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Annual Report

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Central Institute of Fisheries Technology

(Indian Council of Agricultural Research)

CIFT Junction, Matsyapuri P.O., Cochin - 682 029

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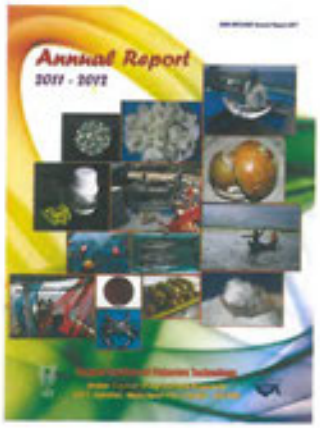

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Contents

Abbreviations used in the text

AAS	-	Atomic Absorption Spectrometer
ABS	-	Acrylonitrile Butadiene Styrene
AHD	-	1-aminohydantion
AKMU	-	Agricultural Knowledge Management Unit
AMOZ	-	3-amino 5-morpholino-methyl z-oxazolidinone
AOZ	-	3-amino-z-oxazolidinone
AP	-	Andhra Pradesh
APC	-	Aerobic Plate Count
APHA	-	American Public Health Association
ASTM	-	American Society for Testing and Materials
ATCC	-	American Type Culture Collection
ATIC	-	Agricultural Technology Information Centre
ATP	-	Adenosine Tri Phosphate
BCP	-	Bromocresol Purple
BCG	-	Bromocresol Green
BHC	-	Benzene Hexa Chloride
BIS	-	Bureau of Indian Standards
BOBP	-	Bay of Bengal Programme
BOD	-	Biological Oxygen Demand
BPDU	-	Business Planning and Development Unit
BRD	-	Bycatch Reduction Device
BTB	-	Bromothymol Blue
BV	-	Biological Value
CCA	-	Copper Chrome Arsenic
CD	-	Compact Disk
CFU	-	Colony Forming Unit
CIFT	-	Central Institute of Fisheries Technology
CIPET	-	Central Institute of Plastic Engineering Technology
CMFRI	-	Central Marine Fisheries Research Institute
CMLRE	-	Centre for Marine Living Resourses & Ecology
CNSL	-	Cashew Nut Shell Liquid
COFISKI	-	Community Fish Smoking Kiln
COS	-	Chito Oligo Saccharides
CPUE	-	Catch Per Unit Effort
CSH	-	Cell Surface Hydrophobicity
CT	-	Chilled Treated
DDG	-	Deputy Director General
DG	-	Director General
DHA	-	Dicosa Hexaenoic Acid
DNA	-	Deoxyribo Nucleic Acid
DO	-	Dissolved Oxygen
DPPH	-	Di Picryl Phenyl Hydrazine
DST	-	Department of Science and Technology
EAEC	-	Entero Aggregative *E. coli*
EEZ	-	Exclusive Economic Zone
EHEC	-	Entero Heamorrhagic *E. coli*
EIEC	-	Entero Invasive *E. coli*
ELISA	-	Enzyme Linked Immuno Sorbant Assay
EO	-	Essential Oil
EPA	-	Eicosa Pentaenoic Acid
EPEC	-	Entero Pathogenic *E. coli*
ERIC	-	Enterobacterial Repetitive Intergenic Consenses
ETEC	-	Entero Toxigenic *E. coli*
ETP	-	Effluent Treatment Plant
EU	-	Europian Union
EVC	-	Ethylene Vinyl Chloride
EVOH	-	Ethyl Vinyl Alcohol

FAO	-	Food and Agriculture Organization
FFA	-	Free Fatty Acid
FCR	-	Feed Conversion Ratio
FPH	-	Fish Protein Hydrolysate
FRP	-	Fibreglass Reinforced Plastic
FTIR	-	Fourier Transform Infrared Spectroscopy
GHP	-	Good Hygienic Practices
GIS	-	Global Information System
GMP	-	Good Manufacturing Practices
GPS	-	Global Positioning System
HACCP	-	Hazard Analysis and Critical Control Point
HAP	-	Hydroxyapatite
HCL	-	Hydro Chloric Acid
HDPE	-	High Density Poly Ethylene
HIPP	-	High Impact Poly Propylene
HIPS	-	High Impact Poly Styrene
HL	-	Head-less
HLSO	-	Head-less Shell-on
Hp	-	Horse Power
HPLC	-	High Pressure Liquid Chromatography
HPP	-	High Pressure Processing
HPV	-	Hepatopancreatic Parvo Virus
HTST	-	High Temperature Short Time
ICAR	-	Indian Council of Agricultural Research
ICMSF	-	International Council for Microbiological Specification of Foods
IHHNV	-	Infectious Hypodermal Haematopoetic Necro Virus
INCOIS	-	Indian National Centre for Ocean Information Services
IP	-	Intelletual Property
IQF	-	Individually Quick Frozen
JED	-	Juvenile Excluder Device
JFE-SSD	-	Juvenile Fish Excluder Cum Shrimp Sorting Device
KOH	-	Potassium hydroxide
LBW	-	Low Birth Weight
LCMS	-	Liquid Chromatography Mass Spectrograph
LDPE	-	Low Density Poly Ethelene
LED	-	Light Emitting Diode
LF	-	Low Frequency
LLDPE	-	Linear Low Density Poly Ethelene
LMWC	-	Low Molecular Weight Chitosan
L_{OA}	-	Length Over All
LOD	-	Limit of Detection
LPG	-	Liquified Petroleum Gas
MBV	-	Monodon Baculo Virus
MFP	-	Myo Fibrillar Protein
Mpa	-	Mega Pascal
MPEDA	-	Marine Products Export Development Authority
MPN	-	Most Probable Number
mpy	-	miles per year
MUFA	-	Mono Unsaturated Fatty Acid
MUG	-	Methyl Umbilliferyl beta D-Glucuronide
NaCl	-	Sodium chloride
NAIP	-	National Agriculture Innovation Project
NEH	-	North East Hill
NFDB	-	National Fisheries Development Board
NIO	-	National Institute of Oceanography
nm	-	nano meter
NPN	-	Non Protein Nitrogen
NPU	-	Net Protein Utilization
NRI	-	Natural Resources Institute
OAS	-	Optically Active Substances
OBM	-	Outboard Machine
OD	-	Optical Density
OPE	-	Oyster Peptide Extract
PA	-	Poly Amide
PAH	-	Poly Aromatic Hydrocarbon

PCA	-	Per Chloric Acid
PCR	-	Polymerase Chain Reaction
PD	-	Peeled and Deveined
PE	-	Poly Ethylene
PER	-	Protein Efficiency Ratio
PET	-	Poly Ester
PFZ	-	Potential Fishing Zone
PLC	-	Programmable Logical Control
PP	-	Poly Propylene
PPHF	-	Presumptive Psychrotrophic Histamine Forming
Ppb	-	parts per billion
ppm	-	parts per million
ppt	-	parts per trillion
PUD	-	Peeled and Un Deveined
PUFA	-	Poly Unsaturated Fatty Acid
PV	-	Peroxide Value
PVC	-	Poly Vinyl Chloride
QIM	-	Quality Index Method
RC	-	Revealed Competitiveness
RLU	-	Relative Luminosity Unit
RPLA	-	Reverse Passive Latex Agglutination
rpm	-	rotations per minute
RS-PCR	-	Ribosomal gene Spacer sequence PCR
RT-PCR	-	Reverse Transcriptase Polymerase Chain Reaction
SAC	-	Space Application Centre
SD	-	Standard Deviation
SDS-PAGE	-	Sodium Dodecyl Sulphate - Poly Acrylamide Gel Electrophoresis
SE	-	Standard Error
SEM	-	Scannig Electron Microscopy/Semi Carbazide
SGR	-	Specific Growth Rate
SHG	-	Self Help Group
SRC	-	Sulphite Reducing *Clostridium*
SS	-	Stainless Steel
SSOP	-	Standard Sanitation Operation Procedures
STPP	-	Sodium Tri Poly Phosphate
TBA	-	Thio Barbituric Acid
TBC	-	Total Bacterial Count
TCA	-	Tri Chloro Acetic Acid
TDH	-	Thermostable Direct Heamolysin
TDS	-	Total Dissolved Solids
TED	-	Turtle Excluder Device
TFA	-	Tri Flouro Acetic Acid
TFS	-	Tin Free Steel
TLC	-	Thin Layer Chromatography
TMA	-	Tri Methyl Amine
TMAN	-	Tri Methyl Amine Nitrogen
TN	-	Tamil Nadu
TOC	-	Total Organic Carbon
TPC	-	Total Plate Count
TSM	-	Total Suspended Matter
TSS	-	Total Soluble Sugar/Total Suspended Solids
TSV	-	Taura Syndrome Virus
TVBN	-	Total Volatile Base Nitrogen
US	-	United States
USFDA	-	United States Food and Drugs Administration
UV	-	Ultra Violet
VC	-	Vacuum Control
VFD	-	Variable Frequency Drive
VHF	-	Very High Frequency
VNTR	-	Variable Number Tandem Repeats
VT	-	Vacuum Treated
WHO	-	World Health Organization
WSSV	-	White Spot Syndrome Virus
WTO	-	World Trade Organization
YHV	-	Yellow Head Virus
ZTMU	-	Zonal Technology Management Unit

Preface

I am highly delighted to put before you the Annual Report of Central Institute of Fisheries Technology for the year 2011-12. The Institute continued its basic research, applied research and also the transfer of improved technologies during the year. As a result of sincere and concrete efforts, this year has been a remarkable year for CIFT.

During the period, a total of 131 training programmes were organized both within the Institute campus and outside. The programmes were on varied topics for the benefit of large number of stakeholders representing processing establishments, fishermen and fisherwomen, students, officials from state and central government organizations and others. A total of 30 outreach programmes on various harvest and post harvest technologies were conducted.

CIFT is handling 23 Institute and 19 externally funded projects sponsored by NAIP, INCOIS, SAC, DST, CMLRE, DBT and ICAR (Network Projects). CIFT had filed 13 patent applications. The newly extended wing of the Visakhapatnam Research Centre of CMFRI/CIFT lab-cum-office was inaugurated by Dr. S. Ayyappan, Director General, ICAR, New Delhi. The ZTM-BPD, South Zone at CIFT, Cochin launched an IP Channel, which is an online resource dedicated to disseminate information regarding Intellectual Property Rights and Technology Management. Dr. B. Meenakumari, DDG (Fisheries), ICAR inaugurated the Solar Fish Drying plant with LPG backup named, 'CIFT Dryer JSDL-55SM' designed, installed and commissioned at ICAR Research Complex, Manipur. A model fish drying unit was set up by CIFT, Cochin at Sevashram Swasrayagram, Angamaly and was formally inaugurated by Adv. Jose Thettayil, MLA, Angamaly. This year, Dr. Kasturirangan, Member (Science), Planning Commission, New Delhi visited CIFT, Cochin and interacted with the scientists about the on-going research work. A Stakeholders Meet was conducted by the Institute in association with Kumbalam Inland Fishermen Development Welfare Co-operative Society at Kumbalam and handed over three coconut wood fishing canoes designed and constructed by CIFT. The Institute conduced one day National Seminar on 'Indian seafood trade - Concerns and adaptive srategies' and a Workshop-cum-Brainstorming session on 'Forecasting technological needs for fishing and fish processing sectors in India'. A 10 day training programme on 'Vistas in nutrient profiling and nutritional labelling of seafood' funded by ICAR, New Delhi was conducted to cater to the needs of young scientists/teachers in the field of Biochemistry and Nutrition.

CIFT has offered various consultancies on construction of hygienic fish market, NABL accreditation of Milk Testing Laboratory, State Laboratory for Livestock, design and construction of Effluent Treatment Plant (ETP), freshwater fish processing unit, production of chitin and chitosan from shrimp waste, design and construction of intermediate mechanized fishing craft, FRP vessels, solar dryers, HACCP certification etc. The Institute generated revenue by means of consultancy, training etc. during the year.

The research programmes of Fishing Technology Division focused on responsible fishing and preservation methods for fishing crafts and gears. Studies on coconut wood panels treated with natural preservatives like cashewnut shell liquid (CNSL), neem oil and fortified chitosan and chemical preservatives like Chromate Copper Arsenate (CCA) creosote, and dual preservative (CCA and Creosote) showed promising results. Surface morphology studies of nano graphene and nano cerium oxide incorporated aluminium using SEM showed that there was a distinct variation in morphology with respect to composition and materials. The corrosion protection increased significantly on addition of nano cerium oxide along with

nano grapheme. Studies on short body shrimp trawl showed that by reducing the funnel length and vertical height of trawl mouth, a 5-10% reduction in quantity of bycatch resulted without affecting the shrimp catch. Cut-away top belly shrimp trawl facilitated increase in shrimp catch with significant reduction in the trawl bycatch. Designed and developed 26 m multi seam finfish trawl for demersal fish resource exploitation and a 300 x 200 mm fish eye with vertical opening.

The Institute emphasized on the development of safe and value added products from fishery resources with extended shelf life. Ready to eat flash fried mince based products, instant fish gravy mix, value added fish products from lizard fish etc. were developed. CIFT also developed a pet food for dogs from tuna canning waste which provide more than 300 calories of energy per 100g and was found superior to commercial pet foods available in the market. Foliar spray prepared from fish waste and squid waste showed promising results. Studies were continued to develop antimicrobial films and freshness indicators for checking quality of fish and fishery products.

Research work on seafood quality assurance and management was carried out at the Institute. Quality Index Method (QIM) scheme validated with an array of biochemical, microbiological and instrumental parameters was developed. Studies on the antimicrobial properties of phytochemicals from seaweed showed promising results. Studies were carried out to elucidate their survival pattern in different preservation methods like freezing, active packaging, solar disinfection, etc.

Research work in Microbiology, Fermentation and Biotechnology Division focused on studies on bacterial flora associated with retail fish markets in Kerala and farmed fish. Genomic library of *Paenibacillus elgii* was constructed. Studies on the production of chitinase by *Vibrio alginolyticus* and *V. harveyi* were carried out.

Nutritional profiling studies of fish, oysters, mussel, scampi etc. were carried out by the Biochemistry and Nutrition Division. Oyster peptide extract (OPex) was developed and its properties were studied. The OPex exhibited good anti-inflammatory, antioxidant and antimicrobial properties. The encapsulated product was launched by Hon'ble DG, ICAR.

The Engineering Division designed and developed a renewable energy solar biomass hybrid dryer for ecofriendly and hygienic drying. A fish de-scaling machine was designed and fabricated. A live fish storage unit was designed and fabricated.

The Extension, Information and Statistics Division conducted socio-economic data collection from fishermen and persons engaged in allied activities in the fisheries sector across the country. It was found that persons engaged in marketing and processing have better literacy skills than in other sectors.

The Institute continued to cater to the industry, fisheries and students by conducting regular training programmes at the Institute and at different parts of the country under outreach programmes.

I hereby compliment all my colleagues for their immense support and creditable work, and thank the fishing industry, fish farmers, fish processing industry, fish consumers, state governments and the ICAR for all the help rendered in carrying out our activities. I am also grateful to the Institute Management Committee for their cooperation and concrete support. I look forward to your constructive criticism and suggestions to improve our research work.

Cochin
30 July, 2012

(Dr. T.K. Srinivasa Gopal)
Director

Executive Summary

- Coconut wood panels treated with natural preservatives like neem oil, Cashewnut Shell Liquid (CNSL), fortified chitosan and chemical preservatives like Chromate Copper Arsenate (CCA), creosote and dual preservative (CCA and creosote) were exposed to marine, atmospheric and soil conditions for five years. Studies revealed that among the natural preservatives, CNSL treated panels showed most resistance to biodeterioration and among the chemical preservative treatments; dual protection treatment was the best in protecting experimental panels of coconut wood.
- The performance of three coconut wood canoes (6.4 m L_{OA}, 0.83 m breadth and 0.42 m depth) put to field trials for eight months of operation was found to be good.
- The treated rubber wood canoe and FRP sheathed rubber wood canoes put to field trials showed signs of biodeterioration problems as they completed 7.5 - 8 years of operation.
- The hooks (Mustad No. 7) exposed to salt spray showed a loss in break load of 37.1 and 46.7% of the original load after 400 and 500 h of exposure, respectively.
- The comparative fouling settlement on different synthetic netting materials used for cage culture showed that after five months exposure to marine waters, maximum fouling biomass was on HDPE twisted monofilament netting followed by sapphire, dyneema (ultra high molecular weight polyethylene), nylon multifilament and the least on nylon monofilament netting.
- Surface morphology studies of nano graphene and nano cerium oxide incorporated aluminium using SEM showed that there was distinct variation in morphology with respect to composition and materials. The particles were uniformly distributed in the matrix. Linear polarization studies showed that the corrosion potential increased significantly on addition of nano cerium oxide along with nano-graphene.
- By reducing the funnel length and vertical height of trawl mouth of short body shrimp trawl, a 5-10% reduction in quantity of bycatch has been achieved, without affecting the shrimp catch.
- In cut-away top belly shrimp trawl, the larger horizontal spread has facilitated the increase in the shrimp catch due to more towing area. Shrimps, being poor swimmers, get collected in the codend, whereas the fishes (bycatch) actively swim and escape from the net, through the top opening.
- Myctophids and other bycatch species were identified from the bycatch of deep sea shrimp trawlers operating off Kollam and Cochin base. Forty seven species including eight species of Myctophids were identified from deep sea shrimp trawl bycatch.
- Design of 45 m four equal panel experimental Myctophid trawl has been completed and two trawls have been fabricated, for operation from FORV Sagar Sampada.
- Updated the database on Myctophid species reported from Indian Ocean, including information on geographical distribution. A total of 137 Myctophid species belonging to 28 genera have been included in the database.
- Decomposition study of *in vivo* phytoplankton absorption using derivative analysis indicated that the pigment composition reflected from the spectral shape and magnitude of the phytoplankton absorption curve resembled the concentration in the natural assemblage from where the sample were collected. Each phytoplankton species has its unique pigment signature and therefore contributes to the shape of the absorption spectrum.
- The 4th derivative regression analysis was found to be an efficient tool for the estimation of chlorophyll-a concentration from phytoplankton retained on filters and is very useful for the monitoring of phytoplankton dynamics using chemotaxonomic marker pigments.
- The maximum absorption of CDOM was during the pre-monsoon season indicating high terrigenous inputs during this period.

- The data collected from the sardine shoal sighted areas indicated the post-monsoon season as the most productive season during the year in terms of chlorophyll-a concentration, which ranged from 0.167 to 10.88 mg m^{-3}. The highest concentration detected in sardine shoal sited water was during post-monsoon period and the lowest during pre-monsoon period.
- Designed and developed 26 m multi seam finfish trawl for demersal fish resource exploitation and the performance was compared with conventional two seam trawl.
- Designed a Juvenile and Trash Excluder Device of semi curved rigid sorting grid design.
- Designed and developed a 300 x 200 mm fish eye with vertical opening and the diversity parameters of catch were analyzed.
- Gear parameter studies were conducted in Cruise No. 291 of FORV Sagar Sampada using the Simrad ITI system available onboard.
- The quality and shelf life of fresh *Pangasionodon hypophthalmicus* fillets treated with potassium sorbate, essential oils (EO) from clove and curry leaf, packed under vacuum were studied. Samples treated with EO from curry leaf showed maximum shelf life of 15 days followed by 13 days with EO from clove and potassium sorbate.
- Effect of short time marination of *P. hypophthalmicus* fillets with acetic acid and sodium chloride on the quality and shelf life was evaluated. Marinated samples had a shelf life of 14 days in chilled storage and control samples had a shelf life of 10 days.
- Fish croquette, a mince based coated product was prepared with Rohu mince and incorporating soy powder as a partial replacer for fish mince in different combinations. The croquette prepared using 25% soy flakes in place of fish mince was found to be better than 100% fish mince based croquette in terms of sensory and texture properties.
- The effect of washing on surimi prepared from *P. hypophthalmicus* was studied. Both single wash and double wash surimi gels exhibited high expressible drip and low water holding capacity with double wash surimi gel showing significantly higher values. The gel strength, and textural parameters like hardness, and stiffness were significantly higher for single wash surimi. The additional washing resulted in a significant decrease in the total pigment content of the double wash surimi.
- Prepared a ready to eat flash fried fish paste product from rohu mince incorporating the EO of clove and curry leaf. Extension of shelf life for five days and three days was observed in samples treated with the curry leaf EO and clove EO respectively. The control sample had 12 days of shelf life under the same conditions.
- Developed an instant fish gravy mix for two types of fish curry. This gravy paste was dried under three different conditions. *viz*., mechanical, vacuum and freeze-drying. Vacuum dried product had higher sensory score. A patent application is being filed for this product.
- Lizard fish was studied for its suitability for value addition. Several products such as fish balls, fish cutlets, fish fingers, fish burger, fish pickle, high quality salted and dried fish, ready to eat fried product, canned product, etc. have been developed and were found to have good acceptability.
- Heat penetration characteristics of tuna canned in coconut oil, ground nut oil and sunflower oil was carried out for standardizing the thermal processing techniques. Thermal processing was carried out for 45 min. at 121°C. An Fo value of 10 min was obtained for coconut oil and ground nut oil while for sunflower oil it was 12 min.
- The seafood mix in brine pack was more acceptable. Storage studies showed that the sea food mix in tomato sauce was not acceptable beyond seven months while the product in brine medium was acceptable up to nine months.
- Ready to serve canned leather jacket curry was developed in TFS cans. A process lethality of around 10.75 was found sufficient for softening the hard bones as well as for sterility. The product had excellent organoleptic characteristics and good acceptability.
- Pet food for dogs was formulated from tuna canning waste consisting of red meat, white meat trimmings, skin and bones. Cereals, pulses and vitamins were incorporated to make it a rich source of protein,

carbohydrate and vitamins. The product also provided good quantity of minerals. 100g of pet food provided more than 300 calories of energy and was found superior to commercial pet foods available in the market.

- Feeding studies were carried out in chicks with fish waste silage and squid waste silage incorporated feed. Dried sardine meal was used as control. Forty five days old chicks were fed with the test feeds for 30 days. No significant difference in growth parameters was observed. The silage-based chick feed is a cheaper replacement for whole sardine meal.
- Hydroxyapatite was prepared from deproteinised fish scale from rohu and catla. Fish scales were converted to hydroxyapatite by a heat treatment process at different temperatures and for different conversion durations based on statistical model.
- Foliar spray was prepared from fish waste and squid waste and biochemical quality parameters assessed. When applied in ladies finger plants, it was observed that plants applied with fish based foliar spray had better performance in terms of production when compared to the control plants.
- Edible fish powder was prepared from trawl bycatch (*Ambassys commersoni*). The head and gut of the fish was removed and it was autoclaved for 30 minutes, dried and powdered. The dried powder was assessed for compositional analysis and nutritive value. The optimum level of incorporation of the edible powder in chutney mix was evaluated by sensory analysis. It was observed that 20% incorporation of the edible powder in chutney base is optimum. Storage studies of the product under room temperature was carried out and it was found to be stable even after six months of storage.
- Fish-scale collagen peptides were prepared using different concentrations of alkalase enzyme to hydrolyze from rohu (*Labeo rohita*) and catla (*Catla catla*) scales.
- The peptide analysis using LCMS-MS revealed that peptides were predominantly of molecular weight less than 3000 Da. According to online databases, these peptides are present in human, bovine, fish and rat collagens.
- Fish bone from rohu and pangasius was separated and treated with proteolytic enzymes for 75 min. under optimum conditions. It was drained, washed thoroughly, and dried in hot air oven and powdered. The calcium isolated was encapsulated with supplemented vitamin.
- The incorporation of chitosan granules to LDPE and LLDPE showed antibacterial effects against both gram positive and negative organisms.
- Bromocresol purple and Bromothymol green were effective as fish freshness indicators for Horse mackerel steaks in HIPP trays under chilled conditions.
- Antimicrobial chitosan sponge indicated marked inhibitory effect on growth of bacteria tested with distinct inhibitory zones of diameter ranging 5-25 mm.
- The effect of ten natural antioxidants on quality characteristics of chilled, stored Giant Trevally fillets indicated a shelf life of 4-6 days for air packed, 6-8 days for Tocopherol and TUR 1001 treated samples, 8-11 days for vacuum packed, SGT 1004, Neaox OF001, Neaox OF002, Neaox P001, Neaox F001 and Neaox F002 samples and 11-13 days for samples treated with ROS 1011, SAG 6001 and ORE 6001, respectively.
- White prawn packed in brine and natural pack and processed to Fo value of 8 in see-through retort pouches were found acceptable up to 12 months.
- Yellow fin tuna steaks processed in brine, in oil and natural pack in indigenous see-through retort pouches and processed to Fo 10 had a shelf life of 12 months.
- The studies on bone powder from Yellow fin tuna suggests that boiling tuna bones in aqueous solution of 0.5% KOH is beneficial for preparing tuna bone powder.
- Chilled storage studies of Ghol, Horse mackerel and Mahi mahi indicated a shelf life of 18, 14 and 18 days for vacuum packed samples compared to 10, 10 and 8 days for air packed samples respectively.
- A shelf life extension of 14, 8 and 16 days was observed for chilled Mahi mahi, Horse mackerel and Ghol packed with oxygen scavenger compared to air packed samples.
- Indicators like Bromocresol purple, Bromothymol blue and mixed indicators can be used as freshness indicators of fishes under chilled conditions.

- Quality comparison of IQF squid (*Loligo duvauceli*) rings and cooked shrimps indicated no major changes in quality except for water holding capacity.
- Shrimp samosa recipe incorporating cleaned and chopped shrimp (*Fenneropenaues merguiensis*) was standardized and quality changes of frozen shrimp samosa packed in HIPP trays indicated an increase in pH and TBA value, whereas total mesophiles counts decreased.
- Quality of Surajbari shrimps, cooked, salted and dried catfish eggs, dried Horse mackerel and commercially processed surimi were monitored for various attributes.
- Collagen prepared from fish scales indicated a protein content of 90% and moisture and mineral content of 8-10% and 2%, respectively.
- Texture analysis of raw and cooked shrimps, squid rings, tentacles and cuttle fish indicated a higher hardness for raw products and higher chewiness, cohesiveness, springiness and gumminess for cooked products.
- Ready to eat product from Kardi (*Palaemon* sp.) was prepared and the product remained tasty and crispy during storage for nine months at ambient temperature.
- Bombay duck marinade was prepared using 3% acetic acid and 10% salt; sample stored at room temperature was found to be acceptable upto 19 days.
- Dressed pabda (*Ompok pabda*) dipped in 0.1M citrate buffer (sodium citrate + citric acid) was acceptable up to 48 hrs. at ambient temperature (26± 2°C).
- Dried and laminated Bombay duck was prepared after treatment with 2% salt and 0.2% potassium sorbate as well as 4% salt and 0.2% potassium sorbate and packed under vacuum; the product was found in good quality even after three months of storage at ambient temperature.
- A draft Quality Index Method (QIM) scheme validated with an array of biochemical, microbiological and instrumental parameters was developed for Indian mackerel *Rastrelliger kanagurta*.
- Challenge studies with different foodborne pathogens were carried out to elucidate their survival pattern in different preservation processes like chilling, freezing and in multiple barrier modes.
- Challenge studies with *Escherichia coli* O157:H7 indicated that this pathogen could survive even after freezing at -40°C (90 min.) and subsequent cold storage condition (-18°C) for more than 15 months.
- Inoculated pathogenic pandemic strain of *Vibrio parahaemolyticus* i.e. O3:K6 Serotype could be isolated from fish substratum after freezing (90 min. at -40°C) and subsequent cold storage at -18°C upto 14 weeks.
- Phytochemicals extracted from *Lawsonia inermis*, *Scoparia dulcis* and the seaweed exhibited broad spectrum antibacterial activity against pathogenic and spoilage flora encountered in seafood.
- Inclusion of oxygen scavenger pack during chilled storage substantially reduced survival of *Staphylococcus aureus* in Yellow fin tuna meat.
- Evaluation of sanitation regime of different seafood processing industries indicated inefficacy of current cleaning schedule for food contact surfaces, where APC as high as 8.4 x 10^5cfu/cm^2 and ATP bioluminescence of 7683 RLU was observed.
- Studies on solar disinfection of water have shown that almost all inoculated non-spore forming food-borne pathogens such as *Salmonella*, *Vibrio cholerae*, *Listeria monocytogenes*, etc. could be eliminated within three hours of exposure to direct sunlight in PET or glass bottles.
- Simulated temperature abuse studies in Yellow fin tuna indicated maximum rate of histamine formation i.e. 15.2 ±0.01 ppm per hour at 30°C.
- Prolific Histamine forming bacteria like *Morganella morganii* could produce substantial amount of histamine in Yellow fin tuna mince during prolonged storage at 5-7°C.
- Validation of consumer preference for fish products by various microbiological and biochemical tests revealed that consumers ignored safety attributes while selecting high priced commodities.
- Hygiene survey of various fish markets of Kerala indicated presence of pathogens like *Salmonella*, *Vibrio cholerae* non-O1 and *Escherichia coli* O157:H7 in products, ice and water supply.
- Profiling studies of Skipjack tuna and Yellow fin tuna landed at Machilipattanam (AP), Nagapattanam (TN)

and Cochin (Kerala) revealed higher accumulation of heavy metals in Skipjack tuna.

- Mass Spectral Libraries of commonly used antibiotics used in aquaculture was developed for rapid screening of the antibiotics and its metabolites in muscle, water and sediments.
- Mass Spectral Library for Histamine was developed for rapid identification and low level screening of the biogenic amine.
- Clam samples were kept in different environmental conditions for about a week for heavy metal analysis. The level of iron and nickel was found to be between 9.718-144.74 and 6-1.075 ppm respectively.
- *Strongylura* sp. had the highest level of Histamine *i.e.*, 20 mg%. *Sardinella longiceps* fish contained 10-12mg% and *Clarias batrachus* contained the Histamine level 13.32mg%. Histamine forming bacteria was positive for 63 samples (90%) in 37°C whereas 18 samples (25.71%) were positive at 15°C; and the counts were 10-30 and 5-20 /g for 37°C and 15°C respectively.
- 1.315 ppm of cadmium was present in one squid sample. In fish samples the level of cadmium was between 0.02–0.531ppm. It indicates that the environment is contaminated with cadmium. Lead content was highest in the muscle of mullet and croaker from Vashi creak (Maharashtra) as 0.632 and 0.699 ppm respectively; sediment of creak also contained 2.52 ppm lead. *Chirrocentrus dorab* contained the highest nickel level of 2.56 ppm.
- *Vibrio cholerae* O1 biovar El Tor Ogawa was detected in three out of 148 seafood samples tested and molecular characterization revealed presence of *tcpA*, *ctx*, *zot*, *ace* and *toxR*, genes.
- Out of 34 fish and shellfish samples collected from retail markets located at Alappuzha and Kottayam districts, 55% were found to be positive for *Vibrio parahaemolyticus*. Among 54 isolates, five strains were positive for *tdh* gene while *ORF8* gene could not be detected in any of the strains.
- *Clostridium botulinum* Type E was detected in two out of 16 samples comprising of farmed fish, pasteurized crab meat and fish products tested.
- Biotype 1A strains of *Yersinia enterocolitica* from fish carried *ystB*, *fepA*, *fepD* and *inv* genes and lack virulence genes including *ail*, *myfA*, *ystA* and *ystC*.
- *Listeria monocytogenes* isolates from fish and ice samples harboured virulent genes *hly*, *plcA*, *iap*, *mpl*, *prfA* and *act A*.
- *Campylobacter jejuni* was detected in two out of 26 fish samples.
- *Escherichia coli* O157:H7 was not detected in any of the 54 samples including 15 water samples (five from river, five from estuary and five from freshwater environment) and 39 fish samples (from landing centres and fish markets located at Alappuzha and Kottayam districts). One sample was positive for enterohaemorhagic *E. coli*.
- One hundred and eight isolates of *Staphylococcus aureus* from fish collected from retail outlets in Alappuzha, Kottayam and Ernakulam districts harboured *coa* gene. Enterotoxin genes *SEC*, *SED*, *SHE* and *SEJ* were absent in all the strains. 90% of the strains had *SEG* gene. *SEA*, *SEB*, *SEE* and *SEI* enterotoxin genes were present in 19%, 20%, 21% and 25% of the strains respectively.
- Antimicrobial resistance to Oxacillin and intermediate resistance to Vancomycin was detected in <3% of the 70 *Staphylococcus aureus* isolates from fish and shellfish.
- Studies on efficacy of different concentrations of H_2O_2 (0.1, 0.2 and 0.3%) on biofilm formed by enteropathogenic *Escherichia coli* (EPEC) on glass slide revealed that all three concentrations of H_2O_2 used can reduce the EPEC *E. coli* population in biofilm after 5 min exposure by 1.939, 3.324 and 3.635 Log_{10}cfu/cm^2, respectively from a concentration of 7.539 Log_{10}cfu/cm^2.
- Studies on bacterial flora associated farmed catfish (*Pangasianodon hypophthalmicus*) and farmed rainbow trout (*Oncorhynchus mykiss*) showed that the microflora was dominated by *Pseudomonas* (*P. fluorescens* and *P. aureofaciens*), *Aeromonas*, Enterobacteriaceae (belonging to the genera *Proteus*, *Providencia*, *Citrobacter* and *Morganella*), *Moraxella*, *Acinetobacter* and *Flavobacterium*.
- Genomic library of the *Paenibacillus elgii* was constructed by partial digestion of the genomic DNA and ligation of fractionated genomic fragments of 2-5 Kb size with

digested pUC18 plasmid resulted in 1200 transformants and none of the 400 transformants screened had the full length chitinase gene.

- Studies on production of chitinase by *Vibrio harveyi* and *Vibrio alginolyticus* revealed that *V. alginolyticus* had greater chitinase activity (134 U/L after one day) than *V. harveyi* (84 U/L after two days). The fed-batch fermentation using a mixed culture of *V. harveyi* and *V. alginolyticus* yielded a product with 990 units of chitinase and a specific activity of 1.250 U/mg by the end of three days of fermentation.
- Studies on lab scale fermentation of alkaline protease from marine bacteria, *Bacillus subtilis* SQ12 in a three Liter Lab scale bioreactor using fish waste based media formulation showed an enzyme activity of 240 U/ml and activity of 410 U/ml for after 24 h and 48 h respectively.
- cDNAsuppression subtractive hybridization of *Mangrovibacter* cells grown under normal (0.5% salt) and salt stressed (5.5% salt) conditions resulted in 37 uni-ESTs that comprised of 25 contigs and 12 singletons, most of which directly or indirectly involving in abiotic stress.
- Difference in load of TPC, H_2S producing bacteria, *Staphylococcus aureus*, faecal Streptococci and MPN of Total Coliforms, faecal Coliforms and *E. coli* between male and female of *Penaeus monodon, P. indicus* and *Macrobrachium rosenbergii* was studied.
- Study on the incidence of pathogenic *E. coli* in fish employing Multiplex PCR was carried out.
- Studies on production of chitinase by *V. harveyi* and *V. alginolyticus* indicated that maximum bioluminescence was associated with low chitinase production while maximum chitinase production was associated with decreasing bioluminescence during fermentation of colloidal chitin in both shake flask and bioreactor culture.
- Isolation and identification of spoilage and pathogenic bacteria from fishery products, water and ice were monitored.
- Sulphate reducing *Clostridia* were found to be positive in 62 samples (88.57%) and the count were between 0.9 – 25/g. It indicates that the Thane creek region (Maharashtra) is heavily contaminated with animal excreta.
- Nutrient profiling of oysters indicated significant proportion of omega-3 fatty acids (51.2%) especially EPA and DHA in the muscle.
- Nutrient profiling of mussels indicated significant proportion of omega-3 fatty acids especially EPA (16-21%) and DHA (29-32%) in the muscle.
- Amino acid profile of oysters and mussels (*Perna viridis*) indicated the presence of all essential amino acids highlighting its nutritive value.
- Oyster was found to contain significant amount of carbohydrate (3.2%), taurine (243mg/100g) and high content of cholesterol (106mg/100g). A high taurine: cholesterol ratio (2:3) was observed which indicate high health beneficiary effect.
- Pigment from shell waste of deep sea shrimp *Penaeus stylifera* was extracted using organic solvents. The yield was around 0.2g%. The antioxidant activity of the pigment was estimated which was relatively low.
- Shellfish of Arabian waters was examined for the presence of polyaromatic hydrocarbons. It is observed that shellfish of Arabian Ocean are devoid of any PAH content in their meat. The off-flavor compound analysis by Head space GCMS also did not indicated the presence of geosmin or its derivatives.
- Presence of chemical residues like heavy metals, pesticides and PAH was examined in edible oysters and mussels collected from the west coast of India. It is observed that oysters and mussels of west coast regions are not containing any toxic residues above the permissible limits.
- The elemental profiling of mussels have shown the presence of iron (128-142 ppm) in rich quantities. Also it contains the essential elements such as Cu (2.2 ppm), Zn (11-20 ppm) and Mg (8.5-9.1 ppm) in considerable quantities.
- Mineral composition reflects the higher levels of Ca (300-333 ppm) and K (1057-1500 ppm) in mussel meat.
- The mussel available in west coast of India is not only safe for consumption, but also nutritionally beneficial for human health.

- An oyster peptide extract (OPex) was developed and properties studied. The OPex prepared from oyster meat exhibited good anti-inflammatory, antioxidant and antibacterial properties.
- Oyster peptide extract prepared was encapsulated for commercial applications. The product has been launched by Hon'ble DG, ICAR on 5th April, 2012 at CIFT, Cochin.
- A simple and fast method has been standardized for the production of biodiesel from fish oil. It is observed that addition of acetyl chloride enhances the rate of reaction.
- A hydrogel effective in absorbing dyes was developed from chitosan.
- Evaluated the pharmacological significance of marine molecules in alleviating age-associated disorders such as diabetes, myocardial infarction, atherosclerosis, obesity, cancer, etc.
- Created an integrated approach for the utilization of marine compounds for the production of nutritional supplements.
- Identified the molecular mechanisms involved in the alleviation of diseases/disorders by marine natural products.
- Antiulcerogenic effects of taurine was studied.
- Oral administration of taurine significantly attenuated the Ibuprofen-induced aberrations (hemorrhagic lesions) in the gastric mucosa and maintained the volume of gastric juice, acidity and peptic activity at near normalcy in albino rats.
- Taurine exerted an antioxidant property by counteracting Ibuprofen-mediated oxidative stress by maintaining mucosal antioxidant status at level comparable to that of controls.
- The results of the present investigation indicate that the antiulcer activity of taurine is attributable to its membrane-stabilizing and antioxidant properties.
- Dietary intake of chitosan (at 2% level) significantly attenuated the Isoprenaline-induced hyper-lipidemic and necrotic damage in myocardium.
- Chitosan also rendered an antioxidant action against Isoprenaline-induced myocardial infarction by maintaining the antioxidant status at higher rate.
- The results indicated that the cardioprotective potential of chitosan was probably ascribable to its hypolipidemic action and/or antioxidant property.
- Biochemical profile of *Diaphus watasei*, a common Myctophid along the west coast of India, collected off Cochin showed a fatty acid profile with high saturated fatty acids content (45%) followed by monounsaturated and polyunsaturated fatty acids.
- The cholesterol content was very low in *Diaphus* compared to other pelagic fishes like oil sardine and Indian mackerel. All essential amino acids are present in a balanced proportion.
- Acid soluble collagen was extracted from tuna skin for the preparation of membrane and the yield was 14%.
- Three types of collagen were extracted from squid skin and biochemical characterization was done.
- Nutritional profiling was done for dried squid, canned squid curry and squid ink.
- Nutritional composition of farmed *Litopenaeus vannamei* (Whiteleg shrimp) and *Penaeus monodon* (Black tiger shrimp) were compared.
- Studies on nutritional composition and biochemical quality evaluation of scampi (*Macrobrachium rosenbergii*) was carried out.
- Nutritional and biochemical characteristics of pacu (*Piaractus brachypomus*) and milk fish (*Chanos chanos*) were studied.
- Nutritional composition and chemical and microbial hazards in crabs were studied.
- Designed and developed a renewable energy solar biomass hybrid dryer for eco-friendly and hygienic drying.
- Designed and fabricated a fish de-scaling machine for removal of scales.
- Design optimization of solar fish dryer with alternate electrical backup heating system was carried out.
- A live fish storage unit was designed and fabricated to maintain fish under live condition with continuous water recirculation.
- Data collected from 31 fishermen respondents of

Alappuzha district operating 8.5m L_{OA} marine plywood boats revealed that the average total investment on a fishing unit was ₹ 3.95 lakhs of which the investment on engine alone was ₹ 1.63 lakhs.

- The data collected from 36 fishermen operating 8.5m L_{OA} marine plywood boats in the fishing centres of Kollam district revealed that the average number of fishing days was 260 per year. The average annual income/profit was about ₹ 1.80 lakhs with an average yearly operational expenses of ₹ 4.98 lakhs.
- Diminishing fish catches, increasing fuel prices, inadequate fuel subsidy, inadequate infrastructural facilities in landing centres and lack of access to institutional finance were reported as constraints.
- The data collected from 55 fisheries officials from different states revealed that the average satisfaction score on the perception about the organizational climate is 85%. The average job satisfaction score was 80%. The mean role expectation index for ten technology transfer roles was 81% calculated in terms of the importance of the each role.
- The mean role performance index for ten technology transfer roles was 59% calculated in terms of the performance of each role.
- The income earned by the fishing labourers who were going in the FRP boats ranged from ₹ 150 to ₹ 200 per day and for mechanized boat labourers, it ranged from ₹ 450 to ₹ 500 per day in Nagapattinam in Tamil Nadu.
- Quality, nutrition and taste were the highly significant parameters influencing the consumer preference for fish than convenience, price and family choice.
- A Model Fish Drying unit was set up at Swasrayagram Sevashram, Pullani, Angamaly. Capacity building training of ten women of an SHG, selected to run the unit was provided on fish handling, drying and accounting and financial management.
- The literacy, health and income status of persons engaged in allied activities in the fisheries sector, *viz*., processing and marketing were analyzed for the states of Kerala, Gujarat, Andhra Pradesh, Maharashtra, West Bengal, Madhya Pradesh and Delhi.
- In general, persons engaged in marketing and processing have better literacy skills than in other sectors as they deal with consumers and work in processing factories where education is an added advantage to their trade. The overall literacy rate was 80.69%. An educational institution was available within a radius of 6.26 km in all the states studied.
- The health status of persons engaged in allied post harvest activities in fisheries like marketing and processing was studied through recording observations regarding vaccination regime, discontinuation of vaccinations, birth weight of infants, incidence of maternal and child mortality, incidence of common diseases and special ailments including lifestyle diseases.
- The highest monthly average income generated by the sample respondents was through fisheries sector with an average amount of ₹ 41,057/- (83.46 per cent of the total income).
- It was found that single day fishing trips incured minimum or no loss and the entire catch was landed without any onboard discards. During the multi-day fishing operations, onboard discards were common when low value fishes were caught.
- A preliminary market survey was conducted at selected wholesale, retail and dry fish markets at Ernakulam and Chennai, and traders of fresh and dry fish were contacted. It was found that losses in marketing of fish varied depending on the species, type of packaging and mode of transportation.
- Under the NAIP 'Mobilizing mass media support for sharing agro information', two video films on success stories, seven short video films, ICAR showcasing window namely, 'Krishi Darpan' exhibition, 36 news paper reports, six AIR interviews, 12 TV channel reports and a TV programme in Doordarshan were produced.

Introduction

The Central Institute of Fisheries Technology (named at the time of inception as Central Fisheries Technology Research Station) was set-up following the recommendation of a high power committee constituted by the Ministry of Food and Agriculture, Government of India. It started functioning at Cochin on 29 April, 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 soon followed. The administrative control of the Institute was brought under the Indian Council of Agricultural Research on 1 October, 1967.

The CIFT is the only national centre in the country where research in all disciplines relating to fishing and fish processing is undertaken. Research Centres at present function at Visakhapatnam (Andhra Pradesh), Veraval (Gujarat) and Mumbai (Maharashtra).

Mandate

- To conduct basic, strategic and applied research in fishing and fish processing.
- To develop designs for fuel efficient fishing vessels and fishing gear for responsible fishing.
- To develop technologies for commercial isolation of bioactive compounds and industrially important products from fish and fishery wastes.
- To design innovative implements and machineries for fishing and fish processing and pilot plants for facilitating commercialization of technologies developed.
- To do advanced research in food safety in fish and fishery products.
- To provide training and consultancy services in fishing and fish processing.

Organizational set-up

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

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

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

The Institute has well equipped laboratories with modern, sophisticated, state-of-the-art equipment for both fundamental and applied research, an excellent library, a workshop and an animal house, an Agricultural Knowledge Management Unit (AKMU) and Agricultural Technology Information Centre (ATIC). The laboratories of the Institute also cater to the needs of the industry by testing processed fishery products, ice, water, and other materials like fishing gear and craft materials, packaging materials, marine paints, fishing craft, engines etc. A Business Planning & Development Unit (BPDU) is also functioning in the Institute to ensure commercialization of technologies on a public-private partnership mode. The Institute also facilitates IP management of ICAR Institutes in the Southern Region through the Zonal Technology Management Unit (ZTMU).

Budget

(For the year 2011-2012 - ₹ in Lakhs)

Particulars	Non-Plan		Plan	
Budget Head	Allocation	Expenditure	Allocation	Expenditure
Establishment charges	1550.00	1548.35	-	-
Overtime allowances	0.50	0.35	-	-
Travelling allowances	19.00	19.00	23.00	23.00
Works (Original)	-	-	100.00	99.97
Works (Maintenance)	117.00	76.80	-	-
Other charges (Equipments)	80.00	70.82	200.00	136.01
Other charges (Contingency)	59.50	97.21	455.40	428.89
Furniture and Fixtures	8.00	1.76	3.10	1.33
Library books	7.00	0.07	35.00	34.99
Other items	5.00	0.07	9.00	8.10
HRD	-	-	5.00	5.00
Information Technology	-	-	25.00	17.30
TOTAL	1846.00	1814.43	855.50	754.59

Staff Position

(As on 31 March, 2012)

Category	Sanctioned	Filled
Scientific	95	60
Technical	132	118
Administrative	81	70
Supporting	71	50
Auxiliary	6	4
TOTAL	385	302

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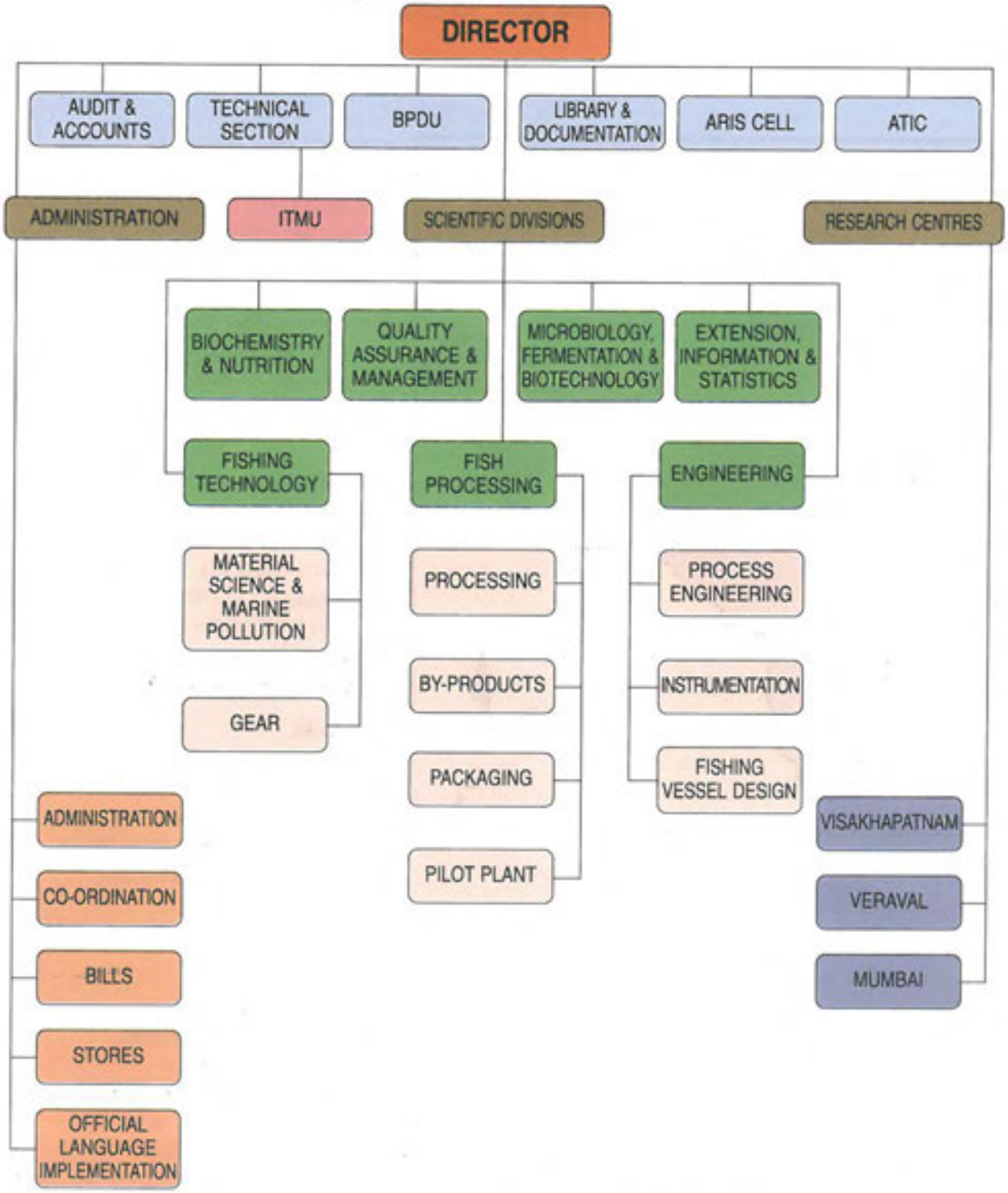
Organogram


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

A Quick Glance at Past Research Achievements

- CIFT has developed and introduced 12 standard designs of mechanized wooden fishing boats in the size range of 7.6 to 15.2 m L_{OA} for coastal and intermediate range. It is estimated that over 80% of the nearly 54,000 mechanized wooden fishing crafts in the Indian fishing fleet confirm to the popular CIFT designs or its later adaptations.
- Hull maintenance of the fishing vessels is important for increasing its service life. CIFT has developed a package of technologies for protection from bio-deterioration, fouling and corrosion for increasing the life span, substantially reducing maintenance cost of fishing vessels.
- Aluminium-magnesium alloy sheathing with cathodic protection and prescribed coating system was developed as a cost-effective substitute for copper sheathing for wooden hulls as protection against marine borers. This technology is widely used in the small-scale mechanized vessels.
- Epoxy resin-based coating developed has improved the life span of cast iron propellers, making it a cost-effective substitute for bronze propeller in fishing boats.
- Spheroidal graphite cast iron with nickel (21-24%) was recommended as substitute for conventional manganese-bronze for propellers of fishing boats, resulting in cost savings of 25-30%.
- Superior cost-effective antifouling paint formulations incorporating cuprous oxide and modified indigenous resins were developed for protection against fouling in fishing boats.
- CIFT has developed technologies for the chemical preservation and upgradation of low cost timbers to make them more durable. These have extended the service life of fishing crafts and contributed towards the efforts against deforestation.
- Technology was evolved for upgradation of cheaper secondary species of wood as substitute for boat scantling, by impregnation with styrene-polyester monomers, fortification with creosote/tributyl tin oxide and polymerization with gamma irradiation.
- Fibreglass canoes and fibreglass sheathed canoes made of rubber wood and introduced by CIFT have become very popular.
- Aluminium boats for reservoir fisheries is another innovation of CIFT.
- CIFT has made immense contribution towards the standardization of the netting, netting yarn and netting twine used for fishery purposes. These developments have led to an increase in the productivity of the fishing gear and increase in net profits due to low maintenance and long service life of the nets.
- CIFT has made significant contributions in the development of fishing gear and methods for the traditional sector, traditional motorized sector, small-scale mechanized sector and large-scale industrial sector in Indian fisheries, which is reflected in the increase in fish production.
- Improvements were made in the design and durability of lobster traps as substitute for traditional traps of short life span and low efficiency, for harvesting of spiny lobsters.
- A mini-trawl for operation from traditional crafts powered by outboard motors of 8-15 Hp, for shallow water shrimp trawling was introduced.
- The purse seine was introduced and popularized for operation from traditional plank built canoes (Thangu vallom) powered by outboard motors, for efficient harvesting of pelagic shoaling fishes. Since its introduction, the mini-purse seine has become very popular among the fishermen of motorized sector along the coast line of Kerala, significantly contributing to the landings of pelagic resources such as sardines, mackerels and anchovies.
- Specially designed trawl for shrimp trawling with vertical opening and extra long wings on either side was found effective for sweeping of wider horizontal area along the sea bed resulting in increased shrimp catch.
- Bulged belly trawl with relatively high opening was designed to improve the catch of fin fishes without compromising on shrimp catch.
- In high opening trawls, vertical opening of the trawl is increased by innovative design improvements, facilitating capture of demersal as well as off-bottom

resources.

- Large mesh trawl with relatively large meshes in the front portion resulted in significant reduction in trawl resistance, making use of the herding effect of large meshes on fin fishes. These deigns have been well accepted by the trawler fishermen of Gujarat, Karnataka and Kerala.
- Otter boards are sheer devices used in trawls for keeping the trawl mouth horizontally open. Different sizes of flat rectangular otter boards and vertically cambered otter boards have been introduced by CIFT for the benefit of small-scale mechanized fleet, during the course of its developments. V-form otter boards with high stability, better hydrodynamic efficiency, low maintenance cost and longer service life is now replacing the flat rectangular boards in the small-scale mechanized sector. Overall savings by adoption of V-form otter boards in place of flat rectangular boards is about 15%.
- Purse seines for catching pelagic fishes such as sardine and mackerel from small mechanized vessels has been developed.
- Long lines for sharks using indigenous hooks has been developed as a low energy resource-specific alternative to energy intensive, less selective fishing methods such as trawling.
- Troll lines for predatory fishes such as Spanish mackerel and barracuda using buffalo horn and stainless steel spoon and fish head jigs were developed.
- Marine gill net optimized for catching sardine, mackerel, Spanish mackerel, pomfret and hilsa, in terms of material and mesh size were introduced for the benefit of non-motorized and mechanized segments of the industry.
- Gear systems have improved the capture fishery production from the inland open water resources significantly over the years. Trammel nets and monolines were also introduced in reservoir systems.
- Technology for the extraction of chitin from shrimp shell and conversion to chitosan has successfully addressed a very serious environmental threat due to the careless disposal of the waste. A number of parties have already taken this technology and started production and marketing. Nearly 20% of the available shrimp shell waste is being used by these industries for conversion to chitin and chitosan. In addition to creating employment, this has become a highly remunerative industry.
- Ready-to-serve fish curry products in retortable pouches can be stored at ambient temperature. This revolutionary technology has been given to more than a dozen parties who have already started production and marketing. This technology has long-term impact in terms of value addition.
- Isinglass is a product that has got application as a clarifying agent in breweries, mainly in the beer industry. The technology was transferred to an industry for commercialization. This has resulted in the production of a value added product which has got demand in domestic and foreign market.
- The technology for extraction of Poly Unsaturated Fatty Acids (PUFA) from fish oil is a very important contribution towards nutritional security by providing a vital nutritional component. Many multinational companies are importing PUFA-enriched products and this technology will lead to import substitution. This value-added product will help in increasing the income of the fishermen.
- Collagen-chitosan film has wide applications as a wound dressing material and in dental surgery. It replaces the imported Teflon membrane used in dental surgery and the cost will be only a small fraction of that of the imported material. The raw material is fish air bladder, which does not find any use now. This technology can utilize the industrial waste and thus can enhance the income of the fishermen.
- Database on biochemical composition of fish serves as the major source of data for product formulation and nutrition labeling.
- A single step microbiological assay was perfected for detecting residues of eight antibiotics in seafood, *viz*., Chloramphenicol, Oxolinic acid, Tetracycline, Oxytetracycline, Furazolidine, Nalidixic acid, Neomycin and Trimethoprim which are commonly found used in aquaculture farms in India. The method can detect the antibiotic residues to a level of 0.1 ppm. About 65 seafood factories in Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat exporting seafood to EU and US are direct beneficiaries of this technology.
- A two step nested PCR method for the detection of White Spot Syndrome Virus (WSSV) in shrimps was developed, standardized, assessed and introduced for commercial use. This method can detect the presence

of as small as 10 virions per host larvae. The technology is being used for regular testing of post larvae before introduction in the farms.

- A RT-PCR method to test the presence of the devastating Yellow Head Virus (YHV) in shrimp farms was developed, assessed and commercialized. This is the only test method for YHV now available in India. The method is being currently used for screening frozen shrimp for YHV, being exported to the US, to meet the phytosanitary regulations of the WTO.
- An improved ELISA method for detection of residues of Chloramphenicol, a 'zero tolerant' antibiotic, in processed seafood for export to EU, US and Japan was evolved. This improved method was assessed and commercialized in 2003. It is now regularly used to monitor Chloramphenicol level in farmed and processed shrimps. Hundreds of shrimp farmers and seafood exporters have gained by the technology.
- The 'Chloritest paper' developed for detection of ppm levels of Chlorine in process water, an essential requirement to implement sanitation and hygiene practice in food processing industry, was transferred to M/s Glaxo Laboratories Ltd. This has resulted in the non-rejection of seafood/food items on the basis of contamination with pathogens significantly, resulting in substantial savings of foreign exchange of the country.
- Suitable programmes were organized for implementation of HACCP in the seafood industry. A software and multimedia CD was also developed for HACCP.
- Throughout India the effluent treatment system attached to seafood processing units is a neglected area resulting in serious environmental problems. To alleviate this problem of pollution by the seafood industry, an efficient effluent treatment plant was designed to treat the effluents conforming to the Pollution Control Board standards.
- The following engineering equipment have been developed by CIFT for use in fishing and fish processing:
  - Stainless Steel Tilting kettle
  - Oil fryer for battered and breaded products
  - Tunnel dryer
  - Fish meat bone separator
  - 15.5 m fuel efficient steel fishing vessel
  - Fiberglass canoes
  - Environmental data acquisition system
  - Temperature-Salinity meter
  - Ship-borne data acquisition system
  - Speed and distance log
  - Trawl depth meter
- The following aspects having management and policy level implications in fisheries have been studied by the Institute:
  - Idle capacity in fish processing plants in India
  - Price analysis of Indian seafood in the export market
  - Economics of artisanal fisheries
  - Economics of operation of fishing vessels of both west and east coast of India
  - Price spread in domestic fish markets of Kerala and Gujarat
  - Fuel utilization pattern by the fishing industry in India
  - Assessment of harvest and post harvest losses in fisheries
  - Estimation of inland fish landings in reservoirs
  - Harvest and post harvest losses in fisheries
- The institute also undertakes research studies which provide feedback for technology development and transfer. The following are some of the works undertaken:
  - Socio-economic profile of fisherfolk in different parts of the country and development of socio-economic status scale.
  - The areas and extent of participation of women in fisheries related activities.
  - The types and activities of Co-operatives and other organizations in fisheries and the role played by them in small scale fisheries.
  - Adoption behavior including extent of adoption, communication, decision making, response to technological gaps of fishermen in traditional, mechanized and motorized sectors and fish curers in relation to technology transfer by the Institute.
  - Evaluation of the training and extension programmes taken up by the Institute in terms of gain in knowledge, awareness, practices and constraints.
  - Studies on ban on monsoon trawling, coastal zone management and socio-legal issues.

RESEARCH ACHIEVEMENTS

Headquarters, Cochin

Fishing Technology Division

Research projects handled

- Studies on fortified natural biocides and corrosion resistant composite materials for protection of fishing craft and gear
- Responsible fishing using improved bottom and semi-pelagic trawls
- Responsible line fishing
- Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- Oceanic tuna fisheries in Lakshadweep sea: A value chain approach
- *In situ* time series measurements of bio-optical parameters off Kochi coast
- Euphotic zone production estimation using satellite data as an input to assess potential yield of pelagic herbivores in the Indian EEZ

Chief findings

- Coconut wood panels treated with natural preservatives like neem oil, Cashewnut Shell Liquid (CNSL) and fortified chitosan and chemical preservatives like Chromate Copper Arsenate (CCA), creosote and dual preservative (CCA and creosote), were exposed to marine, atmospheric and soil conditions for five years. Studies revealed that among the natural preservatives, CNSL treated panels showed most resistance to biodeterioration and among the chemical preservative treatments; dual preservation treatment was the best in protecting experimental panels of coconut wood.
- The performance of three coconut wood canoes (6.4 m L_{OA}, 0.83 m breadth and 0.42 m depth) put to field trials for eight months of operation was found to be good.
- The treated rubber wood canoe and FRP sheathed rubber wood canoes put to field trials showed signs of biodeterioration problems as they completed 7.5 - 8 years of operation.
- The hooks (Mustad No. 7) exposed to salt spray showed a loss in break load of 37.09 and 46.7% of the original load after 400 and 500 h of exposure, respectively.

- The comparative fouling settlement on different synthetic netting materials used for cage culture showed that after five months exposure to marine waters, maximum fouling biomass was on HDPE twisted monofilament netting followed by sapphire, dyneema (ultra high molecular weight polyethylene), nylon multifilament and the least on nylon monofilament netting.
- Surface morphology studies of nano-graphene and nano cerium oxide incorporated aluminium using SEM showed that there was distinct variation in morphology with respect to composition and materials. The particles were uniformly distributed in the matrix. Linear polarization studies showed that the corrosion potential increased significantly on addition of nano cerium oxide along with nano graphene.
- By reducing the funnel length and vertical height of trawl mouth of short body shrimp trawl, a 5-10% reduction in quantity of bycatch has been achieved, without affecting the shrimp catch.
- In cut-away top belly shrimp trawl, the larger horizontal spread has facilitated the increase in the shrimp catch due to more towing area. Shrimps, being poor swimmers, get collected in the codend, whereas the fishes (bycatch) actively swim and escape from the net, through the top opening.
- Myctophids and other bycatch species were identified from the bycatches of deep sea shrimp trawlers operating off Kollam and Cochin base. Forty seven species including eight species of Myctophids were identified from deep sea shrimp trawl bycatch.
- Design of 45 m four equal panel experimental Myctophid trawl has been completed and two trawls have been fabricated, for operation from FORV Sagar Sampada.
- Updated the database on Myctophid species reported from Indian Ocean, including information on geographical distribution. A total of 137 Myctophid species belonging to 28 genera have been included in the database.
- Decomposition study of *in vivo* phytoplankton absorption using derivative analysis indicated that the pigment composition reflected from the spectral shape and magnitude of the phytoplankton absorption curve resembled the concentration in the natural assemblage from where the sample were collected. Each phytoplankton species has its unique pigment signature and therefore contributes to the shape of the absorption spectrum.
- The 4th derivative regression analysis was found to be an efficient tool for the estimation of chlorophyll-a concentration from phytoplankton retained on filters and is very useful for the monitoring of phytoplankton dynamics using chemotaxonomic marker pigments.
- The maximum absorption of CDOM was during the pre-monsoon season indicating high terrigenous inputs during this period.
- The data collected from the sardine shoal sighted areas indicated the post-monsoon season as the most productive season during the year in terms

Fouling on coconut wood after six months exposure

of chlorophyll-a concentration, which ranged from 0.167 to 10.88 mg m^{-3}. The highest concentration detected in sardine shoal sighted water was during post-monsoon period and the lowest during pre-monsoon period.

Report of work done

Assessment of the efficacy of preservatives in protecting timber

Experimental panels of coconut wood of size 3x3x50 cm and 5x5x20 cm treated with natural preservatives (neem oil, cashewnut shell liquid (CNSL) and fortified chitosan) and chemical preservatives (*viz.*, Chromated Copper Arsenate (CCA), creosote and dual preservative (CCA+ creosote) were exposed to marine, atmospheric and soil conditions at the Institute test site and Institute premises respectively. Among the natural preservatives, CNSL showed the best result and among chemical preservatives, dual treatment performed the best.

Grade and index of coconut wood panels exposed for five years

	Treatment/ Exposure	Grade (Y)			Index (I)		
		Marine	Atmosphere	Soil	Marine	Atmosphere	Soil
	Control	4	4	0	1.10	5.50	0.00
Natural	Neem	4	10	4	1.60	9.89	2.00
Natural	CNSL	7	10	4	5.86	9.50	2.25
Natural	Chitosan	0	9	0	0.57	7.90	0.50
Chemical	CCA	9	10	10	7.89	9.67	9.69
Chemical	Creosote	7	9	9	6.71	8.30	9.00
Chemical	Dual	10	10	10	9.70	10.00	9.94

Grade (ASTM D 2481: 1982) 10 = Solid condition; 9 = Light attack; 7 = Moderate attack; 4 = Heavy attack; 0 = Lost/ Completely destroyed

Cassava extract treated wooden panels ready for marine exposure

Assessment of the efficacy of ecofriendly preservatives in protecting timber

The effect of a bio pesticide extracted from Cassava leaves was tested on *Artocarpus hirsuta*, *Calophyllum inophyllum*, *Hevea brasiliensis* and *Terminalia paniculata* wood. The effect of the treatment was compared with dual treatment and chitosan- copper complex treatment. Retention levels of the treatment were: CCA 30 kgm^{-3} + creosote 288 kgm^{-3} (dual treatment), 350 kgm^{-3} (cassava extract) and 30.6 kgm^{-3} (chitosan copper complex) respectively. The treated panels along with control were exposed to marine conditions at Institute test site and the performance monitored on weekly basis.

Performance monitoring of coconut wood canoes

The encouraging results of durability studies on preservative treated coconut wood panels led to the construction of three fishing canoes out of coconut wood from more than 50 years old trees and given different treatment methods. For evaluating the performance in the actual field conditions, the canoes were handed over to Kumbalam Inland Fishermen Development Welfare

Co-operative Society in a Stakeholders Meet conducted by CIFT, Cochin at Kumbalam.

The performance of the coconut wood canoes (6.4 m L_{OA}, 0.83 m breadth and 0.42 m depth) put on field trials for eight months of operation was found to be good.

Coconut wood canoe

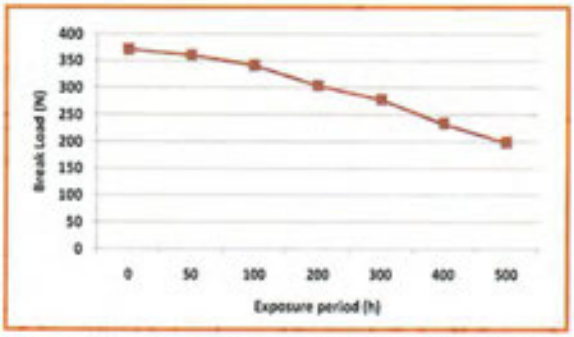
Rubber wood canoe

Performance monitoring of rubber wood canoes

The treated rubber wood canoe and FRP sheathed rubber wood canoes put on field trials showed signs of biodeterioration problems as they completed eight years of operation and were rectified. No further problems were noticed after the repair and all the canoes were found to be in good condition 18 months after the repair.

Assessment of the effect of corrosion on properties of fishing hooks

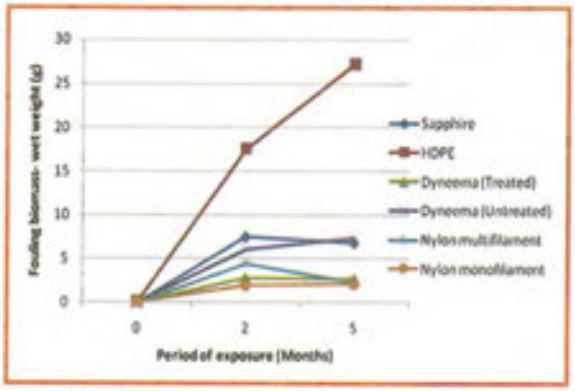
The corrosion of fishing hooks was tested by exposing hook Mustad No. 7 to salt spray for 500 hours as per ASTM B – 117 to assess weight loss, corrosion rate and change in mechanical strength. The hooks after 400 and 500 h exposure to salt spray showed a weight loss of 6.04 and 12.4%, corrosion rate of 23.81 ± 0.08 and 38.99 ± 0.21 mpy and a loss in break load of 37.1 and 46.7% of the original load after 400 and 500 h of exposure respectively.



Change in break load of fishing hooks exposed to salt spray

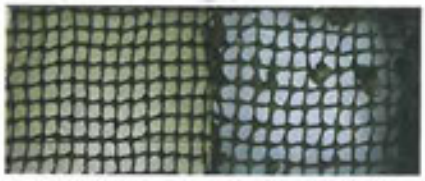
Assessment of the nature of fouling and effect of weathering on synthetic netting used for passive gear

The comparative fouling settlement on different netting materials used for cage culture was assessed by exposing samples of sapphire (high quality highdensity polyethylene - HDPE), polyamide (PA), high density polyethylene (HDPE) and dyneema (ultra high molecular weight polyethylene) netting to marine waters at the test site at Vizhinjam, Kerala state. The fouling biomass on netting



Fouling biomass on different synthetic netting

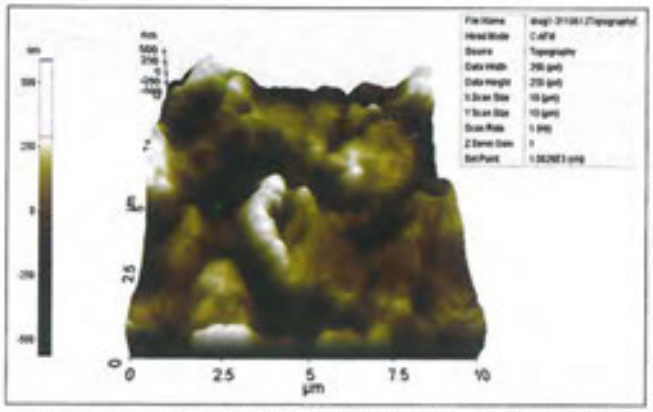
of 18 x 18 cm was assessed every 2-3 months of exposure. Antifouling treated dyneema netting had a fouling biomass of 2.82 g (wet weight) compared to untreated netting having 6.05 g on a netting of 18 x 18 cm within two months of exposure to marine waters. After five months exposure, maximum fouling biomass was on HDPE twisted monofilament netting followed by sapphire, dyneema, nylon multifilament and the least on nylon monofilament netting.



Control netting Netting with fouling settlement after five months exposure

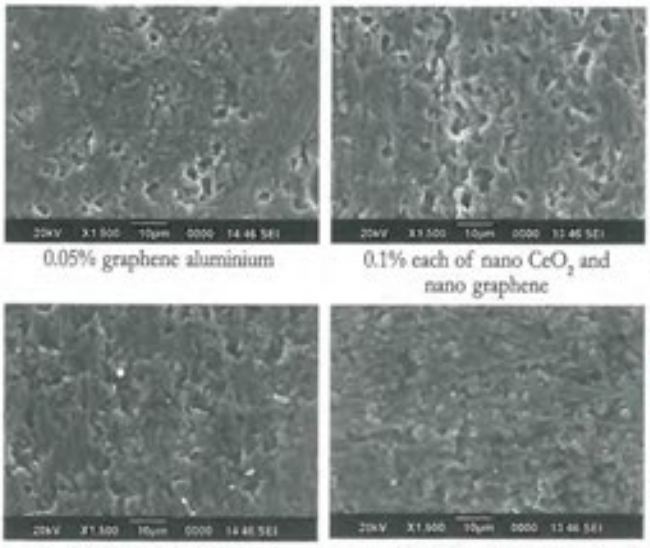
Netting samples of sapphire, PA, HDPE and dyneema were exposed to natural sunlight at the Institute premises for 12 months for assessment of the effect of photodegradation on break load and elongation of the netting. Testing protocols were standardized using Atlas Xenotest (Alpha Plus) for assessing the weathering resistance and colour fastness of different materials.

Electrochemical evaluation of nano graphene and nano cerium oxide incorporated aluminium for marine use



Atomic force micrograph image of nano cerium oxide and nano graphene incorporated aluminium

Nano sized graphene is a monolayered carbon and it is widely used for different nano technological applications. A study was initiated by incorporating mixtures of nano sized cerium oxide and nano sized graphene in varying concentrations into pure aluminium and evaluating the electrochemical characteristics under marine environments. The concentrations of both particulates varied from 0.01 to 0.1%. Surface morphology using SEM showed that there were distinct variation in morphology with respect to composition and materials. The particles were uniformly distributed in the matrix. Linear polarization studies showed that the corrosion potential increased significantly on addition of nano cerium oxide along with nano graphene and varied from -0.919 to -0.667V. Corrosion current density was the lowest in the case of coupons with CeO_2: graphene ratio of 1:2. Highest polarization resistance and lowest corrosion rate was exhibited by these coupons. The electrochemical impedance spectral study showed that the polarization resistance varied from 17 to 23 Ohms and 16893 to 68542 Ohms in the high and low frequency domain respectively. Weight loss experiments were also conducted and the results indicated similar behaviour as in the case of linear sweep voltametric analysis and impedance studies.



0.05% graphene aluminium 0.1% each of nano CeO_2 and nano graphene

0.02% nano CeO_2 and 0.04% nano graphene 0.04% nano CeO_2 and 0.02% nano graphene

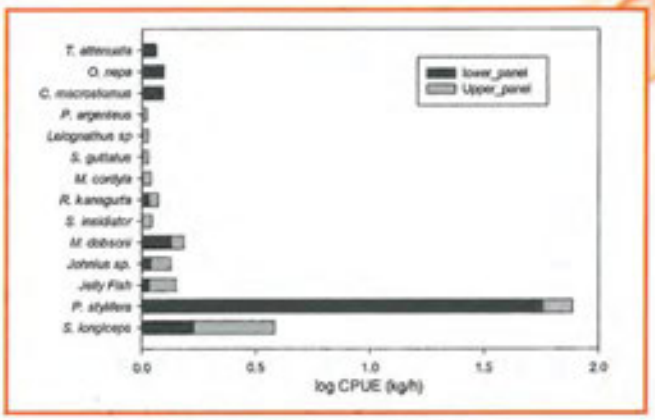
SEM images of surface morphology of the nano cerium oxide and nano sized graphene incorporated aluminium

Responsible fishing using improved bottom and semi-pelagic trawls

Designed and developed 27 m shrimp trawl with relatively short body (funnel) and with large horizontal spread suitable for selective retention of shrimps. The net was tested onboard departmental research vessels and the catches were compared with a commercial shrimp trawl of same size. A total of 26 experiment hauls were carried out using the short body shrimp trawl.

A 44.8 m cut-away top belly shrimp trawl with short body and larger horizontal spread was developed to reduce the incidence of fish catches (bycatch) in shrimp trawls. Comparative field trials have been carried out onboard departmental research vessels off Cochin coast. A total of 42 fishing experiments were carried out using the new trawl design.

Analysis of species encountered in a separator trawl was carried out and the results indicated a clear demarcation of species based on their behavioural responses in the split codend. The mean CPUE (kgh^{-1}) of species that are found to be predominantly benthic or bentho-pelagic were found to be higher in the lower codend and the pelagic species were more in the upper codend. The results of the analysis will help in designing target-specific trawls for the coastal waters off Cochin.



Species profile in separator trawl

Responsible line fishing

A hydraulic long line winch was fabricated and the same has been installed onboard fishing vessel Bharat Sagar, belonging to the Fishermen Co-operative Society - Manaserry Matsya Thozhilali Vikasana Kshema Sahakarana Sangam for carrying out long line fishing on a participatory mode.

The rigging of 1000 branch lines with 1.5 mm PA monofilament line for use in the long liner was completed and arrangements have been made for commencing the experimental fishing from April 2012 onwards.

Dr. S. Ayyappan, DG, ICAR, onboard vessel 'Bharat Sagar' with DDG (Fy.) and ADG (IP&TM) along with Director CIFT, HOD (FT), scientists and boat crew

Euphotic zone production estimation using satellite data as an input to assess potential yield of pelagic herbivores in the Indian EEZ

Study of sardine shoal sighted areas along Cochin coast: The chlorophyll-a concentration of waters, from sardine shoal sighted areas ranged from 0.167 to 10.88 mg m^{-3}. Highest concentration was during post-monsoon period and the lowest during pre-monsoon period. The results showed that the phytoplankton absorption was significantly higher during post-monsoon season and minimum during pre-monsoon. The CDOM absorption was maximum during the pre-monsoon season compared to the other seasons. The suspended matter absorption was significantly higher during post-monsoon season and the detritus absorption coefficients value reached more than 1 m^{-1} during the period.

Rigging of branch lines of long line

Chlorophyll-a concentration varied from 0.009 to 0.0731 mg^{-1} during the period. The nitrite concentration increased with chlorophyll-a concentration even though it varied irregularly with seasons. The results showed that the N/P ratio was almost constant throughout the year in the fish shoal sighted regions off Cochin. The phosphate concentration during the year varied from 0.045 to 2.7615 mg^{-1} and highest concentration exhibited during monsoon season (0.09 to 3.684 mg^{-1}). In general chlorophyll-a concentration increased with the increase in phosphate concentration. The concentration of silicate ranged from 0.0375 mg^{-1} to 1.34 mg^{-1}. Silicate concentration showed less significant variation throughout except in post-monsoon season of 2011 period.

Liner onboard the vessel MFV Bharat Sagar

Hydrographic parameters of the water collected from the sardine shoal sighted areas were continuously monitored for the variation of hydrographic and nutrient concentration. The results showed that there was not much variation in pH through the seasons whereas salinity showed a decreasing trend towards monsoon season. pH ranged from 7.3 to 8.7 and the water collected during the month of June and July showed lower pH. Salinity of water collected from shoal sited regions varied from 25.6 to 35.5 psu. During monsoon season, the salinity was found to be low (25.7 psu) compared to pre-monsoon and post-monsoon. Turbidity was higher during monsoon and post monsoon seasons than the pre-monsoon. The highest turbidity recorded was 6.53 NTU and the lowest 0.325 NTU. Sea surface temperature observed ranged between 27°C and 29°C.

The phytoplankton community composed of 73 genera from 19 orders and 41 families. Sardine samples were collected randomly and biometric parameters were analyzed. Length-weight, total weight, total length, fork length, standard length, head length, gill girth, maximum girth, mouth diameter (both vertical and horizontal) were measured every week. In the last two years, the maximum length and weight recorded was 20 cm and 45 g respectively. Samples belonging to all length classes were observed mainly during monsoon season.

Demonstration of long line operations

View of catch during the operation

A value chain on oceanic tuna fisheries in Lakshadweep sea

Based on the meeting held at Rang Manch, Lakshadweep on 5 November, 2011 to explain the details regarding the NAIP project implementation to the boat owners, five traditional fishing vessels were selected for carrying out the experimental long lining operations. Long line fishing gear materials and accessories were distributed to the boat owners. A training programme on rigging of tuna long line gears was organized at the Department of Fisheries, Minicoy for the boat owners and crew of the boat on 8 November, 2011. A total of 50 branch lines were rigged and five GI baskets for placing branch lines were also fabricated.

Myctophid species in Indian ocean

Design and prototype fabrication of Myctophid trawl

Four equal panel 45 m Myctophid trawl has been designed and fabricated for operating in the Arabian sea onboard FORV Sagar Sampada. The trawl net had a mesh size of 140 mm in the front part and gradually tapering to 25 mm in the codend.

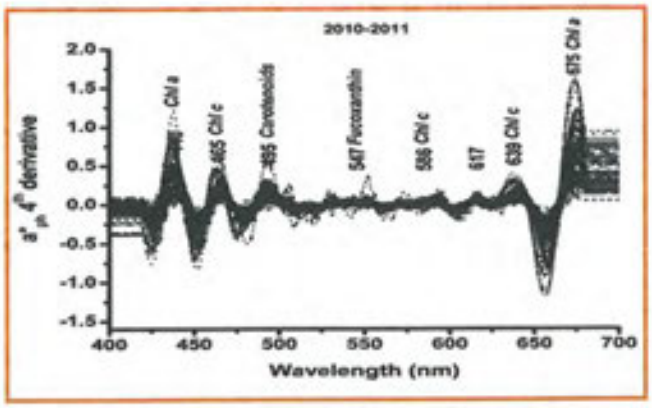
Myctophid species in Indian Ocean

Myctophid samples were collected from the bycatch of commercial deep sea shrimp trawlers operating off southwest coast of Kerala. Fourt seven bycatch species including eight species of Myctophids belonging to the genus *Diaphus* (*Diaphus watasei, D. luetkeni, D. dumerilli, D. hudsoni* and *D. effulgens*), the genus *Myctophum* (*Myctophum spinosum* and *M. obstusirostre*) and genus *Benthosema* (*Benthosema fibulatum*) were identified from the bycatch of deep sea shrimp trawlers operating off Kollam and Cochin coast.

Database on Myctophid species reported from Indian Ocean, including information on their geographical distribution have been updated to include a total of 137 Myctophid species belonging to 28 genera.

In situ time series measurements of bio-optical parameters off Cochin coast

The main objective of INCOIS ad hoc project was to analyze the distribution of optically active substances in the coastal waters off Cochin and to validate satellite derived data using these results. For the analysis, the sampling has been continued at eight pre-fixed stations since 2009. CDOM (analysed using UV-Visible spectrophotometer), Total Suspended Matter, (TSM) (determined using gravimetric method) and chlorophyll-a (using Fluorometer) were measured. Radiometric measurements were also used for validation.



Regresion of 4th derivative of phytoplankton specific absorption spectra

The study revealed a large number of observations with relatively low chlorophyll-a and TSM concentrations. In the case of a CDOM, 440 high frequency distribution is attributed to absorption ranging from 0.05 to 1.5 m^{-1}. The variability in optically active substances is low in the stations during pre and post-monsoon seasons.

Decomposition study of *in vivo* phytoplankton absorption using derivative analysis showed that the pigment composition reflected from the spectral shape and magnitude of the phytoplankton absorption curve correlated very well with the natural phytoplankton assemblages from the sampling locations. Each species has its own unique pigment signature and therefore contributes to the shape of the absorption spectrum.

The regression analysis of phytoplankton specific absorption showed that the concentration of chlorophyll-a can be estimated with reasonable accuracy in samples where the absorption by detritus is a significant variable. This study also suggests that the 4th derivative regression analysis appears to be an efficient tool for the estimation of chlorophyll-a concentration of phytoplankton retained on filters and is very useful for the monitoring of phytoplankton dynamics using chemotaxonomic marker pigments.

Fish Processing Division

Research projects handled

- Innovative packaging techniques for processing and preservation of fish products
- Species specific interventions in value addition of commercially important and emerging species of freshwater fish
- Post harvest processing of commercially important large pelagic, demersal and bycatch fishes for high value products for modern markets and NEH
- Utilization of fish processing waste for the development of innovative products

Chief findings

- The quality and shelf life of fresh *Pangasionodon hypophthalmicus* fillets treated with potassium sorbate, essential oils (EO) from clove and curry leaf, packed under vacuum were studied. Samples treated with EO from curry leaf showed maximum shelf life of 15 days followed by 13 days with EO from clove and potassium sorbate.
- Effect of short time marination of *P. hypophthalmicus* fillets with acetic acid and sodium chloride on the quality and shelf life was evaluated. Marinated samples had a shelf life of 14 days in chilled storage and control samples had a shelf life of 10 days.
- Fish croquette, a mince based coated product was prepared with Rohu mince and incorporating soy powder as a partial replacer for fish mince in different combinations. The croquette prepared using 25% soy flakes in place of fish mince was found to be better than 100% fish mince based croquette in terms of sensory and texture properties.
- The effect of washing on surimi prepared from *P. hypophthalmicus* was studied. Both single wash and double wash surimi gels exhibited high expressible drip and low water holding capacity with double wash surimi gel showing significantly higher values. The gel strength, and textural parameters like hardness, and stiffness were significantly higher for single wash surimi. The additional washing resulted in a significant decrease in the total pigment content of the double wash surimi.
- Prepared a ready to eat flash fried fish paste product from rohu mince incorporating the EO of clove and curry leaf. Extension of shelf life for five days and three days was observed in samples treated with the curry leaf EO and clove EO respectively. The control sample had 12 days of shelf life under the same conditions.

- Developed an instant fish gravy mix for two types of fish curry. This gravy paste was dried under three different conditions. *viz*., mechanical, vacuum and freeze-drying. Vacuum dried product had higher sensory score. A patent application is being filed for this product.
- Lizard fish was studied for its suitability for value addition. Several products such as fish balls, fish cutlets, fish fingers, fish burger, fish pickle, high quality salted and dried fish, ready to eat fried product, canned product, etc. have been developed and were found to have good acceptability.
- Heat penetration characteristics of tuna canned in coconut oil, ground nut oil and sunflower oil was carried out for standardizing the thermal processing techniques. Thermal processing was carried out for 45 min. at 121°C. An Fo value of 10 min was obtained for coconut oil and ground nut oil while for sunflower oil it was 12 min.
- The seafood mix in brine pack was more acceptable. Storage studies showed that the sea food mix in tomato sauce was not acceptable beyond seven months while the product in brine medium was acceptable up to nine months.
- Ready to serve canned leather jacket curry was developed in TFS cans. A process lethality of around 10.75 was found sufficient for softening the hard bones as well as for sterility. The product had excellent organoleptic characteristics and good acceptability.
- Pet food for dogs was formulated from tuna canning waste consisting of red meat, white meat trimmings, skin and bones. Cereals, pulses and vitamins were incorporated to make it a rich source of protein, carbohydrate and vitamins. The product also provided good quantity of minerals. 100g of pet food provided more than 300 calories of energy and was found superior to commercial pet foods available in the market.
- Feeding studies were carried out in chicks with fish waste silage and squid waste silage incorporated feed. Dried sardine meal was used as control. Forty five days old chicks were fed with the test feeds for 30 days. No significant difference in growth parameters was observed. The silage-based chick feed is a cheaper replacement for whole sardine meal.
- Hydroxyapatite was prepared from deproteinised fish scale from rohu and catla. Fish scales were converted to hydroxyapatite by a heat treatment process at different temperatures and for different conversion durations based on statistical model.
- Foliar spray was prepared from fish waste and squid waste and biochemical quality parameters assessed. When applied in ladies finger plants, it was observed that plants applied with fish based foliar spray had better performance in terms of production when compared to the control plants.
- Edible fish powder was prepared from trawl bycatch (*Ambassys commersoni*). The head and gut of the fish was removed and it was autoclaved for 30 minutes, dried and powdered. The dried powder was assessed for compositional analysis and nutritive value. The optimum level of incorporation of the edible powder in chutney mix was evaluated by

sensory analysis. It was observed that 20% incorporation of the edible powder in chutney base is optimum. Storage studies of the product under room temperature was carried out and it was found to be stable even after six months of storage.

- Fish-scale collagen peptides were prepared using different concentrations of alkalase enzyme to hydrolyze rohu (*Labeo rohita*) and catla (*Catla catla*) scales.
- The peptide analysis using LCMS-MS revealed that peptides were predominantly of molecular weight less than 3000 Da. According to online databases, these peptides are present in human, bovine, fish and rat collagens.
- Fish bone from rohu and pangasius was separated and treated with proteolytic enzymes for 75 min. under optimum conditions. It was drained, washed thoroughly, and dried in hot air oven and powdered. The calcium isolated was encapsulated with supplemented vitamin.
- The incorporation of chitosan granules to LDPE and LLDPE showed antibacterial effects against both gram positive and negative organisms.
- Bromocresol purple and Bromothymol green were effective as fish freshness indicators for Horse mackerel steaks in HIPP trays under chilled conditions.
- Antimicrobial chitosan sponge indicated marked inhibitory effect on growth of bacteria tested with distinct inhibitory zones of diameter ranging 5-25 mm.
- The effect of ten natural antioxidants on quality characteristics of chilled, stored Giant Trevally fillets indicated a shelf life of 4-6 days for air packed, 6-8 days for Tocopherol and TUR 1001 treated samples, 8-11 days for vacuum packed, SGT 1004, Neaox OF001, Neaox OF002, Neaox P001, Neaox F001 and Neaox F002 samples and 11-13 days for samples treated with ROS 1011, SAG 6001 and ORE 6001, respectively.
- White prawn packed in brine and natural pack and processed to Fo value of 8 in see-through retort pouches were found acceptable up to 12 months.
- Yellow fin tuna steaks processed in brine, in oil and natural pack in indigenous see-through retort pouches and processed to Fo 10 had a shelf life of 12 months.

Report of work done

Development and standardization of value added products from freshwater fish

Prepared a ready to eat flash fried fish paste product from rohu mince incorporating the essential oils (EO) of clove and curry leaf. The effect of incorporating the EO at a single concentration of 0.05% (w/w) to the fish mince was evaluated based on shelf life and flavor development. Addition of EO improved the flavor and shelf life of the product compared to that of control in chilled conditions. Extension of shelf life for five days and three days was observed in samples treated with the curry leaf EO and clove EO

respectively.

Fish croquette, a mince based coated product was prepared with rohu mince and incorporating soy powder as a partial replacer for fish mince in different combinations. The fish mince was replaced with soy flakes (prepared by soaking the soy chunks in hot water and flaked mechanically) at 25% 50%, 75% and 100%. The croquette prepared by using 25% soy flakes in place of fish mince was found to be better than 100% fish mince based croquette in terms of sensory and texture properties. Shelf life evaluation at chilled storage was carried out and the product had 16 days of storage life.

Corquette from rohu mince

Developed an instant fish gravy mix for two types of fish curry. This gravy paste was dried under three different conditions *viz*., mechanical, vacuum and freeze-drying. Vacuum dried product had higher sensory score. A patent is being filed for this product.


Instant fish gravy mix

Process optimization for improvement of quality and shelf life of freshwater fish products

The quality and shelf life of fresh *Pangasionodon hypophthalmicus* fillets treated with potassium sorbate, essential oils from clove and curry leaf and packed under vacuum were compared with untreated vacuum and air packed fillets. potassium sorbate (0.5 %) was added in combination with 0.2% sodium citrate and essential oils were added at a single concentration of 0.1% (v/v). All the treated samples were packed under vacuum and stored at 2-4°C. Separate vacuum packed and air packed samples were maintained as controls. The biochemical and sensory analyses of samples were carried out at periodic intervals. Results indicated that treated samples exhibited extended shelf life compared to untreated vacuum and air packed samples. Among the treatments, samples treated with essential oil from curry leaf showed maximum shelf life of 15 days followed by 13 days for samples treated with essential oils from clove and potassium sorbate. Vacuum fillets gave less satisfactory results of 11 days shelf life; however was better than fillets maintained in air with shelf life of nine days.

Process formulation to remove muddy flavor of freshwater fish fillets

The effect of washing with organic acids and banana leaf ash for the removal of muddy flavor of rohu fillets was evaluated based on sensory and instrumental methods. Fish filltes were treated with banana leaf ash and organic acids *viz*. citric acid and tartaric acid at different levels and durations. There was a marked improvement in flavor and colour of fish treated fillets compared to controls and the fillets treated with a combination of banana ash and organic acids were found to be more palatable. The colour was significantly improved by washing especially with higher concentration of banana leaf ash.

Shelf life evaluation of microwave treated catfish fillets during chilled storage

The shelf life of microwave processed *Pangasianodon hypophthalmicus* fillets during chilled storage was evaluated. The fillets were chlorinated (2 ppm) for 10 min. and packed under vacuum and air. The fillets were further processed in a microwave processor for 18 seconds under medium mode at a power of

Microwave processed catfish fillets

488 Watts and stored at a temperature of 2– 4°C. The samples were withdrawn at periodic intervals for biochemical analysis. On the whole, the biochemical and sensory evaluation of microwave processed and vacuum packed fillets showed maximum extention in shelf life of 19 days followed by control vacuum packed samples of 12 days. On the contrary, air packed samples showed much lesser shelf life of 10 days irrespective of the treatment given.

Short time marination process to extent the shelf life of fish fillets

Effect of short time marination on the quality and shelf life of chilled stored *Pangasianodon hypophthalmicus* fillets was evaluated. Marination was done by immersing the fish fillets in solutions containing 0.2% acetic acid and 10% NaCl for a period of 10 min. The marinated and control fillets were further packed under air and vacuum and stored at 2-4°C. The biochemical and sensory quality of fish fillets were evaluated at periodic intervals. In general, a sharper decline in overall quality was experienced by 10th day of storage in the case of control samples, whereas marinated samples developed off-flavour only by the end of 14th day of chilled storage.

Effect of incorporation of curry leaf and clove oleoresins in shelf life extension of flash fried fish mince product under chilled storage

Prepared a ready to eat flash fried fish paste product form rohu mince incorporating the oleoresins (EO) of clove and curry leaf. The effect of incorporating the EO at a single concentration of 0.05% (w/w) to the fish mince was evaluated based on shelf life and flavor development. Addition of EO improved the flavor and shelf life of the product by one week compared to that of control. Longer shelf life and better sensory acceptance was observed in samples treated with the curry leaf EO, followed by clove EO.

Use of herbal oleoresins in extending the shelf life of vacuum packed fish fillets under chilled storage

The quality and shelf life of fresh catfish (*Pangasius hypophthalmicus*) fillets treated with EO from clove/curry leaf/potassium sorbate, and packed under vacuum were compared with untreated vacuum and air packed fillets. potassium sorbate (0.5%) was added in combination with 0.2% sodium citrate and EO were added at a single concentration of 0.1% (v/v). All the treated samples were packed under vacuum and stored at 2-4°C. Separate vacuum packed and air packed samples were maintained as controls. The biochemical and sensory analyses of samples were carried out at periodic intervals. Results indicated that treated samples exhibited extended shelf life compared to untreated vacuum and air packed samples. Among the treatments, samples treated with EO from curry leaf showed maximum shelf life of 15 days followed by 13 days for samples treated with EO from clove and potassium sorbate. Vacuum fillets gave less satisfactory results of 11 days shelf life; however was better than fillets maintained in air with shelf life of nine days.

Formulation and preparation of feed incorporated with silage and prawn shell waste

Silage was prepared from processing waste of fish and squid, mixed with rice bran and quality parameters were evaluated. Dried whole sardine was also

analyzed. Feeding studies were carried out in chicks with fish and squid waste silage incorporated feed. Dried sardine meal was used as control. Forty five days old chicks were fed with the test feeds for 30 days. LS mean of the treatments did not vary significantly. Hence it is concluded that the silage based chick feed is a cheaper replacement for whole sardine meal.

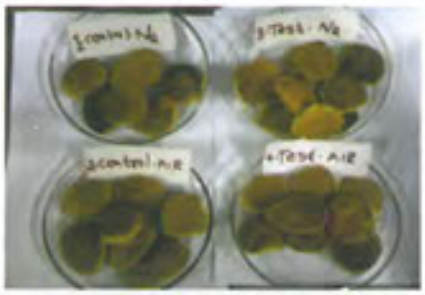
Prawn shell was treated under different conditions and incorporated in fish feed as protein supplement along with other ingredients. As carbohydrate source and binder, maida and corn flour were used. The prepared feed pellets were assessed for physical and biochemical properties. No significant difference was observed in the compositional data and the sinking rate among the samples. The assessment of stability and loss of weight in water indicated that the feed supplemented with boiled and dried prawn shell powder was most stable and showed least loss of weight in water, as compared to other samples.

Preparation and quality evaluation of edible fish powder from trash fish

Edible fish powder was prepared from trawl bycatch (*Ambassys commersoni*). The dried powder was assessed for compositional analysis and nutritive value. The optimum level of incorporation of the powder in chutney mix was evaluated by sensory analysis. The physico-chemical and bacteriological parameters of the edible fish powder during storage are being carried out. The storage study of the edible fish powder was continued. After five months of storage, the product had high organoleptic score of 7.0. The chemical quality indices were also within the acceptable limit.

Utilization of processing discards for developing value added products

Cookies were prepared supplemented with cooked fish mince from frame meat of rohu at different ratios. It was observed that most acceptable level was at 15% of mince than all other combinations. The protein content of control samples was 8.12% while the product with added mince had higher protein (12.16%). The physical and chemical qualities of the products were evaluated and shelf life when packed in nitrogen and in air was assessed.



Fish mince based cookies

Foliar spray from fishery waste

Foliar spray was prepared from fish waste and squid waste and biochemical quality parameters assessed. The products were applied in ladies finger plants in two different concentrations and the results on growth parameters and yield were compared. It was observed that plants applied with fish based foliar spray had better performance in terms of vegetative features and production when compared to the control plants. The plants applied with the squid based foliar spray did not show any significant difference in the yield.

Calcium supplement from fish bone

Fish bone (rohu and pangasius) was separated and treated with proteolytic enzymes for 75 min. under optimum conditions. It was drained, washed thoroughly and dried in hot air oven and powdered. The calcium isolated was encapsulated with supplemented vitamin D.

Vitamin supplemented fish calcium capsules

Preparation of gelatin from fish skin with improved sensory characteristics

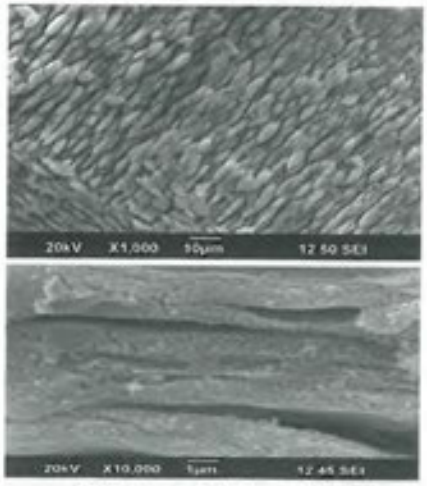
An attempt was made to improve the colour of gelatin isolated from the skin of catfish (*Pangasius sutchi*) by a pre-treatment with organic acid like lactic acid. The pre-treatment was carried out at various combinations of concentrations and duration. Gelatine extracted after pre-treatment with lactic acid at and above 0.05% concentration showed a significant improvement in colour and appearance, as indicated by l, a and *b values. Pre-treatments with acidic solution resulted in a light and transparent gelatine, whereas gelatin obtained without any pre-treatment was dark in colour. However, the yield of gelatin was markedly affected with increase in lactic acid concentration and treatment period used.

Preparation of collagen peptides from fish scale

Collagen peptide from fish scale

Fish scale collagen peptides were prepared using different concentration of alkalase enzyme to hydrolyze rohu (*Labeo rohita*) and catla (*Catla catla*) scales. Higher yield of peptides was obtained with higher concentration of enzyme whereas higher protein content was evident with lower enzyme concentration. The peptide analysis using LCMS-MS revealed that peptides were predominantly of molecular weight less than 3000 Da. Specific peptides from each hydrolysate were selected and submitted to database. According to online databases, these peptides are present in human, bovine, fish and rat collagens. The further characterization of collagen peptides are being carried out by FTIR and UV-VIS spectrophotometry.

Preparation and characterization of hydroxyapatite from fish scale



SEM image of hydroxyapatite

Hydroxyapatite was prepared from deproteinised fish scale from rohu and catla. Fish scales were converted to hydroxyapatite by a heat treatment method at different temperatures and for different conversion durations. Further characterization was carried out based on FTIR, PXRD, SEM, TGA and ICEP analysis.

Canned product from catfish

Canning studies of smoked freshwater catfish (*Wallago attu*) in oil in TFS cans was carried out. Small steaks suitable for packing in TFS cans were cut from skinless and boneless fillets. The steaks were blanched in 10% brine for 15 min. and drained. The blanched steaks were smoked at 50°C for 1 h and 2 h respectively in a smoke kiln. The smoked samples were packed in TFS cans in the ratio, fish and oil 60: 40 and heat processed at 121.1°C. The control samples without smoking was packed into TFS cans and cooked in steam for 20 min. drained, filled with hot refined oil, sealed and heat processed along with smoked samples. The products achieved Fo values 7.40, 10.80 and 13.00 respectively for control, 1 h and 2 h smoked samples. The smoke treatment has improved the texture, appearance, odour and flavour of canned freshwater catfish. The 2 h smoked samples gave attractive golden brown colour and appearance with good odour and flavour. Quality evaluation for 12 months was carried out. There was no can interior adhesion, lacquer peeling or black staining. The products remained in acceptable condition during this period. 2 h smoked samples were better in sensory characteristics than 1 h treated samples

and control samples.

Development of value added products from bycatch fish

Fish burger from low value fishes such as lizard fish and thread fin bream were prepared and their nutritional quality factors evaluated. It provides important nutrients such as protein, carbohydrate, fat, minerals, vitamins, fibre content etc. The burger consists of three parts: fish patties – 30%, leafy vegetables – 30% and burger bun – 40%. The taste panel members rated the overall acceptability of fish burger as excellent with respect to appearance, flavor, texture and taste.

Fish Burger

Development of antimicrobial and antioxidant packaging materials for fish products

The effect of incorporating chitosan granules at different concentrations to synthetic polymers like low density polyethylene (LDPE) and linear low density polyethylene (LLDPE) was evaluated. The antimicrobial effectiveness was tested against both gram positive and gram negative bacterial cultures at regular intervals. Results indicated that the addition of chitosan showed antibacterial effects against both gram positive and gram negative organisms. The inhibitory effect on gram negative organism was evident after 2 h of incubation, whereas, gram negative organism took 24-48 h for a significant reduction. The physical and textural properties of films were also affected when chitosan was added at higher concentration.

Development of CO_2 emitters and dual action active packaging systems for fishes

Usefulness of indicators like Bromocresol purple, Bromothymol green and Bromothymol blue as fish freshness indicators were assessed under chilled conditions. For this, the indicator solutions impregnated into sterile filter paper was attached on to the inner surface of the HIPP trays packed with Horse mackerel steaks. The colour changes in the indicator was monitored at frequent intervals and the quality of fish like volatile bases, fat oxidation, histamine, total mesophilic counts, total psychrotropic counts, *Pseudomonas* spp., *Brochothrix thermospacta* and sensory attributes were assessed. Bromocresol purple impregnated indicator strips changed its colour with the fish spoilage in both direct and indirect contact whereas Bromocresol green changed its colour with indirect contact only, indicating its usefulness as freshness indicators. Bromothymol blue did not change its colour in both direct and indirect contact with the fish spoilage. Sensorily fishes were acceptable up to 9-10 days which was very well correlated with the freshness indicators.

Application of HTST processing technology and development of ready to serve products in flexible and semi rigid containers

Ready to eat Yellow fin tuna steaks in different forms in see-through pouches: Yellow fin tuna steaks processed in brine, in oil and natural pack in indigenous see-through retort pouches in three different forms to Fo value of 10 was analyzed at monthly intervals. The biochemical parameters like PV, FFA and TBA were found to be low and the product was organoleptically acceptable even after 12 months of storage at ambient temperature.

Ready to eat white prawns in brine and natural pack: White prawn (*Fenneropenaeus indicus*) packed in brine and natural pack forms and processed to Fo value of 8 in indigenous see-through retort pouches were periodically analyzed. The biochemical, sensory and textural parameters were determined and the product was found acceptable upto 12 months of ambient temperature storage.

Canning of Asian green mussel (*Perna viridis*): Ready to serve Asian green mussel (*Perna viridis*) in brine were processed in tin-free steel cans (TFS). The shucked meat was again cleaned in potable water and blanched in boiling water for 5 min. About 130±5 g of blanched meat with hot brine (2%) was filled into each can. They were processed in an overpressure autoclave at 121.1°C till they attained Fo value of 8. The time temperature data was collected during heat processing using EVAL data recorder and heat penetration characteristics were determined using formula method. The processed cans were found to be commercially sterile. Thermal process led to a decrease in total amino acid content of the samples. But there was no significant difference between the fatty acid composition of raw and processed samples. The mineral composition of raw mussel was significantly higher than processed samples. The instrumental texture analysis indicated that the product become soft after thermal processing. Based on sensory analysis, the samples remained good and found acceptable during the study period.

***Sous vide* processing of squid rings from Indian squid (*Loligo duvauceli*):** The effects of *sous vide* processing and ordinary air packing on the shelf life of squid rings from Indian squid *Loligo duvauceli* was studied. *Sous vide* processing delayed the formation of total volatile bases and TMA values significantly compared to the control air packs. A slight decrease in the amino acid composition was found between the *sous vide* and control samples but it was not significantly different between each other. There was no significant difference between the fatty acid composition of raw and processed samples. The *sous vide* products had significantly higher L*colour values compared to the control samples. The texture analysis indicated that the *sous vide* samples had better chewiness, and springiness values compared to the control sample. Based on the sensory characteristics, the *sous vide* products were acceptable up to 28 days, whereas the control samples were rejected on the 10th day of chill storage.

Application of multiple hurdle technology for enhancing the shelf life of Indian brown shrimp (*Metapenaeus monoceros*)

The effect of multiple hurdle technology on the extension of shelf life of Indian brown shrimp was studied. Three different hurdles were applied to the same sample so as to minimize the spoilage of the sample. Potassium sorbate, which is an antimicrobial agent, was given as the first hurdle. Sample was dipped in 2% potassium sorbate solution for 10 min and the dipped sample was then marinated with white pepper powder, salt and natural antioxidants like ginger and garlic. This treatment was the second hurdle. The marinated samples were then vacuum packed and *sous vide* processed. The *sous vide* processed samples were then stored in iced conditions. This sample was then compared with the control air packed sample. The multiple hurdle processing delayed the

formation of all the biochemical spoilage indices like TMA, TVN, FFA, PV, TBA and also the microbial load of samples. The chewiness and springiness values were better for multiple hurdle processed samples. Based on microbial and sensory characteristics, the control samples were rejected on 15th day of storage and the multiple hurdle processed samples were still acceptable on 32nd day of ice storage.

Antimicrobial water-soluble chitosan

Prepared a water-soluble composition of low molecular weight chitosan (LMWC) and tested its antibacterial activity against the test cultures of *Vibrio cholerae*, *Salmonella typhi*, *Staphylococcus aureus* and *Bacillus cereus*. The results showed that LMWC markedly inhibited growth of bacteria tested with a distinct inhibitory zones of diameter ranging from 15-19 mm.

Composite film based on chitosan and Gum Arabic

Composite films from chitosan and Gum Arabic were prepared by solution mixing and a film casting procedure. Experiments were conducted on film with various combinations of chitosan and Gum Arabic films were characterized based on mechanical and barrier properties. The best results were obtained for films with a 2:1 combination of chitosan and Gum Arabic. The morphological analysis with scanning electron microscopy revealed a more or less uniform morphology for the composite film.

Preparation and characterization of antimicrobial chitosan sponge

Prepared an antimicrobial chitosan sponge and tested its activity against the cultures of gram positive and gram negative organisms. The results indicated marked inhibitory effect on growth of bacteria tested with distinct inhibitory zones of diameter ranging from 5-25 mm. Further characterization of chitosan sponge was achieved using FTIR, SEM and TGA analysis.

Standardization of tuna sausage

Chilled sausage from tuna was developed in two flavors ie: with and without smoke flavour. Both the sausages were acceptable up to 60 days.

Production of indigenous liquid smoke

The smoke generated from coconut husk was conveyed in to condenser which was cooled to a temperature around 2°C by circulating chilled water. Intermediate injection of saturated steam was done inside the smoke hood using an autoclave. The smoke and steam from the smoke hood was condensed inside the condenser and the liquid was collected. After cooling, the liquid was boiled in an autoclave to concentrate it in to half of the initial volume. This system is having a capacity to produce 1.5 liters of liquid smoke per hour.

Standardization of pulsed light treatment for Yellow fin tuna steaks

Yellow fin tuna steaks were packed in three packing materials and pulsed for 12 seconds on with an energy of 25 J/cm^2. Tuna packed in Polyester polythene laminate had 45%, Polyethylene had 54% and Cast polypropylene had 70% reduction in bacterial load. Tuna steaks were packed in Cast polypropylene pouches and pulsed for 6 sec with an energy of 12 J/cm^2 (as recommended by USFDA) and it had 56% bacterial reduction.

Composite film based on chitosan and Gum Arabic

Antimicrobial chitosan sponge

Tuna sausage

Pulsed light facility

Tuna loins treated with carbon monoxide

Pet feed from tuna waste

Colour enhancement of tuna loins using carbon monoxide

Yellow fin tuna loins were injected with carbon monoxide for 3 min. and immediately sealed in Polyester polyethylene pouches and kept in chilled storage for 24 h to develop the colour. After colour development, residual carbon monoxide was estimated. Carbon monoxide treated samples showed a residue level up to 363 ppm whereas the control samples were having a carbon monoxide residue of 24 ppm.

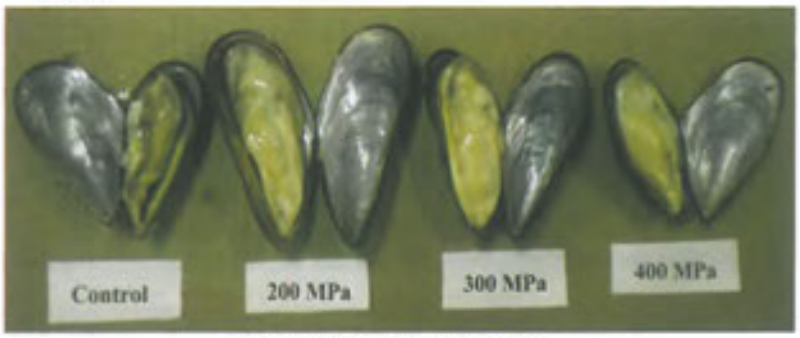
Pet feed from tuna waste

Tuna processing waste was collected fromThermal Processing Unit, M/s Britto Seafood Exports Pvt. Ltd., Tuticorin and dried at 60°C for 12 hours and powdered. This powder was mixed with rice flour, maida, tapioca and dalda in different proportions. The ingredients were then mixed with required amount of water, extruded using a single screw extruder and then cut in to small size manually. It was cooked in steam for 15 min and then dried at 60°C for 12 h to a moisture content of 6%. The product was then packed. The nutritional quality and pet acceptability were studied. Among the different combinations tried, the combination which was proved to be best was selected.

Studies on high pressure processing of high value perishable commodities

Process parameters were optimized for the following products:

- Yellow fin tuna chunks - 200 MPa pressure with 5 min holding time
- PUD shrimps - 250 MPa and holding time of 5 min
- 400 MPa, 25°C for 20 min resulted in superior gel strength for fish mince
- Condiment-incorporated prawns at 250 MPa - 35 days during chill storage
- For shucking meat from oysters - between 200-300 Mpa for 5 min.
- Green mussel meat at 300 MPa - shelf life of 27 days during chill storage
- *Listeria monocytogenes* inoculated prawn samples subjected to 350 MPa and 450 MPa gave a log reduction of 2.5 log10 cfu/g and 4 log10 cfu/g respectively.
- High pressure (100-400 MPa) and holding time (10-30 min) did not affect the physico-chemical properties of EVOH or Polyester polythene laminate films.



High pressure processed oysters

Product development from Myctophids and nutritional evaluation

Battered and breaded products were prepared from *Diaphus watasei* of 15 cm length. The frozen storage study in comparison with similarly prepared anchovy has shown that the product is acceptable even after 12 months of storage; although coated anchovy was preferred by the panellists. Specialty products *viz*., momo and rolls were prepared from the cooked mince of *D. watasei* which were rated high on sensory evaluation. Nutritional evaluation of *D. watasei* meal was carried out in albino rats. The Protein Efficiency Ratio of the test feed was found to be 1.04 and for control feed it was 0.69 while FCR values were 7.43 and 9.13 respectively. Hepato-somatic and Cardio-somatic Index reveals that there is no significant change in the internal organs of rats fed with test feed as compared to control group.

Diaphus mince rolls

Diaphus mince momos

Establishment of a model fish drying unit for Self Help Group of fisherwomen

A model fish drying unit funded by NFDB, Hyderabad for natural drying was constructed at Sevashram Swasrayagram, Angamaly with all necessary facilities for drying fish hygienically. The facility was inaugurated on 20 January, 2012 and has been handed over to the women Self Help Group. The fisherwomen were organized into a self help group of ten members. The group was trained for improved methods for natural fish drying practices and also in maintenance of records for a small unit. The activity was intended to be self-sustaining with minimum initial inputs provided (Detailed report appears elsewhere).

Natural fish drying practice

Quality Assurance and Management Division

Research projects handled

- Studies on effect of different processing methods, additives and natural preservatives on spoilage and pathogenic bacteria in fish and fishery products
- Studies on the detection, surveillance and implications of hazard in seafood meant for export market
- Development of a Quality Index Scheme for commercially important Indian fishes
- Bio-evaluation and purification of natural bioactive compounds of therapeutical and nutraceutical significance from aquatic resources
- Post harvest processing of commercially important large pelagics, demersal and bycatch fishes for high value products for modern markets and NEH
- Changing consumer preferences and its impact on domestic fish trade
- Nutrient profiling and evaluation of fish as a dietary component
- Responsible harvesting and utilization of selected small pelagic and freshwater fishes
- Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala

Chief findings

- A draft Quality Index Method (QIM) scheme validated with an array of biochemical, microbiological and instrumental parameters was developed for Indian mackerel *Rastrelliger kanagurta*.
- Challenge studies with different foodborne pathogens were carried out to elucidate their survival pattern in different preservation methods like chilling, freezing and in multiple barrier modes.
- Challenge studies with *Escherichia coli* O157:H7 indicated that this pathogen could survive even after freezing at -40°C (90 min.) and subsequent cold storage condition (-18°C) for more than 15 months.
- Inoculated pathogenic pandemic strain of *Vibrio parahaemolyticus* i.e. O3:K6 Serotype could be isolated from fish substratum after freezing (90 min. at -40°C) and subsequent cold storage at -18°C upto 14 weeks.
- Phytochemicals extracted from *Lawsonia inermis*, *Scoparia dulcis* and the seaweed exhibited broad spectrum antibacterial activity against pathogenic and spoilage flora encountered in seafood.
- Inclusion of oxygen scavenger pack during chilled storage substantially

reduced survival of *Staphylococcus aureus* in Yellow fin tuna meat.

- Evaluation of sanitation regime of different seafood processing industries indicated inefficacy of current cleaning schedule for food contact surfaces, where APC as high as 8.4 x 10^5cfu/cm^2 and ATP bioluminescence of 7683 RLU was observed.
- Studies on solar disinfection of water have shown that almost all inoculated non-spore forming food-borne pathogens such as *Salmonella*, *Vibrio cholerae*, *Listeria monocytogenes*, etc. could be eliminated within three hours of exposure to direct sunlight in PET or glass bottles.
- Simulated temperature abuse studies in Yellow fin tuna indicated maximum rate of histamine formation i.e. 15.2 ±0.01 ppm per hour at 30°C.
- Prolific Histamine forming bacteria like *Morganella morganii* could produce substantial amount of histamine in Yellow fin tuna mince during prolonged storage at 5-7°C.
- Validation of consumer preference for fish products by various microbiological and biochemical tests revealed that consumers ignored safety attributes while selecting high priced commodities.
- Hygiene survey of various fish markets of Kerala indicated presence of pathogens like *Salmonella*, *Vibrio cholerae* non-O1 and *Escherichia coli* O157: H7 in products, ice and water supply.
- Profiling studies of Skipjack tuna and Yellow fin tuna landed at Machilipattanam (AP), Nagapattanam (TN) and Cochin (Kerala) revealed higher accumulation of heavy metals in Skipjack tuna.
- Mass Spectral Libraries of commonly used antibiotics used in aquaculture was developed for rapid screening of the antibiotics and its metabolites in muscle, water and sediments.
- Mass Spectral Library for Histamine was developed for rapid identification and low level screening of the biogenic amine.

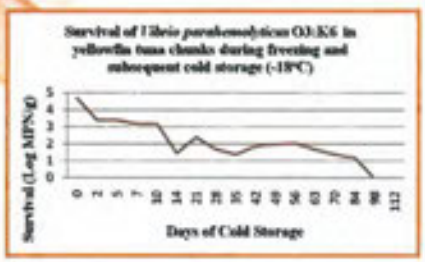
Report of work done

Survival of pathogenic bacteria in seafood and evaluation of biological hazard reduction profile in different processing methods

Challenge studies with various food-borne pathogens was carried out by inoculating fish/fish products at a defined inoculum level followed by subjecting them to normal processing steps. Inclusion of another barrier for further reducing survival of pathogen was also investigated.

Survival profile of pathogens during the processing steps as well as during storage was studied for developing predictive microbiological models.

Survival of enterohaemorrhagic *Escherichia coli* O157:H7 in fish substratum in response to freezing stress was studied. Progressive reduction of this pathogen was monitored in both air pack and vacuum pack consequent to freezing at -40°C and further cold storage at -18°C for 15 months. In air pack, the level of the pathogen reduced from 2.0 x 10^6 MPN/g to 2.9 MPN/g, whereas in vacuum pack the load reduced from 2.0 x 10^6 MPN/g to 2.0 MPN/g in tuna chunks



after 15 months of storage at -18°C. Better recovery of this cold stressed pathogen was observed in MPN method than the direct solid plating media like T-7 or SMAC agar.

Compared to regular strains of *Vibrio parahaemolyticus*, the pandemic strain of *V. parahaemolyticus* O3:K6 was observed to have higher resistance to freezing stress. The level of *V. parahaemolyticus* O3:K6 inoculated to tuna chunks, subsequently frozen (-40°C) and cold stored (-18°C), reduced from an initial level of 4.6 x 10^4 MPN/g to 0.91 MPN/g at the end of 98 days of storage. The pathogen could not be isolated on 112th day of cold storage, indicating complete elimination from the substratum.

Similarly, effect of multiple barriers on survival characteristics of *Staphylococcus aureus* with respect to chilling stress was studied for 41 days. *S. aureus* was inoculated at different levels (10, 100 and 1000 cells/g) to sterile tuna meat substratum, packed in air pack and separately with oxygen scavengers and stored at 0-2°C. Inverse relationship between survival rate and inoculation level was observed. Active packaging had a pronounced effect in reducing the survival of the pathogen.

Role of psychrotolerant bacteria and kinetics of Histamine formation in temperature abuse conditions

In Little tuna (*Euthynnus affinis*), the average load of Presumptive Psychrotrophic Histamine Forming (PPHF) bacteria was 1.72 x 10^4 cfu/g, which was 25% of the total Psychrotrophic Aerobic Plate Count, whereas in Yellow fin tuna (*Thunnus albacares*), the percentage of PPHF was 35%. Histamine forming ability of PPHF isolates were initially screened by ELISA test and it was observed that 15.38% of the isolates from Little tuna and 12.5% of isolates from Yellow fin tuna only possessed histidine decarboxylase activity. The amount of Histamine formed by different isolates at 7°C in 96 hours was estimated by ion-pair HPLC method. The Histamine forming ability of various isolates varied from 0.7 to 5.5 ppm.

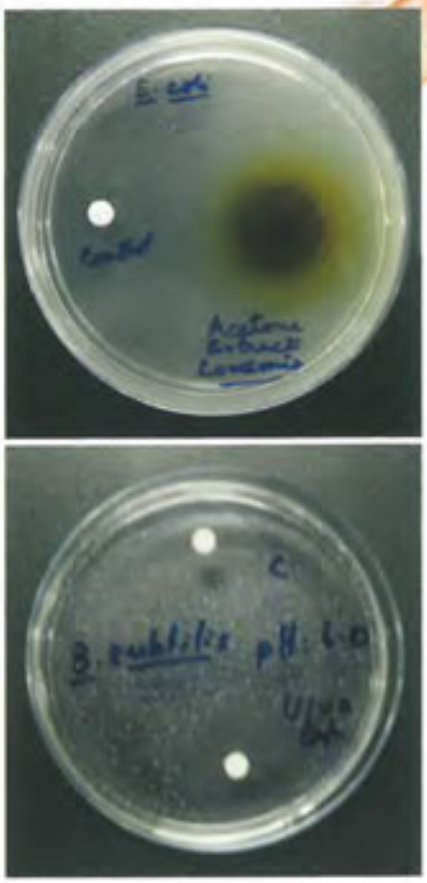
Kinetics of Histamine formation in simulated temperature abuse conditions was studied in Yellow fin tuna mince. Samples were incubated at 5, 15, 25 and 35°C up to 30 hours. In samples incubated at 5°C and 15°C, the increase in Histamine level was marginal. There was rapid increase in Histamine levels in the Yellow fin tuna mince incubated at 25°C. It increased from an initial level of 3.56±0.02 ppm to 114.8 ±9.2 ppm in 26 hours exposure and further increased to 242.8 ±39.6 ppm in 30 hours. Similarly, a sharp increase in Histamine level was noticed after 4h incubation at 30°C. Histamine level which had marginally increased to 3.16 ppm by 4h, increased to 33.2 ppm by 6h.

Kinetics of Histamine formation was studied by inoculating *Morganella morganii* in Yellow fin tuna mince and incubating at 5, 15, 25 and 35°C for different durations. In samples incubated at 5°C, Histamine build up was minimal upto 24h but there was a sharp increase and Histamine level reached 64.28 ± 3.48 ppm at the end of 30h. Histamine level increased to 291.2 ppm and 527.6 ppm after 30h in mince samples incubated at 15 and 25°C. Histamine levels increased to 24.26 ppm within four hours of exposure in samples incubated at 35°C. In six hours, it crossed the maximum tolerance limit (M:200 ppm, EC

regulation 2073/2005) and increased to 976 ppm in 30h exposure.

Screening of phytochemicals for antibacterial compounds

Three plant extracts obtained from *Lawsonia inermis* (Henna), *Scoparia dulcis* (Sweet Broom weed – 'Kallurukky') and seaweed (*Ulva*) were tested for antibacterial properties against sensitive ATCC bacterial cultures by disc or well diffusion assay. The neutral and basic extract of *Lawsonia inermis* and polar extract of *Scoparia dulcis* showed moderate to high antibacterial activity against various pathogenic and spoilage bacteria. The phenolic extracts of Henna and Sweet Broom weed were most effective against *Listeria monocytogenes*, *Streptococcus faecalis*, *Shigella sonnei* and *Vibrio cholerae* with an inhibition zone diameter of more than 7mm by disc diffusion assay. Similarly, methanolic extract of *Ulva* exhibited high antibacterial activity against *V. cholerae* and *L. monocytogenes*.



Disc diffusion assay for phytochemicals having antibacterial properties

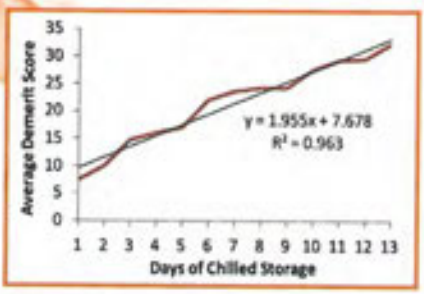
Studies on biofilm formation on food contact surfaces

Efficacy of cleaning regime practiced by seafood industries was evaluated by taking swab samples from various food contact surfaces for enumerating bacterial load (APC). Simultaneously, the same surfaces were evaluated by ATP bioluminescence based hygiene monitoring kit that gives the reading as Relative Light Units (RLU). The food contact surfaces sampled were: processing table, freezing tray, plastic crates, plastic drainer, stainless steel drainer, polythene sheets used for block freezing, filth washing platforms and plastic basins. The food contact surfaces which were just cleaned were also evaluated. The processing tables which were cleaned the previous day and on which processing was about to start had high bacterial load (mean 1.85 x 10^5cfu/cm^2) and RLU (mean, 7193.5) beyond the prescribed upper tolerance limit of 100cfu/cm^2. The processing tables which were just washed had average APC of 46 cfu/cm^2, which was within tolerance limit, but the RLU of 1222 indicated presence of residual food particles. High bacterial load was observed on freezing tray, plastic crates, plastic basins, plastic drainers and filth washing platform even after cleaning. The stainless steel drainers had less RLU (432) but higher bacterial load (4.7 x 10^3cfu/cm^2) indicating the presence of biofilm on the surface. The polythene sheets which are used for wrapping seafood before block freezing had higher bacterial load of 1100 cfu/cm^2 indicating unhygienic storage of this item in the processing plant. In a nutshell, the study indicated inadequacy of current sanitation regime practiced in seafood processing industry.

Staphylococcus aureus (ATCC 6538) could form biofilm with cell density of 6.8 x 10^6 cfu/cm^2 and *Listeria monocytogenes* (ATCC-13932) with cell density of 1.1 x 10^6 cfu/cm^2 on glass surface within six days. Washing with 'Teepol' and chlorine (50 ppm) could not eliminate the organism fully from the surface.

Development of QIM (Quality Index Method) scheme for Indian mackerel (*Rastrelliger kanagurta*)

A draft QIM scheme for sensory evaluation of fresh/chilled Indian mackerel was developed. The developed scheme incorporated various organoleptic characteristics with a total demerit score of 47. The scheme was assessed daily by a sensory panel for 13 days, till the end of storage life. To validate the scheme, various chemical, microbiological and instrumental tests were performed. By conjoint analysis, the significant sensory descriptors



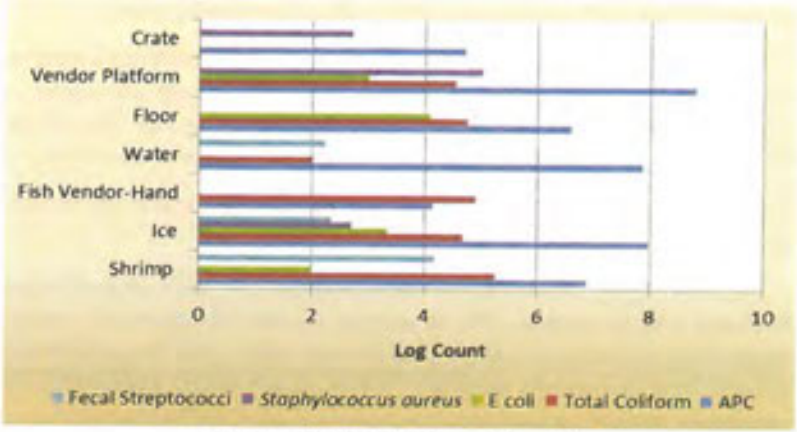
Regression analysis of average demerit score in mackerel during chilled storage

identified were appearance of surface belly discolouration, smell, stiffness, eye clarity and belly firmness.

Histamine level in the chilled mackerel increased from an initial value of 0.92 ppm to 16.44 ppm on 4th day of storage. The increase in Histamine level correlated well with the sensory quality of the fish and remained at 19.52 ppm at the end of 13 days. TBA value which indicates secondary products of lipid oxidation increased from an initial value of 0.768 mg malonaldehyde/Kg to 7.58 mg malonaldehyde/Kg on 11th day of chilled storage and remained at 5.92 mg malonaldehyde/Kg at the end of storage life (13th day). The mean Peroxide Value increased from 4.72% to 48.54% by 11th day and reduced to 15.14% by 13th day of storage. The FFA value remained at 1-3% throughout the experiment. TVBN content increased from an initial mean value of 1.74 mg% to 12.56 mg% by 6th day and remained at 10.81 mg% at the end of storage life i.e. 13th day. Similarly, TMA content increased from an initial value 1.39 mg% to 2.09 mg% by 11th day and remained at 1.74 mg% at the end of storage life. The Aerobic Plate Count was 5.9 x 10^4cfu/g on the 1st day before commencement of storage which increased to 9.6 x 10^5cfu/g at the end of storage life. Similarly, the psychrophilic bacterial count increased from 4.5 x 10^4cfu/g on 1st day to 5.3 x 10^6cfu/g on 13th day of chilled storage. The H_2S count was 1.1 x 10^2cfu/g on the 1st day and remained stable throughout the storage duration. On 13th day of storage it remained at 20 cfu/g. The *Vibrio parahaemolyticus* count decreased from 36 MPN/g on 1st day to 9.4 MPN/g on 3rd day and was undetected from 5th day onwards.

Validation of consumer preference for seafood in domestic fish market

Different market segments across Ernakulam district were selected for consumer preference studies. The consumer preferred fish samples were subjected to an array of biochemical, microbiological and organoleptic analysis to determine the presence of hazards. The ice and water used in fish markets were also analyzed for the presence of hazards. Consumers were found to ignore safety attributes for high priced commodities. High load of indicator organisms like Sulphite reducing *Clostridia*, Coliforms and faecal Streptococci were observed in fish samples as well as in ice used in markets. *Salmonella* and



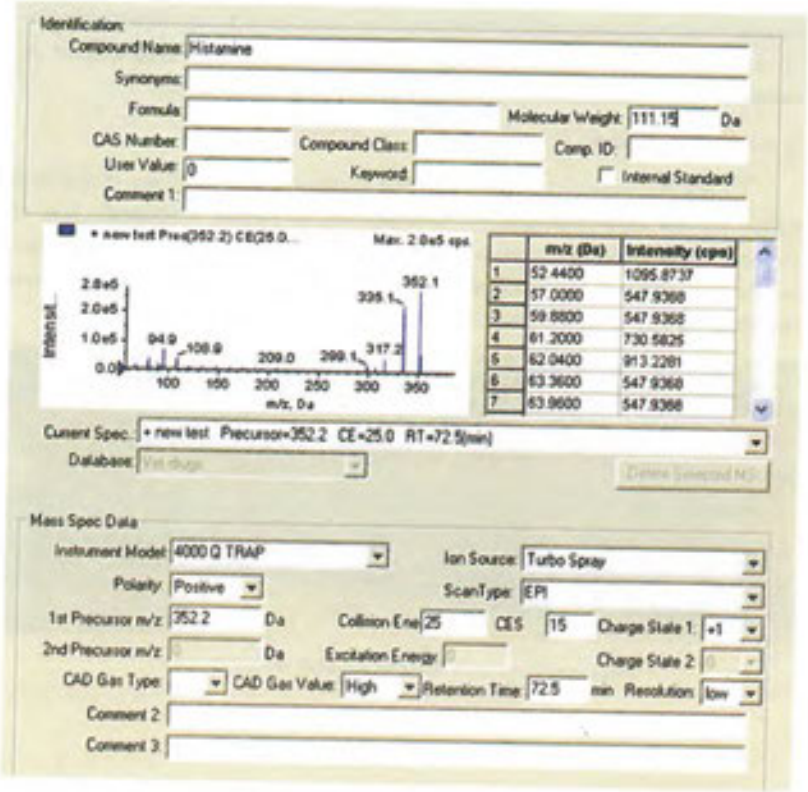
Hygiene assessment of Aroor fish market

non-O1 *Vibrio cholerae* was encountered in market samples. The enterohaemorrhagic *E. coli* O157: H7 was detected in fish market environs and seafood samples.

Dried fishery products were sampled from different fish markets. Highest bacterial load of 8 x 10^5cfu/g was observed in dried sole fish, followed by dried anchovies (1.29 x 10^5cfu/g). Highest fungal count of 5.2 x 10^4cfu/g was recorded in dried anchovies followed by condiment-incorporated dried mackerel (4.8 x 10^2cfu/g). Coagulase positive Staphylococci were present in dried sole fish. Other pathogens like *Salmonella*, *Listeria monocytogenes* and *E. coli* were absent.

Development of libraries for Histamine and antibiotic residues

Developed Mass Spectral Library for Histamine for rapid identification and screening of Histamine even at low levels. The Library is useful to confirm the presence and quantify Histamine at ppb levels and is an efficient tool to eliminate false positives.



The libraries of antibiotics commonly used in aquaculture (Trimethoprim, Tetracycline, Oxytetracycline, Sulfonamide etc.) was developed using standard reference materials. The MRM Catalogue and Spectral Library both contain information on over 12 drugs of abuse and its metabolites. For confirmation of identification, libraries were developed with six MRM transitions and the Library contains up to eight full scan EPI spectra for each compound. This information is very vital for rapid screening of these antibiotics and its metabolites in muscle, water and mud. This exercise is done as part of hazard profiling for antibiotics in the platform. This is highly essential for developing

a GIS based database of antibiotics spread in different areas of aquaculture.

Solar disinfection of foodborne pathogens

Studies on solar disinfection of water have shown that almost all inoculated non-spore forming pathogenic bacteria such as *Salmonella*, *Vibrio cholerae*, *Listeria monocytogenes* etc. could be eliminated within three hours of exposure to direct sunlight. Solar disinfection of water in different containers has shown that glass bottle is more effective than PET bottles.

Suitability of gel ice over flake ice as a preservation medium

Suitability of gel ice as replacement for flake ice was studied. It was concluded that if the sachets are replaced after six days, the effectiveness of gel ice can be improved several folds and can be considered as an effective medium for fish preservation. Studies on the application of gel ice for storage of fish showed that during the initial days of storage, gel have good comparability to flake ice but on prolonged usage it was found to be not effective. Simple linear regression model fitted well for both ice as far as chemical indices of storage is concerned and the exponential function model fitted well for the microbiological characteristics of the fish stored in both cases.

Specific livelihood interventions in fisheries sector

Under the project Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala, a scientific way of culture of edible oyster and preparation of value added products were extended to the Self Help Group members identified at Alapuzha. Training in net mending was provided to them as part time work.

Gel ice

Flake ice

Culturing edible oyster

SHG members with harvested edible oyster bunches

Microbiology, Fermentation and Biotechnology Division

Research projects handled

- Assessment of microbial seafood safety hazards and bioprospecting of aquatic microbial resources for enzymes
- Species specific interventions in value addition of commercially important and emerging species of freshwater fish
- Innovative packaging techniques for processing and preservation of fish products
- Responsible harvesting and utilization of small pelagics and freshwater fishes
- Bioprospecting of genes and allele mining for abiotic stress tolerance
- Effect of high pressure processing on high value perishable commodities
- Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- Oceanic tuna fisheries in Lakshadweep sea: A value chain approach

Chief findings

- *Vibrio cholerae* O1 biovar El Tor Ogawa was detected in three out of 148 seafood samples tested and molecular characterization revealed presence of *tcp*A, *ctx, zot, ace* and *toc*R genes.
- Out of 34 fish and shellfish samples collected from retail markets located at Alappuzha and Kottayam districts, 55% were found to be positive for *Vibrio parahaemolyticus*. Among 54 isolates, five strains were positive for *tdh* gene while *ORF8* gene could not be detected in any of the strains.
- *Clostridium botulinum* Type E was detected in two out of 16 samples comprising of farmed fish, pasteurized crab meat and fish products tested.
- Biotype 1A strains of *Yersinia enterocolitica* from fish carried *ystB, fepA, fepD* and *inv* genes and lack virulence genes including *ail, myfA, ystA* and *ystC*.
- *Listeria monocytogenes* isolates from fish and ice samples harboured virulent genes *hly, plcA, iap, mpl, prfA* and *act A*.
- *Campylobacter jejuni* was detected in two out of 26 fish samples.
- *Escherichia coli* O157:H7 was not detected in any of the 54 samples including 15 water samples (five from river, five from estuary and five from freshwater environment) and 39 fish samples (from landing centres and

fish markets located at Alappuzha and Kottayam districts). One sample was positive for enterohaemorhagic *E. coli*.

- One hundred and eight isolates of *Staphylococcus aureus* from fish collected from retail outlets in Alappuzha, Kottayam and Ernakulam districts harboured *coa* gene. Enterotoxin genes *SEC*, *SED*, *SHE* and *SEJ* were absent in all the strains. 90% of the strains had *SEG* gene. *SEA*, *SEB*, *SEE* and *SEI* enterotoxin genes were present in 19%, 20%, 21% and 25% of the strains respectively.
- Antimicrobial resistance to Oxacillin and intermediate resistance to Vancomycin was detected in <3% of the 70 *Staphylococcus aureus* isolates from fish and shellfish.
- Studies on efficacy of different concentrations of H_2O_2 (0.1, 0.2 and 0.3%) on biofilm formed by enteropathogenic *Escherichia coli* (EPEC) on glass slide revealed that all three concentrations of H_2O_2 used can reduce the EPEC *E. coli* population in biofilm after 5 min exposure by 1.939, 3.324 and 3.635 $Log_{10}cfu/cm^2$, respectively from a concentration of 7.539 $Log_{10}cfu/cm^2$.
- Studies on bacterial flora associated farmed catfish (*Pangasianodon hypophthalmicus*) and farmed rainbow trout (*Oncorhynchus mykiss*) showed that the microflora was dominated by *Pseudomonas* (*P. fluorescens* and *P. aureofaciens*), *Aeromonas*, Enterobacteriaceae (belonging to the genera *Proteus*, *Providencia*, *Citrobacter* and *Morganella*), *Moraxella*, *Acinetobacter* and *Flavobacterium*.
- Genomic library of the *Paenibacillus elgii* was constructed by partial digestion of the genomic DNA and ligation of fractionated genomic fragments of 2-5 Kb size with digested pUC18 plasmid resulted in 1200 transformants and none of the 400 transformants screened had the full length chitinase gene.
- Studies on production of chitinase by *Vibrio harveyi* and *Vibrio alginolyticus* revealed that *V. alginolyticus* had greater chitinase activity (134 U/L after one day) than *V. harveyi* (84 U/L after two days). The fed-batch fermentation using a mixed culture of *V. harveyi* and *V. alginolyticus* yielded a product with 990 units of chitinase and a specific activity of 1.250 U/mg by the end of three days of fermentation.
- Studies on lab scale fermentation of alkaline protease from marine bacteria, *Bacillus subtilis* SQ12 in a three Liter Lab scale bioreactor using fish waste based media formulation showed an enzyme activity of 240 U/ml and activity of 410 U/ml for after 24 h and 48 h respectively.
- cDNAsuppression subtractive hybridization of *Mangrovibacter* cells grown under normal (0.5% salt) and salt stressed (5.5% salt) conditions resulted in 37 uni-ESTs that comprised of 25 contigs and 12 singletons, most of which directly or indirectly involve in abiotic stress.

Report of work done

Vibrio parahaemolyticus in fish and fishery products

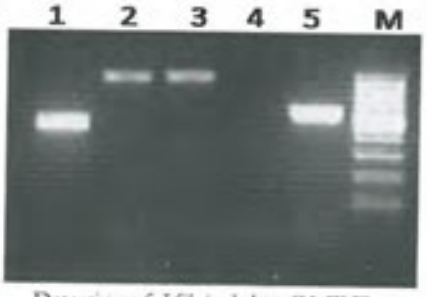
Out of 34 fish and shellfish samples collected from retail markets located at Alappuzha and Kottayam districts screened, 19 (55%) were positive for *Vibrio parahaemolyticus*. Among 54 *V. parahaemolyticus* isolates, 12 (22%) were found to exhibit β-hemolysis on Wagatsuma blood agar (Kanagawa phenomenon) which is an important virulence determinant in *V. parahaemolyticus*.

Virulence and genetic traits of *V. parahaemolyticus* isolated from seafood

Fifty four *V. parahaemolyticus* isolates from seafood were screened for *toxR*, *trh*, *tlh*, *tdh*, and *ORF8* genes. All strains were positive for *toxR*, whereas, the isolates were negative for *trh*. Except two isolates, all were positive for *tlh*. Only five strains were positive for *tdh* gene and none of the strains were positive for *ORF8* gene.

Vibrio cholerae in seafood

A total of 148 seafood samples collected from various retail markets in and around Cochin, Alappuzha and Kottayam were analyzed for the presence of *V. cholerae*. 62% of the seafood samples were positive for *V. cholerae*. A total of 207 *V. cholerae* isolates were identified from seafood. Serotyping of 207 *V. cholerae* isolates revealed that three isolates belong to *V. cholerae* O1 Ogawa. But none of the isolates were found positive for *V. cholerae* O139 Bengal.



Detection of *Vibrio cholerae* O1 El Tor serotype Ogawa in seafood. Lanes 1-5 *tcpA* El Tor, *toxc*, *zot*, *tcpA* classical, *ctxc* genes, m-100bp DNA ladder

Molecular detection of *V. cholerae* serogroups O1 and O139

PCR assay confirmed the presence of *V. cholerae* O1 and El Tor biotype in three seafood samples. O1 strains were negative for *tcpA* Classical biotype. All the O1 Ogawa strains produced PCR amplicon of 471 bp for *tcp*A (El Tor) confirming the El Tor biotype which is mainly responsible for the outbreak of seventh pandemic of cholera worldwide. Non-O1, non-O139 strains detected were negative for O1-*rfb* gene and all *V. cholerae* isolates were negative for O139-*rfb* gene.

Biotyping of *Vibrio cholerae* based on utilization of different carbon sources

The biochemical profile of 207 *V. cholerae* strains isolated from seafood samples was determined. All the isolates utilized glucose, sucrose, mannitol, trehalose, lysine and ornithine. However, 51 out of 207 *V. cholerae* utilized mannose as a sole carbon source. None of the isolates utilized arabinose, cellobiose, myo-inositol, sorbitol, lactose, salicine, rhamnose and arginine.

Antibiotic resistance profile of *V. cholerae* strains

The antibiotic resistance profile of 382 *V. cholerae* isolates from seafood samples revealed that *V. cholerae* O1 strains were sensitive to 20 test antibiotics. Resistance to Cefpodoxime, Ticarcillin, Augmentin and Colistin was noticed in 26, 40, 62 and 84% non-O1 and non-O139 strains, respectively.

Molecular characterization of *Vibrio cholerae* isolated from seafood

Out of 207 *V. cholerae* O1, non-O1 and non-O139 strains isolated from seafood, presence of *ctx, zot, ace* and *toxR*, gene was detected in all three *V. cholerae* O1 biovar El Tor strains. The non-O1, non-O139 were negative for *ctx, zot* genes. However, presence of *ace* was detected in 9.8% (both non-O1 and non-O139) strains and regulatory *toxR* gene was detected in 91% strains isolated from seafood.

Yersinia enterocolitica in fish

Twenty four fish and shellfish samples collected from retail markets located at Alappuzha and Kottayam districts were screened for the presence of *Yersinia enterocolitica*. Sixty presumptive *Y. enterocolitica* cultures were biochemically identified. *Y. enterocolitica* biotype 1A was detected in two samples.

Virulent genes in *Yersinia enterocolitica* from seafoods

The distribution of virulence markers (*inv, ail, ystA, ystB, ystC, yadA, virF*) in *Y. enterocolitica* biotype 1A isolates from seafood were studied. All the biotype 1A strains of *Y. enterocolitica* lack virulence genes including *ail, myfA, ystA* and *ystC*. All biotype 1A strains carried *yst B, fepA, fepD* and *inv* genes.

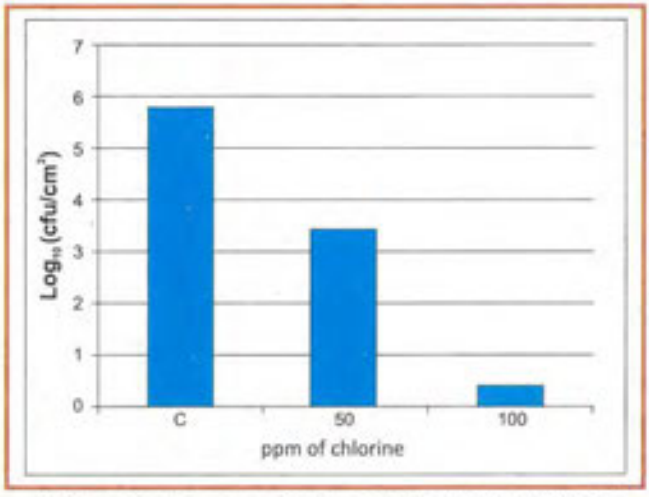
Non-proteolytic *Clostridium botulinum* in fish

Sixteen samples comprising of farmed fish, pasteurized crab meat and fish products were screened for the presence of non-proteolytic *C. botulinum*. *C. botulinum* type E was detected in two samples.

Listeria monocytogenes in fish and environmental samples

A total of 68 samples comprising of 50 fish samples procured from local supermarkets of Cochin and retail markets at Kottayam district and 18 environmental samples were screened. *L. monocytogenes* was detected in one fish sample and the isolate belonged to serogroup 1.

Virulence genes in *Listeria monocytogenes*



Effect of short exposure of chlorine to *L. monocytogenes* biofilm on glass slide

L. monocytogenes isolates from fish and ice samples from Cochin, fish isolates from Goa and type cultures (ATCC, MTCC) were screened for virulent genes β-hemolysin (*hly*), *plcA, iap* (infection associated protein), *mpl* (metalloprotease), *prfA* (the regulatory gene) and *actA*. All the six virulent genes were detected in all the isolates. *actA* gene could not be detected in *L. monocytogenes* MTCC 657.

Effect of chlorine on *L. monocytogenes* on short exposure

The efficacy of different concentration of chlorine (50, 100 and 150 ppm) were checked for inactivation of *L. monocytogenes* in biofilm formed on glass slide on short exposure (approx. 10 sec) by dipping method. It was observed that 50 and 100 ppm of chlorine reduced *Listeria* population by 2.359 and 5.742 Log_{10}cfu/cm^2, respectively. 150 ppm chlorine can completely destroy the *Listeria*

population in biofilm.

Effect of high pressure treatment on *L. monocytogenes* in white shrimp

At 30°C and pressure treatments of 250, 350 and 450 Mpa, *L. monocytogenes* population in muscle of white shrimp spiked with *L. monocytogenes* ATCC 19115 (10^7 cfu/g) and vacuum packed in EVOH pouch was reduced by 0.496, 2.532 and 4.164 Log_{10} cfu/g respectively from an initial population of 107 cfu/g. Studies on combined effect of pressure treatment (250/350 Mpa for 5 min at 30°C) on *L. monocytogenes* in spiked samples treated with Nisin by dipping in 400 IU/ml Nisin solution for 15 min showed that treatments with 350 Mpa and Nisin reduced the *Listeria* population by almost 5.819 Log_{10}.

Studies on pressure destruction kinetics of *L. monocytogenes* at 250 Mpa pressure treatment showed that the pressure D value (Pressure decimal reduction time) of *L. monocytogenes* at 250 Mpa pressure level in white shrimp is 34.52 min.

Thermophilic *Campylobacter* spp. in seafoods

Twenty six samples of seafood procured from local markets of Cochin were screened for the presence of thermophilic *Campylobacter* spp. *Campylobacter jejuni* was detected in two fish samples.

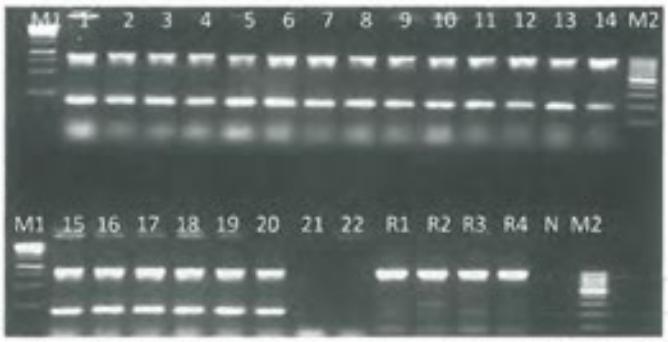
Campylobacter jejuni colonies from fish on Blasser-Wang agar

Development of PCR-based method for detection of enterotoxin producing *Bacillus cereus* in fish

A PCR-based method for detection of enterotoxin producing *B. cereus* has been developed. Muscle of white shrimp, which was found negative to *B. cereus* by microbiological method, was divided into 4 lots (10g each), separately spiked with 100 µl of normal saline containing 10, 100 and 1000 cfu of enterotoxigenic *B. cereus* along with control inoculated with 100 µl of normal saline. After incubation in BHI broth at 37°C overnight, 2 ml of the enrichment from each sample was used for preparation of bacterial cell lysate for PCR assay. Primers targeting gene *hbla* (for enterotoxin) was used for PCR assay. Reverse passive latex agglutination (RPLA) test was also performed using commercial RPLA kit (Oxoid). *hbla* gene (834 bp) was detected in all the spiked samples which were also found positive for enterotoxin by RPLA method. This method has been found cost-effective and takes less time as compared to conventional RPLA-based method which requires three days.

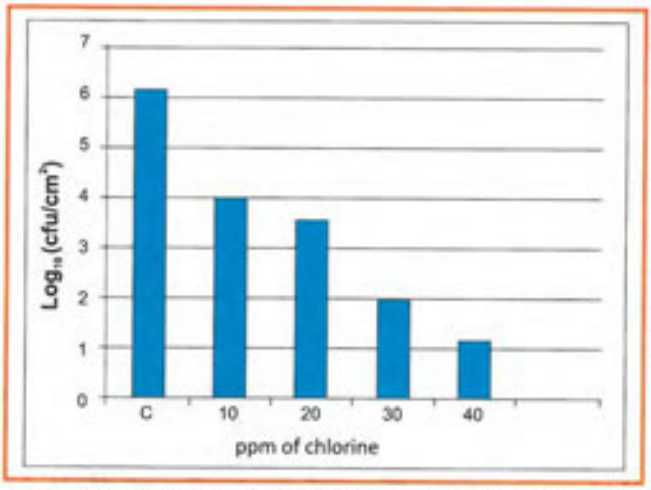
Molecular studies on enteropathogenic *Escherichia coli*

Fifty four samples including 15 water samples (five from river, five from estuary and five from marine environment) and 39 fish samples collected from landing centres and retail outlets located at Alappuzha and Kottayam districts were screened. 57% of the samples were found to harbour *E. coli*. None of the isolates was found to be *E. coli* O157:H7.



Multiplex PCR for detection of enterotoxigenic *Escherichia coli* (ETEC) M1- 1kb marker, 1-22 *E. coli* isolates, R1- strain 11113, R2- strain12568; R3- strain *st3*, *R4- strain O42*, M2-100bp

Pathotyping of 60 *E. coli* isolates using two multiplex PCR, one targeted against *stx1, stx2, eaeA* genes and another targeted against *phoA, LT1, LT2* and *ST1* genes identified 40 strains as Enterotoxigenic (ETEC) and one isolate was found to be enterohaemorrhagic *E. coli*. Four strains were identified as non pathogenic.



Effect of chlorine on biofilm formed by enteropathogenic (EPEC) *E. coli* on stainless steel coupon. C = Control

Effect of H_2O_2 on biofilm formed by enteropathogenic *Escherichia coli* on glass slide

Studies on biofilm formation of enteropathogenic (EPEC) *E. coli* ATCC 35816 on glass slide showed that the bacterial concentration of biofilm was 7.539 Log_{10}cfu/cm^2 after four days. Studies on the efficacy of different concentrations of H_2O_2 (0.1, 0.2 and 0.3 %) after 5 min exposure to inactivate the organism in biofilm revealed that 0.1, 0.2 and 0.3% H_2O_2 can reduce the EPEC *E. coli* population in biofilm by 1.939, 3.324 and 3.635 Log_{10}cfu/cm^2, respectively.

Antibiotic resistance in *E. coli* from aquaculture farms

Studies on antibiotic resistance in 32 *E. coli* isolates from aquaculture system (pond water, pond sediment, *Penaeus monodon*, *Macrobrachium rosenbergii*, *Catla catla* and *Labeo rohita*) showed that *E. coli* isolates from *P. monodon* (3), *M. rosenbergii* (2) and pond sediment (1) were resistant to Tetracycline (upto 60µg concentration). Resistance to Chloramphenicol (upto 30µg concentration) was noticed in *E. coli* isolates from *P. monodon* and *M. rosenbergii*. *E. coli* isolates from *C. catla*, two from pond water and one from pond sediment were resistant to Nalidixic acid. Nalidixic acid resistant *E. coli* isolated from *C. catla* and *M. rosenbergii* showed resistance even at 240µg concentration (the maximum antibiotic concentration on the strip) whereas isolates from pond water and pond sediment showed resistance upto 120µg concentration. One *E. coli* isolate obtained from *C.catla* was resistant to Ciprofloxacin upto 60µg concentration.

Staphylococcus aureus in fish

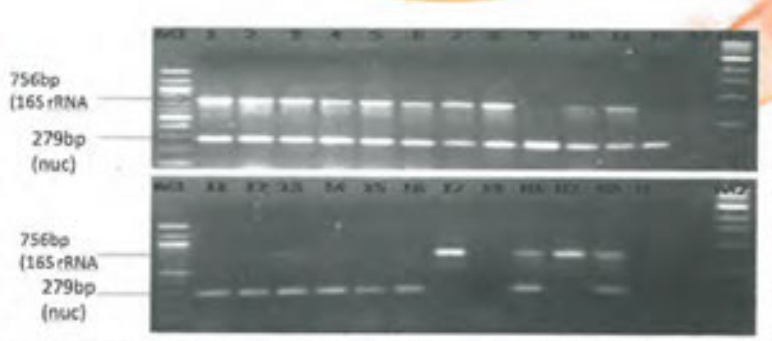
Thirty one seafood samples from 11 retail outlets at Ernakulam, Alappuzha and Kottayam districts were screened for presence of *S. aureus*. 40% samples harbored the organism. Out of 125 isolates, 108 were identified as coagulase positive *S. aureus*.

Enterotoxigenic *Staphylococcus aureus* in seafood

One hundred and eight strains of *S. aureus* isolated from fish collected from retail outlets in Ernakulam, Kottayam and Alappuzha districts were positive for *coa* gene. Enterotoxin genes *SEC, SED, SHE* and *SEJ* were absent in all the strains. 90% of the strains had *SEG* gene. *SEA*, SEB, *SEE* and *SEI* enterotoxin genes were present in 19%, 20%, 21% and 23% of the strains, respectively.

Molecular studies on virulent and antibiotic resistant genes in *Staphylococcus aureus* in seafood

In multiplex PCR performed to detect genes *nuc* (thermostable nucleases), *mecA* (Methicillin resistance), *mupA* (Mupiromycin resistance) and 16srRNA gene sequences in 20 *S. aureus* strains isolated from fish samples using MRSA chrom agar plates, Methicillin or Mupiromycin resistance genes could not be detected in any of the *S. aureus* isolates but the virulent specific *nuc* genes and specific 16s rRNA sequence were present in all the isolates.



Multiplex PCR for discrimination of *Staphylococcus aureus* from CONS and other bacteria. *M1*- 100bp,1-8 *S. aureus* isolates, R1—ATCC 33591, R2- *S. epidermis ATCC 25923,* n-Negative control, M2-1kb.

Antibiotic resistance *in Staphylococcus aureus* from fish

Studies on antibiotic resistance in 70 *S. aureus* isolates from fish and shellfish showed resistance to Penicillin in 47 isolates and resistance to Amoxyclav was found in 36 isolates. Resistance to Oxacillin and intermediate resistance to Vancomycin was detected in <3% of the isolates. Intermediate resistance to Ampicillin and Clarithromycin was detected in 18 and 10 isolates, respectively.

Viral pathogens in shrimp

Post larvae, juveniles and adults of shrimp samples (n=92) were analyzed for the presence of White Spot Syndrome Virus (WSSV), Monodon Baculo Virus (MBV), Yellow Head Virus (YHV) and Taura Syndrome Virus (TSV). One sample was positive for WSSV while two samples were positive for MBV. All the samples were negative for YHV and TSV.

Antibiotic residues in cultured shrimp

Presence of Chloramphenicol in seafood (n=6) was tested by ELISA method using the competitive ELISA method and Ridascreen kit. All seafood samples were found to be negative for Chloramphenicol. Four commercial kits for Nitrofuran derivatives i.e. 3-amino-2-oxazolidinone (AOZ), 3-amino-5-morpholino-methyl-2-oxazolidinone (AMOZ), 1-aminohydantion (AHD) and Semicarbazide (SEM) were validated. The repeat experiments showed the level of detection of 0.1 ppb, 0.05 ppb, 0.15 ppb and 0.9 ppb for AOZ, AMOZ, AHD, SEM, respectively.

Bacterial flora of farmed freshwater fish and shrimp

Bacterial flora associated farmed catfish (*Pangasianodon hypophthalmicus*) collected from freshwater farm situated at Kodungallore, Thrissur district, Kerala, rainbow trout (*Oncorhynchus mykiss*) collected from freshwater farm situated at Munnar, Idukki district, Kerala and farmed gourami (*Osphronemus goramy*) collected from Kadungallore, Ernakulam district were studied. In catfish, the microflora was dominated by *Pseudomonas, Aeromonas, Moraxella, Acinetobacter, Flavobacterium* and *Brochothrix. Pseudomonas* spp. were identified as *P. fluorescens* and *P. aureofaciens.* The counts of H_2S producing bacteria, *Brochothrix thermosphacta, Aeromonas, Pseudomonas* and Enterococci were $\leq 10^3$ cfu/g. In trout, the dominant genera were *Pseudomonas/Shewanella, Aeromonas* and Enterobacteriaceae.

Enterobacteriaceae isolates belonged to genera *Proteus, Providencia, Citrobacter* and *Morganella.*

Studies on microbial profile of farmed gourami revealed that the total aerobic mesophilic count was ≤ 10^5cfu/g and microflora was dominated by *Pseudomonas* and *Aeromonas. Escherichia coli* and Enterococci counts were ≤ 10^3cfu/g. H_2S producing bacteria was dominated by *Aeromonas* spp.

Microflora associated with farmed *Litopenaeus vannamei* was studied. The aerobic bacterial count was ≤ 10^5cfu/g and Enterobacteriaceae count was ≤ 10^3 cfu/g. *S. aureus* was not detected.

Microbiology of ice stored farmed catfish *Pangasianodon hypophthalmicus*

Microbial attributes of ice stored farmed catfish *Pangasianodon hypophthalmicus* collected from freshwater farm situated at Kodungallore, Thrissur district, Kerala were studied. The microbial counts increased gradually during storage and reached >10^7cfu/g on Day 9. Enterococci levels also increased gradually in all the samples and reached a level of 10^4 - 10^5cfu/g.

Effect of vacuum packaging and treatment with clove oil, curry leaf extract and potassium sorbate on the microbial profile of farmed catfish

Microbial profile of ice stored farmed catfish *Pangasianodon hypophthalmicus* treated with clove oil, curry leaf extract and potassium sorbate and stored under vacuum were studied. In all the samples including control, the microbial counts increased gradually during storage. In control samples (without treatment) and sample treated with clove oil, the aerobic mesophilic counts reached >10^7cfu/g on Day 9 whereas in samples treated with curry leaf extract and potassium sorbate, the counts were < 10^7cfu/g. Faecal Streptococci levels also increased gradually in all the samples and reached a level of 10^4 - 10^5cfu/g. The count of *E. coli* was > 100 cfu/g initially and was detected throughout the storage.

Effect of marination and vacuum packaging on the microbial attributes of farmed catfish

Microbial attributes of marinated farmed catfish *Pangasianodon hypophthalmicus* was studied during storage under air and vacuum (VP). In non-marinated samples stored under air, the aerobic count exceeded the limit on Day 6 limiting the shelf life to three days. In marinated samples packed and stored under vacuum, aerobic and anaerobic counts were below the limit count on Day 6. In non- marinated samples stored VP and in marinated samples stored under air, the count exceeded the limit on Day 3.

Effect of microwave heating on the microbiological quality of farmed catfish steaks

Microbiological quality of microwave heated (medium 488W 9 sec) *Pangasianodon hypophthalmicus* steaks stored for 12 days under air and vacuum were studied. The aerobic bacterial counts on steaks stored under air exceeded the limit counts on Day 1 whereas in samples stored under vacuum, the anaerobic and aerobic counts exceeded the limit on Day 6. *E. coli, Aeromonas*

spp. and Enterococci were detected in both samples through out the storage.

Effect of high pressure treatment on the microflora of white shrimp

The effect of 250 Mpa pressure treatment for 6 min. at 400 Mpa/min ramp rate on the spoilage microflora (H_2S producing bacteria, proteolytic bacteria and psychrotrophic bacteria) of white shrimp during chilled storage was studied. Immediately after high pressure processing, a reduction of 1.3, 1.1 and 1.54 Log_{10} cfu/g was noticed respectively for H_2S producing bacteria, proteolytic bacteria and psychrotrophic bacteria.

Studies on psychrotrophic bacteria from aquatic environments

Two hundred and fifty isolates including 36 mesophilic, 185 psychrophilic and 20 aerobic actinomyces and nine anaerobic actinomyces were recovered from farmed rainbow trout, mud and water samples from freshwater farm at Rajamala, Munnar. 16S rRNA gene sequencing of 19 psychrotrophic bacterial isolates identified eight isolates as *Morganella*, five as *Pseudomonas*; two as *Khuvera*, two as *Hafnia*, one as *Serratia* and one as *Aeromonas*. Psychrotrophic bacteria from deep sea prawn and fish samples were identified as genera *Photobacterium*, *Pseudoalteromonas* and *Salini vibrio*.

Bioprospecting of chitin-degrading bacteria for novel enzymes

Out of 20 bacterial strains isolated from shrimp waste, four strains that exhibits maximum chitinase activity were identified. 16S rRNA sequencing identified these strains as *Bacillus cereus* (2 Nos.) and *Paenibacillus elgii* (2 Nos.). Chitin-degrading bacterial strains from marine sediments were identified as *Oceanobacillus iheyensis*. For characterization of chitinase gene, gene specific primers were designed for amplification of chitinase gene from *Oceanobacillus iheyensis*.

Genomic library of *Paenibacillus elgii* for cloning of chitinase gene

Genomic library of *Paenibacillus elgii* was constructed by partial digestion of the genomic DNA and ligation of genomic fragments of 2-5 Kb size with digested pUC18 plasmid resulted in 1200 transformants. None of the 400 transformants screened had the full length chitinase gene.

Studies on production of chitinase by *Vibrio harveyi* and *V. alginolyticus*

V. alginolyticus showed greater chitinase activity than *V. harveyi*. When grown individually, chitinase production was detected by the end of first day of incubation in case of *V. alginolyticus* (134 U/L) whereas in *V. harveyi*, production was lower (84 U/L) and was detected only on second day. The fed-batch fermentation using a mixed culture of *V. harveyi* and *V. alginolyticus* in a bioreactor yielded a product with 990 units of chitinase and a specific activity of 1.250 U/mg by the end of three days of fermentation. The concentration of fermented product to 10% of the original volume using a tangential flow concentrator within 30 min. led to a three fold increase in specific activity but a 54% decrease in total chitinase activity.

Relationship between chitinase production and bioluminescence in *Vibrio harveyi*

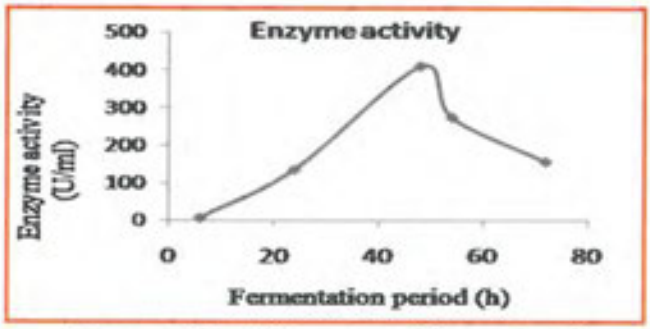
An inverse relationship was found between chitinase production and bioluminescence in *V. harveyi* during fermentation of colloidal chitin in both shake flask and bioreactor culture. The increase in relative luminosity units (RLU) was less than 1 log RLU and lasted for a short duration of time. The inverse relationship might help to understand and monitor chitinase production during chitin fermentation by *V. harveyi* in bioreactors and might possibly be applied to other luminescent, chitinase producing bacteria.

Lab scale fermentation for bacterial alkaline protease enzyme

Fermentation for *B. subtilis* alkaline protease in a Lab scale bioreactor

Fermentation of alkaline protease producing marine bacteria, *Bacillus subtilis* SQ12 was carried out in a three Liter Lab scale bioreactor (New Brunswick, USA) using fish waste based media at 37°C and pH 8.0.

In case of *B. subtilis* SQ12, the enzyme activity is recorded at 6, 24 and 48 h were 8, 136, 410 U/ml. Thereafter, a fall in activity recorded at 54 and 72 h fermentation were 274 U/ml and 156 U/ml respectively. The enzyme activity using fish based media formulation was compared with the commercial bacterial media and found that enzyme activity was in the range 292-375 U/ml.

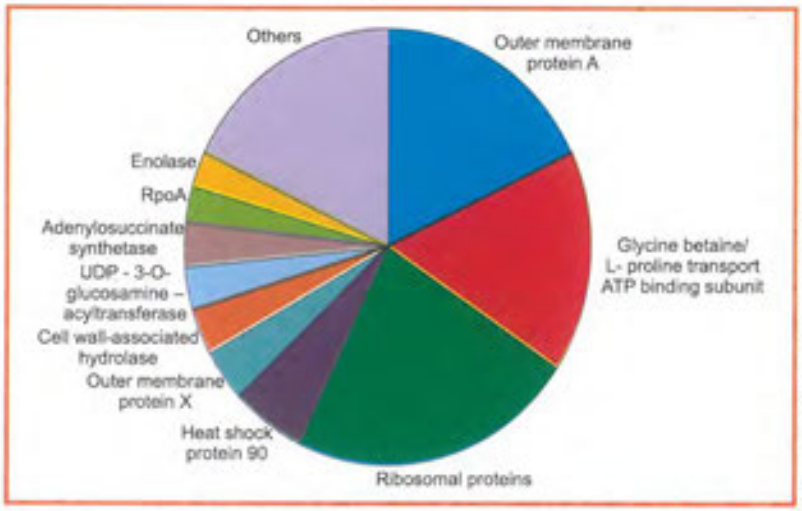


Enzyme activity at different stages of fermentation of *B. subtilis* SQ12

Stability of the protease enzyme with commercial detergents

The crude protease enzyme from *Bacillus subtilis* SQ12 when tested with various commercially available solid detergents *viz*., Surf, Ariel, Tide, Rin and Henko was found to be stable and the activity was in the range of 75-92% for 1 hour at 50°C indicating its potential for incorporation in detergent.

Identification of salt responsive genes from *Mangrovibacter* spp. by prokaryotic suppression subtractive hybridization



Salt responsive genes in *Mangrovibacter* spp.

Molecular mechanisms involved during salt stres in *Mangrovibacter* spp., a facultatively anaerobic, nitrogen-fixing bacterium, isolated from brackish water sediment were studied using cDNA suppression subtractive hybridization. The differentially expressed cDNAs in *Mangrovibacter* cells grown under normal (0.5% salt) and salt stressed (5.5% salt) conditions were identified. One hundred and sixty clones were obtained and resulted in 37 uni-ESTs that comprised of 25 contigs and 12 singletons, most of which were directly or indirectly involved in abiotic stress. Genes that were upregulated at 5.5% salt concentration were glycine betaine/L-proline transport ATP binding sub unit,

outer membrane protein A (OmpA), mechanosensitive channel (MscS), outer membrane protein X (OmpX), DNA-binding ATP-dependent protease La, UDP-3-O-[3-hydroxymyristoyl] glucosamine N-acyl transferase, molecular chaperone DnaK (hsp 70), cell wall-associated hydrolase, colicin uptake protein TolR, Chaperone Hsp10, DNA helicase, Ferrichrome receptor (FcuA), Bacterioferritin-associated ferredoxin, 2,3,4,5-tetrahydropyridine-2,6-carboxylate N-succinyl transferase and eight house keeping genes. The OmpA (16.9%) and glycine betaine/L-proline transport ATP binding subunit (15.6%) genes constituted the maximum number of ESTs. The genes involved in the physiological and molecular mechanisms of bacterial tolerance to osmotic and ionic components of salinity stress were identified in *Mangrovibacter* spp.

Biochemistry and Nutrition Division

Research projects handled

- Biomonitoring of bivalve molluscs and crustaceans from Indian waters as health promoters and indicators of environmental contaminants
- Bioevaluation and purification of natural bioactive compounds of therapeutical and nutraceutical significance from aquatic resources
- Nutritional and pharmacological evaluation of marine molecules in alleviating diseases and disorders
- Nutrient profiling and evaluation of fish as a dietary component
- Isolation and characterization of collagen and gelatin from aquatic sources and development of pharmaceutical and food grade products of commercial importance
- Responsible harvesting and utilization of selected small pelagics and freshwater fishes
- Oceanic tuna fisheries off Lakshadweep seas: A value chain approach
- Utilization strategy for oceanic squids of Arabian sea: A value chain approach
- Resource assessment of deep sea fishes along the continental slope of Indian EEZ

Chief findings

- Nutrient profiling of oysters indicated significant proportion of omega-3 fatty acids (51.2%) especially EPA and DHA in the muscle.
- Nutrient profiling of mussels indicated significant proportion of omega-3 fatty acids especially EPA (16-21%) and DHA (29-32%) in the muscle.
- Amino acid profile of oysters and mussels (*Perna viridis*) indicated the presence of all essential amino acids highlighting its nutritive value.
- Oyster was found to contain significant amount of carbohydrate (3.2%), taurine (243mg/100g) and high content of cholesterol (106mg/100g). A high taurine: cholesterol ratio (2:3) was observed which indicate high health beneficiary effects.
- Pigment from shell waste of deep sea shrimp *Peneaus stylifera* was extracted using organic solvents. The yield was around 0.2g%. The antioxidant activity of the pigment was estimated which was relatively low.
- Shellfish of Arabian waters was examined for the presence of polyaromatic hydrocarbons. It is observed that shellfish of Arabian Ocean are devoid of any PAH content in their meat. The off-flavor compound analysis by Head space GCMS also did not indicated the presence of geosmin or its derivatives.

- Presence of chemical residues like heavy metals, pesticides and PAH was examined in edible oysters and mussels collected from the west coast of India. It is observed that oysters and mussels of west coast regions are not containing any toxic residues above the permissible limits.
- The elemental profiling of mussels have shown the presence of iron (128-142 ppm) in rich quantities. Also it contains the essential elements such as Cu (2.2 ppm), Zn (11-20 ppm) and Mg (8.5-9.1 ppm) in considerable quantities.
- Mineral composition reflects the higher levels of Ca (300-333 ppm) and K (1057-1500 ppm) in mussel meat.
- The mussel available in west coast of India is not only safe for consumption, but also nutritionally beneficial for human health.
- An oyster peptide extract (OPex) was developed and properties studied. The OPex prepared from oyster meat exhibited good anti-inflammatory, antioxidant and antibacterial properties.
- Oyster peptide extract prepared was encapsulated for commercial applications. The product has been launched by Hon'ble DG, ICAR on 5 April, 2012 at CIFT, Cochin.
- A simple and fast method has been standardized for the production of biodiesel from fish oil. It is observed that addition of acetyl chloride enhances the rate of reaction.
- A hydrogel effective in absorbing dyes was developed from chitosan.
- Evaluated the pharmacological significance of marine molecules in alleviating age-associated disorders such as diabetes, myocardial infarction, atherosclerosis, obesity, cancer, etc.
- Created an integrated approach for the utilization of marine compounds for the production of nutritional supplements.
- Identified the molecular mechanisms involved in the alleviation of diseases/disorders by marine natural products.
- Antiulcerogenic effects of taurine was studied.
- Oral administration of taurine significantly attenuated the Ibuprofen-induced aberrations (hemorrhagic lesions) in the gastric mucosa and maintained the volume of gastric juice, acidity and peptic activity at near normalcy in albino rats.
- Taurine exerted an antioxidant property by counteracting Ibuprofen-mediated oxidative stress by maintaining mucosal antioxidant status at level comparable to that of controls.
- The results of the present investigation indicate that the antiulcer activity of taurine is attributable to its membrane-stabilizing and antioxidant properties.

- Dietary intake of chitosan (at 2% level) significantly attenuated the Isoprenaline-induced hyper-lipidemic and necrotic damage in myocardium.
- Chitosan also rendered an antioxidant action against Isoprenaline-induced myocardial infarction by maintaining the antioxidant status at higher rate.
- The results indicated that the cardioprotective potential of chitosan was probably ascribable to its hypolipidemic action and/or antioxidant property.
- Biochemical profile of *Diaphus watasei*, a common Myctophid along the west coast of India, collected off Cochin showed a fatty acid profile with high saturated fatty acids content (45%) followed by monounsaturated and polyunsaturated fatty acids.
- The cholesterol content was very low in *Diaphus* when compared to other pelagic fishes like oil sardine and Indian mackerel. All essential amino acids are present in a balanced proportion.
- Acid soluble collagen was extracted from tuna skin for the preparation of membrane and the yield was 14%.
- Three types of collagen were extracted from squid skin and biochemical characterization was done.
- Nutritional profiling was done for dried squid, canned squid curry and squid ink.

Report of work done

Biomonitoring of bivalve molluscs and crustaceans from Indian waters as health promoters and indicators of environmental contaminants

Biochemical profile of oyster (*Crassostrea madrasensis*) and its nutritional attributes were studied. The proximate composition of the oyster indicated a protein value of 9.41%, lipid of 2.34% and carbohydrate of 3.2%, more than the highest in marine fishes.

Parameter	Wet tissue weight (%)
Moisture	82.64 ± 1.31
Protein	9.41 ± 0.85
Lipid	2.34 ± 0.32
CBH	3.20 ± 0.13
Ash	1.01 ± 0.06

Mineral composition indicated the presence of all essential elements in adequate quantities. An important observation is that oyster meat contained a significant concentration of selenium (10 ppm) which has anti-cancer and antioxidant properties followed by tuna, mussel and other finfishes. It has also high levels of bio-available calcium.

Na	K	Ca	Mg	Mn	Cu	Zn	Fe	Cr	Se
1170	975	309	270	0.814	14.7	95.5	33.3	ND	10.00

* All values in ppm wet weight

Amino acids profile of oyster: Oyster had all the essential amino acids in high concentration. The ratio of Leucine to Isoleucine determines the absorption efficiency of other amino acids and the FAO-recommended value is 2.36. Oyster protein showed a ratio of 2.096.

Amino acid	mg/g Protein
Asp	79.33
Thr	33.87
Ser	33.73
Glu	116.00
Pro	35.20
Gly	43.33
Ala	47.93
Cys	88.67
Val	26.73
Met	21.33
Ile	35.40
Leu	74.20
Tyr	12.87
Phe	30.73
His	25.20
Lys	153.93
Arg	40.73
Try	26.13
TOTAL	**912.93**
Leu/Ile ratio	2.096

FAO/WHO 1991 recommended value - 2.36

Essential amino acid scores of oyster: The amino acid score of oyster

Essential amino acid	Essential amino acid score (g/100g protein)
Lys	1.82
Met+Cys	2.27
Thr	1.59
Ile	1.75
Leu	1.92
Val	1.64
Phe-Tyr	2.34
Try	1.90

protein given in the Table on pre page indicates that the oyster protein is of good quality in terms of essential amino acids.

Nutritional parameters of oyster: Various nutritional parameters like chemical score, protein efficiency ratio, essential amino acid index and biological value are given in the Table below. These parameters are calculated with reference to egg protein which is taken as an ideal protein with a chemical score of 100.

Chemical score	Limiting amino acids		PER		EAAI	Biological value
	Lowest	2nd lowest	PER_1	PER_2		
44%	Thr (44%)	Val (57%)	2.53	2.76	88.43	84.7

Taurine content in oyster: Taurine is present in high concentration in oyster meat. Taurine is a free amino acid present in mammals and is involved in several metabolic pathways. It is an antioxidant molecule and has membrane stabilizing properties too.

Cholesterol content in oyster is high at 106 mg/100g, which is almost twice the content present in finfish. However the taurine : cholesterol ratio is high in oyster which is an indication of good anti-cholesterolemic effect due to the hypocholesterolemic effect of taurine.

Chromatogram showing retention time and peak for taurine content in oyster meat

Levels of taurine and cholesterol in oyster meat and taurine/ cholesterol ratio

	Taurine (mg/100g)	Cholesterol (mg/100g)
Oyster	243 ± 3.5	106 ± 2.2
T:C[1]	2.3	

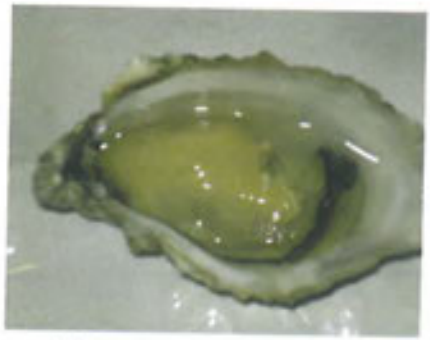
Fatty acids profile of oyster meat: Nutrient profiling of oysters indicated significant proportion of omega-3 fatty acids (51.2%) especially EPA and DHA in the muscle. It also revealed monounsaturated fatty acids as 80.12±1.5 (mg/ 100g muscle) and saturated fatty acid content as 188.1±4.85.

Fatty acids profile of oyster meat

Fatty acid	mg/100g oyster meat
C12:0	11.50±0.21
C14:0	4.71±0.04
C15:0	2.07±0.29
C16:0	27.80±0.03
C17:0	11.90 ±0.22
C18:0	30.60±1.40
C20:0	91.60±2.60
C21:0	2.13±0.01
C23:0	5.80±0.05
C14:1 n-7	1.42±0.02
C16:1 n-7	28.00±0.45
C18:2n-6	11.50±0.27
C18:3 n-6	4.71±0.07
C18:3 n-3	11.90±0.18
C20:2n-6	2.07±0.06
C20:4 n-6	27.80±0.43
C20:5 n-3	112.00±3.70
C22:6 n-3	91.60±2.90
ΣSFA1	188.10±4.85
ΣMUFA2	80.12±1.50
ΣPUFA3	261.58±7.61
Σn-6 FA4	46.08±0.83
Σn-3 FA5	214.90±6.78
n3/n6	4.66
Total FA	**584.20±13.96**

Bioevaluation and purification of natural bioactive compounds of therapeutical and nutraceutical significance from aquatic resources

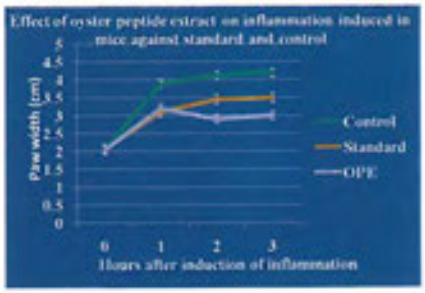
Bioactive peptide extract from edible oyster, *Crassostrea madrasensis*: Cultured oysters were harvested in live condition and depurated for a few hours. Meat was separated from the shells and kept on ice. It was subjected to extraction by homogenization in ethanol: 0.7M HCl (3:1 v/v; 400 ml) at 0°C using a Waring Blender followed by centrifugation (4000 x g for 30 min. at 0°C). The supernatant containing the peptides was collected for further purification by using Sep-Pak C-18 catridges (Waters Associates) connected in series at a flow rate of 2 ml/min. Bound material was eluted with acetonitrile: water: triflouroacetic acid (70:29.9:0.1, v/v/v) and freeze-dried. The freeze dried samples were dissolved in 0.1% TFA and made up to 5 ml. The peptides were quantified by biuret method. The concentration of the extract was 16.82 mg/ml. The extract obtained was hypothesized to contain possible antioxidant, anti-inflammatory and antibacterial activities.



Edible oyster, *Crassostrea madrasensis*

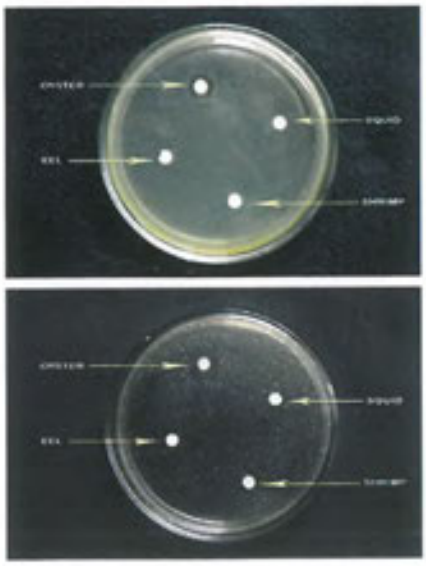
Antioxidant activity of the oyster peptide extract: Dipicryl phenyl hydrazine (DPPH) scavenging assay was carried out in the oyster extract to establish antioxidant activity. IC_{50} value (amount of the extract at which 50% inhibition of DPPH free radical scavenging takes place) for the oyster extract was calculated to be 0.4 mg.

Sample	DPPH IC_{50} values (µg)
Oyster peptide extract	40
Gallic acid	2.78



Anti-inflammatory activity of the oyster peptide extract: Three groups of mice; control, standard and test were taken for the study. Initial thickness of paw was noted in all groups of mice. Test group mice were administered 0.5 ml of oyster peptide extract (OPE) (intraperitoneal). Standard group of mice was injected with Ibuprufen (100mg/kg body weight). Inflammation was induced in all mice by injection of 3.5% formalin, 30 minutes after drug extract administration. Paw thickness was measured at one-hour intervals for three hours. Control group mice showed an increase in the paw thickness. OPE group showed better paw size reduction than the standard group.

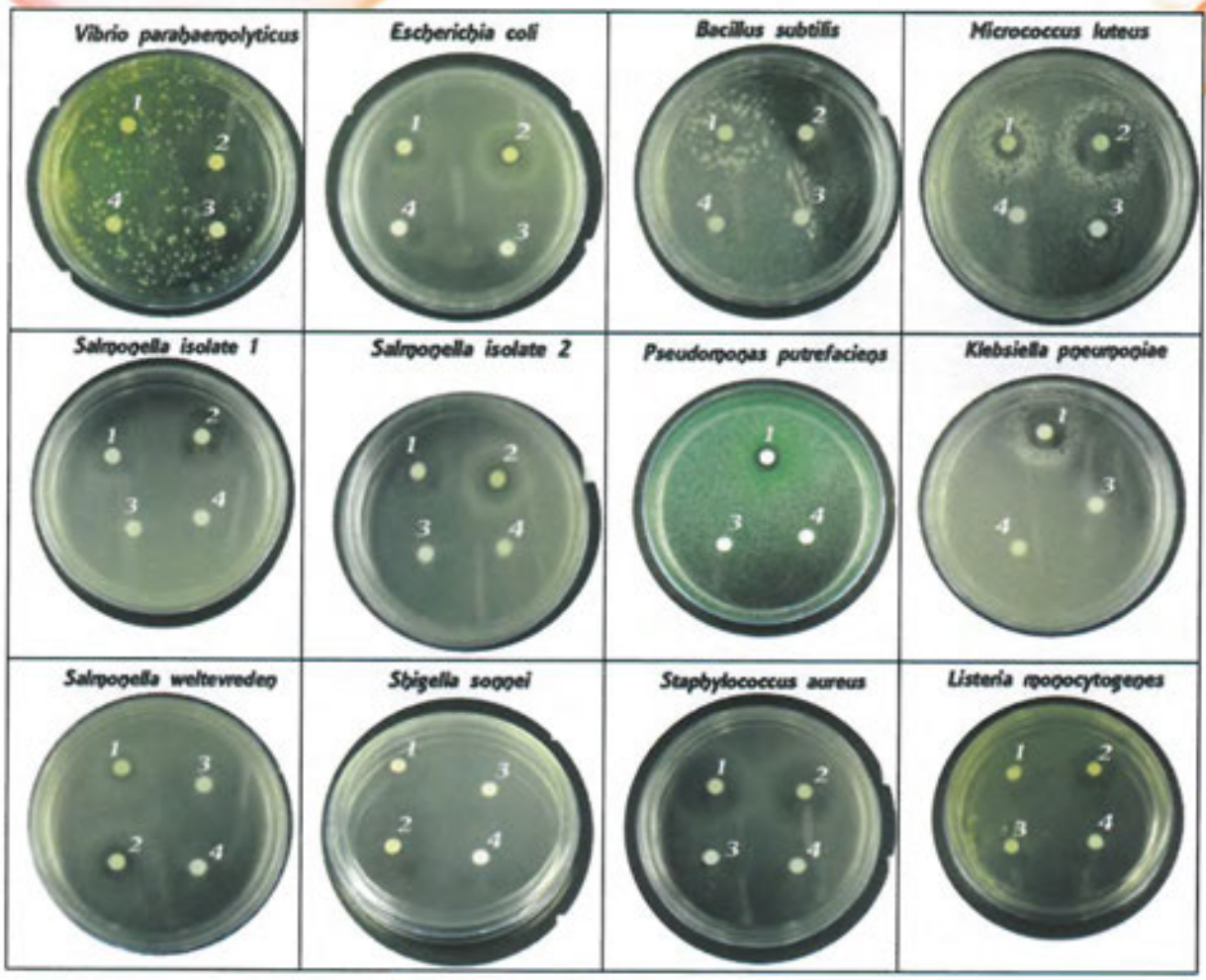
Antimicrobial activity of oyster peptide extract: The extract showed good antibacterial effect on both pathogenic bacteria and spoilage bacteria. Preliminary studies show that the extract has antibacterial effect, the extract showed an inhibition zone of 8-10 mm diameter on *Bacillus subtilis*.



Antibacterial activity of oyster peptide extract against *Bacillus subtilis* at pH 7.2 and 8.8

Bacteria	Zone of Inhibition (mm)	
	OPE 1	OPE 2
1. Spoilage *Pseudomonas putrifaciens*	14mm	ND*
2. *Escherichia coli*	16mm	20mm
3. *Salmonella Welteuredon*	7mm	14mm
4. *Staphylococcus aureus*	30mm	24mm
5. *Shigella sonnei*	14mm	35mm
6. *Listeria monocytogenes*	-	20mm
7. *Lactobacillus planetarium*	11mm	ND
8. *Klebsiella pneumoniae*	19mm	ND
9. Spoilage *Micrococcus luteus*	9mm	25mm
10. Spoilage *Bacillus subtilis*	9mm	30mm
11. *Vibrio parahaemolyticus*	-	31mm
12. Spoilage *Morganella morganii*	-	ND
13. *Streptococcus faecalis*	9mm	ND
14. *Salmonella* isolate-II	9mm	11mm
15. *Salmonella* isolalte-I	10mm	20mm
16. *Escherichia coli*	9mm	14mm
17. *Vibrio cholera* O1	-	10mm

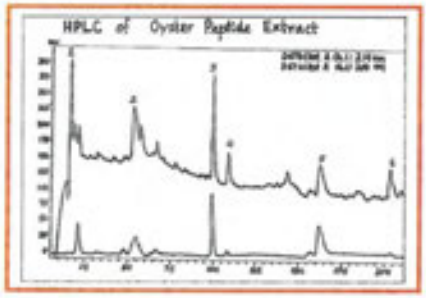
* ND - Not detected



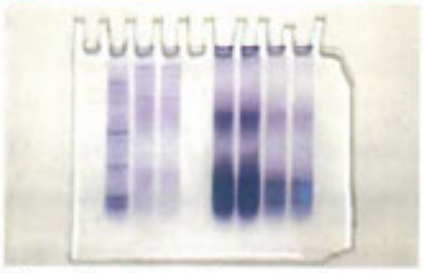
Antimicrobial activity of oyster peptide extract

Characterization of oyster peptide-based nutraceutical by High Performance Liquid Chromatography (HPLC) and Electrophoresis: HPLC of the oyster peptide extract has revealed the presence of six peptide peaks which is shown in the figure. Electrophoresis revealed the presence of six bands in the oyster extract (Lanes 5-8) and molecular weight marker (Lane 1).

Six peptide fragments were detected in the oyster peptide extract and their relative molecular weight (MW) was determined by gel docking using Biorad Software Quantity One.



Fragment	MW-K Da
1	255
2	47
3	23
4	21
5	16
6	8



Electrophorogram of oyster peptide extract

Encapsulated oyster peptide extract (OPex)

Peptide-based nutraceutical product, oyster peptide extract (OPex)

The oyster peptide extract was encapsulated and officially launched by the Honourable D.G., ICAR, Dr. S. Ayyappan at CIFT on 5 April, 2012.

Effect of dietary chitosan supplementation against Isoproterenol-induced Myocardial Infarction in rats

Taurine is primarily utilized in biological system for the elimination of cholesterol from the body through the bile acid conjugation reactions. Chitosan is capable of increasing the faecal excretion of cholesterol without the involvement of taurine-mediated bile acid conjugation reactions. This might be the possible reason for the increase noticed in the cardiac taurine content in Group II chitosan-supplemented rats. Hence, it is possible that the supplementation of chitosan is capable of preserving the cellular taurine content for other important biological processes such as cell membrane stabilization, antioxidation, detoxification and osmoregulation in the myocardium.

Levels of amino acids in heart tissue of normal and experimental groups of rats

Parameters	Group I	Group II	Group III	Group IV
Taurine	38.4 ± 2.45 c, e	52.4 ± 3.34 a, c	18.3 ± 0.86 b	39.1 ± 2.32 a
Arginine	17.8 ± 1.42 a	18.6 ± 1.39 a	26.3 ± 1.77 b	19.4 ± 1.52 c
Asparate	14.2 ± 0.75 a	15.3 ± 0.82 a	7.82 ± 0.37 b	12.9 ± 0.83 a
Glutamate	19.1 ± 1.08 a	20.3 ± 1.15 a	8.98 ± 0.69 b	16.7 ± 0.94 a
Hydroxyproline	1154 ± 95.2 a	1243 ± 91.7 a	712 ± 55.2 b	1080 ± 89.7 a

Values expressed: μmol/g wet tissue. Results are mean ± SD for six animals; one way ANOVA; Duncan's multiple comparison test. Values that have a different subscript letter (a, b, c, d, e) differ significantly ($p<0.05$) with each other.

Extraction of collagen

The extraction of collagen from the skin of Albacore tuna (*Thunnus alalunga*), Dog shark (*Scoliodon sorrakowah*), and Indian major carp ie., rohu (*Labeo rohita*) was done. Characterization of the extracted collagen by studying its amino acid composition, uv-visible absorption spectra and electrophoretic studies were carried out.

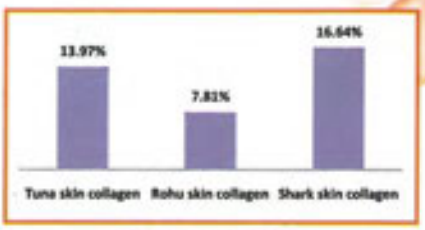
Proximate composition of skin (%)

	Moisture	Protein	Fat	Ash
Tuna skin	56.54 ± 0.09	20.54 ± 0.26	18.32 ± 0.11	4.39 ± 0.03
Rohu skin	76.54 ± 0.45	18.84 ± 0.06	2.93 ± 0.05	2.03 ± 0.04
Shark skin	68.38 ± 0.43	27.73 ± 0.36	0.16 ± 0.02	4.19 ± 0.03

It was observed that generally skin of cartilaginous fishes which include sharks and rays are low in lipid content. This lean species store majority of

their fat in liver. Whereas skin of clupeoid and scombroid species (sardines, mackerels and tuna) is rich in lipid.

The highest yield of collagen was obtained from shark skin (16.64%) followed by tuna skin (13.97) and the lowest in rohu skin (7.81%). Their amino acid composition is presented below:



Total collagen yield

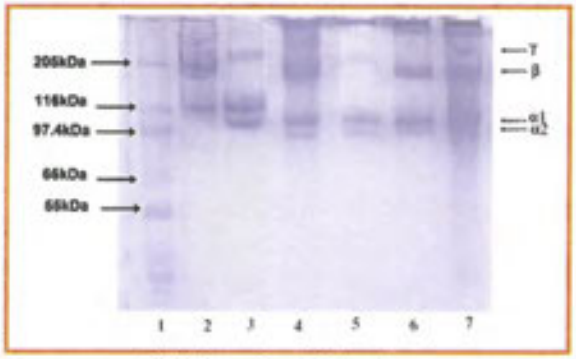
Amino acid composition of the isolated collagen (residues/1000 residues)

Amino acids	Tuna ASC	Rohu ASC	Rohu PDC	Shark ASC	Shark PDC
Ala	118	130	131	109	108
Arg	46	53	54	52	55
Asp	41	43	42	43	40
Cyst	-	-	-	-	-
Glu	74	62	62	76	78
Gly	332	328	330	315	321
Hist	9	7	7	8	7
Iso	9	8	7	21	18
Leus	18	22	21	24	23
Lys	25	24	24	26	29
H.lys	8	6	6	8	4
Meth	11	11	11	12	12
Phen	14	18	20	15	14
H.prol	78	66	68	95	91
Prol	99	115	117	98	109
Ser	43	41	41	32	32
Threo	23	22	22	23	22
Tyr	2	1	1	2	1
Val	28	29	29	25	26

Glycine is present in high levels in all the three collagens which is characteristic of typical collagens. Similarly proline, hydroxyproline and hydroxylysine are also present in high concentrations which is also characteristic of collagens.

UV visible spectra of extracted collagen from all three sources were studied and the absorption maxima was in the range of 200-250nm. There is no peak in the range of 280nm which denotes the absence of other proteins that absorb at 280nm and it indicates that the collagen is free of contamination.

ASC and PDC from the skin of the three species of fishes were extracted. Amino acid patterns, SDS-PAGE pattern and the UV absorbance spectra characterize it as collagen in the pure form. Collagen has tremendous application in medical, pharmaceutical and cosmetic industries. As far as the religious and ethical issues



SDS-Page of purified collagen

Lane 1. High molecular weight marker, Lane 2. Shark ASC, Lane 3. Shark PDC, Lane 4. Tuna ASC, Lane 5. Rohu ASC, Lane 6. Rohu PDC, Lane 7. Type 1 collagen from calf skin

are concerned, this fish collagen have advantages over collagen extracted from bovine or swine sources.

Assessment of Myctophid resources in the Arabian sea and the development of harvest and post harvest technologies

The nutritional profiling of various species was carried out and the possibility of utilization of Myctophid fish powder in poultry was investigated. It is observed that dietary supplementation of Myctophid increased n-3 PUFA content in egg of poultry.

Oceanic tuna fisheries off Lakshadweep seas

Under the project a pet feed was prepared from tuna waste. Biochemical profile of pet feed prepared showed that it is comprised of all essential nutrients required for the pet animals at balanced proportions. Further studies on storage aspects are underway.

Nutrient profiling and evaluation of fish as a dietary component

Biochemical profile of Indian food fishes was carried out and the parametric values are provided in the following tables.

Place of collection: Cochin, Kerala **Month and Year: May, 2011**

Sl. No.	Common name	Scientific name	Moisture	S.D.	Protein	S.D.	Fat	S.D.	Ash	S.D.
1	Mackerel (Big)	*Rastrelliger kanagurta*	77.03	0.03	18.11	0.46	3.36	0.12	1.88	0.11
2	Mackerel (Small)	*R. kanagurta*	77.27	0.13	19.19	0.49	2.18	0.13	2.05	0.08
3	Giant snakehead (Big)	*Channa striatus*	77.82	0.08	16.80	0.29	1.64	0.07	2.60	0.17
4	Giant snakehead (Small)	*C. striatus*	77.14	0.86	18.63	0.28	1.02	0.04	2.26	0.43
5	Japanese Threadfin bream (Big)	*Nemipterus japonicus*	77.38	0.23	16.27	0.54	4.18	0.20	2.43	0.35
6	Japanese Threadfin bream (Small)	*N. japonicus*	77.44	0.44	18.36	0.50	3.36	0.40	0.84	0.33

Fish consumption pattern survey

A socio-economic survey on fish consumption patterns for identifying Low Birth Weight (LBW) among the human population and to study the correlation between LBW and fish consumption is envisaged. The survey on fish consumption pattern is being carried out in Kerala. The salient findings of the survey are:

- Even in the interior-most areas of Kerala state due to improved transportation facilities people have access to fresh fish.

Place of collection: Chennai, Tamil Nadu **Month and Year: August, 2011**

Sl. No.	Common name	Scientific name	Moisture	S.D.	Protein	S.D.	Fat	S.D.	Ash	S.D.
1	Commerson's Anchovy (Big)	*Stolephorus commersoni*	75.75	0.90	13.62	0.40	3.68	0.20	6.54	0.11
2	Commerson's Anchovy (Small)	*S. commersoni*	76.10	0.31	15.49	0.45	1.92	0.24	6.53	0.21
3	Japanese Threadfin bream (Big)	*Nemipterus japonicus*	77.88	0.10	13.50	0.49	3.65	0.10	4.83	0.16
4	Japanese Threadfin bream (Small)	*N. japonicus*	76.97	0.84	16.98	0.08	1.65	0.22	4.60	0.07
5	Mackerel	*Rastrelliger kanagurta*	76.74	0.93	17.15	0.34	3.39	0.17	2.47	0.20

Place of collection: Chennai, Visakhapatnam, Andhra Pradesh **Month and Year: July, 2011**

Sl. No.	Common name	Scientific name	Moisture	S.D.	Protein	S.D.	Fat	S.D.	Ash	S.D.
1	Yellow fin tuna (White meat)	*Thunnus albacares*	73.30	0.05	21.87	0.19	1.18	0.03	3.65	0.41
2	Yellow fin tuna (Red meat)	*T. albacares*	73.00	0.06	23.23	0.41	1.20	0.05	3.36	0.08
3	Little tuna (White meat)	*Euthynnus affinis*	70.18	0.03	23.91	0.13	2.27	0.04	4.5	0.34
4	Little tuna (Red meat)	*E. affinis*	72.95	0.19	21.08	0.61	2.19	0.14	4.36	0.14
5	Commerson's Anchovy	*Stolephorus commersoni*	76.72	0.29	15.05	0.44	2.49	0.21	6.56	0.21
6	Mackerel	*Rastrelliger kanagurta*	72.43	0.21	21.04	0.34	2.25	0.27	4.14	0.06
7	Japanese Threadfin bream	*Nemipterus japonicus*	74.10	0.08	15.19	0.18	6.01	0.33	4.61	0.18
8	Giant snakehead	*Channa striatus*	76.72	0.19	19.25	0.11	0.89	0.18	2.74	0.14

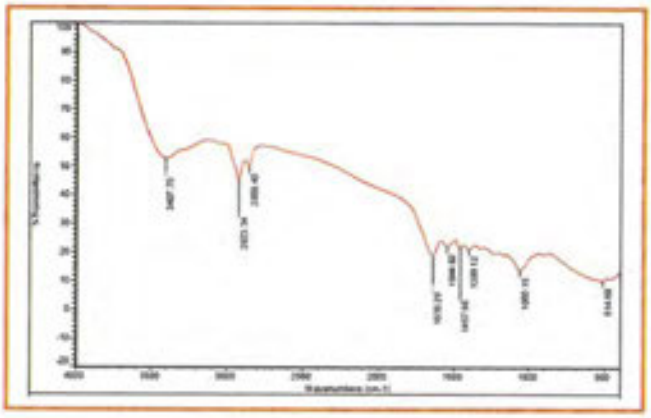
- There has been a gradual shifting from dry/salted fish to fresh fish.
- The most significant disease found in the coastal fish eating population of Kollam district in southern Kerala was the prevalence of goiter in women which arises due to Iodine deficiency. This aspect is contrary to the belief that fish eating populations don't have Iodine deficiency.
- Throughout the survey people liked small fishes like sardine, anchovy over big fishes like tuna, seer fish due to the belief that small fishes are beneficial for human health. This has been proved through analytical studies also.

Utilization strategy for oceanic squids of Arabian sea

Collagens was extracted and purified from Squid (*Stenoteuthis oualaniensis*) skin. Three types of collagen (acid soluble, pepsin soluble and undigestible) were extracted from squid skin. Amino acid, Fourier Transform Infrared Spectroscopy (FTIR), and Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) are carried out. Proximate analysis of the dried oceanic squid, canned squid curry and squid ink were done.

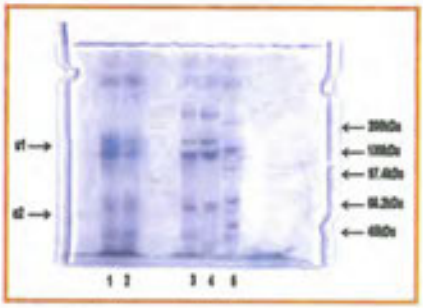
Fourier Transform Infrared Spectroscopy (FTIR): Collagen from squid skin was analyzed by FTIR and the following interpretations were made:

- All the samples have peak at ~1650, and at ~3400 which indicate amide bonds as in peptides and proteins. The peak at 1650 is from amide carbonyl and the one near 3400 is from N-H or O-H bonds.
- Compound STDC has strong Amide I and II bands and N-H peak at 3379. It does not have strong peaks at 2950-2800, indicating lesser aliphatic groups.
- The PSC sample has good peak at 1062, indicating C-O single bonds. This compound also has bigger peaks at 2924 and 2856, indicating aliphatic methylene or methyl groups. Normally, for peptides, we expect two amide bands, Amide I and Amide II. First one is at 1650, while the second is at 1540. This band is associated with the secondary structure of the protein.
- Compound UDC has slightly bigger peak at 2924 and 2858, indicating higher aliphatic amino acid content. The Amide I and II as well as N-H peaks are seen as expected for a peptide. This IR spectrum is similar to that of STDC.
- The transmittance level of sample ASC is below 60%. But we still see signatures of Amides I and II, N-H/ O-H (3400), aliphatic moieites (2923, 2856) and also carbons bearing hydroxyl groups (1060).



FTIR of acid soluble collagen

Sodium dodecyl sulfate polyacrylamide gel electrophoresis: The collagen from squid skin was examined by SDS-PAGE using a 7.5% resolving gel. Both ASC and PSC had the similar electrophoretic pattern of typical Type 2 collagen consisting of α chains with two distinct types (α 1 and α 2 chains) varying in their mobility. The electrophoretic positions of α chains of squid skin collagen are 115 kDa for α 1 chain, and 66 kDa for α 2 chain.



SDS-PAGE pattern of collagen from squid skin (Lane 1&2 UDC, Lane 3 PSC, Lane 4 ASC and Lane 5 Protein Marker)

Squid ink

Proximate composition of squid ink was analyzed.

Proximate composition of squid ink

Parameters	Wet tissue weight (%)
Moisture	53.52
Protein	16.44
Fat	0.77
Ash	21.605

Mineral content of squid ink

Minerals	Contents (mg/100g)
Na	104.7
K	1012.7
Ca	97.2
Cu	37.7
Fe	8.6
Mg	375.6
Zn	37.1

Amino acids of the squid ink

Amino acids	Area (%)
ASP	13.51
THR	2.67
SER	3.48
GLU	15.71
GLY	16.76
ALA	3.99
CYS	0.17
VAL	8.06
MET	0.96
ILE	3.75
LEU	8.48
TYR	6.30
PHE	1.39
HIS	6.06
LYS	8.47
ARG	0.14
TRY	0.10

Products like squid protein concentrate and squid silage were prepared and the nutritional evaluation experiments are underway.

Engineering Division

Research project handled

- Design and development of renewable energy, solar biomass hybrid dryers

Chief findings

- Designed and developed a renewable energy solar biomass hybrid dryer for eco-friendly and hygienic drying.
- Designed and fabricated a fish de-scaling machine for removal of scales.
- Design optimization of solar fish dryer with alternate electrical backup heating system was carried out.

Report of work done

CIFT Dryer (JSDE-55 SM)

Solar biomass hybrid dryer

Designed and developed a renewable energy solar biomass hybrid dryer for harnessing solar energy during favourable weather conditions and utilizing biomass backup to achieve elevated temperatures during unfavourable weather conditions like rain, cloud, night times etc. The system consists of well insulated, efficient solar air heating panels for harnessing solar energy and the hot air generated inside the panel is allowed to flow through a fish drying chamber loaded with fish/vegetables in SS mesh trays. Continuous flow of hot air is maintained with the help of Photo Voltaic cells and fans to enable drying process. The hybrid dryer is equipped with an alternate biomass, firewood water heating system for generating necessary heat energy required during the drying process even under unfavourable weather conditions and non sunny days. Standardization of the system was made by varying the inflow and outflow of hot air circulation system in the drying chamber. Data were collected on various environmental parameters like temperature, air flow and relative humidity inside the chamber to optimize the drying condition inside the chamber. Dryer rate and water activity of the dried product were also determined. For optimization of the drying parameters extensive drying trials were conducted in the solar biomass hybrid dryer using different variety of fishes and with different agricultural products.

Fish de-scaling machine

A fish de-scaling machine is designed and fabricated for removing the scales of fishes. This equipment can remove scales from almost all types/sizes/species of fishes ranging from sardine, tilapia to rohu. The machine is made of SS 304. It contains a 1.5 Hp induction motor and a Variable Frequency Drive (VFD) to vary the speed of the drum depending on the variety of the fish loaded. The

drum is made up of perforated SS 304 sheet fitted in a strong SS frame. Water inlet facility is provided in the drum for easy removal of the scales from the drum so that area of contact to the surface will be more for removal of scales. The water outlet is also provided to remove scales and water from the machine.

An electronic rpm meter was designed and developed and attached with the de-scaling machine to get the read out of the rpm of the drum. The electronic meter directly displays the rpm of the drum. Speed of the drum is a factor influencing the efficiency of removing scales from different sizes and variety of fishes. The sensing part consists of an electro-magnetic sensor attached near to the motor. The signals received from this sensor is conditioned, processed and calibrated to display the data directly in a digital panel meter as rpm of the drum. An LED indication is also given to sense the drum rotation.

DG, ICAR watching the operation of de-scaling machine

Fish with scales

Descaled fish

Design optimization of solar fish dryer with alternate electrical backup heating system

The drying efficiency of the CIFT DRYER JSDE-55 SM was increased by improving the heating system and hot air circulation system by providing thermal insulations in the duct system thereby reducing heat losses. Double glass solar heat collecting panels are also incorporated to increase the heat carrying capacity of air inside the drying chamber. Modifications were made in the solar dryer with electrical backup by increasing the loading capacity inside the chamber. Extensive trials were carried out for studying the temperature distribution as well as air flow inside the drying chamber.

Solar dryer with LPG backup for ICAR Research Complex for NEH at Imphal

Dr. B. Meenakumari, DDG (Fy.), ICAR inaugurated the solar fish drying plant with LPG backup (CIFT DRYER JSDL-55 SM) designed, installed and commissioned at ICAR Research Complex, Manipur under the technical consultancy of CIFT. This 250 kg capacity solar fish drying plant with LPG alternate backup heating system has given excellent results in drying fish much faster than normal sun drying, hygienically and efficiently without losing the nutritional qualities. This solar dryer is ideal for drying other agricultural and horticultural products too by maintaining their colour and flavor.

Solar dryer with alternate backup for Directorate of Fisheries, Manipur

Inauguration of the solar dryer with electrical backup having 20 kg capacity installed and commissioned at Directorate of Fisheries, Manipur for preservation of inland fish was done by Dr. B. Meenakumari, DDG (Fy.), ICAR on 24 October, 2011. Specially designed solar air heating panels are used for harnessing solar energy in this solar dryer and to supply hot air for the drying process. Alternate backup heating system enables drying during unfavourable weather conditions.

Solar fish dryers for Cochin Corporation

Three solar fish dryers with alternate electrical backup heating system having 20 kg capacity (SDE-20) were fabricated and installed at three locations in Cochin Corporation area under the technical consultancy of CIFT, Cochin.

Shri Tony Chammany inaugurating the hybrid solar dryer at West Cochin

Shri Tony Chammany, Worshipful Mayor of Cochin inaugurated the hybrid solar dryer with alternate electrical backup heating system installed at Matsyasree Fish Processing Centre, Fishermen Colony, West Cochin under the CDS and SJSRY programmes with the technical support from CIFT, Cochin on 9 July, 2011.

The labour requirement is considerably reduced compared to open sun drying in beaches/coir mats because of the elimination of cleaning process due to sand and dust contamination. Re-handling process like spreading, sorting and storing because of non-drying or partial drying due to unfavourable weather conditions and spoilage due to rain is also not required. The drying time is reduced considerably with improved product quality. This will ensure quality products eliminating the disadvantages of open sun drying followed in coastal villages. Improved shelf life and value addition of the product fetches higher income for the fisher folk. The eco-friendly solar drying system reduces fuel consumption and can have a significant impact in energy conservation.

Extension, Information and Statistics Division

Research projects handled

- Studies on technology assessment and transfer among the client system
- Assessment of harvest and post harvest losses in fisheries
- Consumer preferences and its impact on domestic fish marketing
- Mobilizing mass media support for sharing agro information
- Responsible harvesting and utilization of selected small pelagic and freshwater fishes

Chief findings

- Data collected from 31 fishermen respondents of Alappuzha district operating 8.5m L_{OA} marine plywood boats revealed that the average total investment on a fishing unit was ₹ 3.95 lakhs of which the investment on engine alone was ₹ 1.63 lakhs.
- The data collected from 36 fishermen operating 8.5m L_{OA} marine plywood boats in the fishing centres of Kollam district revealed that the average number of fishing days was 260 per year. The average annual income/ profit was about ₹ 1.80 lakhs with an average yearly operational expenses of ₹ 4.98 lakhs.
- Diminishing fish catches, increasing fuel prices, inadequate fuel subsidy, inadequate infrastructural facilities in landing centres and lack of access to institutional finance were reported as constraints.
- The data collected from 55 fisheries officials from different states revealed that the average satisfaction score on the perception about the organizational climate was 85%. The average job satisfaction score was 80%. The mean role expectation index for ten technology transfer roles was 81% calculated in terms of the importance of the each role.
- The mean role performance index for ten technology transfer roles was 59% calculated in terms of the performance of each role.
- The income earned by the fishing labourers who were going in the FRP boats ranged from ₹ 150 to ₹ 200 per day and for mechanized boat labourers, it ranged from ₹ 450 to ₹ 500 per day in Nagapattanam in Tamil Nadu.
- Quality, nutrition and taste were the highly significant parameters influencing the consumer preference for fish than convenience, price and family choice.

- A Model Fish Drying unit was set up at Swasrayagram Sevashram, Pullani, Angamaly. Capacity building training of ten women of an SHG, selected to run the unit was provided on fish handling, drying and accounting and financial management.
- The literacy, health and income status of persons engaged in allied activities in the fisheries sector, *viz*., processing and marketing were analyzed for the states of Kerala, Gujarat, Andhra Pradesh, Maharashtra, West Bengal, Madhya Pradesh and Delhi.
- In general, persons engaged in marketing and processing have better literacy skills than in other sectors as they deal with consumers and work in processing factories where education is an added advantage to their trade. The overall literacy rate was 80.69%. An educational institution was available within a radius of 6.26 km in all the states studied.
- The health status of persons engaged in allied post harvest activities in fisheries like marketing and processing was studied through recording observations regarding vaccination regime, discontinuation of vaccinations, birth weight of infants, incidence of maternal and child mortality, incidence of common diseases and special ailments including lifestyle diseases.
- The highest monthly average income generated by the sample respondents was through fisheries sector with an average amount of ₹ 41,057/- (83.46 per cent of the total income).
- It was found that single day fishing trips incured minimum or no loss and the entire catch was landed without any onboard discards. During the multi-day fishing operations, onboard discards were common when low value fishes were caught.
- A preliminary market survey was conducted at selected wholesale, retail and dry fish markets at Ernakulam and Chennai, and traders of fresh and dry fish were contacted. It was found that losses in marketing of fish varied depending on the species, type of packaging and mode of transportation.
- Under the NAIP 'Mobilizing mass media support for sharing agro information', two video films on success stories, seven short video films, ICAR showcasing window namely, 'Krishi Darpan' exhibition, 36 news paper reports, six AIR interviews, 12 TV channel reports and a TV programme in Doordarshan were produced.

Report of work done

Analysis of technology assessment in selected fishing villages

During the period, data were collected from 31 fishermen respondents operating 8.5m L_{OA} marine plywood boats with FRP sheathing in the selected fishing centres in Alappuzha district. Data were collected on their socio-personal variables, technology adoption with reference to fishing craft, gear, engines and economics of fishing. Most of the respondents had operated smaller boats and had used two 9.9 Hp engines. The average total investment on the fishing unit was found to be ₹ 3.95 lakhs of which the investment on engine alone was about ₹ 1.63 lakhs. The average profit was estimated at ₹ 1.68 lakhs

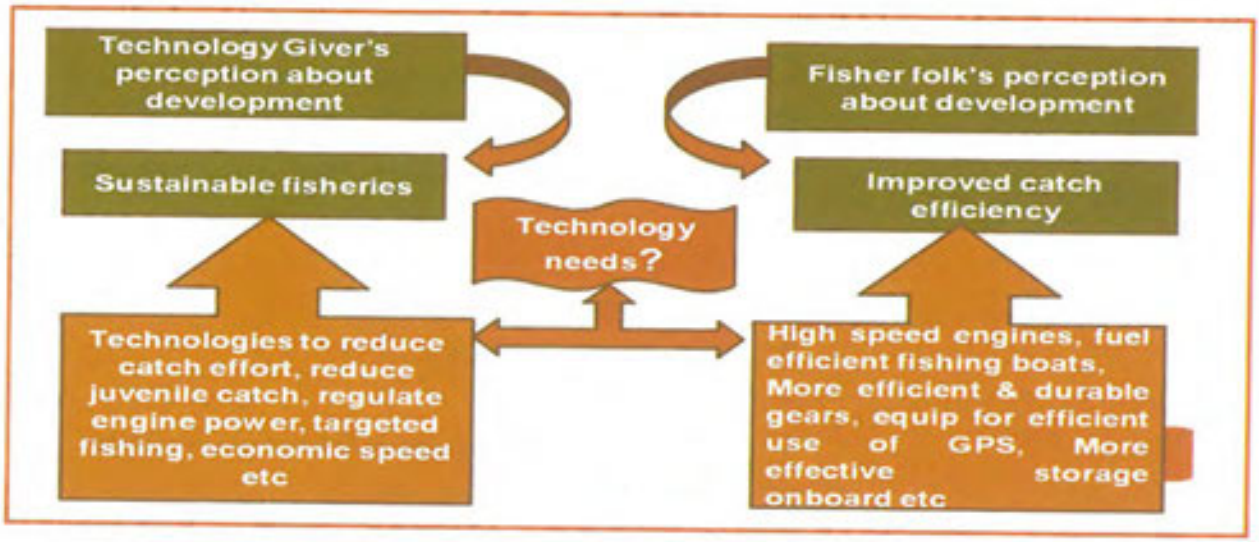
per year. Diminishing fish catches, increasing fuel prices and lack of access to institutional finance were reported as constraints.

Data were also collected from 36 fishermen respondents operating 8.5 m L_{OA} marine plywood boats with FRP coating in the fishing centres of Kollam district such as Thangasery, Vady and Azhikkal. The average number of fishing days was found to be 260 per year. The average annual income/profit was about ₹ 1.8 lakhs with an average yearly operational expenses of ₹ 4.98 lakhs. The number of engines used varied from 1 to 2, and the fuel expenditure was found to be a major factor in influencing the profit obtained. Inadequate fuel subsidy, lack of market intelligence/information system, frequent loss or damage of fishing gears, price fluctuations, lack of cold storage facilities and other infrastructural facilities at fish landing centres, diminishing catches, increasing operational expenditure etc. were expressed as major constraints by the respondents.

The data collected from 30 fishermen respondents operating marine plywood crafts with FRP coating in Kannur district, and 33 fishermen respondents from Thiruvananthapuram district were also tabulated and analyzed.

Technology needs of fisher folk were assessed by contacting 52 fishers in Kannur, Kozhikode and Kollam districts of Kerala. For the need assessment, the purpose for which the fishers need technology were to be defined initially, which was for achieving improvement in the present fisheries scenario. But the means for that was differently perceived by technology givers and takers ie., while sustainable fisheries was ideal future direction for technology givers, it was improved catch efficiency for fishers.

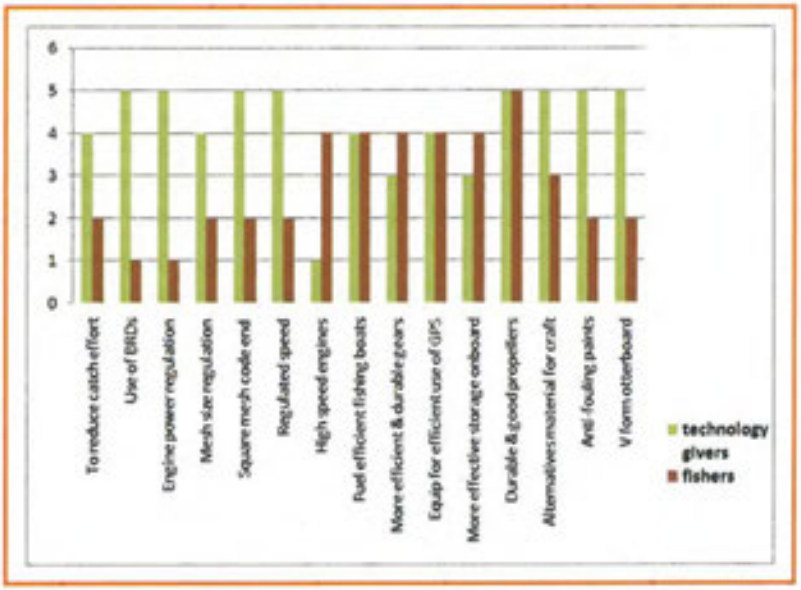
Field observations on technology adoption in Alappuzha



Technology needs perception by technology givers and takers

Perception of technology givers and takers in mechanized fisheries sector on technology needs: The perceived technology needs of fishers were compared with that of technology givers. The 15 technology needs identified (from among developed technologies of CIFT and those

reported by fishers from field) were rated for their priority in a rating scale of 5. From the result, it was found that perception of technology providers and technology takers were same in 20% of technologies and in other technologies, the priority perceived was varying. This reflects the need for further strengthening the extension efforts for making fishers aware of new technologies.



Design and development of renewable energy solar biomass hybrid dryers

Under the component of socio economic aspects of the driers developed by the Institute, the field performance of one dryer installedat Aryad-Kanjikuzhy block panchayath was studied. The managers in charge of operation as well as the women workers who were engaged in drying fish in the dryer were contacted. The observations were made so as to make a SWOT analysis. The results are as follows:

Strength

- Using renewable energy source
- Low cost for fuel for operation
- Hygienic
- Women friendly - can avoid exposure to long hours of sunlight
- Potential of generating employment

Weakness

- The regular availability of fish in sufficient quantity is a must
- In states like Kerala, where two monsoon spread over 4-5 months, solar energy use has limitations
- Regular supply and marketing support is to be assured for full capacity

utilization

- Sometimes, cooked effect is reported for the product
- Takes 2-3 years for break-even, which is not affordable for micro enterprises

Opportunity

- If proper management is ensured, it can surely function as a model community based fish drying unit
- If drying protocol is standardized for different species, superior quality dry fish can be regularly produced
- Have potential of providing employment to women in coastal belt
- Business based on dried vegetables also can be done

Threats

- In case of irregular supply of fish due to seasonal catch variation and dwindling catch, the unit will become uneconomical
- In the absence of a good management input, the facility will fail to serve its purpose
- If ownership is with Government bodies, the chance of failure due to poor operational software is high
- Any small gap in skill and knowledge of women workers on drying procedure for different varieties fish, the result will be very bad

Hence it is inferred that the opportunities can be well exploited if the points identified under the weakness and threats are addressed effectively and it can be recommended as a potential technology at national level.

Performance appraisal of technology delivery systems in selected coastal states of India

During the period, data were collected from ten fisheries officials in the Department of Fisheries, Andhra Pradesh and seven fisheries officials working in the Department of Fisheries, Maharashtra. Under this component, data were also collected from 21 fisheries officials of the Department of Fisheries, Karnataka, and five officials of the State Fisheries Department, Tamil Nadu.

The data collected from 55 fisheries officials from different states were tabulated and analyzed. It was observed that the average age of respondents was 48 years with a mean professional experience of 24 years. The average satisfaction score on the perception about the organizational climate was 85%. The average job satisfaction score was 80%. The data on the job activities attended by the officials and the time spent were recorded. Most of the officials (Assistant Director and above cadre) had spent more percentage of time on administration and implementation of departmental schemes. On selected ten technology transfer activities, their perceptions on role expectation and role performance were determined on three point rating scales. The mean role expectation index for ten technology transfer roles was 81% calculated in terms of the importance of the each role. The mean role performance index for 55

officials on ten technology transfer roles was 59% calculated in terms of the performance of each role.

Manpower assessment studies at Nagapattanam

Manpower assessment in the fishing sector and determination of socio-economic variables in selected fishing villages

Under this component, data were collected from 30 respondents in Nagapattanam district from the 'fishing labourer' category. The income earned by the fishing labourers who were going in the FRP boats ranged from ₹ 150 to ₹ 200 per day and for mechanized boat labourers, it ranged from ₹ 450 to ₹ 500 per day. The gender employment and their contribution to family income were also assessed. Here, the women were mainly involved in fish selling and drying activities. Data were also collected from 30 fishermen respondents operating FRP boats in Nagapattanam district (Nagoor village). Economics of operation from the above data showed that on an average, the operational expenditure per day was ₹ 1290, the revenue per day was ₹ 2757 and the operational profit was ₹ 1124 per day.

The data collected from 42 fishermen respondents at Munambam and 38 women fish processors at Chellanam were tabulated and analyzed. Majority of the fishermen respondents were operating mechanized fishing crafts with 20 years of experience. On an average, the number of fishing days in a year was found to be 239 with an annual income of ₹ 1.15 lakhs. Majority of the women respondents were engaged in fish processing activities like fish drying, preparation of value added fishery products and fish marketing with four years of work experience. On an average, they were engaged for 197 days in fish processing activities and the mean annual income was ₹ 52, 200.

Popularization of appropriate technologies in the selected fishing centres

A training programme on "Fabrication and operation of improved gill nets" was organized under the tribal sub plan programmes at Nellarachal, Ambalavayal, Wayanad on 17 September, 2011. A training course on 'Conversion of diamond mesh nets to square mesh nets' was conducted for 10 officials/ state coordinators of NETFISH, MPEDA, Cochin from 27 September to 1 October, 2011. Two training programmes on 'Production of value added fishery products from freshwater fish for employment and income generation' were conducted at Manipur. The training was conducted in collaboration with the State Fisheries Department, Manipur and the National Association of Fishermen, Manipur unit. The first training programme was conducted at Uchiwa Kabui tribal village, Imphal West during 22-24 March, 2012. The second training programme was conducted at Sekmaijin tribal village, Thoubal district, Manipur during 26-28 March, 2012. Two training programmes on 'Production of value added fishery products' and one training programme on 'Responsible fishing techniques' were conducted in Nagaland.

Consumer preferences and its impact on domestic markets

Consumer survey was carried out at selected markets in Ernakulam and data were collected from 167 respondents. Simultaneously, consumer preferred fish samples were drawn and microbiological and biochemical evaluation were carried out to determine the quality of the fish. Samples of ice and water used

in markets were also collected to assess the general hygienic conditions of the markets. A GIS model with mapping of the market locations and details of the attributes of the markets was also developed.

The consumer preference on fish and fishery products has been assessed using the pre-tested questionnaire covering areas such as demographic variables, fish consumption preferences, consumer attitude towards food safety and quality, and perceived importance of fish quality and nutrition. Almost 36% of respondents were using value added products mostly of fish and prawn pickles other than fresh/chilled fish. About 24% knew about canned products and out of this, 15% had used the products. The consumer awareness on frozen fish products was meagre with only 3.03%.

Non-parametric analysis has been carried out using the parameters such as quality, taste, nutrition, convenience, price, availability, family choice and smell of the fish and fishery products. Kolmogorov-Smirnov Z test results showed that quality, nutrition and taste were the highly significant parameters influencing the consumer preference for fish rather than convenience, price and family choice. This showed that the consumers are ready to purchase fish which is of good quality, having high nutritional value and taste.

Particulars	Parameters of consumer perception							
	Quality	Taste	Price	Nutrition	Convenience (Easy to prepare)	Availability (All seasons)	Family choice	Smell (During preparation)
Kolmogorov-Smirnov Z test	2.334*	1.950*	1.282	1.814*	1.114	0.909	1.194	1.010

* Significant at 1% probability level

The Market Structure, Conduct and Performance (SCP model) has been carried out in Aroor market. Aroor market is operated by co-operatives supported by Matsyafed. The Porters Five Forces analysis has been carried out for Aroor market towards assessing the nature and performance of market in using the forces such as threat of new competitors, threat of substitute products, bargaining power of consumers, bargaining power of suppliers and intensity of competitive rivalry. It was observed that the Aroor market was profitable and attractive to both the buyers and sellers due to the simple entry and exit mechanism and lack of competitive rivalry.

Capacity building of coastal fisherwomen through post harvest technologies in fisheries

Another location was selected for implementing the project work at Sevashram Swasrayagram, Pullani, Angamaly, Ernakulam district of Kerala. A womens' Self Help Group of ten members was organized for the implementation of the project at Angamaly. A model fish drying unit was constructed at Sevashram Swasrayagram for improved fish drying practices.

Adv. Jose Thettayil inaugurating the model fish drying unit

The facility was inaugurated by the Honorable Member of Legislative Assembly, Angamaly Adv. Jose Thettayil on 20 January, 2012. The facility was handed over to the women Self Help Group by Dr. C.K. Murthy, Executive Director, NFDB, Hyderabad on the same day. The women Self Help Group is now working under the guidance of CIFT. The group was trained for hygienic handling and drying of fish and the group has started drying and marketing their products through the retail outlet of Sevashram.

Assessment of literacy, income and health status of fishers

Assessment of literacy levels among persons engaged in processing and marketing in the fisheries sector revealed that 19.35% of the respondents were illiterates while the rest 80.65% had acquired some form of literacy. The percentage of illiterates was more in Andhra Pradesh (36.26%), followed by Madhya Pradesh (29.17%), Delhi (20.50%), West Bengal (17.65%), Gujarat (15.08%) and least for Kerala (4.19%).

The literacy rate was highest in Kerala (95.81%) and lowest for Andhra Pradesh (63.74%). The maximum number of respondents studied upto the secondary level (46.92%) and the rest upto primary level (17.65%). Only 6.33% of the respondents had studied upto the college level. A maximum of 27.44% of respondents from Maharashtra had college education while this percentage was less than 10 in all other states.

The continuing-drop out ratio was 0.99 on the whole and it was 1.76 for Maharashtra, followed by 0.69 for Gujarat, 0.57 for West Bengal, 0.35 for Madhya Pradesh, 0.34 for Kerala, 0.69 for Gujarat and 0.24 for Delhi. The average birth weight of males was 2.77 kg and that of females was 2.58 kg. The birth weight ranges from 2.32 kg in Maharashtra to 3.06 kg in Delhi. In most states, the birth weight of male child was higher than that of female children. The average annual frequency of diseases among the adult family members of the respondents from the post harvest fisheries sector engaged in allied activities of marketing and processing, was found to be 1.10 and 1.51 respectively for males and females. The most frequently occurring health problems were fever and body aches.

It is important to note that atleast a Public Health Centre is available within a distance of 1 to 6 kms in all states and the maximum distance to a hospital is around 13 km. Fairly good health care facilities are available to the households engaged in allied fisheries activities like marketing and processing.

The major income sources were classified into fishery related, labor, agriculture, business and others. The highest monthly average income generated by all the sample respondents was through fisheries sector with an average amount of ₹ 41057.40 (83.46 per cent of the total income) followed by income from labour sector at ₹ 5071.09 (10.31 percent), other sectors at ₹ 1587.52 (3.23 percent), business at ₹ 1359.95 (2.76 per cent) and agricultural sector at ₹ 116.16 (0.24 per cent).

Assessment of harvest and post harvest losses in fisheries

For assessing the harvest and post harvest losses in fisheries, four states were selected two each from the West and East coasts of India. The assessment will be made based on a sample survey carried out by employing stratified

sampling design. Estimation of losses will be done along the major channels of production and distribution of fish namely, fish landing centres/harbours, processing sector, marketing sector and at vendor level. Both the marine and inland sector, will be covered for developing the estimates of harvest and post harvest losses. The inland sector will be restricted to selected farms and reservoirs. The sampling frame constructed for harvest sector comprised of the list of fish landing centres/harbours in the selected states *viz*., Kerala, Andhra Pradesh, Tamil Nadu and Gujarat.

In order to estimate the harvest loss across the categories of mechanized, motorized and traditional sectors, the number of boats operating from the selected centres in these categories were collected and compiled. For harvest loss estimation, the ultimate units of sampling for the marine fishing sector will be crafts.

For post harvest loss estimation, the channels to be covered are pre-processing units, processing units, wholesale, retail and roadside markets, fish vendors and drying yards. The sampling frame data consisting of the list of wholesale markets, retail markets, processing units, farms and reservoirs in the selected centres were collected and compiled for selecting samples in each category. The ultimate units for processing units will be units themselves and for markets it will be traders.

A preliminary survey of the selected fishing harbours/landing centres in Kerala was done to identify the type of losses and the causes. It was found that single day fishing trips do not report losses as the entire catch gets landed for sale. But when the crafts are engaged for multi-day fishing, onboard discards are common. Preliminary survey of selected wholesale, retail and dry fish markets at Ernakulam and Chennai revealed that losses in marketing of fish depended on the species, type of packaging and mode of transportation.

Preliminary analyses of the data on losses from marine sector are given below:

State	Sector	Sample size	Average landing (kg)	Loss (%)
Kerala	Mechanized	40	2546	8.04
	Motorized	40	675	2.06
	Traditional	20	43	1.93
Tamil Nadu	Mechanized	20	1761	10.65
	Motorized	40	980	3.49
	Traditional	5	56	0.56
Gujarat	Mechanized	20	2469	14.60
	Motorized	20	840	9.49

State	Sector	Sample size	Average loss (%)
Kerala	Processing	10	0.13
	Pre-processing	12	0.21
	Drying	5	20.34
Gujarat	Processing	2	0.53
	Pre-processing	2	0.67
	Drying	4	25.00
Tamil Nadu	Drying	4	34.00
	Aqua farms	4	1.5 to 15

State	Sector	No. of centres covered	Sample size (traders)	Average loss (%)
Kerala	Wholesale	2	10	3.25
	Retail	4	12	0.95
	Roadside	2	6	4.56
	Vendors	10	10	11.23
Tamil Nadu	Wholesale	2	10	4.25
	Retail	4	12	1.06

Mobilizing mass media support for sharing agro information

To enhance the communication to the grass-root level farmers for improving farmers' receptivity for new technologies generated by research organizations under ICAR and thus increasing the agricultural production, a Two days Technology Expo cum Farmers' Mela "Krishi Darpan-2012" was organized during 20-21 March, 2012 at Palluruthy, Cochin. During the two days' programme, the following events were organized:

- Exhibition by 16 scientific organisations including all the five ICAR Research Institutes of Kerala, Commodity Boards like Rubber Board, Coir Board, Developmental Departments, Vegetable and Fruit Promotion Council, Kerala (VFPCK), Farm Information Bureau (FIB), NGOs who offer technology support for the farming community and Self Help Groups who commercialized technologies.
- Expo-cum-sale of value added pelagic fish products by rural industries under another NAIP project on Pelagic fish value chain of CIFT.
- A Scientist-Farmer Interaction Meet to provide a unique opportunity to the farmers for clarification of their doubts and for the institutions to get a first hand information on problems of farmers.
- Classes on five selected themes by state level experts on Agriculture, Animal Husbandry and Fisheries.
- Competitions for the public on making of traditional fish recipes, plating coconut leaves and coconut scraping, and the winners were given prizes

in the valedictory function (The detailed report of 'Krishi Darpan' appears elsewhere).

Responsible harvesting and utilization of selected small pelagic and freshwater fishes

Workshops on Fuel efficient fishing: Workshops on 'Fuel efficient fishing' were conducted on 2 and 3 January, 2012 at Puthiyappa and Koyilandi in Kozhikode, where 40 and 50 fishermen respectively participated. Shri T.V. Ramesan, Matysafed District Manager, Kozhikode formally inaugurated the programme and highlighted the importance of "Fuel efficient fishing in the present scenario". The Consortium PI, Shri M. Nasser, Principal Scientist, CIFT conducted a class on fuel efficient fishing in which he stressed upon the problems faced by the ring seiners with respect to fuel expenses, maintenance of propellers etc. and methods to improve the fuel efficiency and to improve the performance of boats. After the class, many of the ring seiners expressed the need for changing their existing propellers and to fix new fuel efficient designs as per the advice given in the class.

Inaugural session in progress

Meeting for the promotion of the value added products: Under the NAIP-RHSSP project, many value-added products are developed and few rural industrial units are being initiated. The product marketing is to be promoted and production units are to be scaled up for which an association was sought from the Kerala State Coastal Area Development Corporation (KSCADC). In this connection, a meeting was organized at the office of Kerala State Coastal Area Development Corporation at Thiruvananthapuram on 4 January, 2012. Dr. K. Ambady, IIS from KSCADC, Shri Padmakumar, MD, Malabar Cements, Shri Agustin Manro, Dy. Director of Fisheries, Dr. P.T. Mathew, Regional Manager, KSCADC and Shri Jayakumar, DGM, KSCADC were present at the meeting. In the meeting, a detailed discussion was held on the promotion of the value-added products developed under the project. The MD, KSCDAC along with his team discussed about the products as well as the mission of KSCADC in detail. KSCADC offered to set up infrastructure support for corporate level marketing and assured that the project and KSCADC together can launch the products at the earliest and initiate the marketing efforts.

Technical guidance for the value added products unit: The value added products unit set up under the Quilon Social Service Society at Kollam requested the NAIP-RHSSP project team to visit the new building of the unit and to provide quality guidance. Accordingly, Dr. S. Sanjeev, Co-PI of the project, Shri M. Nasser, CPI, Dr. S. Ashaletha, Co-PI and Shri Azharudin, SRF of the project visited the proposed site on 11 January, 2012 and offered technical guidance.

Training on Fish based ready to eat value added products: A training programme on 'Fish based ready-to-eat value added products' was held during 24-25 January, 2012. The programme was held at College of Fisheries, GADVASU, Ludhiana to train the participants on the development of innovative fish based value added products from freshwater fishes. Around 40 fish farmers participated in the programme. The CPI of the project, Shri M Nasser, Principal Scientist briefed about the NAIP-RHSSP project objectives and Dr. S. Ashaletha, Co-PI explained about the training programme. More

than six products were developed during the training.

Meeting on Freshwater fish based business prospects: A meeting on 'Freshwater fish based business prospects' was organized at the College of Fisheries, GADVASU, Ludhiana on 25 January, 2012 under the chairmanship of Dr. Asha Dawan, Dean, College of Fisheries. Dr. V.K. Taneja, Vice Chancellor of GADVASU, Dr. V.K. Sood, Director of Fisheries, Dr. G.S Kalkat, Chairman, Punjab State Farmer's Commission and Shri Kaval Jeeth Singh Sidhu, President of Punjab Fish Farmers Association were the dignitaries present on the occasion. While interacting with the participants, Dr. Kalkat emphasized that in order to popularize fish consumption among the masses, there is a need to develop value added products from fish. Dr. V.K. Taneja also asked the farmers to come forward and to take up value addition as an enterprise to popularize fish products in the state for higher economic returns. He also proposed to work out prospects and scope of value added products developed from carp fish especially with reference to quality of products and marketing.

Consultancy on Diagnostic study on development of clam clusters in Perumbalam village, Cherthala district, Alappuzha, Kerala

The consultancy report on the Diagnostic study on development of clam cluster at Perumbalam Village, Cherthala (Block), Alappuzha (Dist.), Kerala was handed over to the office bearers of the Haritha Farmers Club on 17 December, 2011 at CIFT. The consultancy was carried out to study the existing methods of harvest, processing and marketing of clams in the village, to assess the present socio-economic status of the clam fishers, to identify gaps/short comings in technology, skill and other inputs in the existing value chain and to suggest suitable interventions to make the value chain more efficient and to develop a strategy for a sustainable and profitable livelihood option through clam cluster. As per NABARD's Cluster Development Strategy, a diagnostic study had to be conducted, which was undertaken by CIFT under a consultancy agreement with the Haritha Farmers Club, which is the Cluster Development Agency in this particular cluster development initiative. The copies of the report were handed over to Shri K.A. Sreekumar, President and Shri Anoopraj, Secretary of the Club by Dr. T.K. Srinivasa Gopal, Director, CIFT.

Visakhaptnam Research Centre

Research projects handled

- Development of sustainable fishing technologies for exploitation of fishery resources in the east coast of India
- Development and evaluation of Juvenile Excluder Device (JEDs) to reduce the impact of trawling on the marine environment, along east coast of India
- Assessment fisheries resources along the Indian continental slope and Central Indian Ocean
- Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- Oceanic tuna fisheries off Lakshadweep seas: A value chain approach
- Nutritional profiling and hazard assessment of fish and fishery products of marine and lacustrine environs of the east coast of India
- Assessment of microbial seafood safety hazards and bioprospecting of aquatic microbial resources for enzymes
- Changing consumer preferences and its impact on domestic market
- Bio-monitoring of bivalve molluscs and crustaceans from Indian waters as health promoters and indicators of environmental contaminants
- Studies on the detection, estimation and implications of hazards in seafood meant for export market

Chief findings

- Designed and developed 26 m multi seam finfish trawl for demersal fish resource exploitation and the performance was compared with conventional two seam trawl.
- Designed a Juvenile and Trash Excluder Device of semi curved rigid sorting grid design.
- Designed and developed a 300 x 200 mm fish eye with vertical opening and the diversity parameters of catch were analyzed.
- Gear parameter studies were conducted in Cruise No. 291 of FORV Sagar Sampada using the Simrad ITI system available onboard.
- The studies on bone powder from Yellow fin tuna suggests that boiling tuna bones in aqueous solution of 0.5% KOH is beneficial for preparing tuna bone powder.
- Nutritional composition of farmed *Litopenaeus vannamei* (Whiteleg shrimp) and *Penaeus monodon* (Black tiger shrimp) were compared.
- Studies on nutritional composition and biochemical quality evaluation of

scampi (*Macrobrachium rosenbergii*) was carried out.

- Nutritional and biochemical characteristics of pacu (*Piaractus brachypomus*) and milk fish (*Chanos chanos*) were studied.
- Difference in load of TPC, H_2S producing bacteria, *Staphylococcus aureus*, faecal Streptococci and MPN of Total Coliforms, faecal Coliforms and *E. coli* between male and female of *Penaeus monodon, P. indicus* and *Macrobrachium rosenbergii* was studied.
- Study on the incidence of pathogenic *E. coli* in fish employing Multiplex PCR was carried out.
- Studies on production of chitinase by *V. harveyi* and *V. alginolyticus* indicated that maximum bioluminescence was associated with low chitinase production while maximum chitinase production was associated with decreasing bioluminescence during fermentation of colloidal chitin in both shake flask and bioreactor culture.
- Nutritional composition, chemical and microbial hazards in crabs were studied.
- A live fish storage unit was designed and fabricated to maintain fish under live condition with continuous water recirculation.

Report of work done

Development of sustainable technologies for exploitation of fishery resources in the east coast of India

Designed and developed 26 m multi seam finfish trawl for demersal fish resource exploitation on CIFTECH1 vessel with V form otter boards at 25-48 m depth. The trawl yielded a CPUE of 42 kg/hr. The performance of new multi seam trawl was compared with conventional two seam fish trawl. Two seam trawl yielded 28kg/hr. Designed and developed 27 m six seam shrimp trawl and CPUE recorded was 32kg/hr.

The fishery data obtained by experimental trawling was analyzed for quantitative and qualitative study. The major catch comprised of silver bellies (25%), *Upeneus* spp. (20%), mackerel (10%), ribbonfish (10%), anchovies (5%), prawn (5%), *Nemipterus* spp. (5%), Sciaenids (5%), *Saurida* spp. (5%), squids and cuttle fish (5%) and crabs (5%).

Data on trawl fishery was collected for qualitative and quantitative analysis of catch and bycatch from commercial and experimental trawl operations. Commercial trawls landed an average of 1000-5000kg in multi-day (10-18 days) vessels and 100-500kg in single day vessels. The main catches comprised of *Upeneus* spp. (20%), mackerel (15%), prawn (15%), ribbonfish (10%), anchovies (10%), pomfret (10%), Nemipterids (5%), lizard fish (5%), drift fish (5%), crab and cuttle fish (5%). Juvenile catch and discards of commercial trawls and experimental trawls in pre monsoon, monsoon and post monsoon seasons were recorded for qualitative and quantitative analysis. *Upeneus* spp., squid and *Nemipterus* spp. were dominated in the first quarter, ribbon fish, *Upeneus* spp. and pomfret juveniles were recorded in second and third quarters. Large quantities of silver bellies, *Nebea macula* and Sciaenids, were the catch recorded

in the last quarter. Species diversity indices were analyzed for each trawl in various depths and trawling grounds at Visakhapatnam. Data base of trawls, ring seines and stake nets used at Andhra Pradesh were documented.

Development and evaluation of Juvenile Excluder Devices for trawl fisheries along east coast of India

Designed a Juvenile and Trash Excluder Device of semi curved rigid sorting grid design consisting of three iron frames which are connected by hinges. The front part consists of an iron frame fitted with vertical iron bars and the back part consisting of an iron frame similar to the front part fitted with mesh netting instead of iron bars.

Designed and developed a 300 x 200 mm fish eye with vertical opening rigged on 28 m trawl and an oval grid (900 x 600 mm) having 60 mm bar space and rigged to 30 m demersal trawl.

Escapement of finfishes were less than 2.9% and Nil for shellfishes with 100% exclusion of turtles in trawl operations with CIFT-TED installed operations at Dhamra, Odisha.

Diversity parameters of catch of 28 m trawls with fish eye revealed Species Richness (26), Shannon -Wiener Diversity Index (1.13), Shannon's Evenness (0.25), Effective Richness (3.11), Simpson's D (0.36), Simpsons N2 (1.66), Simpsons Evenness (using N2 - 0.064). The trawl biodiversity was consolidated from four trawling grounds.

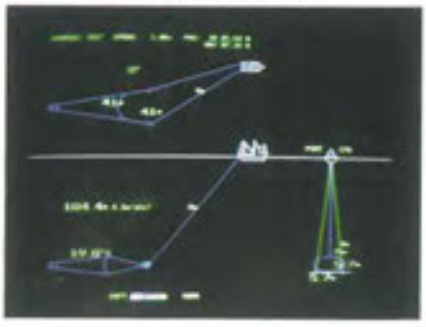
Assessment of fisheries resources along the Indian continental slope and Central Indian Ocean

Gear parameter studies were conducted in Cruise No. 291 of FORV Sagar Sampada using the Simrad ITI system available onboard. Two brackets were installed on the existing otter boards which lodged the sensors responsible for providing horizontal opening of the bottom trawl. The depth and height sensors were tied at the centre of head rope. Two extra float was attached to counter the 6kg weight of the sensors. The present study indicates that vertical opening of the net is greatly affected at deeper waters (beyond 700 m) with the same parameters which were used for trawling at 100 m depth. The equations of the buoyancy of the head rope and weights for the foot rope have to be recalculated for deeper waters.

The continental slope region between 100 to 1050 m depths of east coast of Indian EEZ was selected in Cruise No. 291 for the stock assessment studies of deep sea fishes. A total of 17 fishing operations were done during the study period. The total catch was 1682 kg with a CPUE of 112.9 kg was observed during the cruise. Six major group of deep sea organisms were identified. A total of 74 species of deep sea resources could be collected during this cruise. The catches were mainly dominated by *Lamprogrammus* sp. (774.5 kg) followed by rays (170 kg) and *Gavialiceps* sp. (111.7 kg). Cephalopods (cuttlefish, squid and octopods) are exclusively found in seas, distributed in various depths of the oceans. Seven species of cephalopods (5 squids and 2 octopods) were recorded during the survey. The species of squids which were identified are *Ancirtrocheirus lerueuri*, *Ommastrephes* sp., *Vampyroteuthis* sp. and octopod is *Cistopus indicus*.

ITI sensors tied to the head rope of trawl for vertical opening and depth profile

ITI sensors fixed to the otter boards for horizontal opening



The results of ITI study displayed on screen

Bone powder from Yellow fin tuna

Four batches of Yellow fin tuna bone powders were prepared by boiling tuna bones in 0.5% KOH, 0.5% NaOH, 1% KOH and potable water. The meat adhering to the tuna bones was separated with relative ease in all the alkali treated bones. Tuna bone powders were rich in protein, fat, calcium (19,400 to 26300 mg/100g) and phosphorus (7797 to 8291 mg/100g); with calcium-phosphorus ratio ranging between 2.5 to 3.3:1. The proportion of polyunsaturated fatty acids (PUFA), particularly, docosahexaenoic acid (DHA) content was distinctly higher in tuna bone powder prepared using 0.5% KOH. The study suggests that boiling tuna bones in aqueous solution of 0.5% KOH is beneficial for preparing tuna bone powder. Tuna bone powder finds use as a fortifying agent.

Comparison of nutritional composition of farmed *Litopenaeus vannamei* (Whiteleg shrimp) and *Penaeus monodon* (Black tiger shrimp)

Litopenaeus vannamei (Whiteleg shrimp)

L. vannamei and *P. monodon* shrimp were separated in to two groups *viz.* male and female and analyzed for various nutritional and quality parameters. The protein content of *L. vannamei* was lower than *P. monodon* shrimp. The protein content of male *L. vannamei* shrimp (19.31%) was lower than female shrimp (20.19%) whereas in *P. monodon*, the protein content was relatively higher in male shrimp (21.56%) compared to the female shrimp (20.92%). Lipid content was similar in *L. vannamei* (0.94%) and *P. monodon* female shrimp (0.95%) but the lipid content was relatively lower in male *P. monodon* shrimp (0.6%). Calcium content was distinctly higher in *L. vannamei* (830.9 to 1142.3 mg%) than *P. monodon* (141.28 to 173.13 mg%).

Nutritional composition and biochemical quality evaluation of scampi (*Macrobrachium rosenbergii*)

Male and female scampi were analyzed. The results showed that the both protein and fat content were higher in the female scampi (protein -18.69%; fat - 6.17%) compared to male scampi (protein - 17.8%; fat - 2.70%). The mineral contents *viz.*, Na, K, Ca were 398.528 mg%, 1318.209 mg%, 173.820 mg% respectively in male shrimp. In female it was 588.6 mg% of Na; 1208.0 mg% of K and 173.8 mg% of Ca. The freshness indicator parameter TVBN for the male was 15.48 mg% whereas for the female it was 14.64 mg%. The lipid quality parameters such as Peroxide Value (PV) and Free Fatty Acids (FFA) were 12.077 meq/kg of fat, 37.35% of oleic acid in male prawn and in female prawn the PV and FFA were 9.375meq/kg of fat and 28.005% of oleic acid, respectively. Both the male and female prawn had sulphite value of less than 10 ppm. The protein hydrolysis indicator such as α-amino nitrogen was 139.21 mg% for male and for female it was 135.97 mg%. The microbiological observations revealed that male had total plate count of 4.3×10^2cfu/g where as female had 5.3×10^2cfu/g. H_2S producing bacteria counts were higher in male scampi (1.2×10^3cfu/g) than in female scampi (1.3×10^2cfu/g). Faecal *Streptococci* were enumerated in males and females and the counts were 1.8×10^3cfu/g and 9.7×10^3cfu/g, respectively.

Nutritional and biochemical characteristics of pacu and milk fish

Pacu (*Piaractus brachypomus*) a freshwater fish cultured in Andhra Pradesh was collected from fish markets and subjected to various nutritional and biochemical analyses. The fatty acid profile of pacu showed 12.4% of Saturated Fatty Acid (SFA), 45.5% Mono Unsaturated Fatty Acid (MUFA) and 42.1% of Poly Unsaturated Fatty Acid (PUFA). Milk fish (*Chanos chanos*) is nutritionally a good source of protein (20.3%), fat (3.84%) and beneficial minerals. The fatty acid profile of milk fish constituted 40.77% SFA, 42.96% MUFA and 16.26% PUFA. The freshness parameters namely TVBN and TMA were 12.65 mg% and 8.36 mg%, respectively. The microbial examination revealed that fresh milk fish harboured a total bacterial load of 7.6 x 10^3cfu/g. The chemical and microbiological quality parameters are in acceptable levels.

Milk fish (*Chanos chanos*)

Pacu (*Piaractus brachypomus*)

Microbiological parameters of male and female peneaid shrimps and freshwater prawn

Difference in load of TPC, H_2S producing bacteria, *Staphylococcus aureus*, faecal Streptococci and MPN of Total Coliforms, faecal Coliforms and *E. coli* between male and female of *Penaeus monodon*, *P. indicus* and *Macrobrachium rosenbergii* was studied. *Staphylococcus aureus* was not detected in any of the species. TPC was highest in female *P. monodon* (1.09 x 10^5 cfu/g) but the count of H_2S producing bacteria and faecal Streptococci was low when compared to other species. The highest count of faecal Streptococci was found in male *P. indicus*. Female *M. rosenbergii* had the highest count of faecal Streptococci (9.42 x 10^3/g). MPN total Coliforms and faecal Coliforms was same in both sexes of *P. indicus* and *M. rosenbergii* (140+) and was higher than that observed in *P. monodon* (110 and 9.5 respectively). Between the male and female of each species there was not much difference in the $\log_{10}$ TPC/g. The male of *P. monodon* didn't have any load of H_2S producing bacteria whereas the female of the species had a count of 1 x 10^2 cfu/g. Both sexes of *M. rosenbergii* showed a one log difference in the load of H_2S producing bacteria. There was no difference in the $\log_{10}$ values of faecal Streptococci count in both the sexes of *P. monodon* and *P. indicus* whereas there was a one $\log_{10}$ difference in the count in the male and female of *M. rosenbergii*.

Quality of frozen battered and breaded pacu products

Breaded and battered products were prepared from pacu (*Piaractus brachypomus*) packed in air and vacuum and stored at -18°C in deep freezer and analyzed at monthly intervals for biochemical and microbiological parameters. TPC showed gradual reduction till the fourth month and thereafter started increasing both in air and vacuum packed products but all values were less than 5,00,000 cfu/g. Faecal Coliforms were detected till the end of two months of storage. *E. coli* levels were less than 20/g in air and vacuum packed products. *Vibrio cholerae*, *Salmonella* sp., *Listeria* sp. and coagulase positive Staphylococci were not detected both in freshly prepared and frozen stored pacu products.

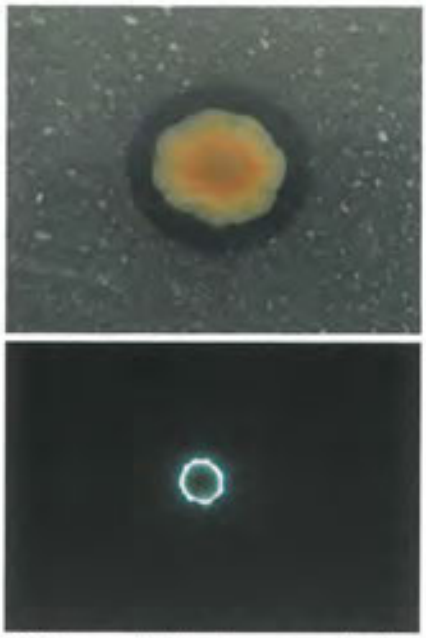
Nutritional profiling of bio-processed fish

Three samples of fermented fish (*Seedhal*) and four samples of dried fish (*Puntius* sp.) collected from Mizoram are being analyzed for nutritional composition, biochemical and microbiological quality parameters.

Studies on the incidence of pathogenic *E. coli* in fish employing multiplex PCR

E. coli was isolated from freshwater fish rohu (*Labeo rohita*), pacu (*Piaractus brachypomus*) and marine fish mackerel (*Rastrelliger kanagurta*) and marine shrimp. A total of 17 *E. coli* cultures (4 from rohu, 4 from pacu, 4 from mackerel and 5 from shrimp) were isolated from the different fishes and were subjected to multiplex PCR by using different primers targeting different virulent genes of *E. coli* namely *eae* (Enteropathogenic *E. coli*), *ipaH* (Enteroinvasive *E. coli*), *stx* (Enterohaemorrhagic *E. coli*), *elt* (labile toxin producing Enterotoxigenic *E. coli*), *est* (stable toxin producing Enterotoxigenic *E. coli*) and *aggR* (Enteroaggregative *E. coli*). 66 % of the *E. coli* cultures isolated from fish were positive for the *est* gene (AL65, AL125 primers; amplicon size147 bp) indicating that they were stable toxin producing Enterotoxigenic *E. coli*.

Studies on production of chitinase by *V. harveyi* and *V. alginolyticus*



Chitinase and bioluminescence production by *Vibrio harveyi*

Endochitinases convert the chitin polymer to N-Acetyl glucosamine (GlcNAc) and chitooligosaccharides (COS) by random cleavage at internal points in the chitin chain. *V. harveyi* and *V. alginolyticus* showed chitinase activity on Luria-Bertani agar containing 2% colloidal chitin agar at 26°C and 37°C and at pH 5.0, 7.0 and 9.0. *V. alginolyticus* showed greater positive and more specific chemotaxis than *V. harveyi* towards COS. When grown individually, chitinase production was detected by the end of first day of incubation in *V. alginolyticus* (134 U/L) whereas in *V. harveyi* production was lower (84 U/L) and detected later (Second day).

Vibrio harveyi, like other luminescent bacteria, is capable of bioluminescence and chitinase production. Our results show that maximum bioluminescence was associated with low chitinase production while maximum chitinase production was associated with decreasing bioluminescence during fermentation of colloidal chitin in both shake flask and bioreactor culture. Colloidal chitin and its degradation products, i.e. chitooligosaccharides and N-acetylglucosamine (GlcNAc), positively influenced bioluminescence. However, the increase in relative luminosity units (RLU) was less than 1 log RLU and lasted for a short duration of time. The transient increase in bioluminescence by chitooligosaccharides and GlcNAc does not offset the decreasing bioluminescence trend during chitin fermentation by *V. harveyi*.

Nutritional composition, chemical hazards and microbial hazards in crabs

The body meat and claw meat of two species of locally available crabs *viz.*, 3-spot crab (*Portunus sanguinolentus*) and Christ shell crab (*Charybdis cruciata*) were analyzed for nutritional composition, heavy metals and microbiological parameters. The fat content of crab body meat (0.51 to 0.76% on wet basis; 2.85 to 3.93 on dry matter basis) was relatively higher than crab claw meat (0.30 to 0.37% on wet basis; 1.81 to 2.21 on dry matter basis). Calcium content was relatively higher in crab claw meat (877.2 to 1427.2 mg/100g on dry basis) than crab body meat (420.7 to 676.5 mg/100g on dry basis). Phosphorus content in crab body meat ranged between 909.6 mg/100g and 914.2mg/100g while in

crab claw meat the phosphorus content ranged between 725.4 mg/100g and 802.5 mg/100g. Iron content in crab claw meat ranged between 11.8 mg/100g and 13.1 mg/100g while in crab body meat the iron content ranged between 10.1 mg/100g and 12.6 mg/100g.

The total plate count of crab body meat (log_{10} 6.1 to 6.5) was slightly higher than crab claw meat (log_{10} 5.7 to 5.8). *E. coli* was detected only in the body meat of 3-spot crab (3.6 MPN/g). Coagulase positive Staphylococci were detected neither in crab body meat nor claw meat. The body meat and claw meat of 3-spot crab and Christ shell crab were analyzed for heavy metals. The cadmium content of crab body meat (0.42 ppm) and claw meat (0.43 ppm) was almost similar. Similarly, cobalt content of crab body meat (1.18 ppm) and claw meat (1.14 ppm) was almost similar. Copper content was higher in claw meat (2.84 ppm) than body meat (1.44 ppm). Zinc content was higher in claw meat (15.6 ppm) than body meat (11.82 ppm). Species wise, the heavy metal contents were higher in *P. sanguinolentus* than *C. cruciata*.

Live fish storage unit

A live fish storage unit was designed and fabricated to maintain fish under live condition with continuous water recirculation. The water from the fibre glass tank containing fish is recirculated by passing through a PVC cylinder containing sponge that prevents the passage of faecal material. The water in the upper chamber of the aeration cylinder is continuously aerated and pumped back into the fibre glass tank. This process helps to maintain dissolved oxygen level in the water tank. Experiments using live fish (rohu) are being carried out.

3-spot crab (*Portunus sanguinolentus*)

Christ shell crab (*Charybdis cruciata*)

Veraval Research Centre

Research projects handled

- Technological innovations on improved utilization and value addition of marine and cultured fishery resources in Gujarat
- Project validation of PFZ along Gujarat coast
- Zooplankton production modeling investigations
- Coastal *in situ* data collection for Case - 2 algorithms
- Measurement of inherent optical properties of seawater and development of inversion algorithms

Chief findings

- Chilled storage studies of Ghol, Horse mackerel and Mahi mahi indicated a shelf life of 18, 14 and 18 days for vacuum packed samples compared to 10, 10 and 8 days for air packed samples respectively.
- A shelf life extension of 14, 8 and 16 days was observed for chilled Mahi mahi, Horse mackerel and Ghol packed with oxygen scavenger compared to air packed samples.
- Indicators like Bromocresol purple, Bromothymol blue and mixed indicators can be used as freshness indicators of fishes under chilled conditions.
- Quality comparison of IQF squid (*Loligo duvaceli*) rings and cooked shrimps indicated no major changes in quality except for water holding capacity.
- Shrimp samosa recipe incorporating cleaned and chopped shrimp (*Fenneropenaues merguiensis*) was standardized and quality changes of frozen shrimp samosa packed in HIPP trays indicated an increase in pH and TBA value whereas total mesophiles counts decreased.
- Quality of Surajbari shrimps, cooked, salted and dried catfish eggs, dried Horse mackerel and commercially processed surimi were monitored for various attributes.
- Collagen prepared from fish scales indicated a protein content of 90% with moisture and mineral content of 8-10% and 2%, respectively.
- Texture analysis of raw and cooked shrimps, squid rings, tentacles and cuttle fish indicated a higher hardness for raw products and higher chewiness, cohesiveness, springiness and gumminess for cooked products.
- Isolation and identification of spoilage and pathogenic bacteria from fishery products, water and ice were monitored.

Report of work done

Shelf life studies on Ghol, mackerel, Mahi mahi etc.

Shelf life of Ghol steaks packed under control air packs were compared with the vacuum packaging. For this, Ghol fish weighing 4.7-5.0 kg, captured from off Okha were used. Two steaks were packed in each packs and were sealed under ordinary air and applying 99.9% vacuum and stored under chilled conditions. Various biochemical, microbiological and sensory quality parameters were monitored at regular intervals. Higher levels of *Lactobacillus* spp., *Brochothrix thermospacta* and lower levels of *Pseudomonas* spp. was observed for vacuum packed samples. Sensorily, air packed samples were acceptable only up to eight days compared to 18 days for vacuum packed samples.

Ghol

Shelf life of vacuum and control air packed Horse mackerel (*Megalopsis cordyla*) steaks packed in high impact polypropylene trays (2 pieces weighing 100g each) stored at 2-4°C was studied. A shelf life of ~9-10 days was observed for control air packs compared to 14 days for vacuum packed samples.

Horse mackeral

Quality and shelf life of Mahi mahi or dolphin fish (*Coryphaena hippurus*) packed in air and vacuum pack stored under chilled condition was undertaken. Various quality attributes like volatile bases, fat oxidation products, formation of dienes, microbial and sensory attributes etc. were monitored regularly. A shelf life of 10 days was observed for air packed samples compared to 18 days for vacuum packed samples.

Mahi mahi

Quality comparison of squid rings and cooked shrimps

Studies on quality comparison of IQF squid (*Loligo duvauceli*) rings and cooked shrimps stored at -18°C are in progress. The increase in volatile bases and fat oxidation products are not significantly different during the storage period. The total plate counts showed slightly declining trend with the storage period and at the end of 10 months storage period, total bacterial counts of 1.45×10^4 and 1.3×10^3cfu/g were observed for squid rings and shrimps, respectively.

Squid rings

Studies on fish freshness indicators

Usefulness of indicators like Bromocresol purple, Bromocresol green and Bromothymol blue as fish freshness indicators were assessed under chilled conditions. For this, the indicator solutions impregnated into sterile filter paper was attached on to the inner surface of the HIPP trays packed with Horse mackerel steaks. The colour changes in the indicator was monitored at frequent intervals and the quality of fish like volatile bases, fat oxidation, histamine, total mesophilic counts, total psychrotropic counts, *Pseudomonas* spp., *Brochothrix thermospacta* and sensory attributes were assessed. Bromocresol purple impregnated indicator strips changed its colour with the fish spoilage in both direct and indirect contact whereas Bromothymol blue changed its colour with indirect contact only, indicating its usefulness as freshness indicator. Bromocresol green did not change its colour in both direct and indirect contact with the fish spoilage. Sensorily fishes were acceptable up to 9-10 days which was very well correlated with the freshness indicators.

Cooked shrimps

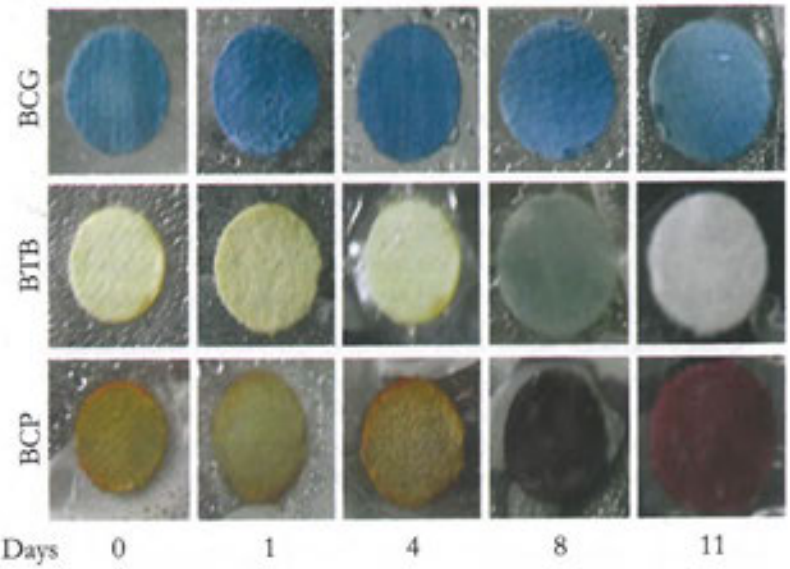
Studies were undertaken to develop freshness indicator for chilled stored

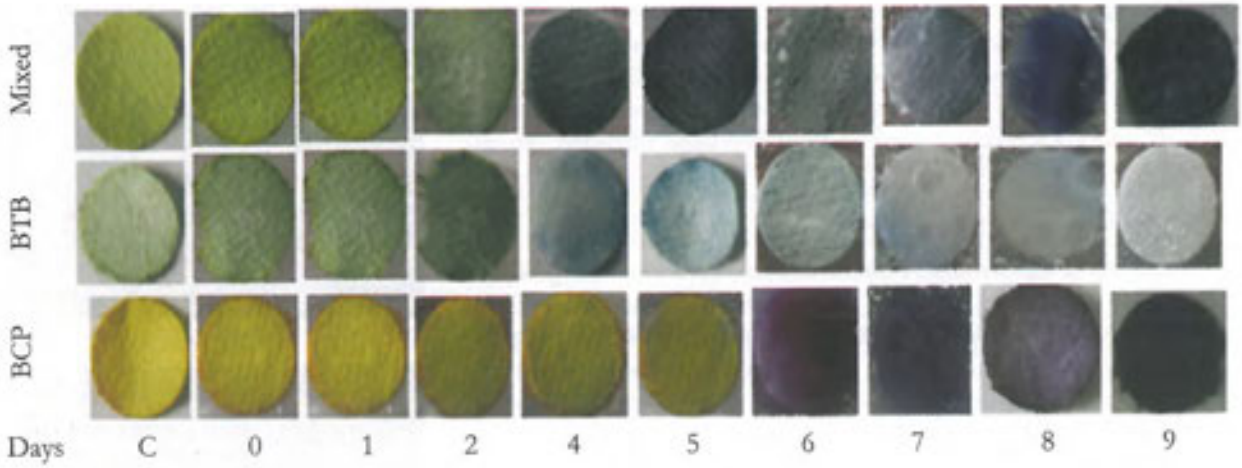
Bromocresol purple

Bromocresol green

Bromothymol blue

Ghol. For this, indicators like Bromocresol purple (BCP), Bromocresol green (BCG) and mixed indicators incorporating BCP, BCG and Bromothymol blue (BTB) at equal ratio were impregnated onto sterile filter paper and used for the study. BCP correlated well with the changes in volatile bases and sensory quality in both direct and indirect contact. BCG and mixed indicators correlated well with the quality attributes in indirect contact.





Studies on proximate composition of catfish eggs

Changes in the proximate composition of catfish eggs, boiled and semi dried, salted and sundried was assessed. Moisture (13.5%) and salt content (10.3%) was higher for salted and sundried samples compared to boiled and semi dried samples (9.3 and 1.03%, respectively). Protein and fat content for boiled and semi dried sample was 57.6 and 17.6% whereas it was 47.6 and 7.9% for salted and dried catfish eggs.

Studies on Surajbari prawns

Surajbari prawns (*Metapenaeus kutchnensis*) were collected from Gulf of Kutch. This is a seasonal fishery of about one month duration during post monsoon season. Samples were analyzed for processing and quality parameters. Tiny and brown prawn samples from processing plants were analyzed for residual sulphite and 7.5 and 15 ppm value was noted. The widespread use of sodium meta bisulphite and sodium sulphite is reported by the fishermen and suppliers to control black spot formation in shrimp.

Processing aspects of various value added products prepared from Surajbari prawns (*M. kutchnensis*) were studied.

Surajbari prawns

Quality parameters of dried Horse mackerel

Quality of traditionally dried Horse mackerel (*Megalopsis cordyla*) marketed in Veraval market was assessed. Mean total bacterial counts of the sample was 5.5 x 10^6cfu/g with very high total volatile nitrogen. The heavy metal analysis indicated very high levels of lead content in the analyzed samples.

Shrimp samosa

A recipe incorporating cleaned and chopped shrimp (*Fenneropenaeus merguiensis*), potato, onion, chilly and spice mixture was standardized for the preparation of shrimp samosa. Shrimp content varied from 30, 40 and 50% and 40% shrimp had better acceptability, sensorily. Quality assessment of frozen stored shrimp samosa packed in HIPP trays was undertaken for six months. The initial pH of the shrimp samosa was 6.79 which increased to 7.0 at the end of six months. The TBA value increased from an initial value of 0.63 to 2.16 mg Malonaldehyde per kg sample whereas conjugated dienes showed an increasing trend reaching 14.67 from an initial value of 11.96. Total mesophilic bacterial counts decreased from an initial counts of 1.3 x 10^4 to 6.0 x 10^2cfu /g.

Shrimp samosa

Quality studies on surimi balls

Quality changes of steamed and fried surimi balls stored under frozen storage were undertaken. For this, fish balls using 70% surimi and other ingredients incorporating paprika and crab flavor (0.1% level each) were prepared. Surimi balls were subjected to two different cooking methods like steaming (for 15 min.) and frying (for 60 sec.) and were packed in laminated pouches. It was frozen stored and quality was assessed at regular intervals. The initial TBA value for steamed and fried surimi balls was 0.41 and 0.69 respectively, which increased to 0.95 and 1.94 mg Malonaldehyde per kg sample at the end of first month. The total mesophilic bacterial levels showed an increase of 1-2 log cfu at the end of first month. pH, TMA and TVBN value did not show much variations.

Surumi balls

Quality and shelf life of Mahi mahi or dolphin fish (*Coryphaena hippurus*) packed in air and vacuum pack stored under chilled condition was undertaken. Various quality attributes like volatile bases, fat oxidation products, formation of dienes, microbial and sensory attributes were monitored regularly. A shelf life of 10 days was observed for air packed samples compared to 18 days for vacuum packed samples.

Studies on fish collagen

Samples of fish collagen prepared from fish scales were collected from Amar Aqua, Porbandar and analyzed for composition and quality parameters. A total of 90% protein, 8-10% of moisture and 2% of mineral content was observed. TVC 1.0 x 10^3cfu/g was noticed and Coliforms were not observed in the sample. Fish collagen is having large export market and is used for direct human consumption for pharmaceutical and skin applications.

Studies on surimi

Processing and quality aspects like protein, fat content and grade of commercial samples of surimi prepared from different fishes like Pink perch, priacanthus, lizard fish and ribbon fish was tested. It is noted that other fishes like reef cod and scienids are added in mix surimi to increase the gel strength.

Texture parameters like hardness 1 and 2, chewiness, springiness, cohesiveness and gumminess for fresh and cooked products of shrimp, squid and cuttlefish were studied. The shrimps (*Metapeneus monoceros*) of size grade 20-40 and 40-60, squid (*Loligo duvaucelli*) rings and tentacles and whole cleaned cuttlefish (*Sepia aculiata*) and cuttlefish tentacles were cooked in a cooker till the core temperature of 72±1°C was achieved and the texture of cooked products were compared with the fresh raw material. Hardness 1 and 2 were observed higher for fresh raw material compared to cooked products whereas chewiness, cohesiveness, springiness and gumminess was observed higher for cooked products.

Heavy metals in various fishes

Heavy metal content of fishes from Jamnagar (White pomfret, Indian mackerel, mullet, grunt, parrot fish, barracuda and freshwater catfish) and from Okha (seer fish, grunt, barracuda, parrot fish, mullet, marine catfish, snapper and silver bellies) were analyzed. Higher levels of lead in the range of 4.8-7.2 ppm was observed for different fishes. Assessment of trace and heavy metal content of *Metapenaeus kutchensis* (Ginger prawn), water and sediment samples collected from Surajbhari was undertaken. Majority of the toxic heavy metals were within the acceptable limits for shellfishes.

Samples of Scombroid fishes were analyzed for Histamine and formaldehyde content in export consignments for quality test. The Histamine content in most mackerel samples was low in the range of 5-20 ppm. However in some cases a higher value of 175 ppm was noted. In seer fish sample Histamine was absent. Formaldehyde content of frozen Longtail and Skipjack tuna was assessed. The formaldehyde levels in Skipjack tuna was in the range of 0.45 – 2.92 ppm whereas in Longtail tuna it was in the range of 0.64 – 4.99 ppm. There are reports of abuse of formaldehyde in fishes as preservative even in domestic market.

Pathogenic bacteria in fish and fishery products

Isolation of spoilage and pathogenic bacteria from the fish and fishery products was carried out. A total of 12 samples consisting of Long tail tuna (n= 3), Ghol fish (n= 1), water (n= 2) and surmi sample (n = 4) and chill stored Ghol fish (n = 2) were screened for the presence Enterobacteria and

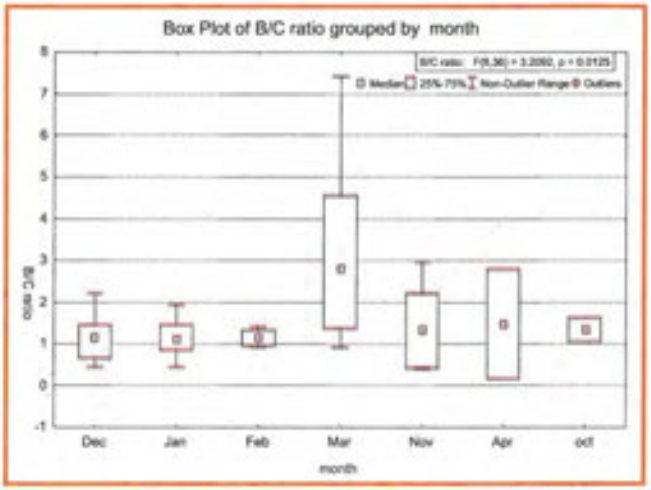
spoilage bacteria. The average TPC of 1.3 to 1.5 x 10^5, Total Enterobacteriacae of 1.0 to 1.6 x 10^4, *E. coli* of 10 to 80 x 10^2, *S. aureus* from 20 to 150 x 10^2, faecal Streptococci of 12 to 260 x 10^2, *Pseudomonas* of 0.7 to 5.6 x 10^6, and few isolates of *Listeria* spp. were isolated from the fish samples. In all the processed samples, the spoilage bacteria such as *Pseudomonas*, *Shewanella* from PIA, Lactic acid bacteria from MRS and *Brochothrix* from STAA and at least of 3-6 isolates of these spoilage bacteria could be isolated and characterized for grams staining, motility, oxidase, catalase, and H and L glucose fermentation and preserved in liquid paraffin for further characterization.

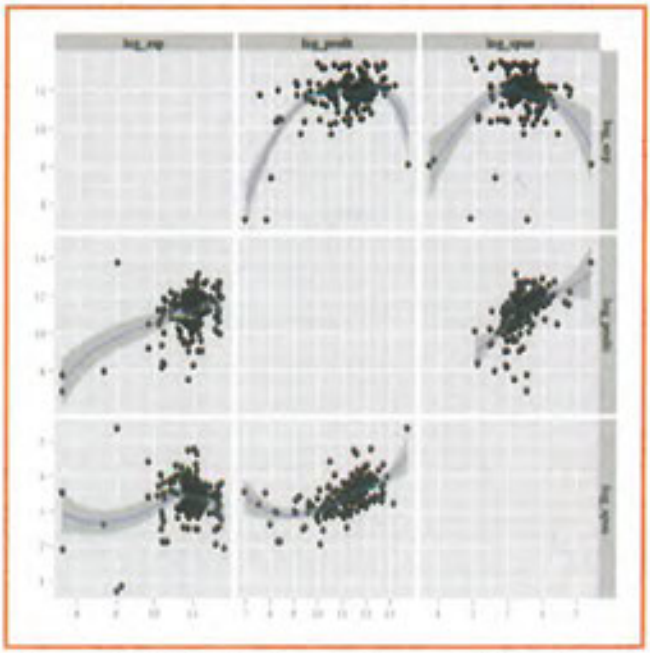
Isolation and identification of Enterobacteria from the *Metapenaeus kutchensis* (Ginger prawn), water and sediment of Surajbari, Gujarat was undertaken and it was found that a TPC of 2.4 x 10^4, 4x 10^4 and 1.5 x 10^4 and VRBGA of 4.5 x 10^3, 1.25 x 10^4 and 8.0 x 10^3cfu/g respectively. The isolates of *Staphylococcus aureus* (10 x 10^2cfu/g) from the prawn and *Pseudomonas* sp. of 1.3 x 10^1cfu/g in the water sample have been isolated. These isolates were preserved in liquid paraffin for characterization.

A total of 11 samples consistjng of water samples, mackerel, seer fish, and ice were screened for the presence Enteropathogenic bacteria and it was observed that the average TPC, Total Enterobacteriacae on VRBGA, *E. coli*, *S. aureus*, and fecal Streptococci ranged from 0.8 x 10^4 to 1.5 x 10^6 cfu.g^{-1}, 4.3 x 10^1 to 1.7 x 10^5 cfu.g^{-1}, 0.5 x10^3 to 0.8 x 10^4 cfu.g^{-1}, and 1.3 x 10^3 to 2.7 x 10^5 cfu.g^{-1} respectively. In fish samples the microbial load were 3.0 x 10^6 cfu.g^{-1} and 1.62 x 10^5 cfu.g^{-1} of TPC, 4.5 x 10^1 and 7.0 x 10^4 of Enterobacteria on VRBGA in Indian mackerel and seer fish samples respectively. Ice samples also indicated that the TPC, Total Enterobacteriacae, *E. coli* and faecal Streptococci ranged between 1.65 x 10^3 to 0.8 x 10^5, 0.25 x 10^2 to 0.7 x 10^5, 4 to 0.7 x 10^3, and 8 to 0.83 x 10^3 respectively. A total of 32 and 24 numbers of *E. coli* and faecal Streptococci isolates were confirmed by IMViC test, EMB agar plate method and catalase test and these confirmed isolates were preserved in liquid paraffin for further study.

Validation of PFZ along Gujarat coast

During the period April 2011 to March 2012 a total 90 Potential Fishing Zone advisories were received from INCOIS. Among them 57 were validated and data regarding location of fishing ground, catch details and economics of the operations were collected from fishing vessels operating from Veraval, Diu and Mangrol fishing harbours along the Saurashtra coast of Gujarat. Total of seven experimental fishing was conducted using hired and departmental fishing vessel.



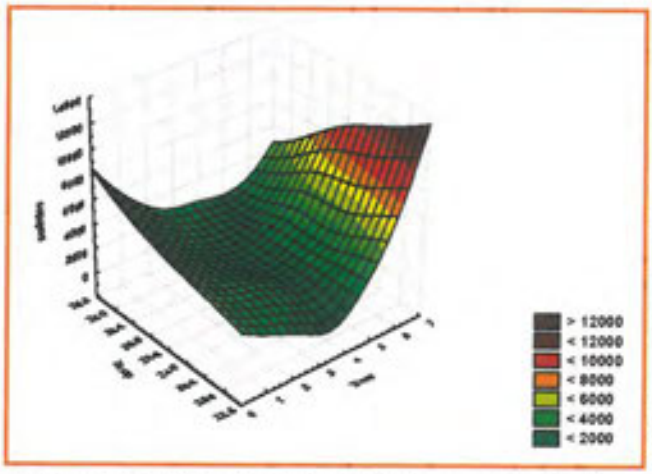


Scatter plot depicting the relationship between CPUE, profit and expenditure in commercial fishing vessels

Zooplankton production modeling investigations

Total of five bongonet sampling operations were carried out using hired and departmental fishing vessel along Veraval coast. Simultaneous data on the physico-chemical parameters were also collected for determining the factors that influence the abundance of copepod species along the coastal waters. A model was developed for predicting the abundance of copepods in collaboration with Space Application Centre (SAC), Ahmedabad, it was found that transparency and temperature were the factors that significantly affected the zooplankton abundance.

Measurement of inherent optical properties of seawater and development of inversion algorithms



Surface plot depicting the relationship of zooplankton abundance with transparency and temperature

Coastal *in situ* data collection for Case - 2 algorithms: Water samples from 22 stations, were collected using Niskin type water sampler along the coastal waters off Veraval and the different physico-chemical parameters like temperature, TSS, TDS, chlorophyll, transparency and nutrients were analyzed as part of the two projects. The data is being used for development of inversions algorithms at SAC, Ahmedabad. The mean temperature was observed to be 25.6°C and the average chlorophyll concentrations in the stations were noted as 0.73 mg/m^3. The water transparency was measured using secchi disc and the mean value was 4.08m. The mean values for the concentration of nitrate and phosphate in the waters were 3.89 and 0.66 µ/liter respectively. The average value for the Total Dissolved Salts (TDS) and Total Suspended Matter (TSM) was 3.39 and 0.16 g/l.

Mumbai Research Centre

Research project handled

- Technologies for utilization of fishery resources at Maharashtra

Chief findings

- Ready to eat product from Kardi (*Palaemon* sp.) was prepared and the product remained tasty and crispy during storage for nine months at ambient temperature.
- Bombay duck marinade was prepared using 3% acetic acid and 10% salt; sample stored at room temperature was found to be acceptable upto 19 days.
- Dressed pabda (*Ompok pabda*) dipped in 0.1M citrate buffer (sodium citrate + citric acid) was acceptable up to 48 hrs. at ambient temperature (26± 2°C).
- Dried and laminated Bombay duck was prepared after treatment with 2% salt and 0.2% potassium sorbate as well as 4% salt and 0.2% potassium sorbate and packed under vacuum; the product was found in good quality even after three months of storage at ambient temperature.
- Clam samples were kept in different environmental conditions for about a week for heavy metal analysis. The level of iron and nickel was found to be between 9.718-144.74 and 6-1.075 ppm respectively.
- Sulphate reducing *Clostridia* were found to be positive in 62 samples (88.57%) and the count were between 0.9 – 25/g. It indicates that the Thane creek region (Maharashtra) is heavily contaminated with animal excreta.
- *Strongylura* sp. had the highest level of Histamine *i.e.,* 20 mg%. *Sardinella longiceps* fish contained 10-12 mg% and *Clarias batrachus* contained the Histamine level 13.32 mg%. Histamine forming bacteria was positive for 63 samples (90%) at 37°C whereas 18 samples (25.71%) were positive at 15°C; and the counts were 10-30 and 5-20/g for 37°C and 15°C respectively.
- 1.315 ppm of cadmium was present in one squid sample. In fish samples the level of cadmium was between 0.02–0.531ppm. It indicates that the environment is contaminated with cadmium. Lead content was highest in the muscle of mullet and croaker from Vashi creak (Maharashtra) as 0.632 and 0.699 ppm respectively; sediment of creak also contained 2.52 ppm lead. *Chirrocentrus dorab* contained the highest nickel level of 2.56 ppm.

Report of work done

Pathogenic and spoilage bacteria in fish and shellfish

Seventy (n = 70) fish and shellfish samples were collected from the various fish markets of Vashi area in Maharashtra coastal region for the assessment of the food pathogenic organisms. None of the samples were found to be positive for *Salmonella, Listeria monocytogens, Vibrio cholerae* and *V. parahaemolyticus.* Sixty four samples (91.43%) were positive for *Staphylococcus* sp. and 50 samples (71.43%) were positive for *Streptococcus* sp.; the count varied from 10-90 in case of both the species. Sulphate reducing *Clostridia* were positive for 62 samples (88.57%) and the count were between 0.9–25/g. *E. coli* was positive for 53 samples (75.71%) and the counts varied at 10-60 /g. Histamine forming bacterial count was carried out at two different temperatures such as 37°C and 15°C. At 37°C, 63 samples (90%) were positive but at 15°C only 18 (25.71%) samples were positive; and the counts were 10-30 and 5-20/g for 37°C and 15°C respectively. The total bacterial count for the collected fish samples were between 2.3 x 10^3 to 2.5 x 10^5/g.

Histamine in fish and fishery products

Histamine content in muscle of the fish and shellfishes *viz., Catla catla, Labeo rohita,* squid, *Tilapia aniletica, Ompak pabda, Nemipterus japonicus* and *Himantura uarnak* species was less than 2.4 mg%. Fishes such as *Sillago sihama, Trypauchen vegina, Channa striatus, C. mrigala,* and *Latus calcarifer* species contained Histamine level below 5.93 mg%. *Sardinella longiceps* fish contained 10-12 mg% of Histamine. *Clarias batrachus* revealed a Histamine level 13.32 mg%. *Strongylura* sp. had the highest level of Histamine *i.e.,* 20 mg%.

Monitoring of toxic metal from fish and shellfish products

Lead content of the muscle of the *Catla catla, Labeo rohita,* squid, *Tilapaia nilotica, Ompak pabda, Himantura uarnak* and *Sardinella longiceps* were below 0.36 ppm and the fishes such as *Sillago sihama, Trypauchen vegina, C. mrigala, Channa striatus* and *Latus calcarifer* contained lead level less than 0.05 ppm. Lead content in the muscle of mullet and croaker from Vashi creak was 0.632 and 0.699 ppm respectively; sediment of creak also contained 2.52 ppm lead.

Nickel content in muscle was 1.62 ppm in *Channa striatus.* Fishes such as *Chirrocentrus dorab,* squid, *Silago sihama, Nemipterus japonicus* and *Clarias batrachus* contained nickel level of 2.56, 2.06, 1.09, 2.04 and 1.91 ppm respectively. cadmium content in the muscle of barracuda, tilapia, freshwater catfish and Indian salmon was above 0.02 ppm and its level in the muscle of squid was 0.142 ppm.

Monitoring of viruses and metals in clams

Eight clam samples were analyzed for the various pathogenic and spoilage organisms and found that one clam sample have higher bacterial count than the recommended level *i.e.,* 5.2 x 10^7/g. Enterobacterial count was also high *i.e.,* 1.8 x 10^5 /g. The clam samples were kept in different environmental condition for about a week for virus and heavy metal analysis. The level of cadmium, chromium, copper, iron, nickel, lead and zinc varied as; 0.113-0.531, 0.035-1.065, 2.51-5.704, 9.718-144.74, 0.376-1.075, 0.245-1.614, 9.79-11.09

respectively. All samples were subjected for the presence of Rota virus agglutination test and found that it is negative.

Insect infestation

Dermestus infestation was observed in dried ribbon fish and Golden anchovy collected from the local market; dried Bombay duck was found infested with *Necrobia rufipes*.

Value added product

A ready to eat product from Kardi (*Palaemon* sp.) was prepared and the product remained tasty and crispy during storage for nine months at ambient temperature. The product was almost bacteria-free with moisture content below 4% and was acceptable to the panel members. Bombay duck marinade was prepared using 3% acetic acid and 10% salt. The maturation time for the samples kept at room temperature and at 4°C was found to be 52 hrs and 13 days respectively. The marinade was packed in solution containing 2% acetic acid and 4% salt in glass bottle with spices like black pepper, garlic, mustard and cumin. Based on the microbiological and sensory analysis, the sample stored at room temperature was found to be acceptable upto 19 days. No halophilic bacteria, enterobacteria and pathogens were detected in the sample during the storage period. The sample stored at 4°C was in good condition after six months of storage and the study on shelf life of the same is under progress.

Ambient temperature storage of pabda was carried out. Based on sensory evaluation and TPC count, the gutted sample dipped in 0.1 M citrate buffer and those in citrate buffer containing 0.2% potassium sorbate was found to be in acceptable condition upto 30 hrs and 48 hrs respectively at ambient temperature (26±2°C). Laminated Bombay duck was prepared after treatment with 2% salt and 0.2% potassium sorbate as well as 4% salt and 0.2% potassium sorbate and packed under vacuum. After three month storage period, both the product has shown good sensory quality and the product treated with 4% salt has shown lower TPC than the product treated with 2% salt. Shelf life study of the laminated Bombay duck is underway. Battered and breaded fish balls were prepared from the cooked meat of Golden anchovy mixed with 5% corn starch, 2% ginger-garlic paste and 1% pepper powder. The product was accepted by the panel members.

Analytical service to the industry

During the year under report a total of seven samples were analyzed from the fish processing industry as follows: Fish microbiology – Three samples, Swab – Three samples and Ice – One sample. The total revenue earned was ₹ 7943/-.

Value chain project under NAIP

Research project handled

- Responsible harvesting and utilization of selected small pelagics and freshwater fishes

The project, "Responsible harvesting and utilization of selected small pelagics and freshwater fishes" was initiated in 2008 with the main focus on creation of a value chain for the selected low value small pelagic fishes like sardine, anchovies, mackerel and freshwater fishes. Under the project interventions were made from production to consumption to increase the value of these low cost fishes, thereby benefitting all the stakeholders. The major outcomes are:

Propeller for ring seine

Onboard fuel monitoring machine

FRP fishing canoe

The harvesting/production of pelagic and reservoir fishes made fuel efficient, cost effective and safer

Fuel efficient propeller designs were developed for each of the seven design groups identified among ring seiners catching pelagic fishes. Prototype operations revealed 16-19% fuel saving on an average. A leading propeller manufacturer in Kollam, Kerala has taken up the technology for commercialization. Improved design of propellers will result in 90.48 lakh litres reduction in fuel consumption amounting to a saving of ₹ 44.60 crore by the ring seine fishery, if adopted in wider scale. Also the intervention will result in considerable reduction in emission of carbon due to burning of fossil fuels.

For five groups of dolnet fishing vessels, fuel efficient propeller designs were developed and experimental operations revealed on an average 21-28% fuel saving. Designs and production protocol are ready for commercialization.

An online fuel monitoring system was developed for assessing the fuel consumption pattern of a fishing vessel with respect to speed and engine rpm. A "speed-rpm-fuel card" was created using the monitoring system to train the fishermen to operate fishing boats.

FRP fishing canoes designed for the dams were introduced among tribal fisherfolk in Palakkad, Kerala replacing the risky and unscientific practice of fishing using old tyre tubes.

Improved gillnetting practices introduced in the dams in Palakkad helped to reduce juvenile catch and get more big size fish from deeper areas.

Interventions in marketing for improved hygiene, ergonomics and minimizing distress sale

Energy efficient chill rooms: At three landing centres along Kerala coast, energy efficient chill rooms were deployed to influence the market force deciding pricing of landed fish. This intervention could avoid distress sale by

fishermen and an estimated increase in earnings was not less than 50%.

Portable women friendly kiosk design: Portable women friendly kiosks for fresh-fish vending and fish-snacks vending were developed. Prototype trials of these kiosks for street side vending has proved that consumers were ready to pay 35-50% higher price for the high quality dressed and packed fish sold in hygienic kiosks, kept in convenient locations.

Trial marketing and consumer preference studies: Trial marketing of high end products developed were done through Kerala State Coastal Area Development Corporation (KSCADC) in Cochin in February, 2012 has shown highly encouraging response from consumers. The five day trial was patronized by 2917 consumers who brought products worth ₹ 1,47,327/-. Another trial marketing was organized in Thiruvananthapuram, Kerala during 4-10 March, 2012.

Established tie-up with Kerala State Coastal Area Development Corporation for corporate marketing of "FISHMAID" products through signature kiosks throughout Kerala.

Brand names were registered for dry fish (DRISH), fresh fish (SEAFRESH), value added fish (FISHMAID), Hygienically dried Bombay duck (FISHSTIX) and Manure prepared from fish (FERTIFISH).

Interventions in processing of pelagic and freshwater fishes

High end ready-to-cook and ready-to-serve products from small pelagic and freshwater fishes: Twenty six high end products from small pelagic fishes (Ready-to-eat and Ready-to-serve) have been standardized along with appropriate consumer packing for the premium markets under the brand name 'FISHMAID' and test marketed which has evoked tremendous consumer response.

Cold chain system: Design for a cold chain system with handling and storage protocol based on sound HACCP standards was developed for retailing of fresh fish.

Cost effective fish drying: Design and production procedures developed for cost effective hygienic fish drying system for low value fishes involving covered small solar rack dryers, moisture analysis, centralized secondary mechanical dryers, grading and packing facility.

Designs for yards for hygienic bulk drying of Bombay duck: Two designs were developed. One for basic drying at landing centre level for bulk production and the other as next level drying, grading and packing facility for premium and export markets. Prototypes were constructed and are in operation.

Meat bone separator: Highly cost effective fish meat extractor was developed and successfully used to extract rohu meat into kheema consistency devoid of pin bones and an innovative processing method was developed to reconstitute the kheema into analogue products. Many value added products including chocolate cookies incorporating 25% dried fish powder (both smell-masked pelagic and freshwater fishes) were developed which has found high acceptance among youths and kids during trial.

Portable women friendly kiosk

Trial marketing and consumer preference

Branding of fish products

Hygienic bulk drying of Bombay duck

Meat bone separator

Omega-3 chicken and egg

Poultry feed based on silage

Fish based products

Micro enterprise at Palakkad

Omega-3 eggs and chicken meat: Omega-3 incorporated feed for poultry was formulated using sardine extracted PUFA and feeding protocol was devised to produce "Omega-3 enriched chicken meat" and "Omega-3 enriched eggs". The meat has been found to be more soft and tastier and the eggs bigger during field trials.

Waste utilization – Feed and manure

Poutry feed: Fish waste poses environmental problems when not properly disposed. With an objective of complete utilization of fish from the fish waste generated during the preparation of value added products, formulate a feed for poultry birds based on silage (from fish waste). The feed technology was taken up by an enterprising poultry farmer at Thrissur.

Organic manure: The waste is processed into silage and added to coir pith which is again a waste product from coir industry to generate good quality organic manure which has been readily accepted by horticulture farmers. It is commercialized by a unit 'Jaivasree' established for the purpose in Munambam, Kerala.

Entrepreneurship development for empowering coastal women

Fishery entrepreneurship capacity building module: A unique training protocol was developed consisting of technology transfer, consumer preference studies, managerial and monitoring tools and skills, packing and storage solutions, product sales strategy etc. for capacity building of fisher folk, especially women for starting fish-based micro enterprises.

Establishment of rural micro enterprises: "Food Court" at St. Angelo Fort, Kannur, Kerala; "Meenoos" at Palakkad town, Kerala; "Fishman" at Munambam, Kerala, "Samurdhi" at Kollam, Kerala, "Fish magic" at Kollam, Kerala which work on value added fish products have been successfully established under the programme.

A unit "Jaivasree" was established by five women in Munambam to produce and market fish waste based organic manure under brand name (FERTIFISH). These units has already resulted in creating employment for 75 fisherwomen who were unemployed.

GENERAL INFORMATION
(1 April, 2011 to 31 March, 2012)

Training Programmes Conducted

Sl. No.	Subject	No. of beneficiaries	Venue and date
1.	Fish biochemistry	8 students	Visakhapatnam 1-30 April 2011
2.	Fish processing	3 students	Visakhapatnam 1-30 April 2011
3.	Fish microbiology	6 students	Visakhapatnam 1 April - 31 May 2011
4.	Biochemical alterations in the nutrient profile of black bream during freezing	1	Cochin 3 March - 2 April 2011
5.	Electrophoretic separation of proteins in *Johnius dussumieri* and quantification of main acids using high performance liquid chromatography	1	Cochin 3 March - 2 April 2011
6.	Nutrient profile of milk fish (*Chanos chanos*) caught from Arabian sea	1	Cochin 3 March - 2 April 2011
7.	Biochemical studies on the amino acid composition, fatty acid profile and mineral status of sharp tooth snapper caught of west coast of India	1	Cochin 3 March - 2 April 2011
8.	Evaluation of freshness and quality of gar fish (*Xenentodon cancila*) using 'K' value and its nutrient profile	1	Cochin 3 March - 2 April 2011
9.	Seafood quality assurance	20	Cochin 21 March - 2 April 2011
10.	Laboratory techniques in microbiological examination of seafood	2	Cochin 21 March - 4 April 2011
11.	Nutritional profiling of black clam	1	Cochin 4 April - 3 June 2011
12.	Laboratory techniques in microbiological examination of seafood	2	Cochin 21 March - 21 April 2011
13.	Laboratory techniques in microbiological examination of seafood	6	Cochin 21 April - 3 May 2011
14.	Microbial enzymes	1	Cochin 21 April - 21 June 2011
15.	Molecular cloning	2	Cochin 21 April - 21 June 2011

Indicates Outstation Training Programmes

Sl. No.	Subject	No. of beneficiaries	Venue and date
16.	Fuel efficiency in fishing vessels	35	Munambam 24 April 2011
17.	Thermal validation	15 production/ quality managers and technologists	Veraval 24 April - 1 May 2011
18.	Retort operation	10 production/ quality managers and technologists	Veraval 24 April - 1 May 2011
19.	Fish processing	10	Visakhapatnam 2 May - 1 June 2011
20.	Fish microbiology	12	Visakhapatnam 2 May - 2 July 2011
21.	Modern analytical techniques in fish based value added products	2	Cochin 3-17 May 2011
22.	Isolation and identification of bacteria of public health significance	22	Cochin 4-7 May 2011
23.	Bacteria of public health significance in seafood	5	Cochin 4-13 May 2011
24.	Molecular characterization of pathogens	3	Cochin 7-20 May 2011
25.	Value addition in fish and shellfish	10	Cochin 9-13 May 2011
26.	Molecular characterization of seafood borne pathogens	1	Cochin 21 March - 21 May 2011
27.	Modern analytical techniques in fish biochemistry	13	Cochin 9-21 May 2011
28.	Fish microbiology	11	Visakhapatnam 9 May - 9 July 2011
29.	Value added products from freshwater fishes	30	Chulliyar, Palakkad 13-14 May 2011
30.	HACCP concepts	48	Cochin 16-21 May 2011
31.	Fish biochemistry	10	Visakhapatnam 19 May - 18 June 2011
32.	Preparation of value added oyster products	12	Azheekkal, Kollam 26 May 2011
33.	Incidence of *E. coli* O157:H7 in fish market	1	Cochin 3 March - 28 May 2011
34.	Anti-bacterial activities of some plant extracts against pathogenic spoilage bacteria in seafood	1	Cochin 3 March - 31 May 2011
35.	Comparative assessment of total bacteria load in seafood by various standard methods	1	Cochin 3 March - 31 May 2011

Sl. No.	Subject	No. of beneficiaries	Venue and date
36.	Determination of effective thawing duration in frozen seafood for estimation of bacterial load	1	Cochin 3 March - 31 May 2011
37.	Isolation of histamine producing psychrotrophs from tuna	1	Cochin 3 March - 31 May 2011
38.	Fish packaging technology	3	Cochin 1 June - 1 July 2011
39.	Laboratory techniques in microbiological examination of seafood	3	Cochin 6-20 June 2011
40.	Laboratory techniques in microbiological examination of seafood	2	Cochin 6 June - 5 August 2011
41.	Detection and molecular characterization of *V. cholerae* from seafood	2	Cochin 6 June - 6 September 2011
42.	Value added products from small pelagics	60	Thalassery 15-18 June 2011
43.	Microbial enzymes	1	Cochin 21 March - 21 June 2011
44.	Biochemical analysis of fishery products	2	Cochin 2-16 July 2011
45.	Microenterprise initiatives	23	Moothakunnam, Ernakulam 8 July 2011
46.	Design and fabrication of new multi seam trawl	50 fishermen	SIFT, Kakinada 11-13 July 2011
47.	PHF and value addition	25 fisherwomen	SIFT, Kakinada 13 July 2011
48.	Innovative products from sardine and mackerel	20	Cochin 20-22 July 2011
49.	Value added products from small pelagics	20	Cochin 22 July 2011
50.	Responsible fishing	20 fishermen	Jharkhand 23-27 July 2011
51.	HACCP - An overview	18	Cochin 26 July 2011
52.	Food packaging techniques and testing of packaging materials	4	Cochin 1-20 August 2011
53.	Detection of molecular characterization of *V. cholerae* from seafood	2	Cochin 6 August - 6 September 2011
54.	HACCP concepts	36	Cochin 8-12 August 2011
55.	Preparation of cattle, poultry and pig feed using silage	1	Cochin 16-30 August 2011

Sl. No.	Subject	No. of beneficiaries	Venue and date
56.	Isolation and identification of *Vibrio parahaemolyticus* from fish in retail outlets and their confirmation using PCR	1	Cochin 16 August - 15 October 2011
57.	Effect of short term marination on the quality and shelf life of chill stored pangasius fillets	1	Cochin 16 August - 18 November 2011
58.	Effect of modified atmospheric packaging on the shelf life of *Pangasianodon hypothalamicus*	1	Cochin 16 August - 18 November 2011
59.	Value added products from fishes and its marketing	30	Kayangulam 19-20 August 2011
60.	Preparation of value added fish products and hygienic handling of cured and dried fishes	15 fisherwomen	Visakhapatnam 29-31 August 2011
61.	Laboratory techniques in microbiological examination of seafoods	1	Cochin 12-24 September 2011
62.	Fabrication and operation of improved gillnets	35 tribal fisher folk	Ambalavayal, Wayanad 17 September 2011
63.	Identification of *Vibrio parahaemolyticus* by PCR	1	Cochin 20 September - 20 October 2011
64.	Innovative products from sardine and mackerel	4	Cochin 22-23 September 2011
65.	Fuel efficient fishing	32	Alappuzha 25 September 2011
66.	Conversion of diamond mesh nets to square mesh nets	10 fisheries officials	Cochin 27 September - 1 October 2011
67.	Laboratory techniques in microbiological examination of seafoods	12 technologists	Visakhapatnam 10-14 October 2011
68.	PCR techniques for detection of white spot syndrome virus	4	Cochin 11-14 October 2011
69.	HACCP concepts	10 quality managers/ technologists	Veraval 11-15 October 2011
70.	Value added products from fish and shellfish	5	Cochin 17-19 October 2011
71.	Innovative products from small pleagics	40	Cochin 20-21 October 2011
72.	Isolation and identification of bacteria of public health significance from food	1	Cochin 24-29 October 2011
73.	Entrepreneurship development for fish based business	53	Cochin 3 November 2011
74.	Value added products	21 fisherwomen	SIFT, Kakinada 3 November 2011

Sl. No.	Subject	No. of beneficiaries	Venue and date
75.	Fresh fish processing and marketing	40	QSS, Kollam 7-8 November 2011
76.	Rigging of tuna long line gears	20 Boat owners and crew co-ordinators of NETFISH, MPEDA	Minicoy, Lakshadweep 8 November 2011
77.	Preparation of value added products	3 women entrepreneurs	Visakhapatnam 8-9 November 2011
78.	HACCP concepts	23	Cochin 14-18 November 2011
79.	Preparation of value added products	60 fisherwomen	Visakhapatnam 21-22 November 2011
80.	Fishery microbiology and biotechnology	2 PG students	Visakhapatnam 21-27 November 2011
81.	Marketing of fresh fish	40	QSS, Kollam 23-24 November 2011
82.	Food packaging techniques and testing of packaging materials	1	Cochin 24 November - 15 December 2011
83.	Fuel efficient fishing	50	Kozhikode 25 November 2011
84.	Production and characterization of alkaline thermostable protease from marine bacteria	1	Cochin 28 November 2011 - 30 January 2012
85.	Studies on incidence of *Vibrio parahaemolyticus* in seafood	1	Cochin 1-31 December 2011
86.	Chitinolytic activity of bacteria from shrimp shell waste	1	Cochin 1 December 2011 - 1 January 2012
87.	Seafood quality assurance	18	Cochin 5-17 December 2011
88.	Modern analytical techniques in monitoring nutrient composition and chemical hazards profiling in *Labeo rohita* and *Catla catla*	1	Cochin 5 December 2011 - 5 January 2012
89.	Packaging of fish products	3	Cochin 7 December 2011 - 13 January 2012
90.	Preparation and quality evaluation of value added products from fish	3	Cochin 7 December 2011 - 13 January 2012
91.	Preparation of value added products, hygienic handling of fish and latest developments in fish processing	20 fisherwomen	Visakhapatnam 8-9 December 2011

Sl. No.	Subject	No. of beneficiaries	Venue and date
92.	Innovative products from mackerel	50	Munambam 12-13 December 2011
93.	Value addition in fish	1	Cochin 13-16 December 2011
94.	Value added products from freshwater fishes	30	Palakkad 15-16 December 2011
95.	Application of multiple hurdle technology for enhancing the shelf life of brown shrimp *Metapenaeus monoceros*	1	Cochin 28 December 2011 - 31 January 2012
96.	Development of ready to serve seafood cocktail soup in tin free steel (TFS) cans	1	Cochin 28 December 2011 - 31 January 2012
97.	Development of protein and omega-3 enriched fish wafers	1	Cochin 28 December 2011 - 31 January 2012
98.	Fuel efficient fishing	22	Puthiyappa and Koyilandi, Kozhikode 2-3 January 2012
99.	Proximate composition and amino acid profile of fish protein concentrate, protein hydrolysate and silage prepared from the deep sea fish *Lamprogrammus exutus* (Legless Cuskeel)	1	Cochin 2 January - 28 February 2012
100.	Isolation and characterization of gelatin from Double spotted queen fish, Bearded croacker and Malabar grouper and its comparative studies	1	Cochin 2 January - 28 February 2012
101.	Isolation and characterization of collagen from skin, air bladder and fish waste of Bearded croaker	1	Cochin 2 January - 28 March 2012
102.	Protein concentrate from oyster (*Crassostrea madrasensis*) and its biochemical, nutritional and functional properties	1	Cochin 2 January - 28 March 2012
103.	Characterization of cyloglucanase and endo-B1, 4-xylogenase genes from marine bacteria	1	Cochin 3 January - 2 February 2012
104.	Production and characterization of alkaline thermostable protease from marine bacteria	2	Cochin 9 January - 8 February 2012
105.	Isolation and characterization of *Listeria monocytogenes* from seafood of Cochin	2	Cochin 9 January - 8 February 2012
106.	Modern analytical techniques in biochemistry	5	Cochin 9 January - 9 February 2012
107.	Modern analytical techniques for the analysis of several phenolic components with potential antioxidant properties in grape extract and vines (*Vites sinifera*)	2	Cochin 9 January - 9 March 2012
108.	Dry fish production	1	Cochin 10-12 January 2012

Sl. No.	Subject	No. of beneficiaries	Venue and date
109.	Fuel efficient operation of fishing vessels through fuel monitoring	35	Kozhikode 14-15 January 2012
110.	Value added products from freshwater fishes	30	GADVASU, Ludhiana 24-25 January 2012
111.	Testing of antibacterial activity against pathogenic becateria	1	Cochin 27 January - 10 February 2012
112.	Value added fish products	2	Cochin 31 January - 3 February 2012
113.	Identification of bacteria	1	Cochin 1-14 February 2012
114.	Fuel efficient operation of fishing vessels through fuel monitoring	35	Thalassery 11-12 February 2012
115.	Value added products and hygienic handling of fish	300 fisherfolk	Payakaraopeta and Pentakota, East Godavari District, AP 14-16 February 2012
116.	HACCP concepts	18	Cochin 1-25 February 2012
117.	Vistas in nutrient profiling and nutritional labeling of seafood	33	Cochin 14-23 February 2012
118.	Development of smoked fish products from catla	2	Cochin 24 February - 20 March 2012
119.	Fish based ready-to-eat value added products	20	GADVASU, Ludhiana 24-25 February 2012
120.	Development of extruded snack food from catla	3	Cochin 27 February - 21 March 2012
121.	Hygienic handling and drying of fish	23	Sevasharm Swasrayagram, Angamaly 1 March 2012
122.	HACCP concepts	14	Cochin 5-9 March 2012
123.	Laboratory techniques in microbiological examination of seafoods	18 technologists from processing industries	Visakhapatnam 12-24 March 2012
124.	Value added fish products	28 fisherwomen	Visakhapatnam 15-17 March 2012
125.	In-plant training	1	Cochin 16-21 March 2012
126.	Demonstration fishing trip	10 boat crew	Onboard vessel 'Amar', Lakshadweep 18 March 2012
127.	Value added fishery products	18	Imphal, Manipur 22-24 March 2012

Seafood quality assurance (Cochin)

Value addition in fish and shellfish (Cochin)

Preparation of value added oyster products (Azheekkal)

Innovative products from sardine and mackerel (Cochin)

Conversion of diamond mesh nets to square mesh nets (Cochin)

Fabrication and operation of improved gillnets (Nellarachal)

Trainees and faculty of HACCP concepts (Veraval)

Hands on training on HACCP concepts (Veraval)

HACCP concepts (Cochin)

Nutritional profiling of seafoods (Cochin)

Value added fish products (Visakhapatnam)

Laboratory methods for microbiological examination of seafood - Trainees and faculty (Visakhapatnam)

Sl. No.	Subject	No. of beneficiaries	Venue and date
128.	Value added fishery products	21	Dimapur, Nagaland 26-29 March 2012
129.	Harvest and post harvest technology of freshwater fish	20	Aizwal and Serlui'B Reservoir, Mizoram 28-30 March 2012
130.	Laboratory techniques in microbiological examination of seafoods	8 students	Visakhapatnam 28 March - 4 April 2012
131.	Responsible fishing, extension methods and fabrication of improved gill nets	40 fishermen	Doyang Reservoir, Nagaland 30-31 March 2012

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 L_{OA}, 20 M L_{OA} and fuel efficient vessel of 18 M L_{OA}
- Design of aluminum craft for inshore waters and FRP pole and line fishing vessels for Lakshadweep
- Substitution of wooden boats by FRP canoes and treated rubber wood canoes for use in backwaters and near-shore waters
- Dual preservative treatment for low valued species of timbers for boat construction
- Painting schedules for aluminum-magnesium alloy and FRP sheathing for under-water hulls of fishing vessels
- Antifouling and anticorrosive paints for protection of fishing craft
- Mercury-free anodes for cathodic protection of fishing craft
- Protective coating for cast iron propeller
- Specifications for different types of synthetic materials for fabrication of different types of fishing gear
- Designs of different types of fishing gear such as trawls for demersal, pelagic and semi-pelagic applications, gill nets, purse seines and traps for exploitation of the different fishery resources
- Otter boards of different sizes and designs to suit demersal trawl fishing operations and variable depth fishing
- V-form steel otter boards for demersal trawls
- Combination wire rope for deep sea fishing

- Bycatch reduction devices such as square mesh codend and fish eye for reducing catch of juveniles and young ones in shrimp trawls
- Turtle Excluder Device (TED) for conservation of marine turtles
- Designs of dryers such as tunnel dryer, rotary fish meal dryer, electrical fish dryer and solar dryer with LPG/electrical backup
- Designs of deep fat fryer and cutlet moulding machine
- Fuel efficient propeller for fishing vessels and other fuel saving devices such as propeller nozzle
- Stainless steel tilting kettle for processing plants
- Oil fryer for battered and breaded products
- Meat bone separator for removal of bones including pin bones from rohu
- Electronic instruments for application in fishing technology, fish processing technology, aquaculture, marine environmental monitoring, agricultural investigations etc.
- Improved methods for freezing, freeze drying, canning, drying and curing of different types of fish and shellfish
- An improved method for production of dried prawns
- Methods for production of quality dried fish products with attractive appearance and long storage life
- Hygienic drying of anchoviella
- Method for economic utilization of low grade fish and conversion of fish wastes into useful byproducts
- Methods for production of value added products such as wafers, pickles and soup powder from fish/shellfish
- Ready-to-use isinglass from fish maws
- Methods for extraction of chitin/chitosan from prawn shell waste and their application in textile and poultry industry and in the medical field
- Pilot plant for production of chitosan
- Method for extraction of shark fin rays and processing shark cartilage
- High gel strength agar from sea weeds
- Method for isolation of squalene from shark liver oil for use in cosmetics
- Improved packaging materials for transportation and storage of fish
- Production of retort pouch packed fish products
- Specific requirements in setting up fish processing plants

- Cleaning schedules for fish processing establishments and boat decks and preparation of deodorant and antiseptic ointment
- Chlorine level indicator paper for instant reading of chlorine level in water used in fish processing plants
- Specifications for various types of seafood, process water and ice
- Procedure for implementation of HACCP
- Design of energy efficient treatment plant for effluent water from processing plants
- Collagen-chitosan film from fish skin, bone and air bladder for treatment of burns and as a barrier material in guided tissue regeneration (GTR) in dentistry
- Fine grade absorbable surgical sutures from fish gut
- Method for preparation of n-3 poly unsaturated fatty acid (PUFA) concentrates from fish oils
- An 18h depuration method to eradicate pathogenic bacteria and grit from bivalves, especially clams and mussels
- Bacteriological culture media for 1) direct detection and enumeration of the potent spoiler bacterium *Alteromonas putrefaciens*, and 2) estimation of total plate count of cured/semi preserved/salted fishery products by preventing swarming of *Bacillus* sp.
- Device for drawing uniform samples from frozen fish blocks for microbiological evaluation
- Polymerase Chain Reaction (PCR) technique for detection of white spot disease syndrome in farmed shrimp

Outreach Programmes Conducted

Outreach training programmes

During the period (April 2011 to March 2012) about 30 training/awareness programmes on various aspects of harvest and post harvest technologies were conducted outside the Institute as indicated in screen in the Chapter on 'Training programmes conducted'.

Exhibitions

The Institute participated in the following exhibitions during the period:

- Exhibition organized as part of the Workshop/Meeting on Expert consultation on revitalizing Indian fisheries education to meet the 21st century aspirations at FCRI, Tuticorin during 8-10 May, 2011.
- Exhibition organized in connection with the 22nd Governing Council

FCRI, Tuticorin, Tamil Nadu

Balasore, Odisha

Kolkata, West Bengal

Pookkottur, Malappuram, Kerala

Anchal, Kollam, Kerala

Jabalpur, Madhya Pradesh

Meeting of Network of Aquaculture Centres for Asia Pacific (NACA) at Cochin during 9-12 May, 2011.

- 'Krishi Mahotsav' organized by Govt. of Gujarat at Sutrapada (12 May, 2011), Porbandar (13 May, 2011) and Jaffarabad (23 May, 2011).
- Exhibition organized by the Press Information Bureau, Thiruvananthapuram at Paingulam, Palai during 6-8 June, 2011.
- Exhibition held in connection with the inauguration of Kumbalam-Chellanam sustainable village project at Kumbalangi on 30 July, 2011.
- 'Utkal Banga Utsav 2011' at Balasore, Odisha during 14-20 August, 2011.
- Exhibition organized by the Press Information Bureau, Thiruvananthapuram at Mannar, Alappuzha during 21-23 August, 2011.
- Exhibition organized as part of the Colloquium on 'Challenges in marine mammal conservation and research in the Indian ocean' at CMFRI, Cochin during 26-27 August, 2011.
- 'Haritholsavam 2011' organized by the District Administration, Ernakulam at Maradu, Cochin during 3-7 September, 2011.
- 15th National exhibition on 'Evolution of India as a great nation in the 21st century', organized by Central Calcutta Science & Culture Organization at Kolkata on 7 September, 2011.
- 'Haritholsavam 2011' organized at the College of Agriculture, Vellayani, Thiruvananthapuram during 19-24 September, 2011.
- Exhibition organized by the Press Information Bureau, Thiruvananthapuram at Pookkottur, Malappuram during 13-15 October, 2011.
- 'Kollam Fest – 2011' organized by the Kollam Corporation at Kollam during 14-20 November, 2011.
- Exhibition organized by the Press Information Bureau, Thiruvananthapuram at Anchal Panchayath in Kollam district during 24-26 November, 2011.
- Exhibition held in connection with 6th National Conference of KVKs, JNKVV, Jabalpur during 3-5 December, 2011.
- '23rd Krishi Shilpa 'O' Banijya Mela', Purba Medinipur, West Bengal during 9-15 December, 2011.
- 'Swasrayabharat – 2012' organized by Swadeshi Science Movement at Cochin during 15-20 December, 2011.
- Exhibition held in connection with 9th Indian Fisheries Forum, Chennai during 19-23 December, 2011.
- Fish Expo – 2011-12 held at Palakkad during 23 December 2011 to 3 January, 2012.

- 'Karshika Mela 2012' organized by Gandhiji Study Centre, Thiruvananthapuram at Thodupuzha during 26 December, 2011 to 1 January, 2012.
- 'Regional exhibition cum seminar' organized by Animal Husbandry Department, Govt. of Kerala at Cochin during 14-16 January, 2012.
- Exhibition held at Municipal Childrens Park, Palakkad during 15 January - 15 February, 2012.
- 'National Fish Festival 2012' held at Raipur, Chattisgarh during 27-29 January, 2012.
- Exhibition held at Archeological Survey of India, Palakkad during 28-29 January, 2012.
- '24th Kerala Science Congress and Science Expo' held at Kottayam during 28-31 January, 2012.
- 'Meenakshi Matsya Utsav' organized by the Directorate of Fisheries, Madhya Pradesh at Bhopal during 4-6 February, 2012.
- 'Indian International Aquashow 2012' at Cochin during 10-15 February, 2012.
- 'Exhibition and Farmers Mela' organized under the NAIP sub project at IISR, Kozhikode during 16-18 February, 2012.
- Exhibition held in connection with the National conference in 'New vistas in Indian agriculture' at CIBA, Chennai during 23-24 February, 2012.
- 'India International Seafood Show' at Chennai during 29 February to 2 March, 2012.
- Exhibition on Disaster management at Thiruvananthapuram during 4-14 March, 2012.
- Exhibition held in connection with Global conference on Women in Agriculture at New Delhi during 13-15 March, 2012.
- Exhibition held in connection with National conference on 'Aquaculture: Fish for billion' at Bhubaneswar during 15-17 March, 2012.
- 'Krishi Darpan – 2012', Cochin during 20-21 March, 2012.
- Exhibition at Aizawl, Mizoram during 28-29 March, 2012.
- 'Biovizag 2K12' – Exhibition held in connection with National conference on 'Advances in biotechnology for sustainable initiatives in 21st century' at Visakhapatnam during 30-31 March, 2012.

Purba Medinipur, West Bengal

Cochin, Kerala

Shri Ajay Vishnoi, MP Fisheries Minister, at CIFT stall in 'Meenakshi Matsya Utsav'

Chennai, Tamil Nadu

New Delhi

Replies to technical queries

Technical queries received from the various categories of clients such as fish processors, technologists, entrepreneurs, Self Help Groups, Government organizations and fisher folk were attended to. The queries were related to the topics such as harvest and post harvest technology of fish, participation in training programmes and payment of fees, technical guidance, analytical testing

services, assistance under technology transfer programmes etc.

Radio Talks

The following radio talks were given by the Scientists/Officers of the Institute during the year:

- **Dr. M.P. Remesan,** Senior Scientist – Monsoon trawl ban in Kerala (In Malayalam), AIR, Kannur (26 July, 2011)
- **Dr. Femeena Hassan,** Senior Scientist – Interview on Ensuring quality in fish products (In Malayalam), AIR, Cochin (28 July, 2011)
- **Shri M.S. Kumar,** Tech. Officer (T7-8) – Migratory behavior of fishes (In Telugu), AIR, Visakhapatnam (11 September, 2011)
- **Shri M.S. Kumar,** Tech. Officer (T7-8) – How fish as food useful for human health (In Telugu), AIR, Visakhapatnam (6 December, 2011)
- **Dr. G. Rajeswari,** Senior Scientist - Methods adopted for conservation of turtles (In Telugu), AIR, Visakhapatnam (31 January, 2012)
- **Dr. G. Rajeswari,** Senior Scientist – Role of fish aggregating devices in resource enhancement (In Telugu), AIR, Visakhapatnam (9 February, 2012)
- **Shri M.S. Kumar,** Tech. Officer (T7-8) – Role of bycatch reduction devices in conservation of non-selective bycatch and endangered marine turtles (In Telugu), AIR, Visakhapatnam (15 March, 2012)

Agricultural Technology Information Centre

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

Awards and Recognitions

Dr. T.K. Srinivasa Gopal and Dr. C. Jessy Joseph receiving the award from Shri Charan Das Mahanth, MoS, Agriculture

Rajarshi Tandon Award

CIFT, Cochin has bagged the 'Rajarshi Tandon Award - 2010' for the best Official language implementation among the ICAR Institutes in the 'C' Region. CIFT got this award for the sixth time. The award was received by Dr. T.K. Srinivasa Gopal, Director and Dr. C. Jessy Joseph, DD (OL) jointly during the ICAR Foundation Day celebrations held on 16 July, 2011 from Shri Charan Das Mahanth, Honourable MoS, Agriculture, Food and Public Distribution, Govt. of India.

Fellowship of ASET

Dr. T.K. Srinivasa Gopal, Director has been conferred with Fellow of

the Academy of Science, Engineering and Technology (FASET) for outstanding contributions in the field of Fish Processing Technology during the 9th Indian Fisheries Forum held at Chennai on 19 December, 2011. The Fellowship was conferred to him by Dr. S.N. Dwivedi, President, Academy of Science, Engineering and Technology (ASET), Bhopal.

Fellowship of FAFST

Dr. T.K. Srinivasa Gopal, Director has been conferred Fellow of Association of Food Scientists and Technologists (India) for the significant contributions made in the area of Research, Development, Industrial Achievement and Human Resource Development in the field of Food Science and Technology during the XXI Indian Convention of Food Scientists and Technologists organized by the AFST(I) and held at Pune on 20 January, 2012. The Fellowship was conferred to him by Shri V.N. Gaur, IAS, CEO, Food Safety and Standards Authority of India.

Jawaharlal Nehru Award

Dr. Geroge Ninan, Senior Scientist, Fish Processing received the 'Jawaharlal Nehru Award' for outstanding Post Graduate Agricultural Research - 2010 (Fisheries) of ICAR, New Delhi for his Ph. D. thesis entitled, "Optimization of process parameters for the extraction of gelatin from skin of freshwater fish and evaluation of physical and chemical properties" under the guidance of Dr. Jose Joseph, Principal Scientist (Retd.), Fish Processing, CIFT, Cochin. The award was received from Shri Sharad Pawar, Honourable Union Minister for Agriculture, Food and Public Distribution on 16 July, 2011.

Young Scientist Award

Dr. George Ninan, Senior Scientist, Fish Processing received the A.V. Jones Young Scientist Award from His Grace the Most Rev. Dr. Joseph Mar Thoma, Metropolitan of the Mar Thoma Syrian Church of Malabar at a function held at Cochin on 22 December, 2011. The award was instituted by the Mar Thoma Syrian Church for achievements in the field of Science and Technology.

Rashtriya Gaurav Award

Dr. Femeena Hassan, Senior Scientist, Quality Assurance and Management received the 'Rashtriya Gaurav Award' for meritorious services, outstanding performance and remarkable role in fisheries instituted by India International Friendship Society, New Delhi. The award was received from Dr. Bhisma Narain Singh, Former Governor of Assam and Tamil Nadu at a Seminar on Economic growth and national integration held at New Delhi on 16 July, 2011.

Best Paper Award

The paper entitled, "Effect of thermal modification on physico-chemical and functional properties of myofibrillar protein from tilapia, *Orechromis mossambicus* (Perter, 1852)" by **Dhanya Ramachandran, Mukund Mohan and T.V. Sankar** published in the Journal of Fishery Technology, Vol. 47 (1) won the best scientific paper award of Society of Fisheries Technologists (India).

Dr. T.K. Srinivasa Gopal receiving the FASET from Dr. S.N. Dwivedi


Dr. T.K. Srinivasa Gopal receiving the FAFST from Shri V.N. Gaur, IAS


Dr. George Ninan receiving the Jawaharlal Nehru Award from Shri Sharad Pawar


Dr. George Ninan receiving the Young Scientist Award from Rev. Dr. Joseph Mar Thoma

The paper entitled, "Performance evaluation of big eye bycatch reduction device on the sea off Cochin, India" by **S. Sabu, T.R. Gibin Kimar, P. Pravin and M.R. Boopendranath** published in the Journal of Fishery Technology, Vol.48(1) won the best scientific paper award of Society of Fisheries Technologists (India).

Dr. J. Charles Jeeva receiving the award from Dr. J. Vasanthakumar, President, SEE, Coimbatore

Best Presentation Award

The research paper entitled, "Market-led livelihood interventions in rural aquaculture sector: Participatory monitoring of self help groups" by **J. Charles Jeeva, Femeena Hassan and Saleena Mathew** presented at the National seminar on 'Innovation in farming system research and extension for inclusive development' held at Madras Veterinary College, Chennai during 24-25 November, 2011 was adjudged as the 'Best presentation' in the Seminar.

The research paper entitled, "Isolation and characterization of collagen from Albacore tuna (*Thunnus alalunga*), Dog shark (*Scoliodon sorrakowah*) and rohu (*Labeo rohita*)" by **G.S. Hema, K. Shyni, Suseela Mathew, George Ninan, R. Anandan and P.T. Lakshmanan** presented at the National seminar on 'Emerging trends in biotechnology and microbiology' held at St. Thomas College, Palai on 30 March, 2012 won the Second prize for Best Paper presented in the Seminar.

Dr. Saly N. Thomas with the award winning poster

Best Poster Award

The Best Poster Award for the theme - Fishing resources, recreational fishing and sustainable management at the 9th Indian Fisheries Forum was awarded to the poster presentation titled, "Marine recreational fishing in Andamans, India" by **Saly N. Thomas, P. Pravin and M.P. Remesan.**

Shri T.R. Ananthanarayanan and Shri R. Yathavamoorthi receiving the award for best poster

The Best Poster Award for the theme - Harvest and Post Harvest Technology at the 9th Indian Fisheries Forum was awarded to the poster presentation titled, "Effect of pulsed light on shelf life of Pearlspot (*Etroplus suratensis*) stored at 2 ± 1°C" by **T.R. Ananthanarayanan, C.T. Nithin, R. Yathavamoorthi, Toms C. Joseph, J. Bindu and T.K. Srinivasa Gopal.**

The paper entitled, "Structural features in collagens extracted and purified from squid skin" authored by **R. Remyakumari and K.K. Asha** has been awarded Second prize in the Poster Presentation during the International conference on 'Recent perspectives in macromolecular structures and functions' held at CARI, Port Blair during 27-28 January, 2012.

The paper entitled, "Thermal process optimization for jackfruit (*Artocarpus heterophyllus* L.)" authored by **Pritty S. Baby, K.P. Sudheer and J. Bindu** has been awarded Third prize in the Poster Presentation during the National seminar on 'Emerging technologies in food processing for ensuring food safety and quality' held at TNAU, Coimbatore during 14-15 October, 2011.

Winners of Inter Zonal Sports Meet with dignitories

Victory in ICAR Zonal and Inter Zonal Sports Meet

CIFT, Cochin came out with flying colours in the ICAR Inter Zonal Sports Meet 2011 held at Kalyani, Kolkata during 16-19 January, 2012 and the ICAR Zonal Sport Meet 2012 held at Hyderabad during 27 February to 2 March, 2012.

At the Inter Zonal Sports Meet a four member contingent from CIFT participated. Smt. P. Jeyanthi, Scientist and Chief De Mission of the CIFT team got first place in Long Jump. The womens' carom winner and runner were Smt. K.K. Sumathy, Tech. Officer (T5) and Smt. V.P. Vijayakumari, P.S. Apart from this, Smt. Vijayakumari got first place in Javelin throw and was winner in Shuttle Badminton Doubles (Women) along with Smt. Tessy Francis (T4). Smt. Tessy Francis was winner in Chess (Women) category.

The following is the list of winning participation in the ICAR Zonal tournament which was held between 25 ICAR institutes in the southern states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh: 1. Foot Ball – Winner, 2. Carroms (Women) – 1st Prize – Smt. K.K. Sumathy, 3. Long Jump (Women) – 1st Prize – Smt. P. Jeyanthi, 4. 200 M Sprint (Women) – 2nd Prize – Smt. P. Jeyanthi, 5. 1500 M – 2nd Prize – Shri Deu Umesh Aroskar, 6. 400 M – 3rd Prize – Shri P.S. Sunil Kumar, 7. 800 M – 3rd Prize – Shri P.S. Sunil Kumar and 8. 100 M Sprint (Women) – 3rd Prize – Smt. P. Jeyanthi.

Victorious Foot Ball team

Analytical Services

The Head Quarters and Research Centres of the Institute undertook testing of samples of different types of raw materials and products received from various organizations, State and Central Govt. Departments and entrepreneurs and issued reports on their quality. The samples tested included fresh and frozen fish and shellfish products, byproducts, prawn larvae from hatcheries, swabs from processing tables and worker's hands, chemicals, salt, water, ice, packaging materials etc. Type testing of marine diesel engines was also carried out and performance certificates were issued to the concerned manufactures in addition to calibration of mercury, alcohol and digital thermometers received from different fish processing plants and the industry. About 1200 samples were tested in the different laboratories of the Institute during the year.

Patents Obtained/Filed/Under Filing

Patents obtained

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

Applications filed at New Delhi Patent Office

- Shelf stable fish sausages in indigenous synthetic casings - C.N. Ravishankar, T.K. Srinivasa Gopal, K.G. Ramachandran Nair and K. Devadasan (No. 2581/DEL/2004)

- Process for the production of high density bulk chitosan - K.G. Ramachandran Nair, George Ninan and P.T. Mathew (No. 2582/DEL/2004)
- Fishing canoes from treated rubber wood - Leela Edwin, Saly N. Thomas and B. Meenakumari (No. 2583/DEL/2004)
- Fibre glass sheathed rubber wood canoe - Leela Edwin and B. Meenakumari (No. 2584/DEL/2004)
- Ready to serve pearl spot moilee in retortable pouches - T.K. Srinivasa Gopal, C.N. Ravishankar, K.G. Ramachandran Nair and K. Devadasan (No. 2585/DEL/2004)
- A package of practice for improving the bacterial quality and food safety of farmed freshwater scampi (*Macrobrachium rosenbergii*) - K.V. Lalitha and P.K. Surendran (No. 3453/DEL/2005)
- Production of edible fish powder from small bony fish by thermal processing using perforated aluminium trays - A.K. Chattopadhyay, B. Madhusudana Rao, S.S. Gupta and R. Chakrabarti (No. 3464/DEL/2005)
- Mesh gauge - A device for easy measurement of fishing net mesh size - U. Sreedhar (No. 42/DEL/2006)

Applications filed at Chennai Patent Office

- Carbon dioxide emitter for extending the shelf life of refrigerated fishery products - C.O. Mohan, C.N. Ravishankar and T.K. Srinivasa Gopal (No. 167/CHE/2010)
- Dual action active packaging system combining carbon dioxide emitter and oxygen scavenger for extending shelf life of refrigerated fish products - C.O. Mohan, C.N. Ravishankar and T.K. Srinivasa Gopal (No. 166/CHE/2010)
- Ready to serve Kerala style sardine curry in retortable pouches and a process for preparing the same - T.K. Srinivasa Gopal, C.N. Ravishankar and P.K. Vijayan (No. 168/CHE/2010)
- Ready to serve Punjabi style catla curry in retortable pouches and a process for preparing the same - C.N. Ravishankar, T.K. Srinivasa Gopal and P.K. Vijayan (No. 178/CHE/2010)
- Ready to serve Manipur style rohu curry in retortable pouches and a process for preparing the same - C.N. Ravishankar and T.K. Srinivasa Gopal (No. 169/CHE/2010)
- Ready to serve Mughali style rohu curry in retortable pouches and a process for preparing the same - T.K. Srinivasa Gopal and C.N. Ravishankar (No. 170/CHE/2010)
- Ready to drink calcium fortified shrimp soup in reportable pouches and a

process for preparing the same - S. Kuberappa, C.N. Ravishankar, T.K. Srinivas Gopal and Jose Joseph (No. 172/CHE/2010)

- Ready to drink iron fortified shrimp soup in retortable pouches and a process for preparing the same - S. Kuberappa, C.N. Ravishankar, T.K. Srinivasa Gopal and Jose Joseph (No. 171/CHE/2010)
- Collapsible lobster trap - P. Pravin and B. Meenakumari (No. 173/CHE/2010)
- Collapsible fish trap - M.P. Remesan, P. Pravin, P. George Mathai and B. Meenakumari (No. 174/CHE/2010)
- Method of extracting *Eichornia crassipes* root extract exhibiting analgesic, anti pyretic, anti ulcer, anti-inflammatory and wound healing effects for treatment of diseases - Suseela Mathew, K. Ashok Kumar, R. Anandan, P.G. Viswanathan Nair, K. Devadasan, K.K. Asha, T.V. Sankar and Sanitha (No. 176/CHE/2010)
- Ready to serve Goan style mackerel curry in retortable pouches and a process for preparing the same - C.N. Ravishankar, T.K. Srinivasa Gopal and J. Bindu (No. 177/CHE/2010)
- Ready to eat mussel meat in retortable pouches and a process for preparing the same for packaging - J. Bindu, T.K. Srinivasa Gopal and C.N. Ravishankar (No. 175/CHE/2010)
- A low cost easy method for extraction of caroteno protein from tropical shrimp waste - R. Chakrabarti (No. 4273/CHE/2011)
- A process for the production of high purity glucosamine hydrochloride from shrimp shell waste - K.G. Ramachandran Nair, K.A. Martin Xavier and K. Devadasan (No. 4274/CHE/2011)
- Ready to eat thermal processed smoked tuna in oil medium in indigenously developed see-through retortable pouch and a process for preparing the same - J. Bindu and T.K. Srinivasa Gopal (No. 4272/CHE/2011)
- Smoked masmin flakes and a process for preparing the same - T.K. Srinivasa Gopal, R. Yathavamoorthi, V.R. Mumtaz, J. Bindu and Suseela Mathew (No. 4276/CHE/2011)
- Extruded fish product utilizing low value fish and a process for preparing the same - T.K. Srinivasa Gopal, C.N. Ravishankar, C.K. Kamalakanth and Jones Varkey (No. 4322/CHE/2011)
- Collagen-chitosan - An absorbable guided tissue regeneration membrane and a process for preparing the same - Suseela Mathew, T.V. Sankar and K. Harikumar (No. 4346/CHE/2011)
- Insulated fish bags for preserving quality of iced-fish - D. Imam Khasim, B. Madhusudana Rao and A.K. Chattopadhyay (No. 4345/CHE/2011)

- Rapid test kit for identification of white spot disease and stress in shrimps and a method thereof - Suseela Mathew, K. Ashok Kumar, R. Anandan, K. Devadasan and P.G. Viswanathan Nair (No. 4344/CHE/2011)
- Fish enriched noodles and a process for preparing the same - A.K. Chattopadhyay, B. Madhusudana Rao and D. Imam Khasim (No.4322/CHE/2011)
- Fish food composition and a process for preparing the same - T.K. Srinivasa Gopal, R. Yathavamoorthi, V.R. Mumtaz, J. Bindu and Suseela Mathew (No. 4321/CHE/2011)

Applications ready for filing

- Extraction of squalene from shark liver oil - T.K. Thankappan
- Cerium oxide and titanium oxide incorporated aluminium metal matrix composites - P. Muhamed Ashraf and S.M.A. Shibli

Trade Marks

Trade Mark applications were filed for three products named, 'Fifers', 'Maricream' and 'Fish Kure'. The Trade Mark for ready-to-eat fish wafer "Fifers" was granted under registration No. 1946892 in Class 29 for 'Wafers made of fish and prawns, snacks, snacks foods made of marine products; snacks and savouries; fish crisps and chips; quick eats, ready-to-mix and ready-to-eat fish foods, products made from meat, fish, prawns; preserved, dried, cooked, canned and frozen fish and nbsp; prawns; fried fish, prawn and marine products; fish and nbsp; prawn pickles, sauces, soup, soup mixes, seafood and seafood products'.

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
- Kerala Fishermen's Co-operative Federation (MATSYAFED)
- National Institute of Fisheries Post Harvest Technology and Training
- Kerala State Pollution Control Board
- Cochin University of Science and Technology

- Kerala Biotechnology Commission, Thiruvananthapuram

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
- Science and Technology Entrepreneurship Development project (STED)
- Bureau of Indian Standards
- Industries Department, Andaman & Nicobar Administration
- Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
- College of Fisheries, Mangalore
- National Research Centre on Plant Biotechnology, Thiruvananthapuram
- Institute of Microbial Technology, Chandigarh
- Central Marine Fisheries Research Institute, Cochin
- Central Institute of Fisheries Education, Mumbai
- National Institute of Cholera and Enteric Diseases (NICED), Kolkata

International Institutions

- Food and Agriculture Organization (FAO), Rome
- Bay of Bengal Programme (BOBP)
- Asia Pacific Fisheries Commission (APFC)
- INFOFISH

Extension and Development Agencies

- Central Social Welfare Board
- South Indian Federation of Fishermen Societies (SIFFS), Thiruvananthapuram
- AFPRD, Hyderabad
- Kanyakumari District Fishermen Sangam's Federation

- Bharat Sevak Samaj, Thiruvananthapuram
- Small Industries Development Bank of India (SIDBI)
- Matsya Mahila Vedi, Chellanam
- Alleppey Diocesan Charitable and Social Welfare Society, Alappuzha
- Vanitha Matsya Thozilali Bank, Neendakara
- Kerala Industrial and Technical Consultancy Organisation (KITCO)
- Avani Agro Society, North Paravur, Ernakulam
- Kerala State Women's Development Corporation Ltd., Thiruvananthapuram
- Chellanam Panchayat SC/ST Co-operative Society Ltd., Cochin
- Development Action through Self Help Network (DARSHN)
- Agency for Development of Aquaculture in Kerala (ADAK)
- Kudumbasree Community Development Society, Pallippuram
- New Dolphin Mechanized Fishing Boat Operators Welfare Association, Visakhapatnam
- Swarna Andhra Mechanized Boat Owners Association, Visakhapatnam
- A.P. Mechanized Boat Operators Association, Visakhapatnam
- Pattuvam Inland Fishermen Co-operative Society, Kannur
- Chellanam-Kandakadavu Fishermen Development and Welfare Co-operative Society, Cochin
- Karnataka Fisheries Development Corporation, Bangalore
- Triptisagar Society for Fishermen Ltd., Jaffarabad, Gujarat
- Gandhi Smaraka Seva Kendram, Alappuzha
- Kottappuram Integrated Development Society (KIDS), Kodungalloor
- MS Swaminathan Research Foundation, Chennai

Technical Guidance/Consultancy

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

- Construction of hygienic fish market at Aroor - M/s Matsyafed, Thiruvananthapuram
- NABL accreditation of Milk Testing Laboratory - Kerala State Dairy Development Board, Thiruvananthapuram
- Design and construction of 25000 lpd Effluent Treatment Plant (ETP) -

M/s M.S. Swaminathan Research Foundation, Poompuhar, Tamil Nadu

- NABL accreditation - State Laboratory for Livestock, Marine and Agri-products, Maradu, Ernakulam
- Design and estimate for modern hygienic fish markets at various states - NFDB, Hyderabad
- Design and construction of freshwater fish processing unit - M/s Sultan Singh Fish Farm, Nilokheri, Karnal, Haryana
- Production of chitin and chitosan from process waste of prawns - M/s Uniloids Biosciences, Hyderabad
- Setting up of an Effluent Treatment Plant (ETP) at Cochin Fishing Harbour - Cochin Port Trust, Cochin
- Providing drawing, design, cost estimate and technical specifications of intermediate mechanized fishing craft - Department of Fisheries, Andaman & Nicobar Administration
- Providing detailed specifications, general arrangement drawing, preparation of estimate and supervision of construction of the FRP vessel at different stages - Directorate of Fisheries, Govt. of Maharashtra
- Setting up of an Effluent Treatment Plant (ETP) - All Kerala Prawn Peeling Association, Ambalappuzha
- Guidance for the commercial production of Solar dryers (CIFT Dryer JSDL-55 SM, CIFT Dryer JSDL 110 SM and CIFT Dryer SDE 5) - Corporation of Cochin
- Renewal of HACCP certification - Sperm Station, Mattupetti and Kulathuppuzha
- Design of HACCP plan and implementation - NRC for Pig, Guwahati
- Development of harvest and post harvest activities in fisheries in the Lanja area of Ratnagiri district, Maharashtra - M/s Navaladevi Aqua Agro Producer Company Limited, Lanja and M/s Matsya Vyavasayik Sahakari Sanstha Maryadit, Lanja
- Technical consultancy analytical works on ten herbal antioxidant extracts - M/s Synthite Industries Ltd., Kolencherry
- Technical feasibility project report for fish processing and fish snack bar - Poyya Eco-Fishing Village, Adat, Thrissur

Committees

Grievance Cell

Chairman: The Director, CIFT

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1. Dr. T.V. Sankar, HOD, QAM

2. Shri Charles Ekka, Senior Administrative Officer
3. Shri C.J. Stephen, Finance and Accounts Officer
4. Dr. T.K. Thankappan, Principal Scientist
5. Shri P.T. Viswambharan, T-II-3
6. Shri P. Mani, UDC
7. Shri M.T. Mani, Cook
8. Shri V. Deepak Vin, SSS

Member Secretary: Asst. Admn. Officer (Cordination), CIFT

Research Advisory Committee

Chairman : Dr. K. Devadasan, former Director, CIFT, Flat No. 7, Kalika Apartments, Cheruparampathu 2nd Cross Road, Kadavanthra, Cochin – 682 020

Members

1. Dr. A.K. Upadyay, Prof. & Head, Fish Processing Technology Department, College of Fisheries, G.B. Pant University of Agriculture and Technology, Pant Nagar, Dist. Udham Singh Nagar, Uttarakhand – 263 145
2. Dr. C. Hridayanathan, Suhas, 29/1069, Janatha Road, Vyttila, Cochin – 682 019
3. Dr. V. Venugopal, B602, Skyline Villa, Opposite ITI Main Gate, Navabharath Compound, Powai, Mumbai – 400 076
4. Dr. Indrani Karunasagar, College of Fisheries, Mangalore
5. Dr. C.K. Mukherjee, Indian Institute of Technology, Kharagpur, West Bengal
6. Dr. Madan Mohan, Asst. Director General (Marine Fisheries), ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi – 110 012
7. Dr. T.K. Srinivasa Gopal, Director, CIFT

Member Secretary : Dr. P. Pravin, Senior Scientist, CIFT

Management Committee

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Members

1. Joint Director of Fisheries (Govt. of Kerala), Central Zone (Ernakulam), Near High Court, Cochin – 682 018
2. The Director of Fisheries, Govt. of Tamil Nadu, Chennai
3. Pro Vice Chancellor, Kerala University of Fisheries and Ocean Studies, Panangad P.O., Cochin - 682 506

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10. Assistant Director General (M. Fy.), ICAR, Krishi Anusandhan Bhavan II, Pusa, New Delhi - 110 012
11. Shri A.V. Joseph, Senior Accounts Officer, CMFRI, Cochin
12. Senior Finance & Accounts Officer, CPCRI, Kasaragod

Member Secretary: Senior Administrative Officer, CIFT

Institute Joint Staff Council

Chairman: Dr. T.K. Srinivasa Gopal, Director, CIFT

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2. Shri P.K. Vijayan, Principal Scientist
3. Dr. Saly N. Thomas, Senior Scientist
4. Dr. K. Ashok Kumar, Senior Scientist
5. Shri C.J. Stephen, F&AO

Secretary (Official Side)

Shri Charles Ekka, SAO

Members (Staff Side)

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2. Shri K. Das, Asst.
3. Shri K.B. Sabukuttan, Asst.
4. Shri C.D. Parameswaran, SSS
5. Shri K.R. Rajasaravanan, SSS

Secretary (Staff Side)

Shri P.S. Nobi, Tech. Officer (T5)

Participation in Training Programmes

Sl. No.	Name(s) of participant(s)	Training attended	Venue and Date
1.	Shri Charles Ekka	Values in administration	ISTM, New Delhi 4-8 April 2011
2.	Dr. K.K. Asha	Protein profiling techniques for identification of biomarkers of chemical contamination in marine life	CIFRI, Barrackpore 23-30 April 2011
3.	Dr. Leela Edwin Dr. T.V. Sankar Dr. C.N. Ravishankar Dr. K. Ashok Kumar Dr. Saly N. Thomas Dr. George Ninan Dr. A.A. Zynudheen Dr. Nikita Gopal Dr. V.R. Madhu Shri A.K. Jha Shri V. Chandrasekar Dr. A.R.S. Menon	Intellectual property and technology management	CIFT, Cochin 26-27 April 2011
4.	Dr. M.M. Prasad (As resource person)	Deep sea fishing and navigation	Visakhapatnam 9 May 2011
5.	Dr. Sanjoy Das	Bioinformatics	Joint Genome Institute, California, USA 9 May - 6 August 2011
6.	Dr. T.V. Sankar (As resource person)	Application of GC-MS in forensic chemical examination	IMG Regional Centre, Cochin 13 May 2011
7.	Dr. A.R.S. Menon	Knowledge management	ISTM, New Delhi 18-20 May 2011
8.	Dr. B. Madhusudana Rao	Fermentation technology	The Univ. of North Carolina, USA 30 May - 27 August 2011
9.	Dr. S.K. Panda Dr. R. Venkateswarlu	Measurement uncertainty in testing and calibrations	CETE, Bangalore 2-5 June 2011
10.	Dr. Toms C. Joseph	Biomolecules	A&M Univ., Texas, USA 15 June - 12 September 2011
11.	Dr. K. Ashok Kumar Dr. S.K. Panda	Lead auditor course for ISO 22000: 2025 Food safety management system	NITS, Noida 18-22 July 2011
12.	Dr. U. Sreedhar (As resource person)	Deep sea fishing and navigation	CIFNET, Visakhapatnam 5 August 2011

Sl. No.	Name(s) of participant(s)	Training attended	Venue and Date
13.	Dr. Femeena Hassan Dr. R. Venkateswarlu	Texture profile of processed foods by sensory and instrumental methods	CFTRI, Mysore 17-19 August 2011
14.	Dr. T.V. Sankar Dr. S.K. Panda	Global food safety management programme	Hyderabad 22-25 August 2011
15.	Dr. Leela Edwin Dr. T.V. Sankar Dr. C.N. Ravishankar	Post Graduate Diploma in Technology Management in Agriculture	NAARM, Hyderabad 3-8 September 2011
16.	Smt. Arathy Ashok	94th Foundation Course for Agricultural Research Service	NAARM, Hyderabad 15 September - 13 December 2011
17.	Dr. P. Muhamed Ashraf	Nanotechnology	Univ. California, USA 19 September - 19 December 2011
18.	Dr. Saly N. Thomas Dr. J. Charles Jeeva Dr. S.K. Panda	E-publishing system for journals	CMFRI, Cochin 27-28 September 2011
19.	Shri P.P. Anil Kumar Shri K. Das	Fixation of pay	ISTM, New Delhi 3-5 October 2011
20.	Dr. V.R. Madhu	Deriving ecological indicators from spectral radiometry	Plymouth Marine Laboratory, U.K. 5 October - 22 December 2011
21.	Shri V. Chandrasekar	Data analysis in social sciences research using SAS	IASRI, New Delhi 10-15 October 2011
22.	Dr. C.O. Mohan Smt. S. Tanuja	Non thermal, non chemical processing and membrane technology	CIAE, Bhopal 12-21 October 2011
23.	Shri K.J. Francis Xavier Shri T.N. Sukumaran	Automatic identification system, marine electronic equipments, navigational equipments and safety at sea	CIFNET, Cochin 19-21 October 2011
24.	Dr. A.A. Zynudheen (As resource person)	Technology clinic for the promotion of small and micro enterprises under food and agro based sector	Alappuzha 16 November 2011
25.	Dr. Femeena Hassan Dr. P.K. Binsi	Synthesis and characterization of nano materials and their applications in agriculture	CIRCOT, Mumbai 16-17 November 2011
26.	Dr. A.R.S. Menon	Re-engineering office process in the context of Right to Information Act	ISTM, New Delhi 21-23 November 2011
27.	Dr. S.K. Panda	Application of ICP-OES hardware	Therma Fisher Ltd., Mumbai 29-30 November 2011
28.	Shri M. Nasser	Basic and advanced Shipflow - simulation software training	Indian Maritime Univ., Visakhapatnam 12-16 December 2011

Sl. No.	Name(s) of participant(s)	Training attended	Venue and Date
29.	Dr. K. Ashok Kumar	Lead Auditor course on Food safety management system as per IS/ISO 22000: 2005	NITS, Noida 12-16 December 2011
30.	Dr. J. Bindu (As resource person)	Technology clinic for the promotion of small and micro enterprises under food and agro based sector	Ernakulam 13 December 2011
31.	Dr. B. Madhusudana Rao	Entrepreneurship development and management for scientists and technologists working in the government sector	EDII, Ahmedabad 19-23 December 2011
32.	Dr. George Ninan (As resource person)	Technology clinic for the promotion of small and micro enterprises under food and agro based sector	Kottayam 23 December 2011
33.	Dr. J. Bindu (As resource person)	Technology clinic for the promotion of small and micro enterprises under food and agro based sector	Kannur 26 December 2011
34.	Shri V. Chandrasekar	Issues in trade and development	CDS, Thiruvananthapuram 4-24 January 2012
35.	Dr. S.K. Panda	Train the trainers good aquaculture practices	TANUVAS, Chennai 17-21 January 2012
36.	Dr. Femeena Hassan	Refresher course on Agricultural research management for directly recruited Senior/ Principal Scientists	NAARM, Hyderabad 19 January - 8 February 2012
37.	Dr. P.K. Binsi	Scanning electron microscopy	CUSAT, Cochin 10 February 2012
38.	Dr. A.R.S. Menon	Sensitization cum training workshops for the PME Cell Incharge/Nodal Officer of Half Yearly Progress Monitoring (HYPM)	NAARM, Hyderabad 13 February 2012
39.	Dr. C.O. Mohan Ms. V. Renuka Smt. Sangeetha D. Gaikwad	Vistas in nutrient profiling and nutritional labeling of seafood	CIFT, Cochin 14-23 February 2012
40.	Dr. P.K. Binsi (As resource person)	Processing and value addition of farm products	Edava 18 February 2012

Visits Abroad

Dr. T.K. Srinivasa Gopal, Director and **Dr. Nikita Gopal,** Senior Scientist were deputed to China during 20-25 April, 2011 to attend the 9th Asian Fisheries and Aquaculture Forum held at Shanghai Ocean University, Shanghai, China. Dr. Srinivasa Gopal attended the Session on Harvest and post harvest technology and presented a paper on 'Ready to serve rice and sardine curry in high impact polypropylene (HPP) containers' by T.K. Srinivasa

Gopal, C.N. Ravishankar and J. Bindu. Dr. Nikita Gopal attended the 3rd Global symposium on Gender in aquaculture and fisheries and presented a paper on 'Role and impact of micro finance institutions in coastal community' by Nikita Gopal and B. Meenakumari.

Dr. T.K. Srinivasa Gopal, Dr. C. Ramachandran, CMFRI and Dr. Nikita Gopal at 9th AFAF venue

Dr. Leela Edwin, Head, Fishing Technology was deputed to Kuala Lumpur, Malaysia to attend the International conference on Innovation and management, 2011 held during 12-15 July, 2011. Dr. Leela Edwin also presented a paper entitled, 'Intellectual property and technology management in agricultural research institutes under National Agricultural Research System (NARS), India: Initiatives of a Zonal Institute' by Leela Edwin, A. Razia Mohammed, Nithin Singh, P. Vineeth Kumar and C.N. Ravishankar.

The scientific team from CIFT, Cochin, including **Dr. C.N. Ravishankar**, Head, Fish Processing, **Dr. C.O. Mohan**, Scientist, VRC of CIFT, Veraval and **Shri G. Omanakuttan Nair**, Tech. Officer (T5) visited M/s Horizon Fisheries Pvt. Ltd., Mandhoo Fisheries Complex, Mandhoo, Republic of Maldives and conducted thermal validation studies during the period 23 April to 2 May, 2011.

Dr. Suseela Mathew, Senior Scientist attended the 7th Asia Pacific Conference on Clinical nutrition held at Bangkok, Thailand during 5-9 June, 2011. Dr. Suseela Mathew also presented a paper entitled, 'Combined dietary supplementation of alpha-tocopherol and poly unsaturated fatty acid concentrate on age associated alterations in rats' by Suseela Mathew, Madona T. Thachil and Mathen Mathew.

Dr. Sanjoy Das, Senior Scientist was deputed to USA during the period 9 May to 6 August, 2011 to attend a three months training on Bioinformatics at Joint Genome Institute, Department of Energy, California, USA. Dr. Iain Anderson, Computational Biologist was his supervisor. During the programme training was given on computer language necessory for development of softwares for molecular biology work, application of computer language in designing bioinformatics tools, application of different bio informatics tools in gene and genome analysis and microarray techniques including data analysis. Training on microarray was imparted at Functional Genomics Laboratory of University of California, Berkeley, USA.

Dr. Iain Anderson and Dr. Sanjoy Das

Dr. S. Ashaletha, Senior Scientist attended the International training course on 'Fisheries governance' held at Wageningen UR Centre for Development Innovation, Netherlands during 26 September to 14 October, 2011 under the Nuffic Fellowship of the Netherlands Government. In this training course, a very good opportunity was provided to learn about fisheries governance and the relation with fisheries management approaches. The course provided excellent insights on challenges that fisheries governance face and there was very good discussions on ways to strengthen fisheries governance in the background of different countries. The course also included management tools and international fisheries management instruments. As a part of the programme, two presentations, a poster presentation on "Gender issues in fisheries scenario of Kerala" and an oral presentation on "Problem tree in assessing co-management issues" were also presented by Dr. Ashaletha.

Dr. S. Ashaletha (first from left) with other participants of the training course

Dr. P. Muhamed Ashraf, Senior Scientist was deputed to attend a training on Nanotechnology at the University of California, USA during 19 September to 19 December, 2011. The training was on advanced knowledge on the application of nano-sized particles for fisheries research especially in the area of nano-sensors. Training focused on the preparation and handling of nano materials, fabrication of biosensors using inter-digitated electrods and sensing of different molecules using the prepared devices. A biosensor was prepared by incorporating single walled carbon nano tube and calixresorcinarene in an inter-digitated electrode for sensing of TAVBN molecules responsible for fish odours.

Dr. J. Bindu, Senior Scientist attended the Institute of food Technologists Annual Meeting and Food Expo 2011 held at New Orleans, Lousiana, USA during 11-14 June, 2011. She also presented the following two poster papers in the Meeting: i. Physiochemical changes in high pressure treated Indian white shrimp (*Fenneropenaeus indicus*) during chill storage, ii. Effect of high pressure on physiochemical changes in Yellow fin tuna during chilled storage.

Dr. B. Madhusudana Rao at the University of North Carolina

Dr. B. Madhusudana Rao, Scientist (SG) was deputed to USA to attend the NAIP sponsored training programme on 'Fermentation technology (Fisheries)' at The University of North Carolina, Pembroke, USA during 30 May to 27 August, 2011. During the period he had conducted studies on the fermentation of chitin in different bioreactors using cultures of *Vibrio harveyi* and *V. alginolyticus*, both separately and as mixed cultures aimed at production of the enzyme chitinase.

Dr. Toms C. Joseph, Scientist (SG) was deputed to USA to attend the NAIP sponsored training programme on 'Biomolecules' at the LINCHPIN Laboratory, A& M University, Texas, USA during 15 June to 12 September, 2011.

Dr. V.R. Madhu, Scientist was deputed to Canada to attend ChloroGIN Project meeting under the FARO project at Bedford Institute of Oceanography, Halifax, Canada during 9-11 August, 2011.The role of *in situ* data for validation of the satellite derived products and the methods for improving the *in situ* data collection were discussed during the meeting.

Dr. V.R. Madhu at Plymouth Marine Laboratory

Dr. V.R. Madhu was also deputed to undergo a training on Deriving ecological indicators from spectral radiometry at Plymouth Marine Laboratory, UK, funded by Partnership for Observation of the Global Oceans and Scientific Committee on Ocean Research (POGO-SCOR) fellowship for the year 2011 from 5 October to 22 December, 2011. The training was on the use of remotely sensed data for use in large scale observation in oceanography for making informed decision regarding the state of the ecosystems and the related fisheries on a global scale. He also attended the Blue Horizon Conference as part of 4th Annual Plymouth Marine Sciences Education Fund Conference held on 14 December, 2011.

Participation in Symposia/Seminars/ Workshops etc.

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
1.	Dr. M.R. Boopendranath	Meeting of the sub-committee constituted for establishing Faculty of Ocean Studies	KUFOS, Cochin 5 April 2011
2.	Dr. T.V. Sankar	Annual review meeting of the outreach activity project under Fisheries Division	New Delhi 5 April 2011
3.	Dr. M.R. Boopendranath Shri M.V. Baiju	Meeting of the committee constituted for the study of issues related to registration of fishing vessels	Cochin 6 April 2011
4.	Dr. T.V. Sankar Dr. K. Ashok Kumar	National workshop on Construction and maintenance of hygiene fish markets	Nellore, A.P. 6-7 April 2011
5.	Dr. M.M. Prasad Dr. G. Rajeswari Dr. R. Raghu Prakash	Workshop on Transboundary diagnostic analysis consultation	Kakinada 7 April 2011
6.	Dr. J. Bindu	Workshop on Towards food security and the second green revolution - Workshop on Extrusion processing	Ludhiana 7-8 April 2011
7.	Dr. T.K. Srinivasa Gopal	Meeting held in connection with preparation of 12th Plan Document	ICAR, New Delhi 18 April 2011
8.	Dr. T.K. Srinivasa Gopal Dr. Nikita Gopal	9th Asian Fisheries and Aquaculture Forum	Shanghai Ocean University, Shanghai, China 20-25 April 2011
9.	Dr. Nikita Gopal	Special FAO workshop on Future directions in gender in aquaculture and fisheries action, research and development	Shanghai Ocean University, Shanghai, China 23-24 April 2011
10.	Dr. M.R. Boopendranath Dr. Saly N. Thomas	Meeting of the National level committee to revise course curricula of M.Sc. (Industrial Fisheries)	CUSAT, Cochin 25 April 2011
11.	Dr. Leela Edwin	International workshop on Sustainable agriculture: Traditional indigenous knowledge systems and food security	CIMP, Patna 3-5 May 2011
12.	Dr. S. Balasubramaniam Dr. Nikita Gopal	Meeting of the committee to scrutinize the proposal of starting an MBA course	KUFOS, Cochin 5 May 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
13.	Dr. M.M. Prasad	Meeting of the XX ICAR Regional Committee No. III	ICAR Res. Complex, Barapani 5-6 May 2011
14.	Dr. T.V. Sankar	Meeting held in connection with modernization of Aroor fish market	Aroor 6-7 May 2011
15.	Dr. P. Muhamed Ashraf	Seminar on Coastal pollution: Mitigating threats from oil spills	New Delhi 6-7 May 2011
16.	Dr. T.V. Sankar	Expert consultation on Revitalizing Indian fisheries education to meet 21st century aspirations	FCRI, Thoothukudi 8-10 May 2011
17.	Dr. T.K. Srinivasa Gopal Dr. Leela Edwin Dr. T.V. Sankar Dr. P.N. Joshi Shri P.K. Vijayan Shri M. Nasser Dr. Suseela Mathew Dr. Femeena Hassan Dr. Saly N. Thomas Dr. V. Geethalakshmi Dr. Nikita Gopal Dr. S. Ashaletha Dr. M.P. Remesan Dr. R. Anandan Dr. George Ninan Dr. G.K. Sivaraman Dr. J. Charles Jeeva Dr. V.R. Madhu Dr. S.K. Panda Smt. P. Jeyanthi Dr. S. Vishnuvinayagam Dr. V. Murugadas Smt. S. Tanuja Dr. P.K. Binsi Smt. P. Viji Smt. Arathy Ashok Shri A.K. Jha	Seminar on Emerging issues in Asian aquaculture	CMFRI, Cochin 12 May 2011
18.	Dr. S. Balasubramaniam Dr. Nikita Gopal	Meeting of the committee to scrutinize the proposal of starting an MBA course	KUFOS, Cochin 13 May 2011
19.	Dr. George Ninan	Workshop on Secondary agriculture	ICAR, New Delhi 16 May 2011
20.	Dr. G. Rajeswari Dr. R. Raghu Prakash	Workshop on Transboundary diagnostic analysis consultation	Puri, Odisha 18 May 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
21.	Dr. T.K. Srinivasa Gopal Dr. M.R. Boopendranath	Meeting held in connection with the preparation of Master Plan for KUFOS (Vision and strategic plan document)	Cochin 23 May 2011
22.	Dr. Leela Edwin Dr. T.V. Sankar Dr. C.N. Ravishankar Shri Nithin Singh Shri S. Abhilash Shri Rakesh Thomas Kurian	ICAR-Industry Meet 2011	New Delhi 23 May 2011
23.	Shri M.V. Baiju	Meeting of the Committee constituted by Kerala Shipping and Inland Navigation Corporation Ltd., Cochin for evaluating the scrap value of Barger Anupama and Aiswarya	Cochin 23 May 2011
24.	Dr. T.K. Srinivasa Gopal	IXth Executive Committee meeting of the Society - NETFISH of MPEDA	Cochin 24 May 2011
25.	Dr. M.R. Boopendranath	Meeting of Sub Group - I (Marine Fisheries including mariculture and brackish water aquaculture) in connection with the preparation of 12th Five Year Plan document	CMFRI, Cochin 24 May 2011
26.	Dr. P. Pravin	Expert committee meeting in connection with NFDB funding in Lakshadweep islands on various fisheries related projects	Cochin 24-27 May 2011
27.	Shri P.K. Vijayan	Workshop on Preparation of technology road map for Kerala in agriculture, fisheries and livestock sector	KSCST&E, Thiruvananthapuram 25 May 2011
28.	Dr. Leela Edwin Dr. M.R. Boopendranath Dr. P. Pravin Dr. Saly N. Thomas Dr. M.P. Remesan Shri M.V. Baiju Dr. V.R. Madhu	Tropical shrimp trawl management benchmark workshop	Cochin 1-2 June 2011
29.	Dr. M.R. Boopendranath	Meeting of the sub-committee constituted for establishing Faculty of Ocean Studies	KUFOS, Cochin 3 June 2011
30.	Dr. S.K. Panda	Meeting for the drafting of ISO standard on Traceability standard of shellfishes including crustaceans and molluscs	NIFPHAT, Cochin 8 June 2011
31.	Dr. C.N. Ravishankar	National committee meeting on Post harvest technology and value addition	ICAR, New Delhi 9-11 June 2011
32.	Dr. M.M. Prasad Dr. L.N. Murthy	Workshop on Indian seafood industry: Present scenario and future prospects	JNTU, Kakinada 10 June 2011
33.	Dr. J. Bindu	Institute of Food Technologists Annual Meeting and Food Expo 2011	New Orleans, USA 11-14 June 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
34.	Dr. V.R. Madhu	Review meeting of INCOIS projects	INCOIS, Hyderabad 13 June 2011
35.	Dr. M.R. Boopendranath Dr. U. Sreedhar	Task force group meeting of the MoES/ CMLRE funded project on Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies	CMLRE, Cochin 14 June 2011
36.	Dr. P. Pravin	Meeting regarding review of the courses at CIFNET	Cochin 14 June 2011
37.	Dr. P. Muhamed Ashraf	Review meeting of INCOIS projects	INCOIS, Hyderabad 14 June 2011
38.	Dr. P.T. Lakshmanan Dr. Leela Edwin Dr. T.V. Sankar Dr. S. Balasubramaniam Shri P.K. Vijayan Dr. M.M. Prasad	Meeting-cum-workshop on Towards more effective role of Heads of Divisions and Regional Stations in ICAR Institutes	CIAE, Bhopal 14-15 June 2011
39.	Dr. T.V. Sankar	Fisheries faculty meeting	KUFOS, Cochin 18 June 2011
40.	Dr. Saly N. Thomas	Tender committee meeting to scrutinize the technical bid in respect of supply of fishing net materials for fishermen of Kolleru lake, A.P.	Hyderabad 22 June 2011
41.	Dr. L.N. Murthy (As resource person)	Seminar sponsored by Indian Red Cross Society, Hyderabad	SIFT, Kakinada 22 June 2011
42.	Dr. U. Sreedhar	Meeting to discuss the Future project proposals	INCOIS, Hyderabad 22-23 June 2011
43.	Dr. M.R. Boopendranath	Meeting of the sub-committee constituted for establishing Faculty of Ocean Studies	KUFOS, Cochin 23 June 2011
44.	Dr. P. Pravin Shri M.V. Baiju	NAIP M&E meeting of OTFLS project	CMFRI, Cochin 23 June 2011
45.	Dr. R. Raghu Prakash (As resource person)	Workshop on Capacity building and training on use of TED	Damra, Odisha 25-29 June 2011
46.	Dr. S. Balasubramaniam Dr. M.P. Remesan	Meeting regarding the implementation of tribal development programmes in Wayanad district	KVK, Ambalavayal 28-29 June 2011
47.	Dr. C.N. Ravishankar	Workshop on Stakeholders consultations and the Bureau of Indian Standards	New Delhi 29 June 2011
48.	Dr. T.K. Srinivasa Gopal Dr. P.T. Lakshmanan Dr. Leela Edwin Dr. T.V. Sankar Dr. S. Balasubramaniam Dr. C.N. Ravishankar	National seminar on Indian seafood trade - Concerns and adaptive strategies	Cochin 30 June 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
	Shri P.K. Vijayan Dr. M.R. Boopendranath Dr. S. Sanjeev Dr. K. Ashok Kumar Dr. P. Pravin Dr. Saly N. Thomas Dr. Nikita Gopal Dr. Femeena Hassan Dr. A.A. Zynudheen Dr. P. Muhamed Ashraf Dr. George Ninan Dr. J. Bindu Dr. M.P. Remesan Dr. R. Anandan Dr. G.K. Sivaraman Shri M.V. Baiju Shri V. Radhakrishnan Nair Dr. S.K. Panda Dr. K.K. Asha Dr. J. Charles Jeeva Dr. Rakesh Kumar Dr. V.R. Madhu Dr. R.Venkateswarlu Smt. P. Jeyanthi Shri V. Chandrasekar Shri Ankur Nagori Dr. P.K. Binsi Dr. V. Murugadas Dr. S. Vishnuvinayagam Smt. Arathy Ashok Shri C.G. Joshy Dr. M. Baiju Dr. G. Usha Rani Dr. K. Sobha Smt. P.K. Shyma Dr. B. Ganesan Smt. K.G. Sasikala Smt. G. Remani		
49.	Dr. T.K. Srinivasa Gopal	Meeting with Russian delegates and DDG (Fisheries)	ICAR, New Delhi 5 July 2011
50.	Dr. T.V. Sankar Dr. S. Balasubramaniam Dr. S. Sanjeev Dr. K. Ashok Kumar Dr. V. Geethalakshmi	Workshop cum brainstorming session on Forecasting technological needs for fishing and fish processing sectors in India	CIFT, Cochin 7 July 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
	Dr. Nikita Gopal Dr. Femeena Hassan Dr. S. Ashaletha Dr. A.A. Zynudheen Dr. George Ninan Dr. J. Charles Jeeva Dr. S.K. Panda Shri V. Radhakrishnan Nair Smt. P. Jeyanthi Shri V. Chandrasekar Smt. Arathy Ashok Shri C.G. Joshy Dr. P.K. Binsi Dr. A.R.S. Menon		
51.	Dr. S. Balasubramaniam Dr. M.R. Boopendranath Dr. Nikita Gopal	National consultative workshop for the preparation of Vision document and strategic plan	KUFOS, Cochin 8-9 July 2011
52.	Dr. Leela Edwin	International conference on Innovation and management, 2011	Kuala Lumpur, Malaysia 12-15 July 2011
53.	Smt. T. Silaja	National seminar on Content management at libraries: New vistas for harnessing information	Thiruvananthapuram 14-16 July 2011
54.	Dr. T.K. Srinivasa Gopal	Conference of Director's of ICAR Institutes and the ICAR Foundation Day celebrations	ICAR, New Delhi 15-16 July 2011
55.	Dr. P. Pravin	GARUDA-National Knowledge Network Partners Meet	Bangalore 15-16 July 2011
56.	Dr. T.K. Srinivasa Gopal	Planning Commission Sub Group XI meeting	ICAR, New Delhi 18 July 2011
57.	Dr. T.K. Srinivasa Gopal Dr. T.V. Sankar	ICAR-CSIR Interface meeting	CSIR, New Delhi 19 July 2011
58.	Dr. T.V. Sankar	Meeting of the Presidents and Secretaries of Professional Societies	ICAR, New Delhi 22 July 2011
59.	Shri M.V. Baiju	Workshop on Coastal shipping project implementation	Cochin 23 July 2011
60.	Smt. P. Jeyanthi	International conference on Financial inclusion and economic growth - Theory and evidence	CIMP, Patna 28-29 July 2011
61.	Dr. S. Ashaletha	Meeting on Sustainable agri-village programme	Kumbalangi, Cochin 30 July 2011
62.	Dr. M.M. Prasad Dr. G. Rajeswari Dr. R. Raghu Prakash Dr. U. Sreedhar	Interactive workshop on Pelagic and demersal trawling	CIFNET, Visakhapatnam 1-3 August 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
63.	Dr. J. Bindu	CIC meeting of the NAIP on Studies on high pressure processing (HPP) of high value perishable commodities	IIT, Kharagpur 8 August 2011
64.	Dr. Nikita Gopal	National consultation on Gender perspective in agriculture	ICAR, New Delhi 8-9 August 2011
65.	Dr. V.R. Madhu	ChloroGIN Project Meeting	Halifax, USA 9-11 August 2011
66.	Dr. M.M. Prasad Dr. G. Rajeswari Dr. R. Raghu Prakash Dr. U. Sreedhar (As resource persons)	Interactive workshop on Pelagic and demersal trawling for Indian Coast Guard Officials	CIFNET, Visakhapatnam 12-13 August 2011
67.	Dr. G. Rajeswari	4th Meeting of Farmers First Committee	Vijayawada 13 August 2011
68.	Dr. P. Muhamed Ashraf	3rd International conference on Frontiers in nanoscience technology	CUSAT, Cochin 14-17 August 2011
69.	Dr. S. Balasubramaniam Shri P.K. Vijayan	Meeting on Establishment of fish processing parks in Tamil Nadu	Chennai 19-20 August 2011
70.	Shri M.S. Kumar	Meeting for finalization of radio talks	AIR, Visakhapatnam 24 August 2011
71.	Dr. P. Pravin Dr. Saly N. Thomas Dr. R. Raghu Prakash	Colloquium on Challenges in marine conservation and research in the Indian ocean	Cochin 26-27 August 2011
72.	Dr. T.K. Srinivasa Gopal Dr. M.R. Boopendranath Dr. K. Ashok Kumar	Brain storming session on Fish stock certification and ecolabelling	NAAS, New Delhi 27 August 2011
73.	Dr. M.R. Boopendranath	Meeting of the Nodal Officers of Research Framework Document (RFD)	ICAR, New Delhi 1 September 2011
74.	Dr. Ferneena Hassan	National seminar on Emerging trends in biotechnology	CUSAT, Cochin 1-2 September 2011
75.	Shri Nithin Singh	E-Summit 2011 - Entrepreneurs' meet	IIM, Kozhikode 3-4 September 2011
76.	Dr. C.N. Ravishankar	Meeting of the Food Safety Standards Authority of India	New Delhi 12 September 2011
77.	Dr. T.V. Sankar (As resource person)	Workshop on Food safety issues	EIA, Cochin 16 September 2011
78.	Dr. M.R. Boopendranath Dr. U. Sreedhar Dr. A.A. Zynudheen Dr. George Ninan	Scientific Advisory Committee meeting of Marine living resources programme	CMLRE, Cochin 16-17 September 2011
79.	Dr. T.V. Sankar Dr. K. Ashok Kumar	Joint meeting of EIC/MPEDA/CIFT on Harmonization of HACCP standards	EIA, Cochin 17 September 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
80.	Smt. P. Viji (As resource person)	Workshop on Maintenance and management of hygienic fish market	Goregaon, Mumbai 22-23 September 2011
81.	Shri P.K. Vijayan Dr. Femeena Hassan	Meeting for the development of a pilot level processing facility	Poyya Fish Farm 23 September 2011
82.	Dr. M.M. Prasad	Mid term review meeting of ATR of XX Meeting of ICAR Regional Committee No. II	CIFRI, Barrackpore 24 September 2011
83.	Dr. Nikita Gopal	Meeting of the clam fishers	QSSS, Kollam 26 September 2011
84.	Dr. T.V. Sankar (As resource person)	World Health Day celebrations	Cochin 28 September 2011
85.	Dr. M.M. Prasad	Meeting of Stakeholders of fish processing facilities	NFDB, Hyderabad 29 September 2011
86.	Shri Nithin Singh	National mega meet on Technology commercialization	NAARM, Hyderabad 29 September 2011
87.	Shri M.V. Baiju	India Innovation Summit	Mumbai 3 October 2011
88.	Dr. C.N. Ravishankar	National dialogue on Application of nanotechnology in agriculture	CIFE, Mumbai 8-9 October 2011
89.	Dr. Santhosh Alex	Executive committee meeting of TOLIC	Visakhapatnam 12 October 2011
90.	Shri M.V. Baiju	Expert committee meeting for providing subsidy for conversion of fishing vessels to tuna long liners and construction of insulated fish hold for existing boats	MPEDA, Cochin 17 October 2011
91.	Dr. K. Ashok Kumar Dr. P. Pravin	Brain storming session on Water platform	NBFGR, Lucknow 17-20 October 2011
92.	Dr. G. Rajeswari	Workshop on Marine fishery resources of east coast of India	Machilipatnam 18 October 2011
93.	Dr. S.K. Panda	Seminar on Antibiotic residues in seafood	Cochin 20-21 October 2011
94.	Dr. T.K. Srinivasa Gopal	CAC meeting on Post harvest technology	New Delhi 22 October 2011
95.	Dr. T.V. Sankar	Workshop on Educational framework for analytical persons at Food Safety Standards Authority of India	New Delhi 3-4 November 2011
96.	Dr. M.M. Prasad	Meeting for approving seafood processing plants for export under the MPEDA Logo scheme	Visakhapatnam 4 November 2011
97.	Dr. J. Charles Jeeva	Meeting of ATIC Managers	Bangalore 4 November 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
98.	Shri T. Jose Fernandez	Swadeshi Science Congress	CPEC, Kollam 7-9 November 2011
99.	Dr. C.N. Ravishankar Dr. M.R. Boopendranath	Meeting of the nominated scientists of NARS with Hon'ble Union Minister and deliberations on the state of Indian fisheries and visioning for XII plan and beyond	New Delhi 8 November 2011
100.	Dr. Leela Edwin	Discussion meeting on Innovation incubation platform proposed by IP&TM Division	ICAR, New Delhi 9-10 November 2011
101.	Dr. C.N. Ravishankar Dr. J. Charles Jeeva	International conference on Innovation approaches for agricultural knowledge management - Global extension experiences	New Delhi 9-12 November 2011
102.	Dr. Nikita Gopal	National seminar on Promotion of fisheries and alternative livelihood in fisheries sector	FCRI, Chennai 10-11 November 2011
103.	Dr. R. Venkateswarlu	National dialogue on Application of nanotechnology in agriculture	TNAU, Coimbatore 11-12 November 2011
104.	Dr. Leela Edwin	Meeting of the Executive Committee of National Institute of Fisheries Administration and Management	Thiruvananthapuram 13 November 2011
105.	Dr. T.K. Srinivasa Gopal Dr. R. Chakrabarti Dr. C.O. Mohan Dr. S. Vishnuvinayagam	Meeting for setting up of the processing unit in the campus	Hindusthan Agro Ltd., Mumbai 15 November 2011
106.	Dr. George Ninan	Chennai Aquaculture Technology Meet	TANUVAS, Chennai 16-17 November 2011
107.	Dr. T.K. Srinivasa Gopal Dr. R. Chakrabarti Dr. C.O. Mohan	3rd R&D Workshop on Food processing sector	Mumbai 17 November 2011
108.	Dr. P.T. Lakshmanan	Brain storming session on Health foods	IASRI, New Delhi 17 November 2011
109.	Dr. S. Balasubramaniam Dr. Nikita Gopal Smt. P. Jeyanthi Shri V. Chandrasekar	Summing up Workshop of the DAHD & F project on An assessment of literacy, income and health status of fishers in India	CMFRI, Cochin 17-18 November 2011
110.	Dr. T.V. Sankar	Institute Management Committee Meeting	CIBA, Chennai 18 November 2011
111.	Dr. George Ninan	Brain storming session on Secondary agriculture	IASRI, New Delhi 18 November 2011
112.	Dr. T.K. Srinivasa Gopal Dr. Leela Edwin Dr. C.N. Ravishankar	'Innovations 4 Industry' - Crop Science Meet	NAARM, Hyderabad 19 November 2011
113.	Dr. P. Pravin	Case study workshop on Lobster fisheries	Nagercoil 19 November 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
114.	Dr. C.N. Ravishankar Shri Nithin Singh Shri P. Vineeth Kumar Shri Rakesh Thomas Kurian Shri S. Abhilash	'Food 360°' - International conference cum exhibition on Agribusiness and food processing	Hyderabad 20-22 November 2011
115.	Shri M.S. Kumar	Farm and Home Unit Rural Programme Subject Committee Meeting	AIR, Visakhapatnam 23 November 2011
116.	Dr. P. Pravin	State level workshop on Fisheries management - Understanding current status and discussion on future options	Chennai 23-24 November 2011
117.	Dr. T.K. Srinivasa Gopal Dr. J. Bindu Shri R. Yathavamoorthi	International symposium on Recent trends in processing and safety of specialty and operational foods	DFRL, Mysore 23-25 November 2011
118.	Dr. J. Charles Jeeva	National seminar on Innovations in farming system research and extension for inclusive development	Madras Vet. College, Chennai 24-25 November 2011
119.	Dr. M.P. Remesan	Indo-Swiss workshop on Ecology and conservation of Chilka lake	WRC, Balugaon 25-26 November 2011
120.	Dr. Nikita Gopal	19th Annual conference of the Agricultural Economics Research Association on Dynamics of supply and demand for labour in Indian agriculture	AAU, Jorhat 28-30 November 2011
121.	Dr. Sanjoy Das Dr. Toms C. Joseph Dr. B. Madhusudana Rao	Impact assessment meet of International training in frontier areas of agricultural sciences	New Delhi 28-30 November 2011
122.	Dr. Santhosh Alex (As resource person)	Hindi Workshop	HPCL, Visakhapatnam 30 November 2011
123.	Dr. M.M. Prasad Shri M.S. Kumar Shri P. Radhakrishna	6th National conference of Krishi Vigyan Kendras	JNKVV, Jabalpur 3-5 December 2011
124.	Dr. T.K. Srinivasa Gopal	IInd Indian Chitin and Chitosan Society Symposium	Univ. Hyderabad 5 December 2011
125.	Shri S. Abhilash	STEM Annual summit	Pune 7-9 December 2011
126.	Dr. Toms C. Joseph (As resource person)	National seminar on Biodiversity and bioprospecting with reference to plants and microbes	St. Alberts College, Ernakulam 8-9 December 2011
127.	Dr. T.V. Sankar	Brainstorming session on the Network project on Fish health	CIBA, Chennai 12 December 2011
128.	Dr. J. Charles Jeeva	Result sharing workshop of Fisheries management for sustainable livelihood project	Chennai 12 December 2011
129.	Dr. T.V. Sankar	Brainstorming session on Researchable issues in aquaculture nutrition	CIBA, Chennai 14 December 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
130.	Dr. V.R. Madhu	Blue horizon conference as part of 4th Annual Plymouth Marine Sciences Education Fund Conference	Plymouth Marine Laboratory, U.K. 14 December 2011
131.	Dr. K.V. Lalitha	Seminar on Biotechnology techniques	MA College, Kothamangalam 15 December 2011
132.	Shri Nithin Singh	Workshop on Food processing	Cochin 15 December 2011
133.	Dr. T.K. Srinivasa Gopal Dr. Leela Edwin Dr. T.V. Sankar Dr. M.M. Prasad Dr. T.K. Thankappan Dr. G. Rajeswari Dr. Saly N. Thomas Dr. R. Raghu Prakash Dr. Femeena Hassan Dr. V. Geethalakshmi Dr. S. Ashaletha Dr. J. Bindu Dr. U. Sreedhar Dr. G.K. Sivaraman Shri V. Radhakrishnan Nair Dr. L.N. Murthy Dr. K.K. Asha Smt. P. Jeyanthi Dr. C.O. Mohan Dr. P.K. Binsi Shri C.G. Joshy Shri M.S. Kumar Shri R. Yathavamoorthi Shri T.R. Ananthanarayanan	9th Indian Fisheries Forum on the theme Renaissance in fishery: Outlook and strategies	Chennai 19-23 December 2011
134.	Shri M.V. Baiju	Subsidy committee meeting	MPEDA, Cochin 20 December 2011
135.	Dr. M.M. Prasad Dr. G. Rajeswari Dr. R. Raghu Prakash Dr. L.N. Murthy Smt. P. Jeyanthi Shri M.S. Kumar	International symposium on Ecosystem approach to fisheries in the Bay of Bengal large marine ecosystems	Chennai 21 December 2011
136.	Dr. R. Badonia	Meeting of the 12th Five year plan formulation of Gujarat Fisheries Department	Ahmedabad October 2011
137.	Shri V. Chandrasekar Shri Ankur Nagori	DST-Lockheed Martin India Growth programme	Cochin 22 December 2011

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
138.	Dr. C.N. Ravishankar Shri Nithin Singh Shri Rakesh Thomas Kurian	FICCI India innovation growth programme	Cochin 22 December 2011
139.	Dr. M.M. Prasad	Agri Tech - 2012 - National Seminar	Palakollu, W.G. district 7 January 2012
140.	Dr. B. Madhusudana Rao Dr. L.N. Murthy	Agri Business Meet	Visakhapatnam 7 January 2012
141.	Dr. R. Badonia	Entrepreneurship development programme	DIC, Veraval 11 January 2012
142.	Dr. T.V. Sankar	Regional expert group workshop on Transboundary aquatic animal health issues in the Bay of Bengal	Bangkok, Thailand 12-13 January 2012
143.	Dr. R. Badonia	Meeting of the Science Advisory Committee	KVK, Kodinar 13 February 2012
144.	Shri Nithin Singh	Annual meeting cum workshop of ZTM-BPD	CIRCOT, Mumbai 13-14 January 2012
145.	Dr. Toms C. Joseph	'Sastrayaan' - Science education programme	North Paravur 17 January 2012
146.	Dr. M.M. Prasad Shri M.V. Baiju	Workshop on Consortium on identifying the collaborative functional areas of the NFDB in exploitation of deep sea resources, post harvesting operations and marketing	Visakhapatnam 19-20 January 2012
147.	Dr. T.K. Srinivasa Gopal	XXI Indian Conference of Food Scientists and Technologists	Pune 20 January 2012
148.	Dr. J. Charles Jeeva	Interaction meet pertaining to new research project proposals for financial support of Indian Council of Social Science Research	New Delhi 22 January 2012
149.	Dr. Leela Edwin	Agri business camp	Cochin 25 January 2012
150.	Dr. Toms C. Joseph	'Sastrayaan' - Science education programme	North Paravur 27 January 2012
151.	Dr. K.K. Asha	International Conference on Recent perspectives in macro molecular structures and their functions	CARI, Port Blair 27-29 January 2012
152.	Dr. K. Ashok Kumar	BIS Meeting on FAD 12 on Fish and fisheries products	New Delhi 28 January 2012
153.	Dr. Toms C. Joseph Dr. Rakesh Kumar Dr. V. Murugadas	Meeting as experts for finalization of technical specification of automatic ELISA	MPEDA, Cochin 30 January 2012
154.	Dr. U. Sreedhar	National workshop on Creation of awareness of CCRF and capacity building for effective implementation in India	CIFE, Mumbai 1-2 February 2012

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
155.	Dr. J. Charles Jeeva	Meeting for reviewing the e-course on Fisheries extension education	FCRI, Thoothukudi 1-2 February 2012
156.	Dr. P.T. Lakshmanan	Partners meeting for mega project on Health foods	CIPHET, Ludhiana 2-3 February 2012
157.	Dr. C.N. Ravishankar Dr. U. Sreedhar	"Meenakshi Matsya Utsav"	Bhopal 4-6 February 2012
158.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Shri Nithin Singh Shri P. Vineeth Kumar	2nd Global Agri-business Incubation Conference	IARI, New Delhi 6-8 February 2012
159.	Dr. Toms C. Joseph	National seminar on Marine microbes	Vellore, Tamil Nadu 10 February 2012
160.	Dr. P.K. Binsi	Workshop on Scanning Electron Microscopy	CUSAT, Cochin 10 February 2012
161.	Dr. M.R. Boopendranath	International seminar on Ornamentals of Kerala 2012	Cochin 11-12 February 2012
162.	Dr. Leela Edwin Dr. Toms C. Joseph	Project development workshop	NAARM, Hyderabad 15-19 February 2012
163.	Dr. S. Sanjeev Dr. Rakesh Kumar	Seminar on One health initiative in addressing food safety challenges	College of Veterinary and Animal Sciences, Mannuthy 16-17 February 2012
164.	Dr. T.K. Srinivasa Gopal	Conference of the Directors' of ICAR Institutes	ICAR, New Delhi 16-18 February 2012
165.	Dr. J. Charles Jeeva	National consultation workshop on Evolving indicators for better management of large marine ecosystems - Socio-economic and governance indicators	FSI, Mumbai 18 February 2012
166.	Shri M.V. Baiju	Seminar on Exploring collaborative functional areas in exploitation of deep sea resources, post harvesting operations and marketing	Visakhapatnam 19 February 2012
167.	Dr. Leela Edwin Dr. M.P. Remesan Dr. Saly N. Thomas Shri M.V. Baiju Shri K.J. Francis Xavier Dr. M. Baiju	Workshop on Fish finding, navigation and electronic instrumentation	CIFNET, Cochin 21 February 2012
168.	Dr. K.K. Asha	Meeting of the expert panel for selection of LCMS-MS and GCMS	MPEDA, Cochin 22 February 2012
169.	Dr. M.R. Boopendranath	Research Framework Document meeting	CIFRI, Barrackpore 23 February 2012

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
170.	Dr. B. Madhusudana Rao	Workshop on Traditional fishers-lifestyles	Visakhapatnam 23 February 2012
171.	Dr. Santhosh Alex	Hindi Workshop	Visakhapatnam 23 February 2012
172.	Shri Ankur Nagori Shri C.R. Gokulan Smt. P.K. Shyma	Business meet on Energy audit	Cochin 24 February 2012
173.	Shri M.S. Kumar	Farm and Home Unit Rural Programme subject Committee Meeting	AIR, Visakhapatnam 28 February 2012
174.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar	India International Seafood Show	Chennai 29 February - 2 March 2012
175.	Dr. C.N. Ravishankar	Annual General Body Meeting of ICAR	New Delhi 6 March 2012
176.	Dr. M.R. Boopendranath Dr. T.V. Sankar	Seminar or Emerging trends in aquaculture, harvesting and post harvest technology	Mar Thoma College, Thiruvalla 7-8 March 2012
177.	Dr. C.N. Ravishankar Dr. M.R. Boopendranath Dr. P. Pravin	International conference on Science and geoploitics of Arctic and Antartic	New Delhi 9-11 March 2012
178.	Dr. L.N. Murthy	National seminar on Recent advances in research on marine environment	Visakhapatnam 10-11 March 2012
179.	Dr. T.K. Srinivasa Gopal	Review meeting of the technologies upgradation programme funded by NFDB to various ICAR and CSIR Institutes	New Delhi 12 March 2012
180.	Dr. Leela Edwin Dr. P. Pravin Shri M.V. Baiju	Expert committee meeting of the National Fund of ICAR	New Delhi 13 March 2012
181.	Dr. Leela Edwin Dr. Nikita Gopal	Global conference on Women in agriculture	New Delhi 13-15 March 2012
182.	Dr. S.K. Panda	International workshop on Strategies in value addition and safety aspects pertaining to dairy and food industry	Madras Veterinary College, Chennai 15-16 March 2012
183.	Dr. K.V. Lalitha Dr. Toms C. Joseph Dr. Rakesh Kumar	International conference on Advances in biological sciences	Kannur University, Kannur 15-17 March 2012
184.	Shri M.S. Kumar Shri M. Prasanna Kumar	National conference on Aquaculture: Fish for billion	Visakhapatnam 15-17 March 2012
185.	Shri Ankur Nagori	Interaction meet of scientists of Farm Machinery & Power and Mechanical Engineering discipline	CIAE, Bhopal 16-18 March 2012

Sl. No.	Name(s) of participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
186.	Shri Nithin Singh	Meeting of the Indian STEPS and Business Incubators Association	Pune 17-19 March 2012
187.	Dr. J. Bindu	Annual workshop of Component 4 of NAIP sub projects	ICAR, New Delhi 19-20 March 2012
188.	Dr. P. Muhamed Ashraf Dr. V.R. Madhu	Coastal ocean colour - A perspective for satellite application in the Indian coast	Goa 19-21 March 2012
189.	Dr. K.V. Lalitha Dr. T.V. Sankar Dr. K. Ashok Kumar	Workshop on Food safety issues in high moisture food commodities	NRC on Pig, Guwahati 22 March 2012
190.	Dr. S. Ashaletha	Review workshop of NAIP on Mobilizing mass media support on sharing agro information	CISH, Lucknow 22-24 March 2012
191.	Dr. P. Muhamed Ashraf Shri M.V. Baiju	National seminar on Marine corrosion and its applications	CUSAT, Cochin 24 March 2012
192.	Dr. S. Ashaletha	Review workshop of NAIP on Responsible harvesting and utilization of selected small pelagics and freshwater fishes	NDRI, Karnal 26-27 March 2012
193.	Shri V. Radhakrishnan Nair	Policy workshop on Training transfer at NARS	NAARM, Hyderabad 27-28 March 2012
194.	Ms. G.S. Hema	National seminar on Emerging trends in applied microbiology and biotechnology	St. Thomas College, Palai 30 March 2012
195.	Dr. B. Madhusudana Rao Shri K.V.S.S.S.K. Harnath Shri D. Rout Shri M. Prasanna Kumar	National conference on Advances in biotechnology for sustainable initiatives in 21st century	Visakhapatnam 30-31 March 2012
196.	Dr. C.N. Ravishankar Dr. J. Bindu	First Indo-US International conference on Polymers for packaging applications	MG University, Kottayam 31 March - 2 April 2012

Special Days and Events

CIFT Participates in Southern Ocean Expedition

Shri S.S. Shaju, Senior Research Fellow, Fishing Technology Division, CIFT, Cochin participated in the "5th Indian Expedition to Southern Ocean (ISOE 2011)" organized by National Centre for Antarctic and Ocean Research, Goa. The expedition started from Port Luis, Mauritius on 21 January, 2011 onboard ice-class vessel FORV *Sagar Nidhi*, up to the latitude of 60°S, along the meridian of 57°30'E and ended at Chennai on 8 April, 2011. The expedition was conducted mainly for multi disciplinary studies and collection of samples from the Subtropical to Polar Regions of Indian sector of Southern Ocean. The objective of the expedition for CIFT was to study the bio-optical characteristics

Shri S.S. Shaju in Southern Ocean

of Southern Ocean. The Scientific expedition team included 17 members from various institutions such as CIFT, Cochin; NCAOR, Goa; CMFRI, Cochin; Federal University of Rio Grande, Brazil; JNU, Delhi; IISc, Bangalore; BIT, Ranchi and Goa University, Goa.

Consultancy on Thermal validation

International Consultancy for Thermal Validation to Maldives Firm

The ZTM-BPD Unit, South Zone located at CIFT, Cochin has provided consultancy to M/s Horizon Fisheries Pvt. Ltd., Mandhoo Fisheries Complex, Mandhoo, Republic of Maldives in the area of thermal validation of seafood. A scientific team from CIFT, Cochin visited Maldives and conducted thermal validation studies during 23 April to 2 May 2011. The consultancy was carried out as per the standard guidelines of National Food Processors Association, USA and guidelines of Campden and Chorleywood Food Research Association, UK. The team also provided training to the management and technical staff of the company on various aspects of thermal process validation, retort operation and optimization of process for thermal processing of products from tuna in retortable pouches and rigid cans.

Inauguration of the Workshop

Zonal Workshop on Intellectual Property and Technology Management in Agriculture

The ZTM-BPD Unit, South Zone along with the ITMU, CIFT has organized "AgrIP 2011", a Workshop-cum-Training programme on Intellectual property and technology management on 26 and 27 April, 2011 at CIFT, Cochin. The programme was inaugurated by Shri P.I. Shaik Pareeth, IAS, District Collector, Ernakulam. A total of 43 participants including scientists and Research scholars from the member institutes under South Zone attended the workshop and training programme. In the Technical Sessions that followed eminent personalities gave an insight into areas of interest in the field of intellectual property and gave guidance in safeguarding the results of technological developments.

Dr. Rakesh Kumar, Scientist making his presentation at IRC

Institute Research Council

The annual meeting of the Staff Research Council of the Institute was held at CIFT, Cochin during 2-3 May, 2011 to review the progress achieved in the ongoing research projects of the Institute during 2010-11 and to discuss the research project proposals for the year 2011-12. Dr. T.K. Srinivasa Gopal, Director chaired the sessions. Dr. T.V. Sankar, Member Secretary, IRC coordinated the proceedings. The House discussed in detail the 17 ongoing research projects, besides seven concluded projects and six new projects apart from the various ad hoc projects.

Anti Terrorism Day Observed

The Institute observed Anti Terrorism Day on 21 May, 2011. The Staff of the Institute assembled together and took Anti Terrorism Day pledge.

Training on Value Added Oyster Products

A one day training on 'Preparation of value added oyster products' was conducted for the Self Help Groups (SHGs) at Azheekkal, Kollam district on 26 May, 2011 by CIFT, Cochin in association with DST, New Delhi. About 60 women members from four SHGs in Azheekkal panchayath participated in the programme.

Officials giving talks

CIFT signs MoU with Uniloids Biosciences

CIFT, Cochin signed a Memorandum of Understanding with Hyderabad based company, M/s Uniloids Biosciences. With this MoU, Uniloids Biosciences will have access to the unique and innovative technology developed by CIFT to convert process waste to chitin and chitosan. The MoU was signed between Dr. T.K. Srinivasa Gopal, Director on behalf of CIFT, Cochin and Shri Chandra Sekhar Yadav, Managing Director, M/s Uniloids Biosciences Pvt. Ltd., in presence of the members of Institute Technology Management Unit and ZTM-BPDU in a simple function held at CIFT, Cochin on 13 June, 2011.

Dr. T.K. Srinivasa Gopal handing over the MoU to Shri Chandrasekhar Yadav

DG, ICAR inaugurated new wing of CMFRI/CIFT at Visakhapatnam

Dr. S. Ayyappan, Director General, ICAR, New Delhi inaugurated the newly extended wing of the Research Centres of CMFRI/CIFT lab-cum-office complex at Visakhapatnam on 10 June, 2011. The DG also dedicated the mariculture laboratories of the Visakhapatnam Regional Centre of CMFRI to the nation. Dr. Ayyappan also launched the online Indian Journal of Fisheries in the ICAR website. Dr. B. Meenakumari, DDG (Fy.), ICAR, Dr. G. Syda Rao, Director, CMFRI, Cochin, Dr. P.T. Lakshmanan, Director Incharge, CIFT, Cochin, Dr. G. Maheswarudu, Scientist-In-Charge of VRC of CMFRI and Dr. M.M. Prasad, Scientist-In-Charge of VRC of CIFT were also present on the occasion.

Dr. S. Ayyappan, DG, ICAR, inaugurating the new wing of CMFRI/CIFT

National Seminar on Indian Seafood Trade

A National Seminar on "Indian seafood trade – Concerns and adaptive strategies" was held at the CIFT, Cochin on 30 June, 2011. The seminar was jointly organized by the Society of Fisheries Technologists (India) (SOFTI) and CIFT, Cochin. About 80 delegates participated in the seminar. Dr. T.K. Srinivasa Gopal, Director, CIFT and Dr. M.K. Mukundan, President, SOFTI chaired the Technical Session. Shri Anwar Hashim, National President, Sea Food Exports Association of India (SEAI) presented the present status of Indian seafood trade tracing its chequered history. Dr. Ram Mohan, Deputy Director, Marine Products Export Development Authority (MPEDA), Cochin, highlighted the export trends during the past decade explaining the reasons. Shri Sebastian Mathew, Programme Advisor, International Collective in Support of Fish Workers, Chennai, discussed the aspects of subsidies in fisheries in the context of WTO. Dr. A. Ramachandran, Director, School of Industrial Fisheries, CUSAT, Cochin, highlighted the Free Trade Agreements (FTAs) and it's impact on Indian seafood trade. Dr. K. Ashok Kumar, Senior Scientist,

Session Chairs Dr. T.K. Srinivasa Gopal and Dr. M.K. Mukundan during the discussions

CIFT explained the emerging scenario of traceability in the light of consumer right to information. Dr. M.E. John, Zonal Director (Retd.), Fishery Survey of India, Mumbai discussed the issue of illegal, unreported and unregulated (IUU) fishing. Dr. T.V. Sankar, Head, Quality Assurance and Management, CIFT, Cochin presented the overall picture of quality issues.

Dr. T.K. Srinivasa Gopal handing over the ore of the canoe

Stakeholders Meet

To find out the durability and performance of the coconut wood fishing canoes designed and constructed by CIFT, it was decided to put them to actual field trials. A stakeholders meet was conducted by the Institute in association with Kumbalam Inland Fishermen Development Welfare Co-operative Society at Kumbalam on 2 July, 2011 to hand over the three coconut wood canoes to the Society for trial operations. Dr. T.K. Srinivasa Gopal, Director, CIFT presided over the function and handed over the canoes to the President of the Society. A video film titled "Rubber wood canoes for artisanal fishing" was also screened during the function for the benefit of the participants.

Dr. K. Gopakumar inaugurating the Workshop

Workshop on Forecasting Technological Needs

A Workshop-cum-Brainstorming Session on 'Forecasting technological needs for fishing and fish processing sectors in India' was jointly organized by IASRI, New Delhi and CIFT, Cochin on 7 July, 2011 at CIFT, Cochin. The workshop was organized as part of the NAIP on 'Visioning, Policy Analysis and Gender (V-PAGe)' - Sub-component - II: 'Technology Forecasting'. The workshop was organized with an objective to provide a platform to fisheries scientists from different disciplines and other major stakeholders to delineate broad contours of future technological needs for sustainable and development oriented fishing and fish processing sectors of the country.

Shri Anwar Hashim, National President, SEAI delivering lecture

The programme was inaugurated by Dr. K. Gopakumar, Former DDG (Fy.), ICAR, New Delhi and presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin. Dr. V.K. Bhatia, Director, IASRI, New Delhi and Dr. P. Ramasundaram, Principal Scientist & PI (V-PAGe), NCAP, New Delhi offered felicitations. The programme was attended by about 100 delegates representing the fisheries research institutions, State Department of Fisheries, MPEDA, Non Governmental Organizations, fishermen associations, fish processing industry and representatives from the print and electronic media. The Technical Session – I was chaired by Dr. K. Gopakumar and Dr. V.K. Bhatia. It was followed by the Technical Session-II on 'Brain Storming Session', which was chaired by Dr. N.G.K. Pillai, ICAR Emeritus Scientist & Former Director, CMFRI, Cochin and Dr. Leela Edwin, Head, Fishing Technology Division, CIFT, Cochin. The brain storming session was attended by the stakeholders from traditional and mechanized fishing sector, fish processing industry, officials from the development departments, NGOs and researchers from CIFT and CMFRI, Cochin.

Awareness Campaign on Microenterprise Initiatives

An awareness campaign was arranged for the Self Help Groups (SHGs) at Moothakunnam, Ernakulam on 8 July, 2011. Shri Saju, Assistant Director,

SAF, Govt. of Kerala delivered a talk on thematic areas of government policies and initiatives, appropriate technologies and financial support for women in fishing communities, policies and strategies for fisheries and aquaculture development, focusing on the role of credit and investment support. Dr. Ferneena Hassan, Senior Scientist, CIFT in her talk on 'Microenterprise initiatives and need for quality seafood products' briefed the SHGs about the importance of maintaining quality and hygiene in their interventions which could help them to capture the international markets. About 45 women participated in the campaign and were prompt in clarifying their doubts and showed much interest to take up the microenterprise concept.

Shri Saju delivering the talk

Training on Multi Seam Trawl

The Visakhapatnam Research Centre of CIFT conducted a training programme on "Design and fabrication of a new multi seam trawl" at SIFT, Kakinada during the period 11-13 July, 2011 for the benefit of net makers and fishermen. The members of the Kakinada Mechanized Fishing Boat Owners Welfare Association and New Dolphin Mechanized Fishing Boat Operators Welfare Association, Kakinada participated in the training programme. Shri Suresh, Principal, SIFT, Kakinada inaugurated the training. The fabricated multi seam trawl was handed over to the Kakinada Mechanized Fishing Boat Owners Welfare Association. Dr. G. Rajeswari, Senior Scientist, CIFT explained about the design details and advantages of the multi seam trawl.

Handing over of the multi seam trawl to fishing boat owners

'Quilon Flavours' – A Seafood Fest Organized by CIFT

"Quilon Flavors", a Seafood Fest was organized at Azheekal, Kollam on 23 July, 2011 as part of the DST funded project 'Location specific livelihood interventions for fisherwomen in Kerala'. The event was inaugurated by Dr. Ferneena Hassan, Senior Scientist and Principal Investigator of the Project. Smt. Lasitha, Project Officer, Matsyafed presided over the function. The main objective of the festival was to bring the fisherwomen to mainstream to discuss the recent developments in production technologies, value addition and marketing of fish and fishery products. The Fest also aimed at creating awareness among the consumers on fish as a healthy food. Recipe competitions on various types of seafood preparations have been arranged for women to bring out the talent in preparing varieties of ready to eat fish products. For the best preparations prizes were awarded by Shri Babu, Secretary, Matsyafed Cooperative Society.

Evaluation of the preparations

Workshop on Advancements in Purse Seine Fishing in India

An awareness creation workshop on "Advancements in purse seine fishing in India" was organized on 25 July, 2011, by ZTM-BPD Unit, South Zone at CIFT, Cochin. About 50 purse seine fishermen attended the workshop. During the workshop Dr. P. Pravin, Senior Scientist, CIFT explained about the design of purse seine net and SONAR, and demonstrated the use of power block which is used to operate purse seine net more efficiently and to reduce the drudgery of the crew on board. Shri Jose Vincent Panakkal, Secretary, Purse

Inaugural session in progress (L to R : Dr. P. Pravin, Dr. T.K. Srinivasa Gopal, Shri Jose Vincent Panakkal and Dr. Leela Edwin)

Seine Net Owner's Association, Cochin Fisheries Harbour acknowledged the role of CIFT in facilitating the fishing operations in the region. Dr. T.K. Srinivasa Gopal, Director, CIFT gave the concluding remarks and distributed the certificates to the participants. The interactive workshop was successful in creating awareness among the purse seine fishermen about the modern techniques used in fishing.

Shri Paul Antony, IAS delivering the Chief Guest's address

'Chetana Mass'

'Chetana Mass 2011' was celebrated at the Institute during 16 August to 14 September, 2011. During the celebrations, various competitions were conducted for the staff members of the Institute. Competitions were held in Phrase writing, Preparation of documentary in Hindi, Identification of Institute products/instruments, Technical reporting, Letter writing, Office order writing, Still photography, Web page news reporting, Advertisement for the print media and Conversation in Hindi. Concluding function of the Chetana Mass was held on 14 September, 2011. Chief Guest of the function was Shri Paul Anthony, IAS, Chairman, Cochin Port Trust. The function was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT. The Chief Guest distributed cash prize to the winners of the various competitions. The meeting was followed by a cultural programme in which artists of Sambalpur Folk Academy, Orissa made a dance performance and staff of CIFT, Cochin made a song presentation.

Hindi letter writing competition at Mumbai

The Visakhapatnam Research Centre of CIFT also celebrated 'Hindi Week'. The concluding meeting was presided over by Dr. M.M. Prasad, Scientist Incharge. Shri N. Kashinath, Divisional Railway Manager, Visakhapatnam was the Chief Guest of the occasion. Dr. G. Maheswarudu, Scientist Incharge, CMFRI Research Centre at Visakhapatnam was the Guest of Honour.

'Hindi Divas' was celebrated at Mumbai Research Centre of CIFT on 14 September, 2011. Several competitions in Hindi were conducted and prizes distributed.

IP Channel Launched

The Zonal Technology Management – Business Planning and Development Unit, South Zone at CIFT, Cochin has launched an "IP Channel" on 18 August, 2011, which is an online resource dedicated to disseminate information regarding Intellectual Property Rights and Technology Management. The channel acts as an awareness tool for the members of ICAR institutions, in the form of interesting short movies based on the vast and complicated subjects of IPR. The video archive will be updated on a monthly basis, and can be accessed through CIFT website. The channel is made as part of the measures taken by ICAR for the pro-active management of technologies and IP assets generated by its Research Institutions. It is targeted to expand the influence of IP protection, to publicize and popularize IP protection laws and regulations, to enhance the legal awareness of IPRs and to encourage invention and innovation activities in India.

National Sadbhawana Day

The Institute celebrated National Sadbhawana Day in connection with the observance of Communal Harmony Fortnight. On 20 August, 2011 the staff of the Institute assembled together and took Sadbhawana Day Pledge.

Shri Vivekanand inaugurating 'Onam' celebrations

Training on Preparation of Value Added Fish Products

Training programme on 'Preparation of value added fish products like prawn/fish pickle, fish wafers, fish cutlets and hygienic handling of cured and dried fishes' was conducted at the Visakhapatnam Research Centre during 29-31 August, 2011 for the benefit of 15 fisherwomen of ICZMP from Ganjam district, Odisha. The following lectures were delivered by the scientists on the occasion: 1. Post-harvest losses: Minimization with simple interventions by Dr. L.N. Murthy, 2. Management of waste: Production of cost effective products by Dr. L.N. Murthy, and 3. Seafood importance and preparation of value added fish products by Smt. S. Tanuja.

'Onam'

The Institute celebrated "Onam" the national festival of Kerala on 2 September, 2011. Traditional floral carpet competition was held in the morning followed by traditional 'Sadya'. Idea Star Singer Fame Shri Vivekanand was the Chief Guest of the afternoon function. The staff and their ward performed various entertainment programmes also.

Floral carpet in the making

Training on Fabrication and Operation of Gillnets

A training programme on 'Fabrication and operation of improved gillnets' was conducted under the Tribal Sub Plan programmes at Nellarachal, Amabalavayal, Wayanad on 17 September, 2011. The programme was conducted by CIFT, Kochi in association with Krishi Vigyan Kendra, Ambalavayal. Thirty five tribal fisherfolk from Vanasree Scheduled Tribe Society, Nellarachal participated in the programme. During the technical session, theoretical orientation on 'Structure and design of improved gillnets for reservoirs' and demonstration of 'Gill net fabrication' was carried out. Socio-economic data were also collected from 34 fisherfolk.

Resource persons with the participants of the programme

Consultancy Agreement Signed with Prawn Peeling Owners Association

CIFT, Cochin has signed an agreement for setting up of an Effluent Treatment Plant (ETP) at the cost of ₹ 75,000/- with All Kerala Prawn Peeling Association, Ambalapuzha. The agreement was signed between Shri A. Safeer, General Secretary, All Kerala Prawn Peeling Owners Association, Ambalapuzha Thaluk Committee, Alappuzha district and Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin on 29 September, 2012.

Dr. T.K. Srinivasa Gopal handing over the MoU to Shri Safeer

Consultancy Agreement Signed with Directorate of Fisheries, Andamans & Nicobar Administration

CIFT, Cochin has signed an agreement with Department of Fisheries,

A&N Administration for acting as a consultant organization for providing drawing, design, cost estimate and technical specifications of Intermediate Mechanized Fishing Craft. The scheme is aimed to encourage the local fishers to venture in mechanized fishing activity in the Islands. CIFT would also supervise the construction of the boats at the boat building yards. In connection with the finalization of drawing, design and estimates of the proposed Intermediate Mechanized Fishing Crafts, Shri M.V. Baiju, Senior Scientist & Naval Architect of CIFT, Cochin visited the Islands during 11-13 October, 2011. The Department of Fisheries organized a meeting of the bankers and interested applicants (fishermen) with Shri Baiju to discuss the modalities for the implementation of the scheme.

Consultancy Agreement Signed with Directorate of Fisheries, Maharashtra

CIFT, Cochin has signed an agreement for a consultancy with Directorate of Fisheries, Govt. of Maharashtra for providing detailed specifications, general arrangement drawing, preparation of estimate and supervision of construction of the FRP vessel at different stages for a 15 m long training cum patrolling boat. The agreement was signed between Shri Parag Nanautia, IAS, Commissioner of Fisheries, Govt. of Maharashtra and Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin on 15 October, 2011.

Participants of the Entrepreneur Meet

Entrepreneur Meet on Fishery Waste Utilization

An Entrepreneur Meet on 'Developments in fishery waste utilization' was jointly organized by ZTM-BPD Unit, South Zone, Cochin and Visakhapatnam Research Centre of CIFT at Visakhapatnam on 21 October, 2011. The Meet is a leading step towards the utilization of seafood waste. The entrepreneur meet was inaugurated by Shri V. Padmanabham, President, The Seafood Exporters Association of India, A.P. Region. Dr. M.M. Prasad, SIC, Visakhapatnam presided over the meeting. Dr. G. Maheswarudu, Scientist-in-Charge, CMFRI, Visakhapatnam Research Centre and Shri A.K. Choudhury, Deputy Director, CIFNET, Visakhapatnam Unit offered felicitations. The following technical talks were delivered in the technical session which followed:

i. An over view of fisheries scenario in Andhra Pradesh – Dr. M.M. Prasad

ii. Chitin-chitosan – Production technology – Dr. A.A. Zynudheen

iii. Industrial applications of chitin and chitosan – Dr. B. Madhusudana Rao

iv. Fish and fish waste utilization – Dr. L.N. Murthy

v. Business overview on chitin and chitosan – Shri Nithin Singh

Dr. B. Meenakumari inaugurating the fish drying plant

Inauguration of Solar Fish Drying Plants

Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR inaugurated the Solar Fish Drying plant with LPG backup named 'CIFT Dryer JSDL-55 SM' designed, installed and commissioned at ICAR Research Complex, Manipur on 24 October, 2011. Dr. Meenakumari also inaugurated the Solar

Fish Dryer with electrical backup installed and commissioned under the technical consultancy of CIFT at Directorate of Fisheries, Manipur on 24 October, 2011.

Vigilance Awareness Week

The Institute celebrated Vigilance Awareness week during 31 October – 5 November, 2011. On 31 October the staff of the Institute assembled together and took Vigilance Awareness Pledge.

Workshop on Entrepreneurship Development

A one day workshop on 'Entrepreneurship development for fish based business' was conducted on 3 November, 2011 at CIFT, Cochin. The workshop was inaugurated by Dr. P.T. Lakshmanan, Director-in-charge, CIFT, Cochin. A presentation on entrepreneurship development was done by Shri M. Nasser, Principal Scientist. Dr. S. Balasubramaniam, Head, EIS Division, Dr. S. Sanjeev, Principal Scientist, Dr. S. Ashaletha, Dr. V. Geethalakshmi and Dr. R. Anandan, Senior Scientists were the other speakers of the day. Around 40 budding entrepreneurs participated in the event.

Dr. P.T. Lakshmanan inaugurating the Workshop

Quami Ekta Week

The Institute celebrated Quami Ekta Week during 9-15 November, 2011. On 23 November the staff of the Institute assembled together and took National Integration Pledge.

Cruise Undertaken

Dr. U. Sreedhar, Senior Scientist, Visakhapatnam Research Centre of CIFT participated in the Cruise No. 291 of FORV Sagar Sampada as Chief Scientist. The Cruise was exclusively programmed to undertake studies on "Stock assessment and biology of deep water demersal resources and collection of environmental data along the east coast of Indian EEZ". The Cruise commenced from Chennai on 22 October and concluded at Chennai on 10 November. Gear parameter studies were conducted using the Simrad ITI system. Two hauls were conducted one at 100m depth and the next at 1000m depth. The study clearly confirms that the vertical opening of the trawl is greatly affected at deeper waters with the same parameters used at 100m depth. The equations of the buoyancy of the head rope and weights for the foot rope have to be recalculated for deeper waters. The continental slope region from 100 to 1050 m depths of east coast of Indian EEZ was studied for the stock assessment studies of deep sea fishes. A total of 17 fishing operations were done with a CPUE of 112.9kg.

Dr. U. Sreedhar (extreme left) on the cruise

Workshops in Official Language

Workshops in Official language on UNICODE were conducted at CIFT, Cochin on 29 July, 29 September and 9 November, 2011 for the benefit of administrative personnel of the Institute. Shri V.T. Santhosh, Technical Director, National Informatics Centre, Cochin introduced the concept of UNICODE to the participants. Smt. Asha Ignatius, NIC conducted practical classes.

Shri V.T. Santhosh speaking on UNICODE

Releasing of technology brochure

A section of the audience

Innovations for Industry Meet

A Business Meet titled "Innovations 4 Industry Meet in Crop Science" was organized by the ZTM-BPD Unit, South Zone, Cochin along with the NAARM, Hyderabad on 19 November, 2011 at Hyderabad for showcasing the innovations from seven prestigious Crop Science Research Institutions under ICAR. The Meet was organized as part of the business incubation drive designed for the agricultural sector to promote entrepreneurs with the help of latest R&D facilities and vast knowledge available with ICAR. The event brought together innovators and entrepreneurs from the field of agriculture on the same platform. Dr. Swapan Kumar Dutta, DDG (Crop Science), ICAR, New Delhi was the Chief Guest for the programme and Dr. Bangali Baboo, National Director, NAIP was the Guest of Honour. During the inaugural meeting, Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin gave the introductory remarks about the event. Dr. S. Mauria, ADG (IP&TM), ICAR offered felicitations. A technology brochure titled "Innovations – A Technology Showcase in Crop Science" prepared by ZTM-BPD Unit, CIFT, Cochin was officially released by Dr. Swapan Kumar Dutta and a Video Film on "Crop Science Innovations" was released by Dr. Bangali Baboo.

The event consisted of an exclusive technical conference that featured technical presentations on the innovations developed by the Crop Science Research Institutions under ICAR, and panel sessions that helped the industry professionals to enhance their technical knowledge, share ideas with scientific community and formulate new business plans. Dr. Leela Edwin, Member Secretary, ZITMC and Dr. C.N. Ravishankar, Principal Investigator, NAIP-BPD Unit gave presentations on the activities of the ZTM-BPD Unit, South Zone in areas of intellectual property protection, technology management, and agri-business incubation. The meet also consisted of an exhibition which provided an opportunity for the private sector to witness the wide range of knowledge-based and entrepreneur-ready technologies. The ICAR institutes participated in the event are, CRIDA, Hyderabad, CTRI, Rajahmundary, DOR, Hyderabad, DSR, Hyderabad, DRR, Hyderabad, NBAIM, Bangalore and SBI, Coimbatore.

Dr. T.K. Srinivasa Gopal handing over the MoU to Shri K.N. Iyer

Consultancy Agreement Signed with M/s Kraftwork Solar Pvt. Ltd.

CIFT, Cochin has signed an agreement with M/s Kraftwork Solar Pvt. Ltd., Poonithura, Cochin for necessary knowhow and guidance for the commercial production of Solar Dryers (CIFT Dryer JSDL-55 SM), CIFT Dryer JSDL 110 SM and CIFT Dryer SDE 5) at the cost of ₹ 45,000/-. The agreement was signed between Shri K.N. Iyer, Managing Director, M/s Kraftwork Solar Pvt. Ltd. and Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin on 2 December, 2012.

Dr. Kasturirangan Visits CIFT

Dr. K. Kasturirangan, Member (Science), Planning Commission, New

Delhi and eminent scientist visited CIFT, Cochin on 7 December, 2011. Addressing the scientists of the Institute he said that the next decade has been declared as the decade of innovations and there is a need to focus on innovations in fisheries that can be adapted to local environments which are unique, simple and affordable to the fisher population. Dr. Vandana Dwivedi, Joint Advisor, Planning Commission and Dr. T.K. Srinivasa Gopal, Director, CIFT were also present. Earlier Dr. Kasturirangan visited the laboratories of the Institute and interacted with the scientists about the on-going research work. Dr. Kasturirangan also participated in a short cruise in the departmental vessel M.V. Matsyakumari-II and discussed with the scientists and staff of the vessel regarding the research projects undertaken by the Fishing Technology Division.

Dr. T.K. Srinivasa Gopal falicitating Dr. Kasturirangan. Also seen is Dr. Vandana Dwivedi

Consultancy Report Handed Over

The consultancy report on the Diagnostic Study on Development of Clam Cluster at Perumbalam Village, Cherthala block, Alappuzha district, Kerala was handed over to the office bearers of the Haritha Farmers Club on 17 December, 2011 at CIFT. The consultancy was carried out to study the existing methods of harvest, processing and marketing of clams in the village, to assess the present socio-economic status of the clam fishers, to identify gaps/short comings in the technology, skill and other inputs in the existing value chain and to suggest suitable interventions to make the value chain more efficient and to develop a strategy for a sustainable and profitable livelihood option through clam cluster. As per NABARD's Cluster Development Strategy, a diagnostic study had to be conducted, which was undertaken by the CIFT under a consultancy agreement with the Haritha Farmers Club, which is the Cluster Development Agency in this particular cluster development initiative. The copies of the report were handed over to Shri K.A. Sreekumar, President and Shri Anoopraj, Secretary of the Club by Dr. T.K. Srinivasa Gopal, Director, CIFT.

Dr. T.K. Srinivasa Gopal handing over the report to Shri K.A. Sreekumar

Consultancy Agreement Signed with Kerala Livestock Development Board

Another consultancy agreement was signed between Dr. R. Rajeev, Deputy General Manager, Kerala Livestock Development Board, Mattupatti Farm, Idukki district and Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin at the cost of ₹ 60,000/- for renewal of HACCP certification for the Sperm Station, Mattupatti Farm.

CIFT Team Participates in the Sixth Southern Ocean Expedition

Dr. P. Pravin, Senior Scientist and Shri K.V. Aneesh Kumar, Senior Research Fellow, Fishing Technology Division participated in the 6th Southern Ocean Expedition 2011-12 (SOE 2011-12) onboard FORV *Sagar Nidhi* of the National Centre for Antarctic and Ocean Research (NCAOR), Ministry of Earth Sciences, Goa. They carried out work under the component. "Studies on the biological and biochemical characteristics of oceanic squids". The expedition started from Goa on 23 December, 2011 to the Southern Ocean.

The Institute carried out experimental squid jigging operations to study the biology and biochemical aspects of oceanic squids. Squid jigs of various makes and types were rigged onboard for hand jigging. A hand operated squid jig reel was also fabricated onboard for jigging operations. A total of 71 squids, approximately weighing 60 kg were landed during the cruise. The expedition team signed off at Mauritius after the successful completion of the voyage on 9 February, 2012 and reached Cochin on 10 February, 2011.

Workshop on Fuel Efficient Fishing

Under the NAIP sub project 'Responsible harvesting and utilization of selected small pelagics and freshwater fishes' two workshops on 'Fuel efficient fishing' were conducted on 2 and 3 January, 2012 at Puthiyappa and Koyilandi in Kozhikode district for the benefit of 40 and 50 fishermen respectively. Shri T.V. Rameshan, District Manager, Matstafed, Kozhikode formally inaugurated the programme and highlighted the importance of fuel efficient fishing in the present scenario. The Consortium PI of the Project, Shri M. Nasser, Principal Scientist, CIFT, Cochin conducted a class on fuel efficient fishing.

Dr. K. Devadasan and Dr. T.K. Srinivasa Gopal during the introductory session

Stakeholders Meeting Held

A stakeholders Meeting for prioritization of research programmes of CIFT for the XII Plan was held on 5 January, 2012 at CIFT, Cochin. Participants representing the fishing and fish processing industries, state fisheries department, MPEDA, input manufacturers, partners in commercialization and academia participated. There were 20 invited participants. The Meeting started with an Introductory Session with a Presidential address by Dr. T.K. Srinivasa Gopal, Director, CIFT. This was followed by a special address by Dr. K. Devadasan, Chairman, RAC who stressed that CIFT has to work on frontier areas in the field like nanotechnology for the benefit of the industry. Shri Anwar Hashim, Seafood Exporter and Former National President, Seafood Exporters Association of India also spoke in the introductory session. In the second session, different themes areas of research were presented by Dr. Leela Edwin, Head, Fishing Technology Division, Dr. C.N. Ravishankar, Head, Fish Processing Division and Head I/c, Engineering Division, Dr. P.T. Lakshmanan, Head, Biochemistry & Nutrition Division, Dr. T.V. Sankar Head, Quality Assurance & Management Division, Dr. K.V. Lalitha, Head, Microbiology, Fermentation & Biotechnology Division and Dr. S. Balasubramaniam, Head, Extension, Information & Statistics Division. The presentations were followed by discussion where the invited participants expressed their views and comments and gave suggestions in each area.

Adv. Jose Thettayil inaugurating the model fish drying unit

Model Fish Drying Unit Inaugurated

A model fish drying unit was set up by CIFT, Cochin at Sevashram Swasrayagram, Pullani, Angamaly, under the ICAR-DRWA network project on 'Capacity building of coastal fisherwomen through post harvest technologies in fisheries'. The unit was formally inaugurated in a simple function at Sevashram Swasrayagram on 20 January, 2012, by Adv. Jose Thettayil, MLA, Angamaly.

Dr. T.V. Sankar, Director-in-charge, CIFT presided over the function. Dr. C.K. Murthy, Executive Director, NFDB formally handed over the unit to a Women's Self Help Group. Rev. Fr. K. Mampilly, President, Sevashram and Dr. S. Balasubramaniam, Head, EIS Division, CIFT offered felicitations.

Training programme in Biochemistry Conducted

A 10-day training programme on "Vistas in nutrient profiling and nutritional labeling of seafood" funded by ICAR, New Delhi was conducted at CIFT, Cochin during 14-23 February, 2012. On 14 February, the programme was formally inaugurated by Dr. K. Gopakumar, Former Deputy Director General (Fisheries), ICAR. Dr. G. Syda Rao, Director, CMFRI, Cochin offered felicitations and released the book titled "Nutrient Profiling and Nutritional Labeling of Seafood". Dr. T.K. Srinivasa Gopal, Director, CIFT delivered the presidential address. The training was meant to cater to the needs of young scientists/teachers in the field of Biochemistry and Nutrition. The short course covered theory and practical classes on the topics such as, Biochemical composition of fish, Sampling procedures, Post mortem changes in fish, Amino acid analysis by HPLC, Fatty acid analysis by Gas chromatograph, Mineral content analysis by Flame photometry, Trace element analysis by Atomic absorption spectrophotometry, Nutrition labeling in seafood, Determination of crude fibre, cholesterol, K value determination, Analysis of fat soluble vitamins, Chemical hazards and seafood safety, Monitoring pollutant profile by GC MS and LC MS MS etc.

Dr. K. Gopakumar inaugurating the Short Course

Release of the book

AgrIP 2012 - Annual Meeting-cum-Workshop

The ZTM-BPD Unit, South Zone at CIFT, Cochin conducted AgrIP 2012, the Annual Meeting-cum-Workshop on 'Evaluation of agricultural technologies for commercialization' during 24 and 25 February, 2012 at Cochin. The Officers-in-Charge of Institute Technology Management Units (ITMUs) and Research Associates from 20 ICAR Research Institutes in South Zone participated in the event. The workshop was inaugurated by Dr. A.S. Saroja, Principal, Govt. Law College, Ernakulam. Dr. T.K. Srinivasa Gopal, Director, CIFT gave presidential address and Dr. Sanjeev Saxena, Principal Scientist (IP & TM), ICAR, New Delhi and Dr. R. Kalpana Sastry, Principal Scientist & Head, ARSMP, NAARM, Hyderabad gave felicitations. An online resource titled "IP Channel", dedicated to disseminate information regarding Intellectual Property Rights and Technology Management was released during the function. Dr. Leela Edwin, Member Secretary, ZITMC welcomed the gathering and Dr. C.N. Ravishankar, PI, BPD Unit gave the vote of thanks.

Dr. A.S. Saroja delivering the Presidential Address

Release of IP Channel

The technical sessions that followed were chaired by Dr. Sanjeev Saxena and Dr. Kalpana Sastry. Shri Karthikeyan Iyer, Founder Director, Craffiti Consulting Pvt. Ltd. gave a talk on 'Technology evaluation and valuation frameworks' that covered topics like key dimensions of technology evaluation, technology potential, assessment of business potential etc. Dr. Surya Mani Tripathi, Scientist (IPR & Regulatory Affairs), ICRISAT, Hyderabad conducted

a training session on 'Use of technology evaluation tools'.

During the second technical session, presentations were made by the Officers-in-Charge of ITMUs from IIHR, Bangalore; DRR, Hyderabad; CTRI, Rajahmundry; DOR, Hyderabad; DOPR, Pedavegi; DSR, Hyderabad; PDP, Hyderabad; NRCM, Hyderabad; PD-ADMAS, Bangalore; NBAIM, Bangalore; NIANP, Bangalore; NRCB, Trichy; DCR, Puttur; SBI, Coimbatore; IISR, Kozhikode; CTCRI, Thiruvananthapuram; CMFRI, Cochin; CIFT, Cochin; CIBA, Chennai and CPCRI, Kasaragod. Dr. Sanjeev Saxena concluded the Meeting-cum-Workshop by reading out the proceedings and recommendations of the technical sessions.

Inaugural session of the training programme

Training on Fish Based Value Added Products Conducted at Ludhiana

A two days training programme on 'Innovative products from freshwater fishes' was conducted on 24 and 25 January, 2012 at College of Fisheries, GADVASU, Ludhiana which was attended by over 60 participants including fish farmers, officials of Punjab State Fisheries Department and scientists. The participants were given training on the development of fish based value added products viz., Momos, Casserole, Roll, Cutlet and Rohu blocks. A discussion was organized on 25 January under the guidance of Dr. Asha Dhawan, Dean, College of Fisheries which was presided over by Dr. G.S. Kalkat, Chairman, Punjab State Farmer's Commission. Shri V.K. Sood, Director of Fisheries, Dr. V.K. Taneja, Vice Chancellor, GADVASU, Shri Kaval Jeeth Singh Sidhu, President of Punjab Fish Farmers Association, Shri M. Nasser and Dr. S. Ashaletha, Scientists from CIFT, Cochin participated in the discussion.

Training in progress

Training programme on Hygienic Handling and Drying of Fish

A one day training programme was organized by CIFT, Cochin on "Hygienic handling and drying of fish" at Sevashram Swasrayagram, Angamally on 1 March, 2012. Under the project a women self-help group of ten members has been organized. The main aim of the training programme was to give awareness for the need of hygiene in handling and drying of fish for better quality products. Dr. Nikita Gopal, Senior Scientist, CIFT welcomed the participants and delivered a brief introduction about the project and the need for hygienic drying for better realization of the money. The training session that followed was led by Dr. J. Bindu, Senior Scientist, CIFT. She offered a class on the hygienic practices to be followed in the drying of fish. She demonstrated fish dressing, salting and methods of drying of different varieties of fish. The salted fish samples were dried hygienically on PVC racks which were provided by CIFT under the project. Dressing and packing of fresh fish for direct marketing was also demonstrated by Dr. Bindu. The dressed fish were packed in small retail packets. A session on maintenance of production and financial records was taken by Dr. Nikita Gopal

CIFT Celebrates International Women's Day

CIFT, Cochin celebrated the International Women's Day on 8 March,

2012. Dr. S. Girija, Director, National Institute of Fisheries Post Harvest Technology and Training, Cochin was the Chief Guest. Dr. T.K. Srinivasa Gopal, Director, CIFT presided over the function. He highlighted that the UN special theme for this year is 'Empower rural women: End poverty and hunger' and stressed that CIFT has been doing its bit to the fishing community by engaging in research for the sector which have directly or indirectly contributed to improving the livelihoods of fishers. Dr. J. Bindu, Chairperson, CIFT Women's Cell welcomed the gathering and Smt. Sreelekha, Member, CIFT Women's Cell proposed the vote of thanks.

Dr. S. Girija delivering the Chief Guest's address

SOFTI Celebrates Golden Jubilee

The Society of Fisheries Technologists (India), SOFTI, established in 1962 is a forum of researchers, technologists, academicians and administrators working in the field of fisheries. The Curtain Raiser Ceremony of the Golden Jubilee Celebrations of SOFTI was held on 14 March, 2012 at CIFT, Cochin. Dr. Ramachandran Thekkedath, Vice Chancellor, Cochin University of Science and Technology, Cochin was the Chief Guest of the programme. Dr. Ramachandran officially released the Golden Jubilee Logo and launched the new website of SOFTI. Dr. T.K. Srinivasa Gopal, President, SOFTI and Director, CIFT presided over the function and released the Golden Jubilee Brochure. Dr. P.T. Lakshmanan, Vice President of the Society welcomed the gathering. Dr. T.V. Sankar, Secretary, SOFTI highlighted the achievements of SOFTI during the last 50 years. Dr. K. Ashok Kumar, Joint Secretary proposed the vote of thanks. The year-long celebrations include seminars, debates, exhibitions and conferences on various aspects of harvest and post harvest of fisheries and will be held in different parts of the country.

Dr. Ramachandran Thekkedath inaugurating the Curtain Raiser Ceremony

"Krishi Darpan - 2012" – An ICAR Window-Showcasing of Agricultural Technologies

To enhance the communication to the grass-root level farmers for improving farmers' receptivity for new technologies generated by Research Organizations under ICAR and thereby increasing the agricultural production, the CIFT, Cochin organized a two days Technology Expo cum Farmers' Mela "Krishi Darpan - 2012" during 20-21 March, 2012 at Palluruthy, Cochin. Dr. T.K. Srinivasa Gopal, Director, CIFT inaugurated the exhibition. Adv. K.N. Sunil Kumar, Councilor, Cochin Corporation presided over the function. Dr. K.G. Padmakumar, Associate Director, Regional Agriculture Research Station, Kumarakom, Smt. Lali, Asst. Director of Agriculture and Smt. Lekha Gopal, Programme Executive, All India Radio (AIR) offered felicitations.

Dr. T.K. Srinivasa Gopal inaugurating 'Krishi Darpan - 2012'

During the two days' programme, 16 stalls involving all the five Research Institutes of Kerala under ICAR (CIFT, CMFRI, CPCRI, CTCRI, IISR and two KVKs), Commodity Boards like Rubber Board, Coir Board, Developmental Departments, Vegetable and Fruit Promotion Council, Kerala (VFPCK), Farm Information Bureau (FIB), NGOs and Self Help Groups who offer technology support for the farming community participated and displayed their technologies

An interactive session in progress

and programmes. Value added products commercialized by rural industries under another NAIP project on Pelagic Fish Value Chain were also displayed and sold. The scientist-farmer interaction meet arranged during the meet provided a unique opportunity to the farmers for clarification of their doubts and for the institutions to propagate their technologies and services and to get a first-hand information on problems of farmers. State level experts on Agriculture, Animal Husbandry and Fisheries took classes for the farmers. Dr. K.G. Padmakumar conducted class on Scientific fish farming, Smt. Sify Joseph, VFPCK on Household vegetable gardening, Dr. Ashkar, Veterinary Surgeon on Goat rearing, Shri M. Nasser, CIFT on Fish based value added products and business opportunities and Dr. Pramudha Devi, Veterinary Surgeon on Calf rearing. For giving an element of interest to the Mela, some competitions were arranged for the public mainly, making traditional fish recipes, plating coconut leaves, coconut scraping and the winners were given prizes in the valedictory function. All the institutes participated were also honored by giving mementos. The best stall award was won by CPCRI, Kasaragod.

Dr. T.K. Srinivasa Gopal handing over the consultancy agreement document to Smt. Chaya Deepak Jadhav

CIFT Signs Consultancy Agreements with Maharashtra Firms

CIFT, Cochin signed Memorandum of Agreement with two firms at Ratnagiri district of Maharashtra for technical guidance to develop harvest and post harvest activities in fisheries in the Lanja area of Ratnagiri district. The agreement signed with M/s Navaladevi Aqua Agro Producer Company Limited, Lanja is for an amount of ₹ 7,38,000/- + 10.3% service tax. The agreement with M/s Matsya Vyavasayik Sahakari Sanstha Maryadit, Lanja is for an amount of ₹ 2,25,650/- + 10.3% service tax. The agreements were signed between Dr. T.K. Srinivasa Gopal, Director on behalf of CIFT, Cochin and Smt. Chaya Deepak Jadhav, Chairperson of both the firms in a simple function held on 24 March, 2012 in presence of the SAO and members of the ITMU, CIFT, Cochin.

Technology Transfer Programmes in NEH States

Distribution of foldable trap at Aizawl

Training on 'Production of value added fishery products' at Manipur: Two training programmes on 'Production of value added fishery products from freshwater fish for employment and income generation' were organized by CIFT, Cochin in collaboration with the State Department of Fisheries, Manipur and the National Association of Fishermen, Manipur. The first programme was conducted at Uchiwa Kabui Tribal Village, Imphal West during 22-24 March, 2012. About 74 participants attended the training. Dr. S. Balasubramaniam, Head, EIS, CIFT inaugurated the training programme and Smt. Premila Devi, Pradhan, Uchiwa Grama Panchayath attended the function as Chief Guest. Dr. N. Prakash, Joint Director, ICAR Regional Centre, Lamphelpat, Imphal attended the valedictory function as Chief Guest and distributed the certificates.

The second training was conducted at Sekmaijin tribal village, Thoubal District, Manipur during 26-28 March, 2012. About 88 participants attended

the training. Shri Umananda Singh, District Fishery Officer, Imphal West attended the valedictory function as Chief Guest and distributed the certificates. During the training, production of value added fishery products *viz*., fish pickle, fish cutlet, fish wafers, fish balls, fish fingers, dried fish and fish silage were demonstrated. The training was imparted by Dr. A.A. Zynudheen and Dr. George Ninan, Senior Scientists from CIFT. Dr. S. Balasubramaniam, Head, EIS, CIFT coordinated the programmes.

Training on 'Value added fishery products' at Nagaland: CIFT, Cochin conducted two batches of training programme on 'Production of value added fishery products from freshwater fish for employment and income generation' at Dimapur, Nagaland during 26-29 March, 2012. The programme was organized in association with the Directorate of Fisheries, Government of Nagaland. More than 100 women Self Help Group members from different parts of Dimapur participated in the programme. The programme was inaugurated by Shri Zenohol, Additional Director of Fisheries, Govt. of Nagaland. During the training programme, value added products from freshwater fishes such as rohu and pangasius were prepared with the technical guidance of resource persons from CIFT. The products prepared included fish balls, fish wafers, fish pickle, fish cutlets, fish fingers, coated fish fillets, fish burgers, fish kebab and silage from fish wastes. The women members actively took part in the hands-on exercises. The training was imparted by Dr. T.K. Thankappan, Principal Scientist and Dr. P.K. Binsi, Scientist from CIFT. Dr. J. Charles Jeeva, Scientist, Senior Scale, CIFT and Shri Neito Koutsu, Chief Executive Officer, FFDA, Dimapur coordinated the programme.

Participants and faculty of training at Aizawl

Training on 'Responsible fishing and extension methods' at Nagaland: A training programme on 'Responsible fishing and extension methods - Fabrication of improved gillnets' was conducted at Doyang Reservoir, Wokha district in Nagaland during 30-31 March, 2012. The programme was organized by CIFT, Cochin in association with the Directorate of Fisheries, Government of Nagaland. About 40 fishermen from different fishing villages in Doyang Reservoir area and five officials from the Department of Fisheries, Nagaland participated in the programme. During the programme, the resource person from CIFT, Dr. M.P. Remesan, Senior Scientist delivered lectures on general status of the inland fishing craft and gear of India, the ill-effects of destructive fishing methods and the basic principles of gillnetting. Awareness was created among the participants about the responsible fishing methods to be followed. Shri B.K. Pradhan, Technical Officer (T5), CIFT handled hands-on training on fabrication/mounting of improved gillnets. The various technical queries raised by the fishermen trainees were cleared by the resource persons. Dr. J. Charles Jeeva, Scientist, Senior Scale, CIFT and Shri Ketuisielie Angami, District Fishery Officer, Wokha coordinated the programme.

Training at Serlui'B reservoir

Administration

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

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

1. Departmental Promotion Committee : 4 times
2. Departmental Selection Committee : Once
3. Assessment Committee : 7 times
4. Career Advancement Committee : -
5. ACP Committee : 3 times
6. Selection test : Once

Cases considered by the Departmental Promotion Committee

Category	Promotion	Declaration of probation & Confirmation	Granting ACP
Scientific	-	01	-
Technical	38	-	-
Administrative	08	09	03
Supporting	-	01	04
Auxiliary	-	-	-

Technical Section

The Technical Section dealt with the following technical matters during the year:

Submission of monthly, quarterly and half yearly reports

Monthly reports on the important activities of the Institute and significant research findings were compiled and sent to ICAR regularly for inclusion in the ICAR monthly report to the Cabinet Secretariat.

Quarterly and six monthly reports on the targets and achievements of the Institute comprising both research and financial aspects were regularly furnished to the Council. Six monthly targets and achievements of all Scientists

were furnished to DG, ICAR, twice in the year under report.

Publication of scientific papers

The scientific research papers meant for publication in research journals and for presentation in Symposia/Seminars by scientists of the Institute were arranged to be presented before the Scrutiny Committee and approval of the recommended papers communicated. During the year the Scrutiny Committee met eight times for screening 24 papers.

Institute Research Council

The Institute Research Council meeting was convened during 2-3 May, 2011 to review the progress achieved in the ongoing research projects of the Institute during 2010-11 and to discuss the research project proposals for the year 2011-12. The Institute Research Project Document for the year 2011-12 was compiled and brought out for discussion at the Meeting. The House discussed in detail the 17 ongoing research projects, besides seven completed projects and six new projects apart from the various ad hoc projects.

Updating Project files

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

PERMISnet, IRS and PIMS-ICAR

The Technical Section helps in maintaining the Personal Management Information System network (PEERMISnet-II) of ICAR up-to-date. Further, also furnishes quarterly inputs to the Intelligent Reporting System (IRS-II) being maintained by ICAR. Through the Project Information Management System (PIMS-ICAR) software, the Institute research projects are being computerized and uploaded online.

Publication of newsletter and other reports

Four issues of Fish Technology Newsletter (Bilingual) were published during the period. Besides, the Institute Annual Report 2010-11 (Bilingual) and Research Highlights 2010-11 were also brought out.

Implementation of Right to Information Act

The Technical Section functions as the office for implementing Right To Information Act-2005 at the Institute. During the period a total of 11 applications were received under RTIA and all were disposed in time.

Human Resources Development activities

The Human Resources Committee functions at the Technical Section. During the period HR Committee met five times to discuss 114 cases. As recommended by the HRD Committee the scientists and officers of the Institute participated in 39 training programmes during the period (Details under the Chapter - Participation in Training Programmes).

Other technical matters

The Section continued to answer queries on various technical matters received from other organizations and individuals. The queries received by the Officer Incharge in the additional capacity of Public Relations Officer, as well as from the feedback option in the Institute Website were attended to. Further, materials for various publications like ICAR News/ICAR Reporter, Agrinews, Fishing Chimes, MPEDA Newsletter, Seafood News, Aqua International, Sea Queen, ICAR Web page etc. were forwarded regularly for publication.

The publicity related and extension oriented activities of the Institute are being regularly presented in the monthly meetings of the Inter Media Publicity Co-ordination Committee of Ministry of Information and Broadcasting, Govt. of India. Besides, the Technical Section functions as the nodal point for releasing Press Releases and Reports.

Library

Library is playing a vital role in providing information service to support research activities of CIFT. It has an extensive collection on all aspects of harvest and post harvest technology of fish. A good collection of digital resources are available to the CIFT community through the library portal http://library.cift.res.in.

During the year the Library acquired 275 books. Forty four foreign and 19 Indian scientific periodicals have been subscribed. Online databases such as ASFA (Aquatic Science and Fisheries Abstracts), FSTA (Food Science and Technology Abstracts), Indiastat.com have also been acquired. More than 2000 journals are available online through CeRA (Consortium of E-resources on Agriculture).

Library's digital resources continued to grow during the period and 1920 scientific papers of CIFT are available in the digital form. Library has supplied copies of 590 articles under DDR (Document Delivery Request) facility of CeRA (Consortium of E-Resources on Aquaculture). As a member of IAMSLIC (International Association of Aquatic and Marine Science Libraries and Information Centers), document delivery service has been provided by CIFT Library to other member countries on request.

The Library in association with NIO, Goa continued to act as a national Input Centre of ASFA database.

PME Cell

Priority setting, Monitoring and Evaluation (PME) Cell functions at the Institute with the following composition:

Dr. S. Balasubramaniam, Principal Scientist & Head, EIS : Scientist Incharge

Dr. A.R.S. Menon, Technical Officer (T9) & OIC, Technical Section : Member

Smt. P.K. Shyma, Technical Officer (T6) : Member

Shri Amit Vengaraj, LDC : Member

The PME Cell serves as a node for information flow and action and has the following Terms of Reference:

- Sensitization of policy makers, managers, scientists and others about PME activities.
- Interface with Agricultural Research Information System (ARIS), Strategic Research and Extension Plan (SREP), Agricultural Technology Management Agency (ATMA), Institute Village Linkage Programme (IVLP), Technology Assessment and Refinement (TAR) and Krishi Vigyan Kendras (KVKs), publication of annual reports, activities related to EFC Memo and other reports to the Council.
- Facilitate monitoring and evaluation of research programmes.
- Impact analysis of the research and extension activities.

ZTM & BPD Unit

The concept of business incubation is an igniting successful business model gaining popularity all over the world. The ICAR through the World Bank funded NAIP has endorsed CIFT, Cochin, to set up a business incubator under the sub-project Zonal Technology Management – Business Planning and Development Unit (ZTM-BPDU), with a total project cost of ₹ 777.716 lakhs, to cater to the needs of entrepreneurs who wish to start up new technology-based businesses. The unit provides physical workspace, management and technical assistance, access to financing and other supporting services to entrepreneurs and young firms to help them survive and grow the start up stage. The set up provides a congenial environment between ICAR Scientists and Entrepreneurs for commercialization of technologies.

Establishment of Business Incubation Centre

The construction of the Business Incubation Centre with the new Business Incubation Office facility and the renovated Pilot Plant complex with the state-of-the-art generic semi-commercial production facility for fish and meat based products was completed during the financial year 2011-12, with a total cost of ₹ 168.85 lakhs. The unique features of the Centre includes the Business Incubation Facility set up with a corporate glance, within the premises of CIFT, with an approximate area of 5000 sq. ft and exclusive in-house facilities such as air-conditioned office suites for nine incubatees, shared facilities of secretarial assistance, video conferencing, communication facilities etc. Arrangements have already been made to rent out the office suites to nine registered incubatees for direct incubation.

Business Incubation Centre

The Plant includes production lines for pre-processing, freezing and

Pilot Plant Complex

Pilot Plant facilities

chilling, preparation of value added products, utilization of byproducts from fish, retort pouch processing, sausage and extruded products, breading and battering, cooking, canning and packaging. These lines are decked with diligently sourced new equipments worth ₹ 302 lakhs from reputed national and international companies in food processing. In addition many types of equipments designed and custom made by the Fish Processing and Engineering Divisions of CIFT, for various fish processing purposes are also installed in the Plant.

The Business Incubation Centre is ready for direct business incubation and was inaugurated on 5 April, 2012 by Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR.

Enrollment of members for direct and virtual incubation

During the period from April, 2011 to March, 2012, 29 entrepreneurs who wish to start commercial ventures with the technical assistance and services of CIFT have enrolled for direct and virtual incubation in the unit. Total number of incubatees as on 31 March, 2012 is 46.

Venture funding assistance for incubatees

Steps were taken to mobilize financial assistance to incubatees. An amount of ₹ 2.5 crore was mobilized for one of the incubatees of ZTM-BPD Unit, M/s Uniloids Biosciences Pvt. Ltd from State Bank of India, Agri-Commercial Branch, for establishing a manufacturing unit for chitin/chitosan at Hyderabad. Four entrepreneurs were selected for financial assistance through Small Farmers' Agri-business Consortium (SFAC). Linkages have also been developed with Micro Small and Medium Enterprises (MSME), National Bank for Agriculture and Rural Development (NABARD), National Fisheries Development Board (NFDB), Marine Products Exports Development Authority (MPEDA), Seafood Exporters Association of India (SEAI) and Indian Step and Business Incubator Association (ISBA) for facilitating the establishment of new agri-business ventures.

Client service

Twenty one entrepreneurs were supported through information sharing of technologies ready for commercialization, business plans, business proposal, collaborative research etc. Incubatee M/s Oriental Biotech has chosen BPD Unit as a partner for market establishment of the product "Nitrifying Bioreactors".

Retail outlet for value added fish products at Karnal

Technical consultancies in the field of fisheries

Establishment of retail kiosks for value added fish products at Karnal, Haryana: As part of the integrated zero waste inland fish processing facility established at Karnal by Shri Sultan Singh, a registered incubatee of ZTM-BPD Unit, a chain of retail outlets of value added fish products is being established at Delhi, Punjab, Haryana and Maharashtra. The first retail kiosk has been opened at Karnal, Haryana under the guidance and support of ZTM-BPD Unit. Wide range of fish products like fish nuggets, burger, fingers, balls etc. are sold under the name 'Fish Bite'.

Commercialization of CIFT technology - Chitin and chitosan: CIFT has developed a technology for the extraction of chitin and chitosan from crustacean wastes, which has various industrial applications in biotechnology, food processing, pharmacy, cosmetics and medicine. The technology was commercialized to M/s Uniloids Biosciences Pvt. Ltd., Hyderabad, who is specialized in the domain of bio fertilizers and respective chemicals. Uniloids Biosciences is a registered incubatee under the ZTM-BPD Unit.

The company was given the technology know-how and training to convert the seafood process waste to chitin and chitosan using the scientific methods developed at CIFT. The ZTM-BPD Unit provided all necessary business support services and the Fish Processing and Quality Assurance & Management Divisions at CIFT provided the technical support and training. Uniloids is now successfully manufacturing, supplying and exporting chitin and chitosan to major market players in this field.

International technical consultancy on Thermal Validation at M/s Horizon Fisheries Pvt. Ltd, Maldives: The Unit has completed an international technical consultancy with M/s Horizon Fisheries, Mandhoo, Republic of Maldives on thermal validation of canned and retort pouch processed tuna products. M/s Horizon Fisheries Pvt. Ltd. is a leading fish processing and marketing company in Maldives. The activities of the company include collection, storage, processing and marketing of tuna and tuna related products which are supplied to major international markets at Thailand, China, Japan, Iran, Oman and New Zealand.

International consultancy on Thermal validation to M/s Horizon Fisheries

The scientific team from CIFT visited Maldives and conducted thermal validation studies during the period 23 April to 2 May, 2011. The consultancy was carried out as per the standard guidelines of National Food Processors Association, USA and guidelines of Campden and Chorleywood Food Research Association, UK. The team also provided training to the management and technical staff of the company on various aspects of thermal process validation, retort operation and optimization of process for thermal processing of products from tuna in retortable pouches and rigid cans.

Design and development of machinery: Five indigenous processing machineries were designed and developed by the Fish Processing and Engineering Divisions of CIFT for the Pilot Plant under ZTM-BPDU project viz., Fish descaling machine, Pre-cooking unit, Steam cooking unit, Screw press and drying unit.

Business/Technology promotion activities

ICAR Industry Meet: The ZTM – BPD Unit coordinated all the fisheries institutes under ICAR, identified the most promising technologies and showcased in the ICAR Industry Meet, held at New Delhi on 23 May, 2011.

DG, ICAR at the Industry Meet

Innovations 4 Industry Meet in Crop Science: A Business meet titled "Innovations 4 Industry Meet in Crop Science" was organized by the ZTM-BPD Unit, Cochin along with NAARM, Hyderabad on 19 November, 2011 at Rajendranagar, Hyderabad for showcasing the innovations from seven prestigious Crop Science Research Institutions under Indian Council of Agricultural Research (ICAR). The Meet was organized as part of the business

Release of Video CD

ZTM-BPD Unit at 'Food 360°'

Mr. Ken Gossen, Executive Director, Food Processing Division, Alberta Agriculture and Rural Development, Canada sharing the Canadian experiences of business incubation

Dr. S. Mauria, ADG (IP & TM) during the inauguration of AgrIP-2011

incubation drive designed for the agricultural sector to promote entrepreneurs with the help of latest R&D facilities and vast knowledge available with ICAR. The event brought together innovators and entrepreneurs from the field of agriculture on a single platform.

A technology brochure titled "Innovations – A Technology Showcase in Crop Science" prepared by ZTM-BPD Unit, CIFT, Cochin was officially released by Dr. Swapan Kumar Dutta, DDG (CS), ICAR, New Delhi and a Video Film on "Crop Science Innovations" was released by Dr. Bangali Baboo, National Director, NAIP, ICAR, New Delhi. ICAR Institutes like DRR, Hyderabad, DOR, Hyderabad, DSR, Hyderabad, CRIDA, Hyderabad, CTRI, Rajahmundry, SBI, Coimbatore, NBAIIM, Bangalore, CIFT, Cochin and NAARM, Hyderabad participated in the technical sessions and show-cased their technologies in the exhibition.

ICAR Technology Pavilion at 'Food 360°' organized by FICCI: ZTM-BPDU participated in the International Conference-cum-Exhibition titled Food 360° organized by FICCI at Hyderabad during 20-22, November, 2011 and presented ICAR Technology Pavilion, representing the entire South Zone member Institutes and showcased the most promising technologies and products in the respective agricultural sector, to the renowned industry participants.

Business Incubation Outreach Programme: A "Business Incubation Outreach Programme" was organized on 8 December, 2011 at CIFT, Cochin as part of the business networking activities taken up by the ZTM-BPD Unit in collaboration with the Food Processing Division (FPD), Alberta Agriculture and Rural Development, Canada. An Industry Interface Meeting was also conducted with the participation of industry representatives from fisheries and other allied agricultural sectors.

Training imparted: ZTM-BPD Unit has imparted training to incubatees and entrepreneurs on various aspects during the year 2011-12. A total of 58 people were trained through these programmes.

Entrepreneurship development and capacity building programmes

AgrIP 2011: A workshop-cum-training programme on Intellectual Property and Technology Management titled AgrIP 2011 was organized by ZTM-BPD Unit, South Zone and ITMU, CIFT during 26-27 April, 2011. A total of 43 participants including Scientists and Research Scholars from the member Institutes under South Zone attended the programme.

Workshop on Advancements in purse seine fishing in India: A Workshop on "Advancements in purse seine fishing" was organized by ZTM-BPD Unit on 25 July, 2011 to sensitize the fishermen and potential entrepreneurs on the use of SONAR and power blocks to improve the efficiency of purse seine fishing. The incubation of entrepreneurs in the manufacture of indigenous power block was addressed. About 50 fishermen, purse seine operators and entrepreneurs attended the meeting.

Request has been sent to MPEDA, Cochin to intervene in the large mesh purse seining industry as it provides large sized and high valued fish with

immense export potential and provide fiscal support through subsidies for developing indigenous power block. CIFT has decided to provide onboard training on SONAR handling and fish shoal identification to be given to purse seine fishermen and ZTM-BPD Unit has enrolled prospective indigenous power block manufactures as incubatees.

Entrepreneurs' Meet on Developments in fishery waste utilization: An Entrepreneurs' Meet on 'Developments in fishery waste utilization' was organized on 21 October, 2011 at Visakhapatnam for sensitizing the entrepreneurs of the possibility of utilization for the production of chitin, chitosan and glucosamine; which have many industrial applications. Dr. A.A. Zynudheen, CoPI, ZTM-BPDU, Dr. L.N. Murthy, Scientist (Sr. Scale) and Dr. R. Venkateswarlu, Scientist, CIFT demonstrated the production of chitin and chitosan preparation to the prospective entrepreneurs. Shri Nithin Singh, Business Manager, ZTM-BPDU, South Zone explained in detail the business proposals for establishing chitin and chitosan plants. An interaction session was organized in which the queries raised by the entrepreneurs were addressed by the scientists. The technical session included five talks on fisheries scenario of Andhra Pradesh; production technology of chitin, chitosan, glucosamine; industrial applications of chitin and chitosan; utilization of waste from fish, and business overview of chitin and chitosan.

AgrIP 2012: The ZTM-BPD Unit, conducted AgrIP 2012, the Annual Meeting-cum-Workshop on Evaluation of agricultural technologies for commercialization during 24-25 February, 2012 at Cochin. The Meeting-cum-Workshop was aimed to provide an opportunity for member Institutes of ICAR South Zone to deliberate on the issues faced in IP management and technology commercialization. The workshop was inaugurated by Dr. A.S. Saroja, Principal, Govt. Law College, Ernakulam. Dr. T.K. Srinivasa Gopal, Director, CIFT gave presidential address and Dr. Sanjeev Saxena, Principal Scientist (IP & TM), ICAR, New Delhi and Dr. R. Kalpana Sastry, Principal Scientist & Head ARSMP, NAARM, Hyderabad gave felicitations. Shri Karthikeyan Iyer, Founder Director, Craffiti Consulting Pvt. Ltd. gave a talk on 'Technology evaluation and valuation frameworks' that covered topics like key dimensions of technology evaluation, technology potential, assessment of business potential etc. Dr. Surya Mani Tripathi, Scientist (IPR & Regulatory Affairs), ICRISAT, Hyderabad conducted a training session on 'Use of technology evaluation tools, methodologies and solutions in technology evaluation, its applications and implementation procedures'. The Officers-in-Charge of Institute Technology Management Units (ITMUs) and research associates from 20 ICAR Research Institutes in South Zone participated in the event.

Online Zonal Database Management System: ZTM-BPD Unit developed an Online Zonal Database Management System for the effective management and commercialization of technologies developed by the ICAR Institutes in the South Zone.

Assistance to the member Institutes: Provided assistance to the member Institutes under the South Zone:

Purse seine net hauling using Power Block

Entrepreneur's Meet on Developments in fishery waste utilization

Inaugural session of AgrIP 2012

Participants of AgrIP 2012

Agri-Business Camp organized at Cochin

ZTM-BPDU incubatee Shri Sultan Singh receiving the Best Incubatee award from Dr. A.P.J. Abdul Kalam

- In commercializing and protecting the intellectual assets, on a case to case basis.
- In formulating model licensing contracts/MoUs, business proposals and technology promotional materials.
- In effective IP management and technology transfer/commercialization.
- In database management of the intellectual assets.

Sponsored collaborative programme: An Agri-Business Camp was organized at Cochin by Small Farmers' Agri-Business Consortium (SFAC), in association with ZTM-BPD Unit, South Zone and Agri-Business Incubator (ABI) at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, on 25 January, 2012. The camp was aimed at facilitating the creation of new and competitive agri-business enterprises and sensitizing on funding opportunities through SFAC and their scheme to agribusiness.

Award: ZTM-BPDU, CIFT incubatee Shri Sultan Singh received the NIABI Award for "Best Incubatee" from Dr. A.P.J. Abdul Kalam, former President of India, for his enterprise excellence and the innovative technology ventures, in setting up integrated zero waste inland fish processing facility/ retail outlets of value added fish products, during the 2nd Network of Indian Agri- Business Incubator (NIABI) Global Conference held during 6–8 February, 2012 at New Delhi.

Institute Technology Management Unit

Intellectual Property Management and Technology transfer/ Commercialization Unit at Institute level, ie. IPM & TU was established by ICAR at Institute level to manage the issues related to Intellectual Property (IP) as per ICAR guidelines for Intellectual Property Management and Technology Transfer/Commercialization which is effective from 6 June, 2008. Institute Technology Management Committee (ITMC) is the high power committee to take the final decision on commercialization of technologies generated at the Institute.

Institute Technology Management Committee (ITMC)

At the Institute level, the ITMC chaired by Director of the institution is the highest decision making body relating to all issues of IP management and technology transfer/commercialization.

ITMC - Members

Dr. T. K. Srinivasa Gopal, Director	:	Chairman
Dr. Leela Edwin, HOD, FT	:	Member
Dr. C.N. Ravishankar, HOD, FP	:	Member
Dr. M. R. Boopendranath, PS	:	Member
Member Secretary, ITMU, CMFRI, Cochin	:	Member
Dr. T.V. Sankar, HOD, QAM	:	Member Secretary

ITMU - Members

Dr. T.V. Sankar, HOD, QAM	:	Officer In Charge
Dr. C.N. Ravishankar, HOD, FP	:	Member
Dr. K. Ashok Kumar, Senior Scientist	:	Member
Dr. Nikita Gopal, Senior Scientist	:	Member
Dr. A.R.S. Menon, Tech. Officer (T9)	:	Member
Shri M. Kirandas	:	Research Associate
Smt. K.A. Anju	:	Research Associate

Post Graduate Studies

Smt. K.K. Asha, Scientist, Biochemistry & Nutrition Division, CIFT, Cochin was awarded Ph. D. degree of Cochin University of Science and Technology, Cochin, for her thesis entitled, "Biochemical studies on protective effect of taurine in experimentally-induced fulminant hepatic failure in rats". She worked under the guidance of Dr. K. Devadasan, former Director, CIFT, Cochin.

Shri V.R. Madhu, Scientist, Fishing Technology Division, CIFT, Cochin was awarded a Ph. D. degree from Jawaharlal Nehru Technological University, Hyderabad for his thesis entitled, "Characteristics and quantification of trawl bycatch along Saurashtra coast, Gujarat, India". He worked under the guidance of Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi.

Ms Sneha Susan Simon, Research Fellow, Microbiology, Fermentation & Biotechnology Division, CIFT, Cochin was awarded a Ph. D. degree from Central Institute of Fisheries Education, Mumbai for her thesis entitled, "Ecology of psychrotrophic pathogens in packaged refrigerated seafoods". She worked under the guidance of Dr. K.V. Lalitha, Head, MFB Division, CIFT, Cochin.

Dr. V.R. Madhu

Dr. K.K. Asha

Dr. Sneha Susan Simon

Invited Talks

The following scientific/technical talks were delivered by experts at CIFT, Cochin:

- Shri Rajesh Kumar, Focuz Infotech India, Cochin - Enterprise Resource Planning (ERP) solutions for ICAR (19 May, 2011)
- Shri Ravi Shankar, Senior Manager, Informatics India Ltd., Bangalore - Effective utilization for e-Resources in agriculture (CeRA) resources (7 June, 2011)

Dr. Ambedkar E. Eknath

Mr. Ken Gossen

- Shri Paul Freeman, Technical Director, Stansted Fluid Power, U.K. - Overview of food lab systems (16 July, 2011)
- Dr. K. Ashok Kumar, Senior Scientist, CIFT, Cochin - National knowledge network (24 August, 2011)
- Dr. P. Pravin, Senior Scientist, CIFT, Cochin - Large mesh purse seine - An introduction (In Hindi) (24 August, 2011)
- Shri Vishnu K. Joshi, Consultant, LIMS, Bangalore - Implementation of Laboratory Integration Management System (31 October, 2011)
- Dr. Ambedkar E. Eknath, Director General, Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, Thailand - Role of NACA in aquaculture development and aquatic resource management (26 November, 2011)
- Mr. Ken Gossen, Executive Director, Food Processing Development Centre, Alberta, Canada - Business incubation - Canadian approach (8 December, 2011)
- Dr. P.C. Sarkar, Senior Scientist, IINRG, Ranchi - Applications of natural resins and gums (16 December, 2011)
- Smt. S. Sindhu, Chief Dietician, Medical Trust Hospital, Cochin - Health through better nutrition and disease management (17 December, 2011)
- Dr. H.S. Murali, Head, Microbiology Division, Defence Food Research Laboratory, Mysore - Biodefence - From India's perspective (21 March, 2012).

Representation in Committees

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

Dr. T.K. Srinivasa Gopal, Director

As Member

- Technical committee, Food Safety Standards Authority of India, New Delhi
- Technical committee, Fish and Fisheries Products, BIS, New Delhi
- Assessment committee for scientists, CFTRI, Mysore
- Board of Studies in Food Science and Technology, University of Mysore and University of Calicut
- Examiner for Ph.D. and M.F.Sc. in University of Mysore, CUSAT, Cochin, College of Fisheries, Mangalore, College of Fisheries, Panangad and College of Fisheries, Tuticorin
- Institute Management Committee, NRC Meat, Hyderabad
- Research Advisory Committee, CIPHET, Ludhiana

- Director Board, Lakshadweep Development Corpration
- Board of Studies, Faculty of Marine Sciences, CUSAT, Cochin

Dr. P.T. Lakshmanan, Head, Biochemistry & Nutrition Division

As Member

- Supervisory Audit Team for approving seafood export to EU
- Inter Departmental Panel of experts of EIA for approval of seafood processing plants for EU
- Subsidy committee, MPEDA, Cochin
- Examiner, M.Sc. Environmental Technology, CUSAT, Cochin
- Task force committee on fisheries, Govt. of Kerala

Dr. Leela Edwin, Head, Fishing Technology Division

As Member

- Task force for Gap analysis of ILO Convention No. 1882, Ministry of Labour and Employment, Govt. of India
- Board of Studies, Industrial Fisheries, CUSAT, Cochin
- Committee for the study of issues related to registration of fishing vessels
- Institute Management Committee, CIFRI, Barrackpore
- Institute Technology Management Committee, NRC for Banana, Thiruchirappalli and IISR, Kozhikode
- Working group on fisheries, Govt. of Kerala
- Expert committee, Coastal Area Development Agency for Liberation, Alappuzha
- Assessment committee set up under Career Advancement Scheme of Technical Personal, CMFRI, Cochin
- Question paper setter/Examiner for TANUVAS, University of Kerala, Thiruvananthapuram, Kerala Agricultural University, Thrissur, CUSAT, Cochin and Forest Research University, Dehradun

Dr. K.V. Lalitha, Head, Microbiology, Fermentation & Biotechnology Division

As Member

- Consultancy team to set up a biological testing laboratory for the Regional Shrimp Hatchery, Azhikode
- Inter Department Panel of experts for approval of fish processing plants for export to EU
- Doctoral committee, College of Fisheries, Mangalore and CUSAT, Cochin
- Examiner, M.F.Sc./M.Sc. and Ph.D., CIFE, Mumbai CUSAT, Cochin

Dr. T.V. Sankar, Head, Quality Assurance & Management Division

As Member

- Management Committee, CIBA, Chennai
- Inter Department Panel of experts for approval of fish processing plants for export to EU
- Section committee for fish and fishery products (FAD 12) and hygiene (FAD 15), BIS, Govt. of India
- Task force on Food safety in aquaculture initiated by NACA, Bangkok

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

As Member

- Expert committee for studying the proposal for setting up an MBA course in Faculty of Management in KUFOS, Cochin
- Sub-committee of Faculty of Management Studies for preparation of the Vision document and strategic plan, KUFOS, Cochin
- Examiner, B.F.Sc. and M.Sc. courses, TANUVAS, Tuticorin

Dr. C.N. Ravishankar, Head, Fish Processing Division & Head I/C Engineering Division

As Member

- Technical committee, Food Safety Standards Authority of India, New Delhi
- Inter Departmental Panel of Experts for approval of seafood processing plants for EU
- Technical committee, Fish and fishery products, BIS, New Delhi
- Technical committee, Establishment of Incubation Centres, NFDB, Hyderabad
- Subsidy committee, Cold storage scheme, MPEDA, Cochin
- Committee on Value added fish products, MPEDA, Cochin
- Committee on Upgradation of seafood packaging by MPEDA, CIFT and IFP
- Technical committee, Science and Societies, DST, New Delhi
- Review committee, DBT, New Delhi
- Examiner for Ph.D. and M.F.Sc. in College of Fisheries, Mangalore, Panangad, Ratnagiri, Verval, Tripura and Tuticorin

Dr. M.M. Prasad, Scientist Incharge, Visakhapatnam Research Centre

As Member

- Institute Management Committee, CIFRI, Barrackpore

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

Dr. R. Badonia, Scientist Incharge, Veraval Research Centre

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- 12th Five Year Plan formation committee of Gujarat Fisheries Department
- External examiner, College of Fisheries, Veraval and Barkatulla University, Bhopal

Dr. R. Chakrabarti, Scientist Incharge, Mumbai Research Centre

As Member

- Board of Studies, CIFE, Mumbai

Dr. M.R. Boopendranath, Principal Scientist

As Member

- Board of Studies in Industrial Fisheries and Marine Biology, CUSAT, Cochin
- Task force on Aquarium reforms in fisheries sector (Govt. of Kerala)
- Task force on Fisheries research (Govt. of Kerala)
- Expert Committee for the Diversification of aquaculture (Govt. of Kerala)
- Expert Committee on Registration of fishing vessels (Govt. of Kerala)
- Technical team for purchase of equipment for deep sea fishing project of Matsyafed
- Sub group for the preparation of 12th five year Plan of CMFRI, Cochin
- Sub committee for establishing Faculty of Ocean studies, KUFOS, Cochin

Dr. S. Sanjeev, Principal Scientist

As Chairman

- National Mirror Committee of ISO/TC 34/SC 9 on Microbiology, BIS, Govt. of India

As Member

- Inter Department Panel of experts of EIA for approval of seafood processing plants for EU
- Expert Group on Export of live bivalve molluscs constituted by EIC, Govt. of India
- Assessment Board for the approval of technologists of MPEDA at Cochin and Chennai
- Committee for monitoring the fish/shellfish growing waters at Padanna, Kasaragod dist. constituted by MPEDA, Cochin
- Expert panel - Implementation of MPEDA Logo Scheme

- Section Committee for fish and fishery products (FAD 12), BIS, Govt. of India

Shri P.K. Vijayan, Principal Scientist

As Member

- Project review and monitoring committee of DST project on Value addition of low value marine pelagic fishes at Tharangambadi, Tamil Nadu
- Inter Department Panel of experts for approval of fish processing plants for export to EU
- DPC, Coir Board, Cochin and MPEDA, Cochin
- Technology upgradation scheme for marine products, MPEDA, Cochin
- Interest subsidy committee for seafood processing units, MPEDA, Cochin

Shri M. Nasser, Principal Scientist

As Member

- Inland Harbour Crafts and Fishing Vessel Sectional Committee, Bureau of Indian Standards, New Delhi
- Transport Engineering Division Council, BIS, New Delhi
- Marine Engineering and Safety Aids Sectional Committee, BIS, New Delhi
- Committee for review of long pending infrastructure projects in fisheries sector, State Planning Board, Govt. of Kerala
- Expert committee for the finalization of the technical specifications of the mother vessels proposed to be procured by Lakshadweep Administration at Kavaratti

Dr. P. Pravin, Senior Scientist

As Member

- Expert committee on NFDB funding in Lakshadweep islands on various fisheries related projects
- Expert team to Lakshadweep islands for survey work of NFDB, CMFRI, CICEF, State Fisheries Department and UT of Lakshadweep

Dr. K. Ashok Kumar, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Assessment Board for the approval of technologists at MPEDA, Cochin and Chennai
- Expert group on Export of live bivalve molluscs constituted by EIC, Govt. of India
- Consultative committee for construction and modernization of fish markets with the financial assistance of NFDB, Hyderabad

- Expert group for review of standard conditions for sanitary import of various fish/fishery products of Ministry of Agriculture, Govt. of India
- Expert Committee for the construction of modern hygienic fish markets in all states, NFDB, Hyderabad

Dr. Saly N. Thomas, Senior Scientist

As Chairman

- Textile material for marine fishing purpose, Sectional Committee TX18, BIS, New Delhi

As Member

- Expert committee for selection of fishing net materials for supplying to fishermen of Kolleru lake, A.P.
- Paper setter for M.Sc. Industrial Fisheries, CUSAT, Cochin and B.F.Sc., KUFOS, Cochin

Dr. G. Rajeswari, Senior Scientist

As Member

- Regional Committee of MPEDA for evaluation of assistance in acquisition of GPS, Fish finder, Radiotelephone and Fish holds to fishermen of Mumbai

Dr. Femeena Hassan, Senior Scientist

As Member

- Interest subsidy committee, MPEDA, Cochin
- Inter Departmental Panel of experts for approval of seafood processing plants for EU

Dr. Suseela Mathew, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Examiner and question paper setter, B.F.Sc, KAU, Thrissur
- Examiner and question paper setter for Department of Marine Biology and Biochemistry, CUSAT, Cochin

Dr. V. Geethalakshmi, Senior Scientist

As Member

- Examiner for Ph.D. course thesis evaluation in Biostatistics of NIMHANS, Bangalore

Dr. M.P. Remesan, Senior Scientist

As Member

- Committee for the selection of Group C (Jr. Clerks) and Field Supervisors, MPEDA, Cochin

Dr. Nikita Gopal, Senior Scientist

As Member

- Expert committee for studying the proposal for setting up an MBA course in Faculty of Management in KUFOS, Cochin
- Committee to review the Freight assistance scheme foe value added products of MPEDA, Cochin
- Working group on ILO Convention 1882, Ministry of Labour and Employment, Govt. of India
- Sub-committee of Faculty of Management Studies for preparation of the Vision document and strategic plan, KUFOS, Cochin

Dr. A.A. Zynudheen, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Inter Departmental Panel for assessment of technologists, EIA, Cochin
- Board of examiners, M.Sc. Aquaculture, University of Calicut

Dr. R. Anandan, Senior Scientist

As Member

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

Dr. J. Bindu, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Board of examiners, M.Sc. Aquaculture, University of Calicut

Dr. U. Sreedhar, Senior Scientist

As Member

- Regional Committee of MPEDA for evaluation of assistance in acquisition of GPS, Fish finder, Radiotelephone and Fish holds to fishermen of Mumbai

Dr. George Ninan, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Committee for financial aid for setting up of modern ice plants constituted by MPEDA, Cochin
- Board of examiners, M.Sc. Aquaculture, University of Calicut
- Vidyalaya Management Committee, Kendriya Vidyalaya No. 1, Naval Base, Cochin

Dr. S. Ashaletha, Senior Scientist

As Member

- Examiner for PG courses, KAU, Thrissur

Dr. Sanjoy Das, Senior Scientist

As Member

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

Shri M.V. Baiju, Senior Scientist

As Memebr

- Expert committee for conversion of mechanized boats for deep sea fishing of Directorate of Fisheries, Govt. Kerala
- Committee for providing subsidy for conversion of fishing vessels to tuna long liners by MPEDA, Cochin
- Tender committee of RARS, Kumarakom to select the boat builder for the construction of research vessel
- Tender committee for the procurement of two research vessels for CMFRI, Cochin
- Tender committee for purchase of boats and fishing gears for Kerala Sustainable Urban development Project
- Committee constituted by KSINC, Cochin for evaluating the scarp value of the Barger Anupama and Aiswarya
- Working group for formulating the 12th Five Year Plan for Department of Fisheries, Govt. of Kerala
- Committee to prepare the requirement for the registration of fishing vessels for the Govt. of Kerala
- Technical committee constituted by the Director General of FSI to purchase new auxiliary engines with generator sets for the vessels Matsya Varshini and Matsya Darshini

Dr. B. Madhusudana Rao, Scientist (SG)

As Member

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

Dr. Toms C. Joseph, Scientist (SG)

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Consultancy team to set up a biological testing laboratory for the Regional Shrimp Hatchery, Azhikode

- Animal Ethics Committee, CMFRI, Cochin
- Institutional biosafety committee, College of Veterinary and Animal Sciences, KAU, Thrissur
- Committee for finalizing the technical specification and selection of ELISA equipment, MPEDA, Cochin

Dr. Rakesh Kumar, Scientist (Sr. Scale)

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Committee for finalizing the technical specification and selection of ELISA equipment, MPEDA, Cochin

Dr. J. Charles Jeeva, Scientist (Sr. Scale)

As Member

- Board of Examiners for Ph.D. programme, Madras University, Chennai
- Examiner for the UG and PG courses of CIFE, Mumbai, KAU, Thrissur, TANUVAS, Thoothukudi, CAU, Tura, Meghalaya and TNAU, Coimbatore

Dr. L.N. Murthy, Scientist (Sr. Scale)

As Alternate Member

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

Dr. S.K. Panda, Scientist (Sr. Scale)

As Member

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

As Alternate Member

- Expert group for drafting international standard (ISO/TC 234) on Traceability of shellfishes including crustaceans and molluscs

Dr. K.K. Asha, Scientist (Sr. Scale)

As Member

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

Dr. V.R. Madhu, Scientist

As Member

- Regional Committee of MEPEDA for evaluation of assistance in acquisition of GPS, Fish finder, VHF and Fishhold on-board mechanized fishing vessels

Dr. C.O. Mohan, Scientist

As Member

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

Dr. S. Visnuvinayagam, Scientist

As Member

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

Smt. P. Viji, Scientist

As Member

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

Dr. P.K. Binsi, Scientist

As Member

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

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

As Member

- Inter Media Publicity Co-ordination Committee (Kerala), Ministry of Information and Broadcasting, Govt. of India
- Editorial Board, Applied Science Periodicals, Siwan, M.P.
- Editorial Board as Chief Editor, Science India, Cochin

Visitors

The following were some of the dignitaries who visited the Institute during the period:

- Shri P.I. Shaik Pareeth, IAS, District Collector, Ernakulam (CIFT, Cochin on 26 April, 2011)
- Dr. S. Mauria, Assistant Director General (IP&TM), ICAR, New Delhi (CIFT, Cochin on 26 April, 2011)
- Dr. S. Ayyappan, Director General, ICAR, New Delhi (CIFT RC Visakhapatnam on 10 June, 2011)
- Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi (CIFT RC Visakhapatnam on 10 June, 2011)
- Dr. G. Syda Rao, Director, CMFRI, Cochin (CIFT RC Visakhapatnam on 10 June, 2011)

Dr. S. Ayyappan, Dr. B. Meenakumari and Dr. G. Syda Rao at CIFT RC, Visakhapatnam

Shri M.V. Baiju, Senior Scientist in discussion with Shri Ramesh Dawala

- Shri Ramesh Dawala, Honourable Minister of Fisheries, Govt. of Himachal Pradesh (CIFT, Cochin on 16 September, 2011)
- Dr. K. Kasturirangan, Member (Science) and Dr. Vandana Dwivedi, Joint Advisor, Planning Commission, New Delhi (CIFT, Cochin on 7 Decembe,r 2011)
- Dr. S. Girija, Director, NIFPHAT, Cochin (CIFT, Cochin on 8 March, 2012)
- Dr. Ramachandran Thekkedath, Vice Chancellor, CUSAT, Cochin (CIFT, Cochin on 14 March, 2012)

On-going Research Projects

Institute Projects

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
1.	Studies on fortified natural boicides and corrosion resistant composite materials for protection of fishing craft and gear	Dr. Saly N. Thomas	Cochin	Cochin	Dr. Leela Edwin Dr. P. Muhamed Ashraf
2.	Responsible line fishing	Dr. P. Pravin	Cochin	Cochin	Dr. Leela Edwin Dr. Saly N. Thomas Dr. M.P. Remesan Shri M.V. Baiju
3.	Responsible fishing using improved bottom and semi-pelagic trawls	Dr. M.P. Remesan	Cochin & Veraval	Cochin Veraval	Dr. M.R. Boopendranath Dr. P. Pravin Dr. V.R. Madhu Shri A.K. Jha
4.	Development of sustainable fishing technologies for exploitation of fishery resources in the east coast of India	Dr. G. Rajeswari	Visakha-patnam	Visakha-patnam	Dr. R. Raghu Prakash Dr. U. Sreedhar
5.	Development and evaluation of Juvenile Excluder Devices (JEDs) for trawl fisheries along east coast of India	Dr. R. Raghu Prakash	Visakha-patnam	Visakha-patnam	Dr. G. Rajeswari Dr. U. Sreedhar
6.	Post harvest processing of commercially important large pelagic, demersal and bycatch fishes for high value products for modern markets and NEH	Shri P.K. Vijayan	Cochin	Cochin	Dr. C.N. Ravishankar Dr. George Ninan Dr. Femeena Hassan Dr. J. Charles Jeeva
7.	Species-specific interventions in value addition of commercially important and emerging species of freshwater fish	Dr. George Ninan	Cochin	Cochin	Shri P.K. Vijayan Dr. A.A. Zynudheen Dr. J. Bindu Dr. R. Venkateswarlu

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
					Dr. P.K. Binsi Smt. P. Viji Dr. K.V. Lalitha Dr. Suseela Mathew
8.	Utilization of fish processing waste for the development of innovative products	Dr. A.A. Zynudheen	Cochin	Cochin	Dr. T.K. Thankappan Dr. George Ninan Dr. R. Anandan Dr. P.K. Binsi
9.	Innovative packaging techniques for processing and preservation of fish products	Dr. C.N. Ravishankar	Cochin	Cochin	Dr. K.V. Lalitha Dr. J. Bindu Dr. R. Venkateswarlu Dr. P.K. Binsi
10.	Technologies for utilization of fishery resources at Maharashtra	Dr. R. Chakrabarti	Mumbai	Mumbai	Shri S.P. Damle Dr. S. Vishnuvinayagam Smt. P. Viji
11.	Technological innovations on improved utilization and value addition of marine and cultured fishery resources in Gujarat	Dr. R. Badonia	Veraval	Veraval	Dr. C.O. Mohan
12.	Studies on the detection, surveillance and implications of hazard in seafood meant for export market	Dr. Femeena Hassan	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. P.T. Lakshmanan Dr. S. Sanjeev Dr. T.K. Thankappan Dr. K. Ashok Kumar Dr. L.N. Murthy
13.	Studies on effect of different processing methods, additives and natural preservatives on spoilage and pathogenic bacteria in fish and fishery products	Dr. S. Sanjeev	Cochin & Veraval	Cochin Veraval	Dr. T.V. Sankar Dr. C.N. Ravishankar Dr. K. Ashok Kumar Dr. Femeena Hassan Dr. K.K. Asha Dr. S.K. Panda Dr. C.O. Mohan
14.	Development of a Quality Index Scheme for commercially important Indian fishes	Dr. T.V. Sankar	Cochin, Veraval & Visakha-patnam	Cochin Veraval Visakha-patnam	Dr. S. Sanjeev Dr. K. Ashok Kumar Dr. Femeena Hassan Dr. S.K. Panda Dr. R. Venkateswarlu Dr. C.O. Mohan Dr. M.M. Prasad
15.	Assessment of microbial seafood safety hazards and bio-prospecting of aquatic microbial resources for enzymes	Dr. K.V. Lalitha	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. Sanjoy Das Dr. Toms C. Joseph Dr. Rakesh Kumar Dr. V. Murugadas Dr. B. Madhusudana Rao

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
16.	Bio monitoring of bivalve molluscs and crustaceans from Indian waters as health promoters and indicators of environmental contaminants	Dr. P.T. Lakshmanan	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. Suseela Mathew Dr. R. Anandan Dr. K.K. Asha Dr. B. Madhusudana Rao Dr. L.N. Murthy
17.	Bio-evaluation and purification of natural bioactive compounds of therapeutical and neutraceutical significance from aquatic resources	Dr. Suseela Mathew	Cochin	Cochin	Dr. P.T. Lakshmanan Dr. K. Ashok Kumar Dr. R. Anandan Dr. K.K. Asha
18.	Nutritional and pharmacological evaluation of marine molecules in alleviating diseases and disorders	Dr. R. Anandan	Cochin	Cochin	Dr. P.T. Lakshmanan Dr. Suseela Mathew Dr. A.A. Zynudheen Dr. Rakesh Kumar
19.	Nutritional profiling and hazard assessment of fish and fishery products of marine and lacustrine environs of east coast of India	Dr. M.M. Prasad	Visakha-patnam	Visakha-patnam	Dr. B. Madhusudana Rao Dr. L.N. Murthy
20.	Design and development of renewable energy, solar-biomass hybrid dryers	Dr. P.N. Joshi	Cochin	Cochin	Dr. S. Ashaletha Shri Ankur Nagori
21.	Consumer preferences and its impact on domestic fish marketing	Dr. Nikita Gopal	Cochin & Viskha-patnam	Cochin Viskha-patnam	Dr. V. Geethalakshmi Shri V. Radhakrishnan Nair Dr. S.K. Panda Smt. P. Jeyanthi Shri V. Chandrasekar Dr. B. Madhusudana Rao
22.	Studies on technology assessment and transfer among the client system	Dr. Balasubramaniam	Cochin, Veraval & Visakha-patnam	Cochin Verval Visakha-patnam	Dr. V. Geethalakshmi Dr. S. Ashaletha Dr. J. Charles Jeeva Smt. P. Jeyanthi Shri V. Chandrasekar Smt. Arathy Ashok Shri A.K. Jha Dr. R. Raghu Prakash Dr. B. Madhusudana Rao
23.	Assessment of harvest and post harvest losses in fisheries sector	Dr. V. Geethalakshmi	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. Nikita Gopal Shri V. Radhakrishnan Nair Shri V. Chandrasekar Smt. Arathy Ashok Dr. L.N. Murthy

ICAR (Plan Scheme)

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
24.	Zonal Technology Management - Business Planning and Development Unit	Dr. Leela Edwin Dr. C.N. Ravishankar	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. George Ninan Dr. A.A. Zynudheen Shri Nithin Singh (Business Manager) Shri Rakesh Thomas Kurian* Dr. Elizabeth Carolin* Shri P. Vineeth Kumar* Dr. B. Madhusudana Rao
25.	Intellectual property management and technology transfer/ commercialization	Dr. T.V. Sankar	Cochin	Cochin	Shri M. Kirandas* Smt. K.A. Anju*
26.	Nutrient profiling and evaluation of fish as a dietary component	Dr. T.V. Sankar	Cochin	Cochin	Dr. P.T. Lakshmanan Dr. Suseela Mathew Dr. R. Anandan Dr. K.K. Asha Shri A. Mathivanan* Shri Jones Varkey*
27.	Capacity building of coastal fisher-women through post harvest technologies in fisheries	Dr. C.N. Ravishankar	Cochin	Cochin	Ms. K.B. Biji*

NAIP Projects

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
28.	Responsible harvesting and utilization of selected small pelagics and freshwater fishes	Shri M. Nasser	Cochin	Cochin	Dr. Leela Edwin Dr. K.V. Lalitha Dr. S. Sanjeev Dr. R. Anandan Dr. V. Geethalakshmi Dr. S. Ashaletha Dr. P.K. Binsi Smt. Anju* Shri T.N. Nishil* Shri Daniel Raj* Shri Muhammed Azharuddin* Shri Ratheesh Mathew* Shri John Philip Corrya* Shri C.G. Rakesh* Ms. Rohan Maria Peter* Ms. E.S. Sumi*

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
					Ms. K. Rajeswari* Ms. Evangeline Francis*
29.	Bioprospecting of genes and allele mining for abiotic stress tolerance	Dr. Toms C. Joseph	Cochin	Cochin	Dr. K.V. Lalitha
30.	Oceanic tuna fisheries off Lakshadweep seas: A value chain approach	Dr. T.K. Srinivasa Gopal	Cochin & Laksha-dweep	Cochin	Dr. P. Pravin Shri M.V. Baiju Dr. K. Ashok Kumar Dr. Suseela Mathew Dr. J. Bindu Dr. Toms C. Joseph Shri K.V. Aneesh Kumar* Shri P.S. Khanolkar* Shri R. Yathavamoorthi*
31.	Studies on high pressure processing (HPP) on high value perishable commodities	Dr. J. Bindu	Cochin	Cochin	Dr. T.K. Srinivasa Gopal Dr. Sanjoy Das Dr. K.K. Asha Shri Ginson Joseph* Shri C.K. Kamalakanth*
32.	Mobilizing mass media support for sharing agro information	Dr. S. Ashaletha	Cochin	Cochin	Shri Aswin Antony*
33.	Utilization strategy for oceanic squids (cepahalopods) in Arabian sea: A value chain approach	(Dr. K.S. Mohamed, CMFRI, Cochin)	Cochin & Mumbai	Cochin	Dr. K.K. Asha Shri M.V. Baiju Ms K.R. Remyakumari*

MoES/CMLRE Projects

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
34.	Resource assessment of deep sea fishes along the continental slope of Indian EEZ	Dr. Suseela Mathew	Cochin & Visakha-patnam	Cochin Visakha-patnam	Shri Nav Jyothi Biswas* Dr. R. Raghu Prakash Dr. G. Rajeswari Shri Uma Maheswar Rao*
35.	Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies	Dr. M.R. Boopendra-nath	Cochin & Visakha-patnam	Cochin Visakha-patnam	Shri P.K. Vijayan Dr. T.V. Sankar Dr. M.P. Remesan Dr. Sanjoy Das Shri K. Predeep* Shri P.M. Vipin* Shri T. Jose Fernandez* Shri Renju Ravi* Dr. G. Rajeswari Dr. R. Raghu Prakash

DBT Project

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
36.	Isolation and characterization of collagen and gelatin from aquatic sources and development of pharmaceutical and food grade products of commercial importance	Dr. Suseela Mathew	Cochin	Cochin	Ms K. Shiny* Ms G.S. Hema*

DST Project

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
37.	Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala	Dr. Femeena Hassan	Cochin	Cochin	(Dr. Saleena Mathew, CUSAT, Cochin) Dr. J. Charles Jeeva

INCOIS Projects

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
38.	*In situ* time series measurements of bio-optical parameters off Cochin coast	Dr. P. Muhamed Ashraf	Cochin	Cochin	Shri S.S. Shaju* Ms. P. Minu* Shri B. Santhosh Kumar*
39.	Project validation of PFZ along Gujarat coast	Dr. V.R. Madhu	Veraval	Veraval	Shri Vishal Gohel*

SAC Projects

Sl. No.	Name of project	Principal Investigator	Location of project	Co-investigators	
40.	Euphotic zone production estimation using satellite data as an input to assess potential yield of pelagic herbivores in the Indian EEZ	Dr. P. Muhamed Ashraf	Cochin	Cochin	Shri P.H. Dhiju Das* Shri T. Baby*
41.	Coastal *in situ* data collection for Case - 2 algorithms	Dr. V.R. Madhu	Veraval	Veraval	Shri Shabir Ahmad Dhar*
42.	Measurement of inherent optical properties of seawater and development of satellite based algorithms	Dr. V.R. Madhu	Veraval	Veraval	Ms M.R. Roshini*

*Research Fellow

Papers Published in Refereed Journals

- Aneesh, K.V., Paresh, K., Pravin, P., Meenakumari, B. and Radhakrishnan, E.V. (2012) – First record of the pelagic Thresher Shark, *Alopsias pelagicus* (Pisces: Alopiiformes: Alopiidae) from the Lakshadweep sea, India, *Marine Biodiversity Records,* **5:** 1-2.
- Balasubramaniam, S., Charles Jeeva, J. and Ashaletha, S. (2012) – Adoption of quality management practices in seafood processing sector in Cochin region, *Fish. Technol.,* **49(1):** 80-86.
- Balasubramaniam, A., Meenakumari, B., Erzine, K., Boopendranath, M.R. and Pravin, P. (2011) – Estimation of drift gill nets selectivity for *Carrangoids papuensis* in Kanyakumari coast of South India, *Asian Fish. Sci.*, **24:** 62-77.
- Bindu, J., Ravishankar, C.N., Dinesh, K., Mallick, A.K. and Srinivasa Gopal, T.K. (2011) – Heat penetration characteristics and shelf life of ready to serve masheer curry in opaque reportable pouches, *Fish. Technol.*, **48(2):** 141-148.
- Binsi, P.K. and Shamsundar, B.A. (2012) – Purification and characterization of transglutaminase from four fish species: Effect of added transglutaminase on the viscoelastic behavior of fish mince, *Food Chemistry,* **132(4):** 1922-1929.
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- Charles Jeeva, J., Balasubramaniam, S., Ashaletha, S. and Jeyanthi, P. (2012) – Analysis of socio-economic variables and impact of Tsunami among the mechanized boat operators in Tamil Nadu, *Fish. Technol.,* **49(1):** 92-98.
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- Ferneena Hassan, Charles Jeeva, J. and Sangeetha K. Pratap (2012) – Economics of cost of compliance with HACCP in seafood export units and its limitations for applicability in domestic markets, *Indian J. Fish.*, **59(1):** 141-145.
- Geethalakshmi, V., Nikita Gopal and Murthy, L.N. (2011) – Capacity utilization in fish processing industry – A case study of Gujarat, *Fish. Technol.*, **48(2):** 171-174.
- George Ninan, Lalitha, K.V., Zynudheen, A.A. and Jose Joseph (2011) –

Effect of chilling on microbiological, biochemical and sensory attributes of whole aqua cultured Rainbow trout (*Oncorhynchus mykiss* Walbaum, 1792), *J. Aqua. Res. Dev.*, **3,** Special issue: Fisheries and Aquaculture Advancements S5-001 DOI: 10.4172/2155-9546.S5-001.

- George Ninan, Zynudheen, A.A. and Joseph, A.C. (2012) – A comparative study on the physical, chemical and functional properties of carp skin and mammalian gelatins, *J. Food Sci. & Technol.*, (DOI: 10.1007/s13197-012-0681-4).
- George Ninan, Zynudheen, A.A., Regina, M. and Joseph, A.C. (2011) – Effectiveness of spices on the quality and storage stability of freeze-dried fish balls, *Fish. Technol.*, **48(2):** 133-140.
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- Kamalakanth, C.K., Ginson, J., Venkateswarlu, R., Sanjoy Das, Chauhan, O.P. and Srinivasa Gopal, T.K. (2011) – Effect of high pressure on K-value, microbial and sensory characteristics of Yellow fin tuna (*Thunnus albacare*) chunks in EVOH films during chill storage, *Innovative Food Sci. & Emerging Technol.*, **12:** 451-455.
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- Pankaj Kishore, Lalitha, K.V., Toms C. Joseph and Nirmala Thampuran (2012) – Biotyping and antibiotic resistance profile of *Yersinia enterocolitica* associated with seafoods from south-west coast of India, *Fish. Technol.*, **49(1):** 64-71.
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- Pravin, P., Meenakumari, B., Baiju, M., Barman, J., Barauah, D. and Kakati, B. (2011) - Fish trapping devices and methods in Assam – A review, *Indian J. Fish*, **58(2):** 127-135.
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- Hand book of Fishing Technology (In Hindi) - B. Meenakumari, M.R. Boopendranath, P. Pravin, Saly N. Thomas, M.M. Prasad, G. Rajeswari, U. Sreedhar, R. Raghu Prakash and Prem Kumar (Eds.) (2011) 379 p.
- Fishing Methods of Chilka Lagoon - M.P. Remesan, P. Pravin, B.K. Pradhan and B. Meenakumari (2011)
- Nutritional Profiling and Nutritional Labeling of Seafoods - Suseela Mathew, P.T. Lakshmanan, R. Anandan, K.K. Asha and A.R.S. Menon (Eds.) (2012)
- CIFT Semi-pelagic Trawl Systems: An Ecofriendly Alternative to Bottom Trawling for Small-scale Mechanized Sector - M.R. Boopendranath, M.P. Remesan, P. Pravin and V.R. Madhu (2012) (English & Hindi versions)
- HACCP Workbook Version 1.1. - S.K. Panda, K. Ashok Kumar and T.V. Sankar (2012)
- Oyster Delights - Femeena Hassan, Saleena Mathew and Bably J. Vijayan (2012)

Shri Charan Das Mahanth, Honorable Minister of State for Agriculture, Govt. of India releasing the book on Hand book of Fishing Technology at ICAR Foundation Day Celebrations on 16 July, 2011

List of Personnel in CIFT

(as on 31 March, 2012)

Managerial Personnel

Director : Dr. T.K. Srinivasa Gopal

Heads of Division		
Biochemistry & Nutrition Division	:	Dr. P.T. Lakshmanan, Principal Scientist
Fishing Technology Division	:	Dr. Leela Edwin, Principal Scientist
Microbiology, Fermentation & Biotechnology Division	:	Dr. K.V. Lalitha, Principal Scientist
Quality Assurance & Management Division	:	Dr. T.V. Sankar, Senior Scientist
Extension Information & Statistics Division	:	Dr. S. Balasubramaniam, Principal Scientist
Fish Processing Division & Engineering Division (I/c)	:	Dr. C.N. Ravishankar, Principal Scientist

Scientist-Incharge of Research Centres		
Visakhapatnam Research Centre	:	Dr. M.M. Prasad, Principal Scientist
Veraval Research Centre	:	Dr. R. Badonia, Principal Scientist
Mumbai Research Centre	:	Dr. R. Chakrabarti, Principal Scientist

Administration & Accounts		
Senior Administrative Officer	:	Shri Charles Ekka
Finance & Accounts Officer	:	Shri C.J. Stephen

Other Personnel

HEADQUARTERS, COCHIN

Scientific Personnel

Principal Scientist

1. Dr. T. K. Thankappan
2. Dr. M.R. Boopendranath
3. Dr. S. Sanjeev
4. Shri M. Nasser

Senior Scientist

1. Dr. K. Ashok Kumar
2. Dr. Saly N. Thomas
3. Dr. P. Pravin
4. Dr. V. Geethalakshmi
5. Dr. Suseela Mathew
6. Dr. R. Anandan
7. Dr. Nikita Gopal
8. Dr. Femeena Hassan
9. Dr. M.P. Remesan
10. Dr. A.A. Zynudheen
11. Dr. S. Ashaletha
12. Dr. Sanjoy Das
13. Dr. J. Bindu
14. Dr. P. Muhamed Ashraf
15. Dr. George Ninan
16. Shri M.V. Baiju

Scientist (Selection Grade)

1. Dr. Toms C. Joseph

Scientist (Senior Scale)

1. Shri V. Radhakrishnan Nair
2. Dr. J. Charles Jeeva
3. Dr. Rakesh Kumar
4. Dr. K.K. Asha
5. Dr. S.K. Panda

Scientist

1. Dr. V.R. Madhu
2. Smt P. Jeyanthi
3. Dr. R. Venkateswarlu
4. Shri Ankur Nagori
5. Dr. P.K. Binsi
6. Dr. V. Murugadas
7. Shri C.G. Joshy
8. Smt. Arathy Ashok
9. Ms Jesmi Debbarma
10. Ms A. Jeyakumari
11. Ms. S. Remya
12. Ms V. Renuka
13. Smt. S.J. Laly

Technical Personnel

T-9 (Technical Officer)

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

T-6 (Technical Officer)

1. Shri C.R. Gokulan
2. Smt. K.B. Beena
3. Dr. K. Sobha
4. Shri V. Gopalakrishna Pillai
5. Dr. M. Baiju
6. Dr. G. Usha Rani

7. Smt. M.K. Sreelekha
8. Smt. T. Silaja
9. Smt. P.K. Shyma

T-5 (Technical Officer)

1. Shri T.N. Sukumaran
2. Shri Jose Kalathil
3. Smt. K.K. Sumathy
4. Shri Thomas Teles
5. Shri K.B. Thampi Pillai
6. Smt V.C. Mary
7. Shri K.P. Vijayan
8. Shri D. Padmanabhan
9. Shri T.R. Sreekumaran
10. Shri P.T. Viswambharan
11. Smt. M. Rekha
12. Shri C. Rajendran
13. Shri K.D. Jos
14. Dr. B. Ganesan
15. Smt. K.G. Sasikala
16. Smt. K.K. Kala
17. Shri Sibasis Guha
18. Shri P.S. Babu
19. Shri V.N. Dileepkumar
20. Shri G. Omanakuttan Nair
21. Shri P. Shankar
22. Shri T.V. Bhaskaran
23. Smt. G. Remani
24. Shri T. Gangadharan
25. Shri P.S. Nobi
26. Shri P.N. Sudhakaran
27. Shri Aravind S. Kalangutkar
28. Shri A.K. Unnikrishnan
29. Shri K.S. Leon
30. Smt. K.P. Leelamma
31. Shri P.S. Raman Namboodiri
32. Shri Arockia Sami
33. Smt. Ancy Sebastian
34. Shri Tomy Rebellow

T-4

1. Shri T.P. Haridasan : Carpenter
2. Smt K.S. Mythri : Senior Laboratory Assistant
3. Smt P.K. Geetha : Senior Laboratory Assistant
4. Shri C. Subash Chandran Nair : Project Operator
5. Shri K.K. Narayanan : Boilerman
6. Shri Sajith K. Jose : Draughtsman
7. Shri P.V. Sajeevan : Draughtsman
8. Shri V.K. Siddique : Refrigeration Mechanic
9. Smt. P.A. Jaya : Senior Laboratory Assistant
10. Shri T. Mathai : Senior Laboratory Assistant
11. Shri A.K. Naik : Mechanic

T-3

1. Shri T.P. Saju : Engineer - Civil
2. Shri P. Bhaskaran : Junior Library Assistant
3. Smt. N. Lekha : Junior Laboratory Assistant

4.	Shri P.D. Padmaraj	:	Junior Laboratory Assistant
5.	Smt. Bindu Joseph	:	Media Assistant
6.	Shri T.B. Assisse Francis	:	Driver
7.	Smt. N.C. Shyla	:	Field Assistant
8.	Shri N. Sunil	:	Plant Attendant
9.	Shri P.S. Sunil Kumar	:	Driver
10.	Shri R.N. Sahoo	:	Driver (Launch)

T-II-3

1.	Shri K.S. Babu	:	Turner

T-I-3

1.	Shri V.T. Sadanandan	:	Junior Laboratory Assistant

T-2

1.	Shri G. Gopakumar	:	Carpenter
2.	Shri V.A. Sudhakaran	:	Plumber
3.	Shri K.V. Mohanan	:	Driver
4.	Shri K. Nakulan	:	Driver
5.	Shri C.K. Suresh	:	Machine Operator
6.	Shri N. Krishnan	:	Junior Laboratory Assitant
7.	Shri K.D. Santhosh	:	Junior Laboratory Assistant
8.	Shri K. Dinesh Prabhu	:	Plant Attendant
9.	Smt. Tessy Fransis	:	Field Assisstant
10.	Shri T. Jijoy	:	Junior Laboratory Assistant
11.	Shri K.C. Anish Kumar	:	Junior Laboratory Assistant
12.	Dr. K.A. Martin Xavier	:	Field Assistant

T-1

1.	Shri G. Vinod	:	Junior Laboratory Assistant
2.	Shri Ajith V. Chellappan	:	Junior Laboratory Assistant
3.	Kum. N. Karthika	:	Junior Laboratory Assistant
4.	Shri M.T. Udayakumar	:	Junior Laboratory Assistant
5.	Smt. K. Reshmi	:	Junior Laboratory Assistant
6.	Kum. Anu Mary Jose	:	Junior Laboratory Assistant
7.	Smt. G. Archana	:	Junior Laboratory Assistant
8.	Shri V.N. Sreejith	:	Junior Laboratory Assistant
9.	Smt. P.J. Mary	:	Junior Laboratory Assistant
10.	Shri P. Suresh	:	Junior Laboratory Assistant

Administrative Personnel

1.	Shri R. Anilkumar	:	Admn. Officer
2.	Dr. C. Jessy Joseph	:	Dy. Director (Official Language)
3.	Smt. Pushpalatha Viswambharan	:	Asst. Admn. Officer
4.	Smt. K. Gracy	:	Asst. Admn. Officer
5.	Shri P. Krishna Kumar	:	Asst. Admn. Officer
6.	Shri T. Viswanathan	:	Asst. Admn. Officer
7.	Shri K.S. Sreekumaran	:	Asst. Fin. & Accts. Officer
8.	Shri P.P. Anil Kumar	:	Asst. Fin. & Accts. Officer
9.	Smt. V.P. Vijayakumari	:	Private Secretary
10.	Shri P.K. Reghu	:	Private Secretary

Assistant

1. Shri P.V. Venugopalan
2. Shri K.B. Sabukuttan
3. Smt. T.D. Usheem
4. Smt. P.K. Thankamma
5. Smt. A.A. Cousallia
6. Shri K.K. Sasi
7. Shri P. Padmanabhan
8. Smt. A.R. Kamalam
9. Smt. T.K. Shyma
10. Smt. V.S. Aleyamma
11. Smt. G.N. Sarada
12. Shri C.K. Sukumaran
13. Smt. V.K. Raji
14. Smt. K. Renuka
15. Shri M.N. Vinodh Kumar
16. Shri K. Das
17. Shri P.K. Somasekharan Nair

Personnel Assistant

1. Shri P.K. Raghu
2. Smt. S. Kamalamma
3. Smt. N. Leena
4. Shri K.V. Mathai
5. Shri R.D. Goswamy
6. Smt. Anitha K. John

Upper Division Clerk

1. Shri P. Mani
2. Smt. Jaya Das
3. Smt. P.R. Mini
4. Shri T.N. Shaji
5. Smt. A.R. Raji
6. Smt. E. Jyothilakshmy
7. Smt. Shiji John
8. Shri P.G. David
9. Shri Santhosh Mohan

Lower Division Clerk

1. Smt. G. Surya
2. Shri P. Rajeev
3. Smt. K.V. Suseela
4. Shri T.D. Bijoy
5. Shri Amit Vengraj
6. Shri P.P. George
7. Kum. Subin George
8. Smt. Suni Surendran
9. Kum K.S. Sobha
10. Kum. T. Deepa

11. Shri Deu Umesh Aroskar

Supporting Personnel

Skilled Support Staff

1. Shri M.R. Bharathan
2. Shri P.A. Sivan
3. Shri G.B. Mahanandia
4. Shri C.D. Parameswaran
5. Smt. C.G. Radhamoney
6. Shri E. Damodaran
7. Shri P.V. Raju
8. Shri A.V. Chandrasekharan
9. Shri M.M. Radhakrishnan
10. Shri K.K. Karthikeyan
11. Shri M.N. Sreedharan
12. Smt. U.K. Bhanumathy
13. Shri T.K. Rajappan
14. Shri O.P. Radhakrishnan
15. Shri P. Raghavan
16. Shri T.M. Balan
17. Shri V. Deepak Vin
18. Smt. P.T. Mary Vinitha
19. Shri K.R. Rajasaravanan
20. Shri K. Thinakaran
21. Shri P.N. Nikhil Das
22. Shri A. Vinod
23. Shri Kedar Meher
24. Shri K.S. Ajith

Auxilary

1. Shri M.T. Mani : Cook
2. Shri M.V. Rajan : Bearer

VISAKHAPATNAM RESEARCH CENTRE

Scientific Personnel

Senior Scientist

1. Dr. G. Rajeswari
2. Dr. R. Raghu Prakash
3. Dr. U. Sreedhar

Scientist (SG)

1. Dr. B. Madhusudana Rao

Scientist

1. Dr. L.N. Murthy

Technical Personnel

T (7-8) (Technical Officer)

1. Shri M.S. Kumar

T-6 (Technical Officer)

1. Shri K.V.S.S.S.K. Harnath
2. Shri C. Srihari Babu
3. Shri B.K. Panda

T-5 (Technical Officer)

1. Shri U. Alagumalai
2. Shri A.K. Panigrahi
3. Dr. Santhosh Alex
4. Shri Damodar Rout
5. Shri N. Venkata Rao

T-4

1. Shri K.C. Gopala
2. Shri P. Radhakrishna

T-3

1. Shri M. Venkateswara Rao
2. Shri M. Prasanna Kumar

T-2

1. Shri S.N. Dishri

T-1

1. Shri G. Bhushanam

Administrative Personnel

Assistant Administrative Officer

1. Shri G.C. Adhikari

Assistant

1. Smt. B. Hemalatha

Personal Assistant

1. Smt. D.A.L. Satyanarayanamma
2. Shri G. Chinna Rao

Upper Division Clerk

1. Shri Y. Kanakaraju
2. Shri S. Appa Rao

Lower Division Clerk

1. Shri D.L. Pattanaik

Supporting Personnel

Skilled Support Staff

1. Shri V.V. Ramana
2. Shri Sanyasi Ganik
3. Shri M.S. Prabhakar Rao
4. Smt. Nalla Naveena
5. Smt. Neelima Besra
6. Smt. Gyana Netri Nag

VERAVAL RESEARCH CENTRE

Scientific Personnel

Senior Scientist

1. Dr. G.K. Sivaraman

Scientist

1. Dr. C.O. Mohan
2. Shri A.K. Jha
3. Shri V. Chandrasekar

Technical Personnel

T-6 (Technical Officer)

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

T-5 (Technical Officer)

1. Shri K.U. Sheikh

T-2

1. Shri H.V. Pungera
2. Shri G. Kingsely

T-I-3

1. Shri S.H. Ummer Bhai

T1

1. Shri K. Ajesh
2. Shri J.B. Malmadi

Administrative Personnel

Assistant

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

Upper Division Clerk

1. Shri D.P. Parmar
2. Shri Arockia Shaji

Supporting Personnel

Skilled Support Staff

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

13. Shri P. Ramakrishna

Auxiliary

1. Shri J.K. Khodidas : Wash Boy

2. Smt. Veena Sreedhar Narkar : Coffee/Tea Maker

MUMBAI RESEARCH CENTRE

Scientific Personnel

Scientist

1. Dr. S. Vishnuvinayagam
2. Smt. P. Viji

Technical Personnel

T-6 (Technical Officer)

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

T-5 (Technical Officer)

1. Shri P.S. Gadankush

T-2

1. Shri T.A. Waghmare

Administrative Personnel

Assistant Administrative Officer

1. Shri M.S. Bhatkar

Assistant

1. Shri A.N. Agawane

Supporting Personnel

Skilled Support Staff

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

BURLA RESEARCH CENTRE

Technical Personnel

T-6 (Technical Officer)

1. Shri B.K. Pradhan

T-5 (Technical Officer)

1. Shri Kirtan Kisan

T-3

1. Shri H.S. Bag (Driver)

Administrative Personnel

Upper Division Clerk

1. Shri L.N. Badi

Supporting Personnel

Skilled Support Staff

1. Shri Jaisingh Oram
2. Shri T.N. Banchoor
3. Shri S.N. Dash
4. Shri S.K. Mehar