease control (organized by ADAK and BFFDA)	Kumbalangi 13 June 2003
32	Dr. K. Sobha (as faculty)	Hindi Workshop for managerial and non-managerial staff of FACT, Alwaye	Cochin 18 June 2003
33	Dr. R. Badonia	Regional Conference of State Secretaries of Animal Husbandry, Dairy and Fisheries, Western States	Veraval 20 June 2003
34	Dr. K. Sobha (as faculty)	Hindi Workshop for managerial and non-managerial staff of Cochin Shipyard	Cochin 24 June 2003
35	Dr. Krishna Srinath	Workshop on Best practices in financial support for women in coastal fishing communities (organized by FAO and NABARD)	Goa 1 - 4 July 2003
36	Shri. V. Radhakrishnan Nair	Workshop on Overall development of Mattancherry area (organized by Cochin Corporation)	Cochin 4 July 2003
37	Dr. Krishna Srinath	'Focus a village' programme (launched by South Indian Bank in connection with its Platinum Jubilee celebrations)	Chellanam 12 July 2003
38	Dr. R. Badonia Shri. U. Sreedhar	Workshop on Towards sustainable fisheries in Gujarat	CMFRI, Veraval 14 July 2003
39	Dr. K. Sobha (as faculty)	Hindi Workshop for managerial and non-managerial staff of Office of Principal General Manager, Telecom	Cochin 16 July 2003
40	Shri. K. Santhosh Alex (as resource person)	Official Language Seminar	Visakhapatnam 24 July 2003
41	Dr. M.M. Prasad	National Seminar on Aquatic environment and fisheries : Problems and solutions (in Hindi)	CIFRI, Barrackpore
42	Dr. K. Devadasan	ICAR Directors' Conference	New Delhi 29 - 31 July 2003
43	Shri. Sibsankar Gupta Dr. B. Madhusudana Rao	Workshop on Control of antibiotic residues in aquaculture shrimps (organized by Export Inspection Council of India and Ministry of Commerce)	Visakhapatnam 12 August 2003
44	Dr. B. Meenakumari	Seminar on Co-learning approach on Responsible fisheries management (organised by MCITRA and CMFRI)	Calicut 13 - 14 August 2003

Sl. No.	Name(s) of participant(s)	Symposia/seminar etc. attended	Venue and Date
45	Dr. K. Sobha (as faculty)	Hindi Workshop for Section Officers of Spices Board on Official Language rules and acts	Cochin 13 - 14 August 2003
46	Dr. K. Devadasan Dr. P.K. Surendran Dr. Krishna Srinath Dr. K.G. Ramachandran Nair Dr. M.K. Mukundan Dr. K.V. Lalitha Dr. G.R. Unnithan Dr. P.T. Lakshmanan Dr. M.M. Prasad Dr. K. Ashok Kumar Shri. Prem Kumar Shri. P. Pravin Shri. A.A. Zynudheen Smt. J. Bindu Shri. George Ninan	International Symposium on Fresh water prawns, *Macrobrachium rosenbergii* (organized by College of Fisheries, Panangad)	Cochin 21 - 23 August 2003
47	Dr. P.K. Surendran Dr. B. Madhusudana Rao	Workshop on Priorities of research and human resource development in fisheries biotechnology (organized by National Academy of Agricultural Sciences)	Hyderabad 25 - 26 August 2003
48	Shri. U. Sreedhar	Workshop of collaborative agencies	Ahmedabad
49	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations Cochin Port Trust	Cochin 15 September 2003
50	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations Coir Board	Cochin 17 September 2003
51	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations BSNL	Cochin 20 September 2003
52	Dr. P.T. Lakshmanan	Seminar on HPLC - Total solution for analytical laboratories (sponsored by M/s. Waters India P. Ltd., Bangalore)	Cochin 23 September 2003
53	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations Income Tax Office	Cochin 24 September 2003
54	Dr. B. Meenakumari	National Seminar on Reef ecosystem remediation	SDMRI, Tuticorin 24 - 26 September 2003
55	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations MPEDA	Cochin 25 September 2003
56	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations Coconut Development Board	Cochin 25 September 2003
57	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations Income Tax Office	Cochin 26 September 2003
58	Dr. B. Meenakumari (as resource person)	Workshop organized in connection with 'World Space Week Celebrations 2003'	VSSC, Trivandrum 8 October 2003

Sl. No.	Name(s) of participant(s)	Symposia/seminar etc. attended	Venue and Date
59	Dr. T.K. Srinivasa Gopal	1st International Nutraceuticals Summit (organized by MMACTIV & CFTRI)	Mumbai 8 - 10 October 2003
60	Dr. Krishna Srinath	National Seminar on Social protection of fish processing workers (organized by Govt. of Kerala in association with Kerala Institute of Labour and Employment & Social Security Assn. of India)	Cochin 10 October 2003
61	Dr. K. Sobha (as judge)	Hindi Fortnight celebrations Coir Board	Cochin 14 October 2003
62	Dr. G. Rajeswari	Workshop on Use of TED and conservation efforts (joinly organized by the NGO Visakha Society for Prevention of Cruelty to Animals and Forest Dept., Govt. of Andhra Pradesh)	Visakhapatnam 18 October 2003
63	Dr. B. Meenakumari Dr. M.R. Boopendranath Shri. V. Vijayan Dr. Leela Edwin Dr. Saly N. Thomas Shri. P. Privin Dr. S.K. Panda Smt. Sandhya Sukumaran	Seminar on Indian marine fishing industry - Challenges and opportunities (organized by Garware Wall Ropes Ltd., Pune)	Cochin 22 October 2003
64	Dr. M.K. Mukundan (as resource person)	Workshop on HACCP and safety of packaged drinking water (organised by BIS, Trivandrum Branch)	Cochin 28 October 2003
65	Smt. K.K. Asha	Workshop on Current trends in forensic and clinical applications of biotechnology	AIMS, Cochin 1 November 2003
66	Dr. Krishna Srinath (Chaired session on Gender and Biodiversity)	Seminar on Agrobiodiversity (organized by M.S. Swaminathan Research Foundation Community Agrobiodiversity Centre, Kalpetta, in connection with 13th Swadeshi Science Congress)	Kalpetta, Wayanad 7 November 2003
67	Dr. Krishna Srinath Dr. G.R. Unnithan Dr. S. Balasubramaniam Smt. Mary Thomas Dr. V. Geethalakshmi Shri. J. Charles Jeeva	National Workshop on Methodologies for prioritization of fisheries research in India	NAARM, Hyderabad 10 - 11 November 2003
68	Dr. K.V. Lalitha	International Workshop on Water safety and water microbiology (organized by UNESCO MIRCEN for Marine Biotechnology and Dept. of Fishery Microbiology, UAS, College of Fisheries, Mangalore)	Mangalore 10 - 14 November 2003

Sl. No.	Name(s) of participant(s)	Symposia/seminar etc. attended	Venue and Date
69	Dr. G. Rajeswari Shri. J. Charles Jeeva	World Fisheries Day Celebrations (organized by a Network of NGOs)	Atchuthapuram, Visakhapatnam 21 November 2003
70	Dr. A.R.S. Menon	Workshop on Decentralized rural technologies (organised by Swadeshi Science Movement & CAPART)	Cochin 30 November - 1 December 2003
71	Dr. P.K. Surendran Dr. Nirmala Thampuran	Scientific Workshop held in commemoration of Sree Sankara College Golden Jubilee celebrations	Kalady 3 December 2003
72	Dr. T.K. Srinivasa Gopal Dr. P.T. Mathew Shri. A.K. Mallick Smt. Leema Jose Shri. S. Prasanna Shri. S. Santhosh Smt. T.K. Sini Shri. P. Yesudason	5th International Food Convention (IFCON-2003)	CFTRI, Mysore 5 - 8 December 2003
73	Dr. K. Sobha (as resource person)	Hindi Workshop, Cochin Shipyard Ltd.	Cochin 9 December 2003
74	Dr. S.K. Panda Shri. L. Narasimha Murthy	National Workshop on Strategies for fisheries development in the next decade (organized by Professional Fisheries Graduates Forum and College of Fisheries, Mangalore)	Mangalore 12 - 13 December 2003
75	Shri. M.V. Baiju	Seminar on Emerging challenges in national shipping ports and ships	Cochin 12 - 13 December 2003
76	Dr. K. Sobha (as resource person)	Hindi Workshop, Coir Board	Cochin 18 December 2003
77	Dr. M.K. Mukundan	Workshop on Safety of packaged drinking water (organized by Bureau of Indian Standards)	Cochin 18 December 2003
78	Shri. D.K. Garg Shri. S.P. Damle	National Seminar in Hindi on Fish processing - Present status and future prospects	CIFE, Mumbai 19 - 20 December 2003
79	Dr. S. Balasubramaniam	Workshop for Nodal Officers of ICAR Institutes on Video film production	NAARM, Hyderabad 26 - 27 December 2003
80	Shri. L. Narasimha Murthy Shri. V.R. Madhu	Workshop on Marine fisheries certification for sustainable fisheries management	Veraval 31 December 2003

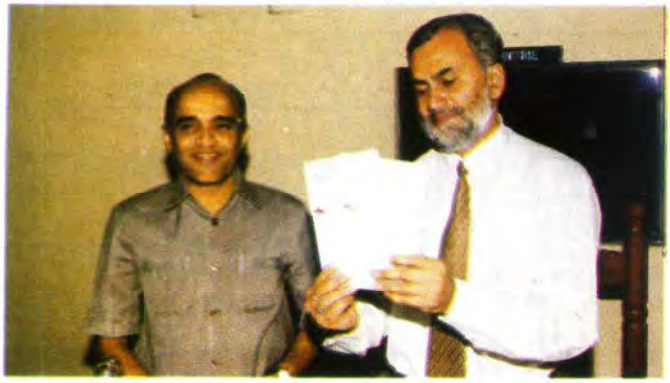
Special Days and Events

Release of publications

At a function organized on 6 February 2003, Dr. S.Z. Qasim, former Member, Planning Commission, formally released the following publications brought out by the Institute: 1) PCR technique for detection of white spot syndrome virus, and 2) Enzyme linked immunosorbant assay (ELISA) for Chloramphenicol residue in shrimp. The first copy of each was received by Dr. K. Gopakumar, former DDG (Fy), ICAR.

Dr. S. Z. Qasim releasing the publication on PCR technique

Publications on 'Synthetic fish netting yarns' and 'Trawling methods and designs of Saurashtra coast' were released by Dr. S. Ayyappan, DDG (Fy), ICAR at a function held at the Institute on 15 February 2003.



Dr. S. Ayyappan releasing the publication on Synthetic fish netting yarns

On 22 August 2003, Prof. K.V. Thomas, Hon'ble Minister for Fisheries and Tourism, Govt. of Kerala, released a book entitled 'Seafood safety' brought out by the Society of Fisheries Technologists (India) in association with CIFT. Shri. K. A. Kunjumoideen, Member, National Executive Committee, Seafood Exporters' Association of India received the first copy from the Hon'ble Minister. Dr. K. Devadasan, Director, CIFT and President, SOFT(I) presided over the function. Felicitations were offered by Dr. K. Gopakumar, former DDG (Fy), Dr. Mohan Joseph Modayil, Director, CMFRI and Dr. J. Bhojan, Director, MPEDA. Dr. P.K. Surendran, Convener of the Symposium on Seafood Safety held the previous year gave a brief description of the book for the benefit of the audience.

Prof. K.V. Thomas releasing the book on Seafood safety

National Science Day

The Institute Headquarters at Cochin celebrated National Science Day on 28 February 2003. A talk on DNA was delivered by Dr. P.K. Surendran for benefit of the students of Girls' High School, Ernakulam in keeping with the theme of the year '50 years of DNA - 25 years of IVF - the Blueprint of life'.

Visakhapatnam Centre observed the Day on 28 February 2003. The Centre was thrown open to the public and an exhibition was arranged in which photographs, charts and products developed at the Centre were displayed. The children and adults showed keen interest in the various extension and research activities of the Institute.

The Burla Research Centre also observed the Day on 28 February 2003. Lectures on post harvest fish handling, preservation and product development along scientific lines were arranged in which more than fifty students of a local school, accompanied by their staff, participated. An exhibition was also organized.

'National Science Day' - Visit of school children to the Visakhapatnam Centre

National Science Day celebrations at Burla

Launching of vessel

A new generation fuel efficient, deep sea multi-purpose fishing vessel CIFTECH-1 (15.5m OAL) with optimal features in hull design to achieve reduced resistance and a propeller designed to reduce hydro-dynamic losses acquired for the Visakhapatnam Centre, after MMD registration and certification for LSA, FFA and LSS, was made operational during the year under report.

National Seminar

A National Seminar on 'Fishing and fish processing industries of Gujarat - Present status and future needs' was held at Veraval on 7 March 2003 under the joint auspices of the Veraval Research Centre of CIFT and SOFT(I). Dr. K. Devadasan, Director, CIFT presided over the function. Dr. Mohan Joseph Modayil, Director, CMFRI inaugurated the function which was presided over by Dr. K. Devadasan. Felicitation was offered by Shri. K.P. Thomas, President, SEA of India, Gujarat region.

Inaugural function of seminar

Farmers' Meet

The Burla Research Centre participated in the CHASIR BHET 2003 (Farmers Meet 2003) held at the premises of Agricultural Technology Management Agency (ATMA), Sambalpur during 3-5 April 2003. The exhibition stall was visited by more than 500 farmers from different regions of Western Orissa and consumer opinion on the value added products developed at the Centre collected. More than 95% of the respondents scored excellent in sensory evaluation of fish pickles and wafers.

Farmers Meet at ATMA, Sambalpur

A Farmers' Meet was also held at the Institute's Headquarters at Cochin on 5 September 2003 in which ten farmers participated. Discussions were held with concerned scientists on various problems faced by them in prawn culture, fish disease, use of PCR kit etc.

One day Seminar

A one day Seminar on Resource generation from seafood waste was organized by CIFT at Aroor on 23 April 2003 as part of NATP on Development of value added products from low cost fish and processing waste from fish and shell fish, in association with Aroor Industries Association.

Dr. K. Devadasan inaugurating the seminar

Inauguration of ATIC

The Agricultural Technology Information Centre (ATIC) of CIFT was formally inaugurated on 26 April 2003 by Dr. Mangala Rai, Secretary, DARE & Director General, ICAR. The function was attended by Dr. S. Ayyappan, DDG (Fy), ICAR, Dr. K. Gopakumar, former DDG (Fy) and Shri. Abraham J. Tharakan, President, Seafood Exporters' Association & Vice Chairman, MPEDA. A book entitled 'Fish canning - Principles and practices', written by Shri. K.K. Balachandran, retired Pr. Scientist of the Institute, was released on the occasion.

Dr. Mangala Rai inaugurating ATIC

Dr. Mangala Rai releasing the book on Fish canning - Principles and practices

Dr. S. Ayyappan releasing ATIC Newsletter

Release of device for measuring mesh size

A simple device for easy measurement of mesh size of trawls and gill nets designed at the Veraval Research Centre of CIFT was formally released at a function held at the Centre on 13 June 2003. Shri. Vipul Mitra, IAS, Fisheries Commissioner, Govt. of Gujarat, was the Chief Guest.

The device is handy and portable, is made of steel and facilitates accurate measurement.

Shri. Vipul Mitra, I.A.S. releasing the mesh size measuring device

World Environment Day

The Institute celebrated World Environment Day on 23 June 2003 by organizing a seminar-cum-demonstration programme on Production of fish ensilage from fish waste. The programme was organized at Govt. U.P. School, Azheekkal. More than 100 school children were appraised of the useful ways of converting fish waste into useful fish ensilage for incorporation in poultry feed. Dr. K. Devadasan, Director, CIFT presided over the function which was, inaugurated by Smt. R.C. Roselin, President, Elamkunnapuzha Grama Panchayat. Felicitation was offered by Shri. James Sebastian, Member, Elamkunnapuzha Grama Panchayat. Dr. K.G. Ramachandran Nair, Head, Fish Processing Division and Shri. K.P. Antony, Pr. Scientist delivered the technical talks. Dr. P.T. Mathew, Pr. Scientist, demonstrated the preparation of fish ensilage from fish waste.

Dr. K. Devadasan delivering presidential address at World Environment Day celebrations

Inauguration of a production unit

A small scale unit for production of silage from cuttlefish waste was inaugurated at Thycattussery in Alappuzha district on 30 August 2003. A demonstration on the method of production was also held for the benefit of the participants.

Special Fish Farmers' Day

Special Fish Farmers' Day was jointly celebrated on 15 July 2003 at Poyya Fish Farm (Trichur dist.) by CIFT, CMFRI, State Fisheries Dept. and organisations such as Fish Farmers' Devt. Agency (FFDA), Brackishwater Fish Farmers' Devt. Agency (BFFDA) and Agency for Devt. of Aquaculture in Kerala (ADAK). Panel discussion on the topic 'Fish farming - disease and prevention' was held in which more than 100 fish farmers actively participated. Dr. K. Devadasan, Director, CIFT presided over the function which was inaugurated by Smt. T. Radhamoni, President, Poyya Grama Panchayat. Dr. Mohan Joseph Modayil, Director, CMFRI delivered the Key-note address. Dr. Krishna Srinath, Acting Head, Extension Division, CIFT welcomed the gathering and Shri. K.B. Shaji, Joint Director of Fisheries proposed vote of thanks. Dr. M.P. Dileep, Director, National Institute of Fisheries Admn. & Resource Management served as moderator and Dr. Toms C. Joseph, Scientist as panel member.

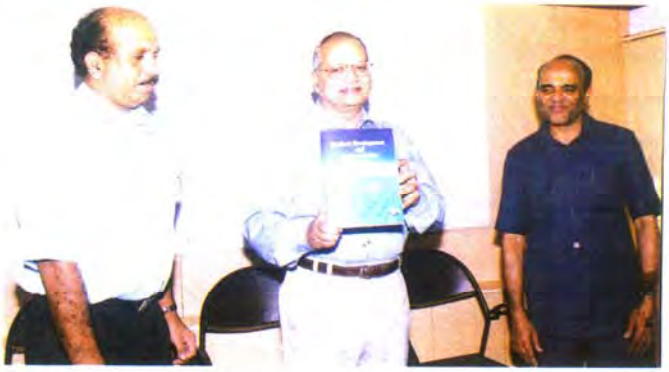
Dr. Krishna Srinath speaking at Special Fish Farmers' Day celebrations

Winter School

A Winter School on Product development and seafood safety was held at the Institute from 11 November - 10 December 2003 in which 25 candidates from various Research Institutes, Universities and colleges in Kerala, Tamil Nadu, Karnataka, Maharashtra and Uttaranchal participated. Dr. P.T. Mathew was the Director of the Winter School. The School was inaugurated on 11 November 2003 by Shri. Gyanesh Kumar, IAS, Dist. Collector, Ernakulam. Dr. K. Devadasan, Director, CIFT presided over the function. Felicitations were offered by Shri. Karamchand, Jt. Director, EIA, Cochin and Dr. Saleena Mathew, Professor, Industrial Fisheries, CUSAT.

Participants of Winter School with faculty members

A manual entitled 'Product development and seafood safety' brought out in connection with the Winter School was released by Dr. Sawant, ASRB Member on 22 November 2003.



Dr. Sawant releasing the manual on Product development and seafood safety

Women in Agriculture Day

The Women in Agriculture Day was celebrated at Ezhupunna on 4 December 2003 in association with Kudumbasri Unit of Ezhupunna. Talks were delivered on the nutritional aspects of fish and preparation of fish ensilage by Dr. P.G. Viswanathan Nair, Head, Biochemistry and Nutrition Division and Dr. K.G. Ramacandran Nair, Head, Fish Processing Division, respectively. Demonstration was also conducted on preparation of ensilage. Dr. K. Devadasan, Director, CIFT presided over the function. Shri. P.P. Thevan, President, Ezhupunna Grama Panchayat, inaugurated the programme.

Dr. K. Devadasan speaking at Women in Agriculture Day celebrations

Felicitations were offered by Smt. Mariam Vasu, Ezhupunna Panchayat Member and Shri. M.K. Jonappan, Standing Committee Chairman. Smt. Anees Raphael, Member, Kudumbasri Unit, Jyoti Group, Ezhupunna proposed the vote of thanks. Dr. Krishna Srinath welcomed the gathering. About 100 women participated in the programme.

The Visakhapatnam Research Centre observed 'Women in Agriculture Day' at Pedajalaripeta fishing village in Visakhapatnam district, on 4 December 2003 with the main aim of creating awareness about hygiene and sanitation among fisherwomen who have an important role in fish handling and marketing. The importance of hygienic handling of fish, rack drying of fish, preservation methods, preparation of value added products from low value fishes and eco-friendly waste disposal were explained to them.

An exhibition with display of photographs and charts on various aspects of fishing and fish processing and value added products prepared as per CIFT technologies was arranged as a part of the day. A good number of fisherwomen engaged in fish based activities in the landing centres/fish markets/pre-processing/processing units participated in the programme and showed keen interest in knowing about CIFT technologies, which could help them in additional income generation.

Quality monitoring facility dedicated

Smt. Bhavanaben Chikhalia, Hon. Minister of State for Parliamentary Affairs and Tourism, GOI, dedicated the sophisticated equipment LC MS MS (Liquid chromatograph - Mass spectrometer) acquired by the Veraval Research Centre of the Institute to the fisheries and food industry of Gujarat on 12 December 2003. The facility is installed mainly to support the export oriented food industries, particularly seafoods, and will serve to provide the much needed residue monitoring services to the industry as per EU norms. The Minister also released a book 'Sustainable fisheries development - Focus on Gujarat', brought out jointly by the Society of Fisheries Technologists (India) and CIFT, on the occasion.

Smt. Bhavanaben Chikhalia, releasing the publication on Sustainable fisheries development

Smt. Bhavanaben Chikhalia at LC MS MS Lab

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 as shown below:

1. Departmental Promotion Committee : 7 times
2. Departmental Selection Committee : Twice
3. Assessment Committee : 7 times
4. Placement Committee : Twice
5. Compassionate Appointment Committee : Twice

Staff position as on 31 December 2003

Category	Sanctioned	Filled
Scientific	101	72
Technical	173	143
Administrative	96	8 9
Supporting	120	85
Auxiliary	7	5
Total	**497**	**394**

Cases considered by the Departmental Promotion Committee

Category	Promotion	Declaration of probation	Confirmation	Assured Career Progression (ACP) Scheme
Scientific	8	-	-	-
Technical	7	4	6	
Administrative	12	3	3	4
Supporting	18	2	2	-
Auxiliary	-	-	-	-

Technical Section

During the reported period the Technical Section monitored the following technical matters of the Institute.

Compilation of Research Project Programmes document

The Research Project Programmes of the Institute for the year 2003-2004, comprising 7 new projects, 15 ongoing projects and summary of 7 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.

Preparation and submission of technical reports

Monthly report on the important activities of the Institute, significant research findings, training programmes, seminars/symposia/workshops etc. conducted and participated 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 monthly feed back to DG, ICAR

Monthly report on targets and achievements of plan/ non-plan expenditure, outstanding advances, infrastructural works carried out, research/development/technology, human resource development, extension activities and target for the following month are regularly compiled and furnished to ICAR through the software provided.

Further, six monthly targets and achievements of all the individual scientists of the Institute were furnished to Council during July and January.

Publication of scientific papers

The scientific papers including research notes, popular articles etc. for publication in journals and papers meant for presentation in 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.

Participation of Scientists in Seminars/Symposia/ Workshops/Short term training courses

Request 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 on 26 June 2003 to review the progress achieved in the ongoing research projects of the Institute for the year 2002-2003 and to discuss the research project proposals for the year 2003-2004. Dr. A. D. Diwan, ADG (M. Fy), ICAR, attended the meeting as Council's representative. Shri. V. Narayanan Nambiar, Principal Scientist, acted as the Member Secretary of the SRC.

Updating project files

Project Leaders' files of all the 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 quarterly Fish Technology Newsletter

Four issues of Fish Technology Newsletter (bilingual) were published during the period.

Other technical matters

The Technical Section answered queries on various technical matters received from other organisations and individuals. Besides, matters related to awards/fellowships/ tour reports of scientists etc. were also monitored. Further, material for ICAR News/ICAR Reporter/Agri-News/Fishing Chimes/MPEDA Newsletter/Sea Food News and the like were forwarded regularly, many of which have been published.

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

Official Language Implementation

In view of the status of Hindi as envisaged in the constitution, maximum work was done in Hindi in the Institute during the year.

Regular quarterly meetings were held under the Chairmanship of the Director. As per the decisions taken in the meetings, various programmes in Hindi like National seminars, creative writing camp, workshop for all categories of staff members, Chetana Mas, technical talks by eminent personalities from other organizations as well as from the Institute, radio talks, Doordarshan programmes etc. were arranged. Training for the CUSAT students in Official Language Management etc. were conducted. Active measures have been taken to get scientific and technical literature related to various divisions of the Institute written in Hindi and published.

In order to increase the capacity and versatility of the Hindi Language, promote better dissemination of information related to the activities of the Institute and motivate the staff to increasingly do their work in Hindi, as in the yester years, this year also a Hindi Scientific House Journal "Jaladhi" was published.

During the year, ICAR has sanctioned a Winter School- Short Course in Official Language on 'Harvest and Post Harvest Technologies for Marine and Inland Fishes of India' which was conducted during 25 August to 4 September 2003. It was for the first time in ICAR that such a course in Official Language was sanctioned and the credit goes to the Institute. Twentyfive participants from different states attended the course. Dr. K. Gopakumar, delivered the inaugural address and released the Short Course Manual. Since the participants were from different parts of India, the Short Course was also a stage for cultural amity. Though the programme was in Hindi the majority of faculty support was from the Institute itself from the non Hindi speaking personnel.

Parliamentary Standing Committee on Official Language inspected the Official Language implementation activities of the institute on 7 November 2003. They have expressed their happiness at the progress in the field of O.L. implementation by the Institute.

Chetana Mas celebrations


Dr. K. Gopakumar, former DDG (Fy), ICAR releasing 'Jaladhi'

Scientific/Technical Talks

Subject	Speaker	Venue & Date
Official Language and functional language (in Hindi)	Shri. A.K. Saxena Bharat Sanchar Nigam Ltd., Ernakulam	Cochin 18 January 2003
Visit to few European nations in connection with study of antibiotic residues in fish and fish products	Dr. P.K. Surendran CIFT, Cochin	Cochin 29 January 2003
Visit to Canada to attend training programme on 'Studies on fluctuation of oil sardine fishery of south west coast of India and application of remote sensing' at Halifax, Canada, under POGO-IOC-SCOR Fellowship	Dr. B. Meenakumari CIFT, Cochin	Cochin 29 January 2003
Pelagic resources of Visakhapatnam (in Hindi)	Dr. A.K.V. Naseer CMFRI, Cochin	Cochin 29 January 2003
Gandhian studies (in Hindi)	Dr. Apoorvanand Academic Secy. M.G. International University, Wardha	Cochin 21 February 2003

Library

Acquisition

The library purchased a total of 468 books during the year. It subscribed to 35 foreign and 38 Indian scientific periodicals during the period. 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(FHN) and IS on CD-ROM (Food and Agriculture; Textiles) have also been acquired. At present, the library holds 9,474 books, 5,623 bound volumes of journals and 161 CD-ROMs.

Automation

Web OPAC module of SLIM++ Library Automation package was installed in the library during the period. Digital library unit acquired a computer, scanner and a laser printer. 128 KBPS leased line internet connectivity was also acquired during the period, under NATP fund.

Services

During the year, 4,524 bonafide readers visited the library and 2,615 books were issued and retrieved. Reprographic unit of the library supplied copies of 60,000 pages of documents on requisition. CD-ROM based information access facility through LAN and access to J-gate has been provided. Issues of current contents were also brought out fortnightly.

The library in association with NIO, Goa, continued to act as a national input centre of ASFA database.

Representation in Committees

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

Dr K. Devadasan, Director

As Chairman

- Organising Committee, National Seminar on Riverine and reservoir fisheries - Challenges and strategies, jointly organised by SOFT(I) and CIFT

As Expert Member

- ASRB Board

As Member

- Academic Council of CIFE, Mumbai
- Senate of Cochin University of Science and Technology
- Extension Council of CIFE, Mumbai
- Governing Body of National Institute of Administration and Management, Ernakulam
- Organising Committee, International Symposium on Fresh water prawns organised by College of Fisheries, Panangad

Dr. M.K. Mukundan, Acting Head, Quality Assurance and Management Division

As Principal Member

- Supervisory Audit Team
- Bureau of Indian Standards for fishery products, FAD-12
- MPEDA Subsidy Committees
  - Interest Subsidy Committee
  - Effluent Treatment Plant Subsidy Committee
  - Water Purification Subsidy Committee
  - Subsidy Committee on Value Addition

As Lead Auditor

- EMS ISO 14000

As Lead Assessor

- ISO 17025 Laboratory Accreditation (NABL)

Dr. Krishna Srinath, Acting Head, Extension, Information and Statistics Division

As Member

- Expert Committee constituted by Govt. of Kerala for preparation of Action Plan for green mussel culture in the backwaters
- Working group on fisheries, Corporation of Cochin
- Core Committee on Pollution, Corporation of Cochin

Dr. P.K. Surendran, Head, Microbiology, Fermentation and Biotechnology Division

As Member

- Statutory Audit Team of EIC of India

Dr. B. Meenakumari, Head, Fishing Technology Division

As Principal Member

- Textile Materials for Marine Fishing Purpose Sectional Committee TX18, Bureau of Indian Standards, New Delhi

As Member

- Expert Committee to look into the result and impact of trawl ban and conservation of existing fisheries wealth, Govt. of Kerala

Dr. P.G.Viswanathan Nair, Head, Biochemistry and Nutrition Division

As Member

- Committee for selection of equipment and setting up of laboratories for MPEDA, Cochin

As Expert Member

- Committee for purchase of HPLC-MSMS for APEDA, New Delhi

Shri. P.R.G. Varma, Principal Scientist

As Principal Member

- Inter Departmental Panel of EIA for approval of seafood processing plants in Kerala, Tamil Nadu and Karnataka regions for export to EU

As Alternate Member

- BIS Sectional Committee on fish and fishery products - FAD 12

Dr. Jose Joseph, Principal Scientist

As Co-opted Member

- Academic Council, CIFE, Mumbai
- Committee constituted by MPEDA for extending subsidy assistance for construction of large cold storages for storing fish and fishery products

Dr. P.T. Lakshmanan, Principal Scientist

As Member

- Committee for aquaculture inputs, MPEDA
- Supervisory Audit Team

As Expert Member

- Committee to scrutinize applications under scheme of assistance to establish independent/captive pre-processing units

Dr. T.K. Srinivasa Gopal, Principal Scientist

As Member

- Sub-group on 'National Food Policy' of Ministry of Food Processing, New Delhi
- Collaborative project of MPEDA, CIFT and IIP on upgradation of seafood packaging

Dr. Imam Khasim Saheb, Principal Scientist

As Alternate Member

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

Shri. Sibsankar Gupta, Principal Scientist

As Member

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

Dr. P.N. Joshi, Acting Head, Engineering Division

As Technical Expert Member

- Subsidy committee constituted by MPEDA for modernising the seafood processing industry in India

Shri. P. George Mathai, Principal Scientist

As Member

- Expert Group under the Scheme on Demonstration of commercial fishing for tuna, MPEDA, Cochin

Shri. V. Narayanan Nambiar, Principal Scientist

As Member

- Inter Departmental Panel of the Export Inspection Council of India for assessing fish processing establishments for approval for export of fishery products to European Union.

Dr. S. Sanjeev, Principal Scientist

As Member

- Inter Departmental Panel of Experts for assessment of seafood processing plants for EU approval for Kerala, Tamil Nadu and Karnataka regions - constituted by EIC of India
- Expert Group on Export of live bivalve molluscs - constituted by EIC of India

Dr. S. Balasubramaniam, Principal Scientist

As Member

- High level committee on extension and training constituted by MPEDA

Shri. A.C. Joseph, Principal Scientist

As Member

- Core group to identify various value added marine products for export - Committee constituted by MPEDA
- Supervisory Audit Team constituted by Govt. of India for monitoring performance of Inter Departmental Panel and approval of fish processing establishments for export to European Union
- Committee constituted by MPEDA for scrutinizing applications for releasing subsidy for flake/chip/tube ice making machines and refrigerated truck/insulated transport containers

As Alternate Member

- FAD 45 - Food hygiene sectional committee - Bureau of Indian Standards, New Delhi

Dr. Nirmala Thampuran, Principal Scientist

As Member

- Inter Departmental Panel of EIC of India

Dr. K.V. Lalitha, Principal Scientist

As Member

- Inter Departmental Panel of EIC of India

Shri. M. Nasser, Principal Scientist

As Principal Member

- Transport Engineering Division Council of Bureau of Indian Standards, New Delhi

As Member

- Expert Committee to draw up a Fisheries Master Plan for Kerala

Dr. M.R. Boopendranath, Principal Scientist

As Member

- Committee of experts under the MPEDA scheme for extending financial assistance for installation of fish finder, GPS, radio telephone and fish hold
- MPEDA Expert Committee to approve specifications of fish finder, radio telephone, GPS and fish hold under scheme for assistance to boat owners
- Task Force, DOD-MLR Project on Resource assessment and biology of deep sea fisheries along the continental slope of Indian EEZ

Dr. R. Badonia, Principal Scientist

As Chairman

- Nagar Rajya Bhasha Karyavayan Samithi (TOLIC), Veraval of Dept. of Official Language

As Member

- Inter Departmental Panel of Experts for approval of seafood processing plants for European Union
- Consultative group of Porbander base of Fisheries Survey of India

Shri. S.P. Damle, Senior Scientist

As Member

- Inter Departmental Panel for assessing fish processing establishments for export of fish and fishery products to European Union
- Regional Committee of MPEDA for evaluation of assistance in acquisition of GPS, fish finder, radio telephone and fish holds for fishermen of Mumbai

Shri. D.K. Garg, Senior Scientist

As Member

- Consultative Committee for Mumbai base of Fishery Survey of India
- Committee constituted by Govt. of Maharashtra for undertaking study on mechanised fishing vessels and to suggest improvements in operational efficiency by adopting technological advancements

Dr. C.N. Ravishankar, Senior Scientist

As Member

- Collaborative project of MPEDA, CIFT and IIP on upgradation of seafood packaging
- Inter Departmental Panel for approving fish processing units for exporting fish and fish products to European Union

Dr. Saly N. Thomas, Senior Scientist

As Alternate Member

- Textile Material for Marine Fishing Purpose, Sectional Committee TX18, Bureau of Indian Standards, New Delhi

Shri. P. Pravin, Scientist (SG)

As Member

- Expert group constituted by MPEDA under the scheme - Demonstration of commercial fishing for tuna

Dr. Raghu Prakash, Scientist

As Member

- Sub-committee on tuna long lining

Dr. Toms C. Joseph, Scientist

As Subject Expert

- Departmental Purchase Committee of State Fisheries Dept. for purchase of PCR laboratory equipment

Visitors

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

- ICLARM Group comprising
  - Dr. Madan Mohan Dey, World Fish Centre, Penang, Malaysia
  - Dr. P.K. Joshi, Principal Scientist, NCAP, New Delhi
  - Dr. S.S. Anjanikumar, NCAP, New Delhi
  - Dr. P. Kumar, HOD, IARI, New Delhi
  - Dr. Pradeep Kathiana, CIFRI, Barrackpore
  - Dr. Shiyani, Professor, Gujarat Agricultural University
- Delegation of Members of Board of Regents, University of Agricultural Sciences, Bangalore, comprising
  - Shri. M.G. Mugadar
  - Shri. A.S. Viswanath
  - Shri. Vinayakumar
  - Shri. Y.R. Khan
  - Shri. B.N. Vishwanath
- Dr. S.Z. Qasim, Member Planning Commission (Retd.)
- Management Committee Members of NBFGR, Lucknow comprising
  - Dr. R.P. Singh
  - Dr. K.K. Tripathi
  - Shri. Ganesh Bharathi
- Dr. Mangala Rai, DG, ICAR
- Dr. S. Ayyappan, DDG(F), ICAR
- Eight member delegation from Iran sponsored by Indian Embassy, Teheran
- Smt. Binoo Sen, Secy. (A&AH) accompanied by Shri. Vipul Mitra, Commissioner of Fisheries (Veraval R.C.)
- Prof. Y. Sreekrishna, Member, CIFRI QRT
- Dr. Mario Pedini, World Bank Expert, NATP
- Expert Committee of the European Union
- Parliamentary Standing Committee on Official Language
- Smt. Bhavanaben Chikhalia, Union Minister of State for Parliamentary Affairs & Tourism, Govt. of Gujarat (Veraval R.C.)
- Dr. Sawant, Member, ASRB

Dr. Mario Pedini, World Bank Expert

Iranian team examining CIFT exhibits

Expert Committee of European Union

A member of Expert Committee of EU in the Microbiology lab

Publications

Anandan, R. (2003) - Modern analytical equipment in seafood quality evaluation - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 327

Anandan, R., Suseela Mathew, Asha, K.K., Ammu, K. & Viswanathan Nair, P.G. (2003) - Effect of peroxidised PUFA on tissue defence system in experimentally induced myocardial infarction in rats - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 330

(Ansar Ali, A., Sudhir, B.), Srinivasa Gopal, T.K. & Vijayan, P.K. (2003) - Suitability of indigenous aluminium cans for fish canning - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 132

Antony, K.P. (2003) - Quality and safety standards for fish and fish products with special reference to ISO 9000 standards - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 209

Antony, K.P., Muraleedharan, V. & Mukundan, M.K. (2003) - Preparation of quality upgraded tuna mas and mas based diversified convenience products - *Fish. Technol.* **40**(2) : 133

Arnab Sen, Parmar, H., Badonia, R. & Nair, K.G.R. (2003) - Fish meal industry in Gujarat - Paper presented at Seminar on Fishing and Fish Processing Industries of Gujarat - Present status and future needs, 7 March 2003

Arnab Sen, Parmar, H., Badonia, R. & Ramachandran Nair, K.G. (2003) - A perspective on the fishmeal industry in Gujarat - *Sustainable Fisheries Development - Focus on Gujarat* : 168

Arnab Sen, Zynudheen, A.A., George Ninan & Badonia, R. (2003) - Pre-processing hazards at the Veraval fish landing centre in Gujarat - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 536

Asha, K. K. (2003) - Seafood enzymes and their influence on quality - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 283

Ashok Kumar, K. (2003) - Toxicology and pharmacology of seafood toxins - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 239

Ashok Kumar, K., (Sona, R.) & Mukundan, M.K. (2003) - Marine biotoxins - An overview - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 302

Badonia, R., Arnab Sen & Devadasan, K. (2003) - Fish processing and quality assurance in Gujarat - Trends and prospects - Paper presented at Seminar on Fishing and Fish Processing Industries of Gujarat - Present status and future needs, 7 March 2003

Badonia, R., Arnab Sen & Devadasan, K. (2003) - Trends in fish processing and quality assurance in Gujarat - *Sustainable Fisheries Development - Focus on Gujarat* : 152

Balasubramaniam, S. & Krishna Srinath (2003)- Impact of the institutional training on the quality control practices in fish processing centres - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 642

Balasubramaniam, S., Ramesan, M.P. & Nikita Gopal (2003) - Fish catch variations and associated variables among fishermen operating plank built crafts - *Fish. Technol.* **40**(2) : 139

Bindu, J. (2003) - Curing of fish - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 97

Bindu, J. (2003) - Freeze drying of fish - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 113

Bindu, J., (Nasser, M.) & George Joseph, K. (2003) - Studies on the insect infestation of cured fish and their control - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 95

Braj Mohan, (Singh, D.P. & Thiagarajan, R.) (2003) - Adoption of recommended practices by fish processing plants in Kerala - *Fish. Technol.* **40**(1):50

Braj Mohan, (Singh, D.P. & Thiagarajan, R.) (2003) - Technological gap in the adoption of post-harvest technology - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 580

Chakrabarti, R. & Varma, P.R.G. (2003) - Fungi in salted and dried fish from coastal Andhra Pradesh - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 418

Damle, S.P. (2003) - Maharashtra ke matsya parisanskaran udyog mein khatre ka vishleshan aur nirnayak nujantran bindu - Paper presented at National Seminar in Hindi on `Fish processing - Present status and future prospects', CIFE, Mumbai, 19-20 Dec.

Devadasan, K. (2003) - Fish in human nutrition - Paper presented at 5th International Food Convention, IFCON 2003, CFTRI, Mysore, 5-8 December

Devadasan, K. (2003) - Current trends in post-harvest technology of fish - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 1

Devadasan, K. (2003) - Recent advances in the production of value added fishery products - *Sustainable Fisheries Development - Focus on Gujarat* : 93

(Femeena Hassan, Saleena Mathew), Mukundan, M.K. & (Somy Kuriakkose) (2003) - Effect of connective tissue and cooking regime on the properties of shark meat - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 87

Francis Thomas (2003) - Indian and EU standards of water for seafood industry - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 217

Francis Thomas, Mukundan, M.K., Varma, P.R.G., Radhakrishnan, A.G. & Muhamed Ashraf, P. (2003) - Water quality problems in relation to seafood processing in different regions of India - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 520

George Joseph, K. (2003) - Diversified products from mussel meat - Tech. Bull. No.3 (Eds. S. Subramanian & P.K. Asokan), Pub; Director, ICAR Research Complex for Goa

George Mathai, P., Boopendranath, M.R., Pravin, P., Remesan, M.P. & Sreedhar, U. (2003) - Strategies for fishing technology development in Gujarat - *Sustainable Fisheries Development - Focus on Gujarat* : 107

George Ninan (2003) - Handling and chilled storage of fish - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 43

George Ninan (2003) - Chemical composition of fish and shell fish - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 16

George Ninan & Swamy Kumar, M. (2003) - Types of craft and gear in use for the exploitation of fishes in small reservoirs of India - Paper presented at Workshop on Fishery Management in Lentic Water Systems, organized by CICFRI, Jabalpur, 19-20 February

George Ninan, Bindu, J., Ashok Kumar, K. & Jose Joseph (2003) - Biochemical changes during the chilled storage of *Macrobrachium rosenbergii* (de Man 1879) and evaluation of the freshness - Paper presented at International Symposium on Freshwater prawns, organized by College of Fisheries, Panangad, Cochin, 21-23 August

Gopakumar, K. (2003) - Hazards associated with seafood consumption - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 7

Jose Joseph (2003) - Food additives - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 305

Jose Joseph (2003) - Freezing methods for fish products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 59

Jose Joseph (2003) - Sensary evaluation of seafood - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 99

Jose Joseph (2003) - Sensory evaluation of seafood - A review - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 385

Joseph, A.C. (2003) - Coated fish products for export and domestic markets - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) :1

Joseph, A.C. (2003) - Value added fishery products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 125

Joseph, A.C. (2003) - Value added fishery products - Status paper presented at International Seminar on Food Processing and Packaging, Trivandrum, 8 May

Joshi, P.N. (2003) - Engineering and safety aspects in the production and storage of frozen fishery products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 405

Joshi, P.N., (Manoj, V.S. & Maheswaran, K.) (2003) - Safety in refrigeration plants and cold storages - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 150

(Kavitha, O.), Anandan, R., Suseela Mathew & Viswanathan Nair, P.G. (2003) - Biochemical composition and nutritive value of common fish feed ingredients of plant and animal origin - *Fish. Technol.* **40**(2) : 121

(Kavitha, O.), Anandan, R., Suseela Mathew & Viswanathan Nair, P.G. (2003) - Biochemical composition and nutritive value of common fish feeds available in Cochin area - *Fish. Technol.* **40**(2) : 115

Krishna Srinath (2003) - Human resource development - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 453

Krishna Srinath (2003) - Socio-legal issues in seafood industry - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 623

Krishna Srinath & Braj Mohan (2003) - From coastal small scale to deep sea fishing - Triumph of Kerala Fishermen's Associations - *Fishing Chimes*, April

Kumar, P. & Meenakumari, B. (2003) - Methods of prawn harvesting from the river Mahanadi, Orissa - Paper presented at International Symp. on Freshwater prawns, College of Fisheries, Cochin, 21-23 August

Kumar, P. & Meenakumari, B. (2003) - Uttarpurv main matsya pargran ki samasyaen aur aavasyaktayen - Paper presented at Official Language National Seminar on Inland fisheries of India - CIFT, Cochin, 5 September

Lakshmanan, P.T. (2003) - Chemical contaminants in seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 251

Lakshmanan, P.T. (2003) - Heavy metal residues in molluscan shell fish - Problems and remedy - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 247

Lakshmanan, P.T. (2003) - National and international quality standards for fish and fishery products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 259

Lakshmanan, P.T., Ashok Kumar K., (Patange, S.) & Mukundan, M.K. (2003) - A nucleotide based method for evaluation of quality of ice stored scampi, *Macrobrachium rosenbergii* - Paper presented at International Symp. on Freshwater Prawns, Cochin, 21-23 August

Lalitha, K.V. (2003) - Anaerobic pathogens in seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 373

Lalitha, K.V. & Surendran, P.K. (2003) - *Clostridium botulinum* in fin fish and shell fish - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 359

Lalitha, K.V. & Surendran, P.K. (2003) - Detection of *Clostridium botulinum* by PCR method - *Seaf. News,* 11 Nov. - Dec. : 4

Lalitha, K.V. & Surendran, P.K. (2003) - Detection of *Clostridium botulinum* by PCR method - *Aqua International*, March

Lalitha, K.V. & Surendran, P.K. (2003) - Distribution of *Clostridium perfringens* in fish and aquatic environments - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 388

Lalitha, K.V. & Surendran, P.K. (2003) - Effect of handling and chlorine treatment on the microbial quality of farmed freshwater scampi (*Macrobrachium rosenbergii*) - Paper presented at International Symposium on Freshwater prawns, organized by College of Fisheries, Panangad, Cochin, 21-23 August

Lalitha, K.V., Unnithan, G.R. & Surendran, P.K. (2003) - Reduction in microbial load of farmed freshwater scampi *(Macrobrachium rosenbergii)* by application of permitted food preservatives - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 447

(Latha Unnikrishnan, Sally Simon), Meenakumari, B. & Devadasan, K. (2003) - Trace metal concentration in four species of edible fishes from the southwest coast of India - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 259

Leela Edwin & (Hridayanathan, C.) (2003) - Selective effect of ring seines - *Fish. Technol.* **40**(1):55

Leela Edwin, Saly N. Thomas & Meenakumari, B. (2003) - Rubber wood - Can it replace hard wood in boat building? *Infofish International,* 5/2003

(Leema Jose, Manju, S., Sonaji, E.R.), Srinavasa Gopal, T.K., Ravishankar, C.N. & Ashok Kumar K. (2003) - Nucleotide catabolism of pearlspot in modified atmosphere storage - Paper presented at 5th International Food Convention, IFCON 2003, CFTRI, Mysore, 5-8 December

Madhusudana Rao, B. & Surendran, P.K. (2003) - Coliphage test: A quick and easy method to detect faecal pollution in water and fish - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 556

Madhusudana Rao, B. & Surendran, P.K. (2003) - Microbial populations in deep sea water and fish of South East Arabian sea with spherical emphasis on *Escherichia coli* and coliphages - *Fish. Technol.* **40**(2): 105

(Mallick, A.K.), Srinivasa Gopal, T.K., Ravishankar, C.N. & Vijayan, P.K. (2003) - Suitability of polymer coated tin free steel cans for canning Rohu (*Labeo rohita*) in curry medium - Paper presented at 5th International Food Convention, CFTRI, Mysore, 5-8 December

(Manju, S., Sonaji, E.R., Leema Jose), Srinivasa Gopal, T.K., Ravishankar, C.N. & Unnikrishnan Nair, T.S. (2003) - Modified atmosphere packaging of whole pearl spot *(Etroplus suratensis)* - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 144

(Martin Xavier, K.A., Umesh A. Prabhu), Ramachandran Nair, K.G. & Mathew, P.T. (2003) - Utilization of fish bone as calcium supplement - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) :58

Mathew, P.T. (2003) - Biogenic amines in seafood - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 290

Mathew, P.T. (2003) - Chemical quality evaluation of seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 321

Mathew, P.T. (2003) - Non-conventional fishery products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 161

Meenakumari, B. (2003) - Fishery resources and harvesting methods in inland and marine sector - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 419

Meenakumari, B. (2003) - Development of marine fishing technology in India - Paper presented at Seminar on Indian marine fishery industry - Challeges and opportunities, Cochin, 22 October

Muhamed Ashraf, P. & Leela Edwin (2003) - Sediment characteristics of prawn aquaculture systems - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 589

Muhamed Ashraf, P. & Pillai, A.G.G.K. (2003) - Changes in phosphate fractions in prawn aquaculture systems at different stages of cropping - *Ind. J. Fish.* **50**: 157

Muhamed Ashraf, P., Radhakrishnan, A.G. & Pillai, A.G.G.K. (2003) - Evaluation of polycyclic aromatic hydrocarbons in the aquaculture systems of Cochin - *Ind. J. Fish.* **50**:

Mukundan, M.K. (2003) - A criteria for food safety - Paper presented at Workshop on Food Safety, organized by Confederation of Indian Industry on Food Safety, Cochin, 18 February

Mukundan, M.K. (2003) - HACCP audit - Paper presented at Workshop on Food Safety, organized by Confederation of Indian Industry on Food Safety, Cochin, 18 February

Mukundan, M.K. (2003) - HACCP criteria for packaged drinking water - Paper presented at Workshop on Safety of packaged drinking water, organised by Bureau of Indian Standards, Cochin, 18 December

Mukundan, M.K. (2003) - Quality criteria of aquaculture scampi - Invited paper presented at International Symp. on Freshwater prawns *Macrobrachium rosenbergii,* Cochin, 21-23 August

Mukundan, M.K. (2003) - Risk analysis of seafood for food safety - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 466

Mukundan, M.K. (2003) - Sanitation and standard operation procedures for packaged drinking water processing plants - Paper presented at Workshop on Safety of packaged drinking water, organized by Bureau of Indian Standards, Cochin, 18 December

Mukundan, M.K. (2003) - The concept of total quality management in seafood industry - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 193

Muraleedharan, V. (2003) - Surimi and surimi based products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 133

Nair, P.R., Antony, K.P., Ravishankar, C.N., Nambiar, V.N. & Srinivasa Gopal, T.K. (2003) - Effect of vacuum packaging on frozen storage of seer fish chunks - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 138

Narayanan Nambiar, V. & Surendran, P.K. (2003) - Contamination by pathogenic bacteria during handling and processing of seafoods - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 458

Narayanan Nambiar, V. & Surendran, P.K. (2003) - Microbial hazards in fish sold in retail markets of Cochin - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 399

Nikita Gopal & Mary Thomas (2003) - Women professionals in ICAR fisheries institutes - *Fishing Chimes*, **22**, (10&11) 114

Nikita Gopal, Unnithan, G.R. & Radhakrishnan Nair, V. (2003) - Seasonal variation in prices of Indian frozen shrimp in Japanese market - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 634

Nirmala Thampuran (2003) - Microbial aspects of fish and chilled fish - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 351

Nirmala Thampuran (2003) - Inherent microbial hazards associated with seafood - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 350

Nirmala Thampuran & Surendran, P.K. (2003) - Detection of *Vibrio cholerae* by polymerase chain reaction method - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 550

Percy Dawson & Boopendranath, M.R. (2003) - CIFT-TED: Construction, installation and operation, *Kachhapa* **8**: 5

Prasad, M.M. (2003) - Role of bacteria in aquaculture - Paper presented at seminar on Aquatic environment and fisheries - Problems and solutions (in Hindi) at CIFRI, Barrackpore, 23 & 24 February 2003

Prasad, M.M. & Bandyopadhyay, J.K. (2003) - 'Jalkrishi main sukshamjiviyon ki bhumika' (Role of bacteria in aquaculture) - Proc. Jaliya paryavaran avam matsyiki : Samasyan avam samadan (Aquatic environment and fisheries : Problems and solutions) - National Seminar in Official Language, CIFRI, Barrackpore, 23 - 24 February : 89

Prasad, M.M. & Bandhyopadhyay, J.K. (2003) - Quality of commercial smoke cured freshwater prawns harvested from Mahanadi river system and Hirakud reservoir - Paper presented at International Symp. on Freshwater prawns, organized by College of Fisheries, Panangad, Cochin, 20-23 August

Prasad, M.M., Bandyopadhyay, J.K. & Kumar, P. (2003) - Post harvest scenario of inland fisheries - A glance at needs of NEH region - Paper presented at National Seminar in Official Language on Inland fisheries of India - Cochin, 5 September

(Prasanna, S., Kiran, B.D.) & Srinivasa Goapl, T.K. (2003) - Comparative economic and energy analysis of thermal processing of mackerel packed in brine using flexible pouch and tin cans - Paper presented at 5th International Food Convention, CFTRI, Mysore, 5-8 December

Prem Kumar & Meenakumari, B. (2003) - Methods of prawn harvesting from Mahanadi river system (Orissa) - Paper presented at International Symp. on Freshwater prawns, organised by College of Fisheries, Panangad, Cochin, 21-23 August

Radhakrishnan, A.G. & Anandan, R. (2003) - Organochloro pesticides, polynuclear aromatic hydrocarbons and toxic heavy metals in locally marketed marine fishes - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 199

Raghu Prakash, R. (2003) - Accumulation and release of petroleum hydrocarbons by *Mytilopsis sallei* from the harbour waters of Visakhapatnam - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 241

(Rajalekshmi, M.), Mathew, P.T., Jose Joseph & Thankamma, R. (2003) - Effect of chitosan treatment on the frozen storage stability of sardines - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 46

Rajeswari, G. (2003) - Pesticide induced histopathological changes in *Macrobrachium rosenbergii* - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 226

Rakesh Kumar (2003) - Detection of food pathogens by molecular biology techniques - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 381

Rakesh Kumar & Surendran, P.K. (2003) - Bacteria of sanitary significance in brackish water aquaculture farms and shrimps - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 406

Ramachandran Nair, K.G. (2003) - Fishery by-products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 149

Ramachandran Nair, K.G. (2003) Products from less utilized fish - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) :13

Ramachandran Nair, K.G. (2003) - Resource generation from seafood waste - *Seaf. News.* **11** Nov. - Dec. : 6

Ravindranathan Nair, P. (2003) - Packaging of fish and fish products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 187

Ravishankar, C.N. (2003) - Post mortem changes in seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 33

(Rekha Devi, K.), Varma, P.R.G., Sanjeev, S. & Ashok Kumar, K. (2003) - Incidence of *Escherichia coli* and *Staphylococcus aureus* during seafood processing - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 517

(Renjith, K.R.), Lakshmanan, P.T. & Mukundan, M.K. (2003) - Concentrations of metals in *Euthynnus affinis* and *Thunnus albacares* from Arabian sea - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 271

Saly N. Thomas, Leela Edwin & George, V.C. (2003) - Catching efficiency of gill nets and trammel nets for penaeid prawns - *Fisheries Research* **60**: 141

Sanjeev, S. (2003) - Bacteria of public health significance in seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 357

Sanjeev, S. & Mukundan, M.K. (2003) - Shigella in fish and fishery products and its survival in prawn homogenate at -20°C - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 394

Sanjeev, S. & Mukundan, M.K. (2003) - Incidence and antibiotic sensitivity of *Vibrio vulnificus* in frozen fishery products - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 364

Sanjeev, S., Varma, P.R.G. & Mukundan, M.K. (2002 - issued in 2003) - Incidence of *Vibrio metschnikovii* in frozen fish products - *Ind. J. Fish.* **49**(3) : 311

Sankar, T.V. (2003) - Pesticide, polychlorobiphenyls and polyaromatic hydrocarbons in seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 271

Sankar, T.V. & Viswanathan Nair, P.G. (2003) - Organochlorine pesticides and poly chlorinated hydrocarbons in seafood - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 187

(Santhosh, S., Sini, T.K.) & Mathew, P.T. (2003) - Study on variation in properties of chitosan prepared from squid pen and shrimp shell at different alkali concentrations - Paper presented at 5th International Food Convention IFCON 2003, CFTRI, Mysore, 5-8 December

(Seema Nair, P.) & Surendran, P.K. (2003) - Antibacterial activity of *Lactobacillus* species against pathogens of seafood origin - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 427

(Shine Kumar, C.S.) & Ramachandran Nair, K.G. (2003) - High viscosity chitosan from *Macrobrachium rosenbergii* - Paper presented at International Symp. on Feshwater prawns, College of Fisheries, Panangad, Cochin, 21-23 August

(Sini, T.K.), Joseph, A.C., Muraleedharan, V. & Ravishankar, C.N. (2003) - Storage characteristics of sausage prepared from freshwater fish rohu (*Labeo rohita*) at ambient and refrigerated temperature - Paper presented at 5th International Food Convention, CFTRI, Mysore, 5 - 8 December

(Sona, A.), Ashok Kumar, K., Mukundan, M.K., (Jugunu, R., Kripa, V. & Gopinathan, C.P.) (2003) - On occurrence of certain biotoxins along the Kerala coast - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 314

Sreedhar, U., Badonia, R., Pravin, P. & George Mathai, P. (2003) - Technological adaptations in gill nets of Gujarat - *Sustainable Fisheries Development - Focus on Gujarat* : 143

Sreedhar, U., Badonia, R., Pravin, P. & George Mathai, P. (2003) - Technological adaptations in gill net fabrication and operation off Saurashtra coast - Paper presented at Seminar on Fishing and Fish Processing Industries of Gujarat - Present status and future needs, 7 March 2003

Srinivasa Gopal, T.K. (2003) - Recent developments in packaging of fish and fishery products - *Souvenir*, College of Fisheries, Mangalore

Srinivasa Gopal, T.K. (2003) - Retort pouch packaging - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 87

Srinivasa Gopal, T.K. & Ravishankar, C.N. (2003) - Safety of packaging materials for seafoods - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 122

(Sudha, K.), Nirmala Thampuran & Surendran, P.K. (2003) - Ecology and distribution of *Vibrio parahaemolyticus* in fish and fishery environments - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 370

(Sudha, K.), Nirmala Thampuran & Surendran, P.K. (2003) - Survival of certain *Vibrio species* at low temperature storage - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 379

(Sudhansu Sekhar Das), Lakshmanan, P.T. & Mukundan, M.K. (2003) - Studies on removal of toxic heavy metal residues from process water - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 277

(Sudhansu Sekhar Das), Radhakrishnan, A.G. & Mukundan, M.K. (2003) - Studies on removal of chlorinated pesticide residues from process water - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 215

Surendran, P.K. (2003) - Adverse effect of antibiotic residues in seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 333

Surendran, P.K. (2003) - Antibiotic residues in seafood - A hazard - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 543

Surendran, P.K. (2003) - Microbiological quality evaluation of seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 339

(Teresa Neelima Giles), Anandan, R. & Sankar, T.V. (2003) - Effect of temperature on thiol group of myofibrillar protein from common carp - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 81

Thankamma, R. (2003) - Speciality products - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 139

Thankappan, T.K. (2003) - Fish meal and oil - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 177

Thankappan, T.K. (2003) - Isolation of squalene from shark liver oil - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 173

(Thippeswamy, S.), Ammu, K. & Jose Joseph (2003) - Changes in sulfhydril groups during processing of milk fish, *Chanos chanos* - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) :70

Toms C. Joseph (2003) - Viruses and parasites associated with seafood - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 369

Toms, C. Joseph & Surendran, P.K. (2003) - Polymerase chain reaction for the detection of white spot syndrome virus in post-larvae of penaeid shrimps - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 422

(Umesh, A. Prabhu, Martin, K.A.), Mathew, P.T. & Ramachandran Nair, K.G. (2003) - Utilisation of cuttle fish and tuna waste - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) :54

Unnikrishnan Nair, T.S. & Menon, A.R.S. (2003) - Value addition in fisheries-Popularisation of modern technology is the need of the hour, *Fisheries World*, August 2003, 17

Varma, P.R.G. (2003) - Faceal indicator organisms in seafoods - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 365

Varma, P.R.G., Sanjeev, S. & Mukundan, M.K. (2003) - Microbial quality status of processed seafood exported from India - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 491

Vijayabharathi, K. & Ramakrishnan, K. (2003) - Indigenous electronic instruments for assessing quality of fishery products - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 167

Vijayan, P.K. (2003) - Canning preservation of fish and shell fish - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 79

Vijayan, P.K., Surendran, P.K. & Jose Joseph (2003) - Histamine in dried fish - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 336

Vijayan, V., Manoharadoss, R.S. & (Sherine Sonia Cubelio) (2003) - Target specific 51.0 m long wing semi-pelagic trawl for off-bottom fishing in Indian EEZ - *Fish. Technol.* **40** (1): 24

Vijayan, V., Percy Dawson, Varghese, M.D., George Mathai, P. & Baiju, M.V. (2003) - Operational efficiency of suberkrub and polyvalent otterboards for target specific in-shore semi-pelagic trawling - *Fish. Technol.* **40**(1):28

Viswanathan Nair, P.G. (2003) - Nutrition labelling - An overview - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 321

Viswanathan Nair, P.G. (2003) - Role of fish fatty acids in control of coronary heart disease - *Manual* - Winter School on Product development and seafood safety, organized by CIFT, Cochin, 11 Nov. - 10 Dec. : 299

(Yesudhason, P.) Srinivasa Gopal, T.K. & Ravishankar, C.N. (2003) - Effect of high CO_2 atmosphere on the shelf life of seer fish steaks during chill storage - Paper presented at 5th International Food Convention, CFTRI, Mysore, 5 - 8 December

Zynudheen, A.A., George Ninan, Arnab Sen & Badonia, R. (2003) - Incidence of cadmium in processed products of cephalopods from Gujarat, India - *Seafood Safety* (Proc. of Symp. on Seafood safety - Status and strategies; 28-30 May 2002) : 266

Zynudheen, A.A., George Ninan, Arnab Sen & Badonia, R. (2003) -Marketing channels and market intermediaries in the fish trade in Veraval (Gujarat) - *Seaf. Exp. J.* **34**, Feb. - March : 3

Other publications

Books

- Sustainable fisheries development : Focus on Gujarat (Proc. of Seminar on Fishing and fish processing industries of Gujarat - Present status and future needs - organised by Society of Fisheries Technologists (India) and CIFT, Cochin, 7 March 2003 at Veraval): Eds: M.R. Boopendranath, R. Badonia, T.V. Sankar, P. Pravin & Saly N. Thomas
- Seafood safety (Proc. of Symp. on Seafood safety - Status and strategies - organised by Society of Fisheries Technologists (India) and CIFT, Cochin, 28 - 30 May 2003 at Cochin) : Eds : P.K. Surendran, P.T. Mathew, Nirmala Thampuran, V. Narayanan Nambiar, Jose Joseph, M.R. Boopendranath, P.T. Lakshmanan & P.G. Viswanathan Nair
- Fish canning - Principles and practices- K.K. Balachandran

Monograph

- Semi-pelagic trawling - M.P. Remesan, P. Pravin & V. Vijayan

CIFT Special Bulletins

- Spl. Bull. No. 11 - Synthetic fish netting yarns - B. Meenakumari & K. Radhalakshmi
- Spl. Bull. No. 12 - CIFT-TED for turtle-safe trawl fisheries - A success story in responsible fishing - M.R. Boopendranath

Fish Technology Newsletter

- Vol. XIV, No. 1, No.2, No.3 & No. 4, 2003

Reports

- Harvest and post harvest technology aspects of freshwater fish - J.K. Bandyopadhyay, M.M. Prasad and Prem Kumar (Report on training-cum-demonstration held in Madhubani, Bihar and CIFT, Burla/ATMA, Sambalpur)
- Follow-up action on the FAO deputation programme - ICAR-AHRD fellowship - 2001 UTF/IND/162/IND-Fish Processing Technology - M.M. Prasad
- Selective accumulation of toxicants by cephalopods, viz. squid and cuttle fish and changes in quality, its upgradation and safety of products - P.T. Lakshmanan

CIFT Tech. Advisory Series

- Processing of Bombay duck (Hindi)

Laboratory Manual

- Mircrobiological examination of seafood - P.K. Surendran, Nirmala Thampuran, V. Narayanan Nambiar & K.V. Lalitha

Technical Folder

- Processing and preparation of value added products from mussel meat - A.A. Zynudheen & K. George Joseph (Malayalam)

List of Personnel in CIFT

(as on 31 December 2003)

Managerial Personnel

Director : Dr. K. DEVADASAN

Heads of Divisions

Fishing Technology Division	:	Dr. B. Meenakumari, Principal Scientist
Fish Processing Division	:	Dr. K.G. Ramachandran Nair, Principal Scientist
Biochemistry & Nutrition Division	:	Dr. P.G. Viswanathan Nair, Principal Scientist
Quality Assurance & Management Division	:	Dr. M.K. Mukundan, Principal Scientist
Microbiology, Fermentation & Biotechnology Division	:	Dr. P.K. Surendran, Principal Scientist
Engineering Division	:	Dr. P.N. Joshi, Principal Scientist
Extension, Information & Statistics Division	:	Dr. Krishna Srinath, Principal Scientist

Scientist/Officer-In-Charge of Research Centres

Veraval Research Centre	:	Dr. Rajendra Badonia, Principal Scientist
Visakhapatnam Research Centre	:	Shri. Sib Sankar Gupta, Principal Scientist
Burla Research Centre	:	Shri. J.K. Bandyopadhyay, Senior Scientist
Calicut Research Centre	:	Shri. K. George Joseph, Principal Scientist
Mumbai Research Centre	:	Shri. Dinesh Kumar Garg, Senior Scientist
Hoshangabad Research Centre	:	Shri. Moka Swamy Kumar, Technical Officer (T6)

Administrative & Accounts

Senior Administrative Officer	:	Shri. Ravi Kumar

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.R. Girija Varma
6. Shri. V. Muraleedharan
7. Shri. P.K. Vijayan
8. Dr. T.K. Thankappan
9. Dr. Nirmala Thampuran
10. Shri. P. George Mathai
11. Dr. Francis Thomas
12. Smt. Mary Thomas
13. Dr. M. R. Boopendranath
14. Dr. S. Sanjeev
15. Dr. P.T. Lakshmanan
16. Shri. P. Ravindranathan Nair
17. Shri. V. Vijayan
18. Smt. K. Vijayabharathy
19. Dr. G. Ragopalan Unnithan
20. Dr. K. V. Lalitha
21. Dr. S. Balasubramaniam
22. Shri. K. P. Antony
23. Shri. M. Nasser

Senior Scientist

1. Dr. Leela Edwin
2. Dr. C.N. Ravishankar
3. Dr. K. Ashok Kumar
4. Dr. T. V. Sankar
5. Dr. Saly N. Thomas

Scientist (Selection Grade)

1. Smt. R. Thankamma
2. Shri. Pravin Puthra

Scientist (Senior Scale)

1. Smt. Suseela Mathew
2. Dr. V. Geethalakshmy
3. Shri. M.P. Remesan
4. Dr. Nikita Gopal
5. Smt. J. Bindu
6. Shri. A.A. Zynudheen
7. Shri. P. Muhamed Ashraf

Scientist

1. Shri. George Ninan
2. Dr. Toms C. Joseph
3. Dr. R. Anandan
4. Shri. V. Radhakrishnan Nair
5. Shri. Rakesh Kumar
6. Dr. D. Muthuchelvan
7. Smt. K.K. Asha
8 Dr. Sanjoy Das
9. Dr. S.K. Panda

Technical Personnel

T- 9 (Technical Officer)

1. Shri. K.J. Francis Xavier
2. Shri. K.S. Ganesan

T- 8 (Technical Officer)

1. Dr. A.R.S. Menon

T- 7 (Technical Officer)

1. Shri. M.S. Rajan

T- 6 (Technical Officer)

1. Shri. C. Chandrasekharan
2. Shri. M.V. Baiju

T- 5 (Technical Officer)

1. Shri. P.T Sebastian
2. Shri. N. M. Vasu
3. Shri. M. K. Sasidharan
4. Shri. T. K. David
5. Shri. M. K. Kuttikrishnan Nair
6. Shri. C.R. Gokulan
7. Shri. V. Gopalakrishna Pillai
8. Shri. M.M. Devassia
9. Shri. G. Ramadas Kurup
10. Shri. G. Ratnakaran Nair
11. Smt. K. B. Beena
12. Dr. K. Sobha
13. Shri. T.N. Sukumaran
14. Shri. P. Feroz Khan

T- 4

1.	Shri. E.K. Balakrishnan	:	Senior Draughtsman
2.	Smt. K. Sarasamma	:	Senior Draughtsman
3.	Smt. P.K. Shyma	:	Wireless Operator
4.	Shri. M. Baiju	:	Technical Assistant
5.	Smt. G. Usha Rani	:	Laboratory Technician
6.	Shri. P.M. Joseph	:	Machinist
7.	Shri. Jose Kalathil	:	Refrigeration Mechanic
8.	Shri. K.B. Thilakan	:	Junior Laboratory Assistant
9.	Shri. P. Bahuleyan	:	Telephone Operator
10.	Smt. K.K. Sumathy	:	Laboratory Technician
11.	Shri. P.A. Josi Augustine	:	Refrigeration Mechanic
12.	Shri. K.N. Rajagopalan	:	Refrigeration Mechanic
13.	Smt. T. Silaja	:	Junior Library Assistant
14.	Shri. K.B. Thampi Pillai	:	Draughtsman
15.	Smt. V.C. Mary	:	Junior Laboratory Assistant
16.	Shri. C. Rajendran	:	Refrigeration Mechanic
17.	Shri. C.C. Sivan	:	Welder-cum-Blacksmith
18.	Shri. M.K. Asokan	:	Deckhand
19.	Shri. K. D. Jos	:	Field Assistant
20.	Shri. B. Ganesan	:	Animal House Keeper
21.	Smt. K.G. Sasikala	:	Junior Laboratory Assistant
22.	Smt. K.K. Kala	:	Technical Assistant
23.	Shri. Sibasis Guha	:	Photographer-cum-Artist
24.	Shri P.S. Babu	:	Senior Field Assistant
25.	Shri. T.R. Sreekumaran	:	Oilman
26.	Shri. K.P. Vijayan	:	Deckhand
27.	Shri. V.N. Dileepkumar	:	Engine Driver
28.	Shri. P. Shankar	:	Hindi Translator
29.	Smt. Ancy Sebastian	:	Technical Assistant
30.	Shri. G. Omanakuttan Nair	:	Junior Laboratory Assistant

T-II-3

1.	Shri. K.K. Narayanan	:	Boilerman

T- 3

1.	Shri. P.T. Viswambharan	:	Electrician
2.	Smt. G. Remani	:	Junior Laboratory Assistant
3.	Shri. J. Samarajan	:	Field Assistant
4.	Shri. Philip Durom	:	Senior Carpenter
5.	Shri. T. Balan	:	Deckhand
6.	Shri. P.N. Sudhakaran	:	Net Making Supervisor
7.	Shri. E.K. Chinnappan	:	Deckhand
8.	Shri. A. S. Kalangutkar	:	Senior Field Assistant
9.	Smt. K.P. Leelamma	:	Junior Laboratory Assistant
10.	Shri. P.S. Raman Namboodiri	:	Junior Laboratory Assistant
11.	Shri. A.A. Kunjappan	:	Field Assistant
12.	Shri. A.K. Unnikrishnan	:	Cook
13.	Shri. Arokiasami	:	Deckhand

T-I-3

1.	Shri. Tomy Rebellow	:	Boilerman
2.	Smt. K.S. Mythri	:	Junior Laboratory Assistant
3.	Shri. P.S. Nobi	:	Net Making Supervisor
4.	Shri. C. Subhash Chandran Nair	:	Projector Operator

T-2

1.	Shri. T. Mathai	:	Junior Laboratory Assistant
2.	Smt. N. Lekha	:	Junior Laboratory Assistant
3.	Shri. R.N. Sahoo	:	Launch Driver
4.	Shri. P.N. Sukumaran Nair	:	Field Assistant
5.	Shri. P.D. Padmaraj	:	Junior Laboratory Assistant
6.	Smt. P.K. Geetha	:	Junior Laboratory Assistant
7.	Shri. N. Sunil	:	Plant Attendant
8.	Shri. Sajith K. Jose	:	Draughtsman
9.	Shri. P.V. Sajeevan	:	Draughtsman
10.	Smt. P.A. Jaya	:	Junior Laboratory Assistant
11.	Shri. G.C. Meher	:	Oilman
12.	Shri. V.K. Siddique	:	Refrigeration Mechanic
13.	Shri. R. Rangaswamy	:	Driver
14.	Shri. V. A. Sudhakaran	:	Plumber
15.	Shri. Umesh D. Aroskar	:	Driver
16.	Shri. K.V. Mohanan	:	Driver
17.	Shri. K. Nakulan	:	Driver
18.	Shri. G. Gopakumar	:	Carpenter
19.	Shri. T. B. Assise Francis	:	Driver
20.	Shri. K.S. Babu	:	Turner
21.	Smt. Bindu Joseph	:	Media Assistant
22.	Shri. C.K. Suresh	:	Machine Operator
23.	Smt. N.C. Shyla	:	Field Assistant
24.	Shri. N. Krishnan	:	Junior Laboratory Assistant
25.	Shri. V.T. Sadanandan	:	Junior Laboratory Assistant
26.	Shri. K.D. Santhosh	:	Junior Laboratory Assistant
27.	Shri. K. Dinesh Prabhu	:	Plant Attendant

T-1

1.	Smt. Tessy Rony	:	Field Assistant
2.	Shri. P.A. Shanmughan	:	Tindal
3.	Shri. P.S. Sunil Kumar	:	Driver
4.	Shri. T. Jijoy	:	Junior Laboratory Assistant
5.	Shri. K.C. Anishkumar	:	Junior Laboratory Assistant

Administrative Personnel

1.	Smt. K. Usha	:	Administrative Officer
2.	Shri. R. Anilkumar	:	Asst. Administrative Officer
3.	Shri. A. George Joseph	:	Asst. Administrative Officer
4.	Shri. M. Gopalakrishnan	:	Asst. Administrative Officer
5.	Smt. M. A. Prasanna	:	Asst. Administrative Officer
6.	Shri. P.K. Sreedharan	:	Asst. Administrative Officer
7.	Shri. H. Ganesha	:	Asst. Fin. & Accts. Officer
8.	Dr. C. Jessy Joseph	:	Asst. Director (Official Language)
9.	Shri. K. Ravindran	:	Private Secretary

Assistant

1. Shri. M. T. Joseph
2. Shri. A.K. Venugopalan
3. Smt. C. G. Marykutty
4. Shri. V. R. Kesavan
5. Smt. K. R. Gita Rani
6. Smt. N. Prabhavathy Amma
7. Smt. Pushpalatha Viswambharan
8. Shri. T.M. Ramaraj
9. Smt. M. Jully
10. Shri. Y. Philipose
11. Shri. R. Viswanathan
12. Smt. K.A. Nazeem
13. Smt. T. K. Susannamma
14. Smt. K. Gracy
15. Shri. P. Krishna Kumar
16. Smt. P.C. Kamalakshy
17. Shri. P.V. Venugopalan

Personal Assistant

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

Stenographer grade III

1. Smt. Anitha K. John
2. Shri. T. Viswanathan

Upper Division Clerk

1. Smt. N.I. Mary
2. Smt. M. S. Susanna
3. Shri. P. P. Varghese
4. Shri. P.K. Thomas
5. Smt. P.K. Thankamma
6. Smt. A. A. Cousallia
7. Shri. K. K. Sasi
8. Shri. P. Padmanabhan
9. Smt. A.R. Kamalam
10. Smt. T.K. Shyma
11. Shri. V.S. Ambasudhan
12. Shri. A.P. Gopalan
13. Smt. T. D. Usheem
14. Smt. V. S. Aleyamma
15. Smt. G. N. Sarada
16. Shri K.B. Sabukuttan
17. Shri C.K. Sukumaran
18. Smt. Lillykutty George
19. Shri P.K. Somasekharan Nair
20. Shri P. Mani
21. Smt. Jaya Das

Lower Division Clerk

1. Shri P. Bhaskaran
2. Smt. K. Renuka
3. Smt. P.R. Mini
4. Smt. V.K. Raji
5. Shri M.N. Vinodh Kumar
6. Shri K. Das
7. Shri T. N. Shaji
8. Smt. A.R. Raji
9. Smt. E. Jyothilekshmy
10. Smt. Shiji John
11. Shri. P.G. David
12. Shri. Santhosh Mohan

Cook

1. Shri V. Ramachandran

Supporting Personnel

Supporting staff grade IV

1. Shri. T.V. Manoharan
2. Shri. C. A. Krishnan
3. Shri. K.K. Karthikeyan

Supporting staff grade III

1. Shri. K.K. Karthikeyan
2. Shri. K.N. Mukundan
3. Shri. P. Gopalakrishnan
4. Shri. K.B. Bhaskaran
5. Shri. K.A. Kunjan
6. Shri. T.T. Thankappan
7. Shri. P.R. Unnikrishna Panicker
8. Shri. A.R. John
9. Shri. P.A. Sivan
10. Smt. C.G. Radhamoney
11. Shri. C.D. Parameswaran

Supporting staff grade II

1. Shri. P.P.George
2. Shri. P.V. Raju
3. Shri. A.V. Chandrasekharan
4. Shri. E. Damodaran
5. Shri. M.M. Radhakrishnan
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. M.T. Udayakumar
12. Smt. P.T Mary Vinitha
13. Shri. O.P. Radhakrishnan
14. Shri. P. Raghavan
15. Shri. T.M. Balan
16. Shri. V. Deepak Vin
17. Shri. T.D. Bijoy

Supporting staff grade I

1. Shri. K.R. Rajasaravanan

Auxiliary

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

VERAVAL RESEARCH CENTRE

Scientific Personnel

1. Dr. Imam Khasim	:	Principal Scientist
2. Shri.L. Narasimha Murthy	:	Scientist
3. Shri. V.R. Madhu	:	Scientist

Technical Personnel

1. Shri. J.B. Paradwa	:	T-5 (Technical Officer)
2. Shri. K.U. Dholia	:	T-5 (Technical Officer)
3. Shri. Thomas Teles	:	T-5 (Technical Officer) (Bosun)
4. Shri. K.U. Sheikh	:	T-4 (Junior Laboratory Assistant)
5. Shri. D. Padmanabhan	:	T-4 (Boat Driver)
6. Shri. G. Kingsley	:	T-2 (Boat Driver)
7. Shri. K.C. Gopalan	:	T-3 (Cook)
8. Shri. G.M. Vaghela	:	T-3 (Junior Laboratory Assistant)
9. Shri. H.V. Pungera	:	T-2 (Junior Laboratory Assistant)
10. Shri. S.H. Ummer Bhai	:	T-1 (Driver)

Administrative Personnel

1. Shri. S.B. Purohit	:	Upper Division Clerk
2. Shri. M.M. Damodara	:	Upper Division Clerk
3. Shri. D.P. Parmer	:	Lower Division Clerk

Supporting Personnel

1. Shri. P.A. Abdul Rehman	:	Supporting Staff Grade IV
2. Shri. M.R. Bharathan	:	Supporting Staff Grade IV
3. Shri. Harbhajan	:	Supporting Staff Grade III
4. Shri. B.M.A. Khoker	:	Supporting Staff Grade III
5. Shri. D. B. Chudasama	:	Supporting Staff Grade III
6. Shri. K. J. Damor	:	Supporting Staff Grade III
7. Smt. Chandrika C. Tank	:	Supporting Staff Grade II
8. Smt. G. N. Chorwadi	:	Supporting Staff Grade II
9. Shri. D. K. Viram	:	Supporting Staff Grade II
10. Shri. J. B. Malamdi	:	Supporting Staff Grade II
11. Shri. R. N. Gosai	:	Supporting Staff Grade II
12. Shri. A. M. Vala	:	Supporting Staff Grade II
13. Shri. M. K. Kana	:	Supporting Staff Grade II
14. Smt. Harshaben A. Joshi	:	Supporting Staff Grade II
15. Shri. N. K. Masani	:	Supporting Staff Grade II
16. Smt. Pushpaben P. Chudasama	:	Supporting Staff Grade II
17. Smt. Motiben K. Fofandi	:	Supporting Staff Grade II
18. Shri. Thinakaran	:	Supporting Staff Grade I
19. Shri. N. Arockia Shaji	:	Supporting Staff Grade I

Auxiliary

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

VISAKHAPATNAM RESEARCH CENTRE

Scientific Personnel

1	Shri. A.K. Chattopadhyay	:	Principal Scientist
2	Dr. R. Chakrabarti	:	Principal Scientist
3	Dr. G. Rajeswari	:	Scientist (Sr. Scale)
4.	Shri. U. Sreedhar	:	Scientist (Sr. Scale)
5.	Dr. R. Raghu Prakash	:	Scientist (Sr. Scale)
6.	Dr. B. Madhusudana Rao	:	Scientist
7.	Shri. J. Charles Jeeva	:	Scientist

Technical Personnel

1.	Shri. B.C. Besra	:	T-7 (Technical Officer) (Skipper)
2.	Shri. A. Veeranjaneyulu	:	T-6(Technical Officer)
3.	Shri. V.V. Ramakrishna	:	T-6(Technical Officer)
4.	Shri. C. Srihari Babu	:	T-5(Technical Officer)
5.	Shri. K.V.S.S.S. K. Harnath	:	T-5(Technical Officer)
6.	Shri. U. Alagumalai	:	T-5(Technical Officer) (Bosun)
7.	Shri. K. Santhosh Alex	:	T-4(Junior Hindi Translator)
8.	Shri. K. Prakasa Rao	:	T-4(Engine Driver)
9.	Shri. N. Ventaka Rao	:	T-3(Field Assistant)
10.	Shri. M. Venkateswara Rao	:	T-3(Driver)
11.	Shri. P. Radhakrishna	:	T-2(Junior Laboratory Assistant)
12.	Shri. V. Kamaraju	:	T-1(Tindal)

Administrative Personnel

1.	Shri. G.C. Adhikari	:	Assistant
2.	Smt. B. Hemalatha	:	Assistant
3.	Smt. D.A.L. Satyanarayanamma	:	Personal Assistant
4.	Shri. Y. Kanakaraju	:	Upper Division Clerk
5.	Shri. G. Chinna Rao	:	Upper Division Clerk

Supporting Personnel

1.	Shri. Orilika Heman	:	Supporting Staff Grade IV
2.	Shri. C. Kamaraju	:	Supporting Staff Grade IV
3.	Shri. B. Sivanadam	:	Supporting Staff Grade III
4.	Shri. K. Appa Rao	:	Supporting Staff Grade III
5.	Shri. S. Appa Rao	:	Supporting Staff Grade III

MUMBAI RESEARCH CENTRE

Scientific Personnel

1.	*Shri. S.P. Damle*	:	*Senior Scientist*

Technical Personnel

1.	Smt. Sangeetha D. Gaikwad	:	T-5 (Technical Officer)
2.	Smt. Triveni Gopal Adiga	:	T-5 (Technical Officer)
3.	Shri. B. B. Pinjari	:	T-2 (Driver)
4.	Shri. P. B. Bait	:	T-1 (Plant Attendant)
5.	Shri. T. A. Waghmare	:	T-1(Junior Laboratory Assistant)

Administrative Personnel

1.	Shri. M. S. Bhatkar	:	Assistant
2.	Smt. Smitha K. Shirishkar	:	Assistant
3.	Shri. A. N. Agawane	:	Upper Division Clerk

6. Shri. S. Chakram	:	Supporting Staff Grade III
7. Shri. V. Venkata Ramana	:	Supporting Staff Grade II
8. Shri. G. Bhushanam	:	Supporting Staff Grade II
9. Shri. M. S. Prabhakara Rao	:	Supporting Staff Grade I
10. Smt. Nalla Naveena	:	Supporting Staff Grade I
11. Shri. P. Ramakrishna	:	Supporting Staff Grade I

BURLA RESEARCH CENTRE

Scientific Personnel

1 Dr. M.M. Prasad	:	Senior Scientist
2 Shri. Prem Kumar	:	Scientist

Technical Personnel

1. Shri. B.K. Pradhan	:	T-5(Technical Officer)
2. Shri. B. K. Panda	:	T-5 (Technical Officer)
3. Shri. A. K. Panigrahi	:	T-5 (Technical Officer)
4. Shri. P.M. Pattanayak	:	T-4 (Lab. Technician)
5. Shri. Kirtan Kisan	:	T-3 (Electrician)
6. Shri. Sathrughan Kumura	:	T-3 (Tindal)
7. Shri. Damodar Rout	:	T-3 (Junior Laboratory Assistant)
8. Shri. A.K. Naik	:	T-3 (Mechanic)
9. Shri. H.S. Bag	:	T-2 (Driver)
10. Shri. Surjananda Dishri	:	T-1 (Junior Laboratory Assistant)

Administrative Personnel

1. Shri. J. K. Mishra	:	Assistant Administrative Officer
2. Shri. Udekar Pandey	:	Assistant
3. Shri. Laxminarayan Badi	:	Upper Division Clerk
4. Shri. Premlal Panda	:	Upper Division Clerk

Supporting Personnel

1. Shri. Gajendra Karali	:	Supporting Staff Grade IV
2. Shri. K.C. Mehar	:	Supporting Staff Grade IV
3. Shri. Santhosh Banchor	:	Supporting Staff Grade IV
4. Shri. Satrughan Seth	:	Supporting Staff Grade IV
5. Shri. S.C. Mehar	:	Supporting Staff Grade IV
6. Shri. K.C. Nayak	:	Supporting Staff Grade IV
7. Shri. B.N. Guru	:	Supporting Staff Grade III
8. Shri. Jaisingh Oram	:	Supporting Staff Grade III
9. Shri. S.N. Mirdha	:	Supporting Staff Grade III
10. Shri. Godabari Mahanandia	:	Supporting Staff Grade III
11. Shri. D.L. Pattanaik	:	Supporting Staff Grade III
12. Shri. T.N. Banchor	:	Supporting Staff Grade II
13. Shri. S. N. Dash	:	Supporting Staff Grade II
14. Shri. B. K. Deo	:	Supporting Staff Grade II
15. Shri. Nande Oram	:	Supporting Staff Grade II
16. Shri. Sanyasi Ganik	:	Supporting Staff Grade II
17. Smt. Gyananetri Nag	:	Supporting Staff Grade I
18. Shri. Amit Vengraj	:	Supporting Staff Grade I

Supporting Personnel

1.	Shri. B. M. Ghare	:	Supporting Staff Grade III
2.	Shri. C. B. Kolvalkar	:	Supporting Staff Grade III
3.	Shri. V. S. Salvi	:	Supporting Staff Grade II

CALICUT RESEARCH CENTRE

Technical Personnel

1.	Shri. K. Vasudevan Nair	:	T-7(Technical Officer)
2.	Smt. Tara Karupalli	:	T-4 (Junior Laboratory Assistant)
3.	Smt. M. K. Sreelekha	:	T-4 (Junior Laboratory Assistant)
4.	Shri. T. Gangadharan	:	T-3 (Senior Laboratory Assistant)
5.	Smt. M.V. Valsala	:	T-2 (Field Assistant)
6.	Shri. T.P. Balakrishnan	:	T-2 (Driver)

Administrative Personnel

1.	Shri. M. Ravindran	:	Assistant
2.	Shri. K.P. Velayudhan	:	Assistant

Supporting Personnel

1.	Shri. P. Rajeev	:	Supporting Staff Grade II

HOSHANGABAD RESEARCH CENTRE

Supporting Personnel

1.	Shri. Rattan Chand	:	Supporting Staff Grade IV