

Annual Report 2012-2013



Central Institute of Fisheries Technology

(Indian Council of Agricultural Research)

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



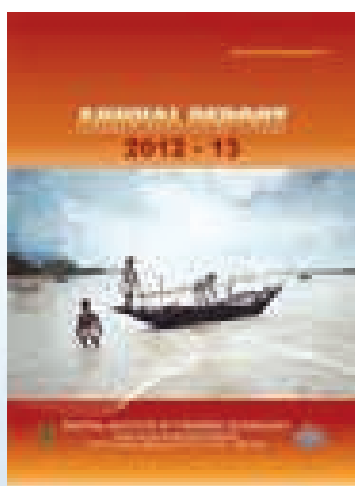
CIFT Annual Report 2012-2013

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Cover : Fishing in Hoogly river
Oil on canvas by Dr. P. Pravin

ISSN: 0972- 0667 Annual Report CIFT

Published by : **Dr. T.K. Srinivasa Gopal**
Director, CIFT
Compilation & Editing : **Dr. A.R.S. Menon**
Photo Editing : **Sibasis Guha/K.D. Santhosh**
Printers : **PrintExpress**, Ashoka Road, Kaloor,
Cochin - 682 017

June, 2013



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Abbreviations used in the text

AAS	- Atomic Absorption Spectrometer	DNA	- Deoxyribo Nucleic Acid
ABS	- Acrylonitrile Butadiene Styrene	DO	- Dissolved Oxygen
ABTS	- 2,2' Azino-bis (Bethylbenzothiazolin 6-Sulphuric acid)	DPPH	- Di Phenyl Picryl Hydrazyl
AC	- Alternate Current	DSC	- Deep Scattering Layer
ACHe	- Acetylcholine esterase	DST	- Department of Science and Technology
AFM	- Atomic Force Microscope	EAEC	- Entero Aggregative <i>E. coli</i>
AP	- Andhra Pradesh	EEZ	- Exclusive Economic Zone
APC	- Aerobic Plate Count	EHEC	- Entero Heamorrhagic <i>E. coli</i>
APFC	- Asia Pacific Fisheries Commission	EIEC	- Entero Invasive <i>E. coli</i>
APHA	- American Public Health Association	EIS	- Electrochemical Impedence Spectra
ASC	- Acid Soluble Collagen	ELISA	- Enzyme Linked Immuno Sorbant Assay
ASTM	- American Society for Testing and Materials	EPA	- Eicosa Pentaenoic Acid
ATCC	- American Type Culture Collection	EPEC	- Entero Pathogenic <i>E. coli</i>
ATIC	- Agricultural Technology Information Centre	ERIC	- Enterobacterial Repetitive Intergenic Consenses
BATH	- Bacterial Adhesion To Hydrocarbon	EST	- Expressed Sequence Tag
BCG	- Bromocresol Green	ETEC	- Entero Toxigenic <i>E. coli</i>
BCP	- Bromocresol Purple	ETP	- Effluent Treatment Plant
BHC	- Benzene Hexa Chloride	EU	- European Union
BIS	- Bureau of Indian Standards	EVC	- Ethylene Vinyl Chloride
BOBP	- Bay of Bengal Programme	EVOH	- Ethyl Vinyl Alcohol
BOD	- Biological Oxygen Demand	FAO	- Food and Agriculture Organization
BPD	- Business Planning and Development	FCR	- Feed Conversion Ratio
BRD	- Bycatch Reduction Device	FFA	- Free Fatty Acid
BTB	- Bromothymol Blue	FPH	- Fish Protein Hydrolysate
BV	- Biological Value	FRP	- Fibreglass Reinforced Plastic
CC	- Chilled Control	FS	- Faecal Streptococci
CCA	- Copper Chrome Arsenic	FTIR	- Fourier Transmission Infra Red
CCB	- Copper Chrome Boron	GAG	- Glycosaminoglycans
CDOM	- Chromophoric Dissolved Organic Matter	GHG	- Green House Gases
CFU	- Colony Forming Unit	GHP	- Good Hygienic Practices
CIFT	- Central Institute of Fisheries Technology	GIS	- Global Information System
CIPET	- Central Institute of Plastic Engineering Technology	GOI	- Government of India
CMFRI	- Central Marine Fisheries Research Institute	GSH	- Reduced Glutathione
CMLRE	- Centre for Marine Living Recourses & Ecology	GPS	- Global Positioning System
CNSL	- Cashew Nut Shell Liquid	GPx	- Glutathione peroxidase
COFISKI	- Community Fish Smoking Kiln	GR	- Glutathione Reductase
CPUE	- Catch Per Unit Effort	HACCP	- Hazard Analysis and Critical Control Point
CSH	- Cell Surface Hydrophobicity	HAP	- Hydroxyapatite
CT	- Chilled Treated	HDL	- High Density Lipoprotein
DC	- Direct Current		
DG	- Director General		
DHA	- Dicoxa Hexaenoic Acid		





HDPE	- High Density Poly Ethylene	Glucuronide	
HF	- High Frequency	NaCl	- Sodium Chloride
HIPP	- High Impact Poly Propylene	NAIP	- National Agriculture Innovation Project
HIPS	- High Impact Poly Styrene	NEH	- North East Hill
HL	- Head Less	NFDB	- National Fisheries Development Board
HLSO	- Head-less Shell-on	NGO	- Non Gazetted Organization
HO	- Head On	nm	- nano meter
HOBT	- High Opening Bottom Trawl	NPN	- Non Protein Nitrogen
HP	- High Pressure	NPU	- Net Protein Utilization
Hp	- Horse Power	OBM	- Outboard Machine
HPLC	- High Pressure Liquid Chromatography	OCP	- Organo Chloro Pesticide
HPP	- High Pressure Processing	OD	- Optical Density
HPV	- Hepatopancreatic Parvo Virus	PA	- Poly Amide
HSDT	- High Speed Demersal Trawl	PAH	- Poly Aromatic Hydrocarbon
HTST	- High Temperature Short Time	PANI	- Poly Aniline
ICAR	- Indian Council of Agricultural Research	PCA	- Per Chloric Acid
ICPAES	- Inductively Coupled Plasma Atomic Emission Spectroscopy	PCR	- Polymerase Chain Reaction
IHHNV	- Infectious Hypodermal Haematopoetic Necro Virus	PD	- Peeled and Deveined
ILC	- Inter Laboratory Comparison	PDC	- Pepsin Digestible Collagen
INCOIS	- Indian National Centre for Ocean Information Services	PE	- Poly Ethylene
IQF	- Individually Quick Frozen	PEG	- Poly Ethylene Glycol
IR	- Infra Red	PER	- Protein Efficiency Ratio
ISO	- Indian Standards Organization	PEST	- Poly Ester
JFE-SSD	- Juvenile Fish Excluder Cum Shrimp Sorting Device	PFS	- Potential Fishing Zone
KFDC	- Karnataka Fisheries Development Corporation	PP	- Poly Propylene
LCMS	- Liquid Chromatography Mass Spectrograph	Ppb	- parts per billion
LDL	- Low Density Lipoprotein	ppm	- parts per million
LDPE	- Low Density Poly Ethylene	PPS	- Probability Proportion to Size
LF	- Low Frequency	ppt	- parts per trillion
L _{OA}	- Length Over All	PRA	- Participatory Rural Appraisal
LOD	- Limit of Detection	PUD	- Peeled and Un Deveined
LPG	- Liquefied Petroleum Gas	PUFA	- Poly Unsaturated Fatty Acid
LPO	- Lipid Peroxidation	PV	- Peroxide Value / Photo Voltaic
LT	- Little Tuna	PVC	- Poly Vinyl Chloride
MBV	- Monodon Baculo Virus	QIM	- Quality Index Method
MDR	- Multi Drug Resistance	RC	- Revealed Competitiveness
MFP	- Myo Fibrillar Protein	RCA	- Revealed Comparative Advantage
Mpa	- Mega Pascal	RED	- Radial Escapement Device
MPEDA	- Marine Products Export Development Authority	ROS	- Reactive Oxygen Species
MPN	- Most Probable Number	RPLA	- Reverse Passive Latex Agglutination
mpy	- miles per year	rpm	- rotations per minute
MRM	- Multiple Reactions Monitoring	RRA	- Rapid Rural Appraisal
MRSA	- Methicillin Resistant <i>Staphylococcus aureus</i>	RSM	- Response Surface Methodology
MUFA	- Mono Unsaturated Fatty Acid	RS-PCR	- Ribosomal gene Spacer sequence PCR
MUG	- Methyl Umbelliferyl beta D-	RT	- Room Temperature
		RT PCR	- Reverse Transcriptase Polymerase Chain Reaction
		SAC	- Space Application Centre
		SDS-PAGE	- Sodium Dodecyl Sulphate - Poly Acrylamide Gel Electrophoresis
		SE	- Standard Error
		SEM	- Scanning Electron Microscopy
		SFA	- Saturated Fatty Acid
		SHG	- Self Help Group
		SJ	- Skip Jack



SLF	- Sustainable Livelihood Framework	TLC	- Thin Layer Chromatography
SOD	- Super Oxide Dismutase	TMA	- Tri Methyl Amine
SP	- Semi Pelagic	TMAN	- Tri Methyl Amine Nitrogen
SPT	- Semi Pelagic Trawl	TOC	- Total Organic Carbon
SPTS	- Semi Pelagic Trawl System	TOT	- Transfer of Technology
SRC	- Sulphite Reducing Clostridium	TPC	- Total Plate Count
SS	- Stainless Steel	TSH	- Total Sulphydral
SSOP	- Standard Sanitation Operation Procedures	TSS	- Total Soluble Sugar/Total Suspended Solids
STPP	- Sodium Tri Poly Phosphate	TVBN	- Total Volatile Base Nitrogen
TBA	- Thio Barbituric Acid	VC	- Vacuum Control
TBARS	- Thio Bartituristic Acid Reductase Substances	VHF	- Very High Frequency
TBC	- Total Bacterial Count	VNTR	- Variable Number Tandem Repeats
TCA	- Tri Chloro Acetic Acid	VT	- Vacuum Treated
TDS	- Total Dissolved Solids	WSSV	- White Spot Syndrome Virus
TDH	- Thermostable Direct Heamolysin	WTO	- World Trade Organization
TED	- Turtle Excluder Device	YF	- Yellow Fin
TFA	- Tri Flouro Acetic Acid	YHV	- Yellow Head Virus
TFS	- Tin Free Steel		
TIN	- Triangulated Irregular Network		





Preface



The year 2012-13 has been another year of notable achievements in the colourful history of the Central Institute of Fisheries Technology. As the Director, it is my proud and pleasant privilege to present the Annual Report of the Institute for the information and benefit of all policy makers, researchers and other stakeholders in the fisheries sector.

On the harvest side, the research on use of alternate wood materials for craft construction yielded encouraging results.

Rubber wood canoes designed by the Institute were found to be in good condition even after 10 years of field trials which proves it as a successful substitute for conventional boat building timber. Also the possibility of using cassava leaf extract as a good biopesticide against biodeterioration of wooden logs emerged out. Available data of the existing fishing gear materials and designs revealed an upward trend in the size of the net used, with the length of the head rope increasing significantly higher. During the year the Fishing Technology Division also designed and developed 26m multi seam (14 seam) demersal fish trawl and 28m eight seam fish trawl for exploitation of fishery resources. A new design of bag type stake net was fabricated with HDPE attached with 50mm square mesh window as BRD for elimination of juveniles.

The Fish Processing Division developed an intermediate moisture product from *Pangasius* fillet prepared by combination of pH modification, controlled microwave heating and drying technique which remained in acceptable condition for more than 45 days in chilled condition. Application of sous vide technique improved quality characteristics of chill stored Pabda fish. A ready to constitute fish curry from instant fish gravy mix with good shelf life in chilled condition was also developed. Chitin hydrolysate assessed for antimicrobial properties showed that a solution at 20-50 mg/mL markedly inhibited the growth of most gram-negative and gram-positive bacteria. Bio-availability of fish calcium powder prepared from Tuna and *Pangasius* tested in albino rats along with supplemented vitamin D and peptide showed that incorporation of vitamin D increased the absorption of calcium in rats. Ready to eat products from edible oyster meat like oyster fry (dry), oyster masala (semi gravy) and oyster curry were prepared in retortable pouches. Application of multiple hurdle technology by dipping in potassium sorbate, vacuum packing and sous vide processing extended the shelf life of Indian Mackerel significantly. Hydroxyapatite prepared from Catla and Rohu scales were tested for their efficacy in

removing the heavy metal content from aqueous solution of known concentration of heavy metals. The results indicated a significant reduction in the content of iron and toxic heavy metals.

The most significant achievement of the Quality Assurance and Management Division is the finalization of a Quality Index Method scheme for sensory grading of chilled Indian Mackerel with 14 sensory descriptors and total demerit score of 33. Principal component analysis indicated retention of prime quality of fish for initial five days of chilled storage. Most Probable Number method was observed to be the most suitable method for recovery and enumeration of injured *Vibrios* from high pressure processed shrimp. Studies on survival of *Vibrios* in high pressure indicated complete elimination of pathogenic *Vibrio* species. A depuration system designed for edible oyster could significantly reduce load of trace metals after 72 hours of depuration.

The Microbiology, Fermentation and Biotechnology Division could isolate a Methicillin-resistant coagulase positive *Staphylococcus aureus* from fish and PCR amplification of which showed presence of *mecA* gene. Real time PCR-based methods were standardized for quantitative detection of *Listeria monocytogenes* and *Shigella* spp. in seafood. Multi-drug resistance against six drugs (Cefpodoxime, Ticarcillin, Augmentin, Colistin, Ceftriaxone and Moxifloxacin) was found in 12% of the 60 non-O1, non-O139 *V. cholerae* isolates. But O1 strains were found sensitive to all the antibiotics tested. A low percentage (3.9%) of *E. coli* isolated from fish showed resistance to antibiotic Meropenem but Meropenem resistant *E. coli* were found resistant to Norfloxacin, Ciprofloxacin, Gentamicin, Amoxicillin, Penicillin, Methicillin, Nalidixic acid and Tetracycline. Bacteria tolerant to 20%





salt were identified as Genera Kocuria, Haererehalobacter, Staphylococcus and Bacillus. Biodegradable antimicrobial packaging film was prepared using chitosan incorporating ginger essential oil and its antimicrobial properties were evaluated against *S. aureus*.

The researches at the Biochemistry and Nutrition Division have shown that the Omega-3 fatty acids on lipid moiety of Tuna, Green mussel and clam are rich in dicosahexaenoic acid (DHA). The amino acid profiling showed that Cuttlefish, oysters and mussels are good sources of all essential amino acids. Glycine was found to be the prominent amino acid in mussel (21.25%), oyster (18.50%) and Cuttlefish (16.56%). Fatty acid profile of Green mussel, clam and Tuna indicated the presence of mono and poly unsaturated fatty acids in rich proportions. A non-enzymatic method and an enzymatic method were developed for the preparation of Oyster peptide extract possessing antioxidant and anti-inflammatory activities. A method has been developed for the isolation and purification of astaxanthin from deep sea shrimp and Blood-spotted swimming crab having good antioxidant activity. Studies on the antiaging effect of dietary chitosan supplementation in young and aged rats have shown that the dietary intake of chitosan was capable of restoring the depleted myocardial antioxidant defense and suggest that dietary chitosan is an effective therapeutic agent in treatment of age-associated disorders.

During the year, the Engineering Division could fabricate a prototype of solar fish dryer having a capacity of 5 kg using solar PV panels. They could also design and fabricate a 10 kg capacity fish meal plant. The portable and battery operated High Speed Digital Water Current Meter for water current measurements in Hoogly Estuary, West Bengal designed and fabricated by the Division comes handy for fishing operations in the river. A prototype of fish de-scaling machine was developed for de-scaling of small and medium sized fishes.

Data collected by the Extension, Information and Statistics Division from fishermen respondents at Thaikkal fishing village in Alappuzha district and Thayyil fishing village in Kannur district revealed that fishermen were involved in mainly 'Thangu vala' fishing (20 m ring seiners), disco vala fishing (14.5 m marine plywood 'vallams') and gillnet fishing with smaller 'vallams' (9 m). Fishermen respondents were interested in technology interventions in

the subject areas such as hygienic fish handling in the landing centres, reduction of post harvest loss, use of responsible fishing methods, use of improved packing methods for transport/sale, and production of value added fishery products. The extent of awareness and adoption of 10 selected improved practices were studied and escalating fuel costs, inadequate fuel subsidy, diminishing catches, lack of adequate measures for safety at sea and poor landing centre facilities were reported as operational constraints. Using a Probability Proportional to Size sampling design the energy use and GHG emission associated with Kerala fish processing sector were estimated. Harvest losses in marine fisheries was estimated from Ernakulam district as 1.14% for traditional sector, 3.65% for motorized sector, 14.15% for mechanized trawlers undertaking up to seven days fishing and 18.73% for trawlers fishing more than seven days.

During the period under report a total of 123 training programmes were organized both within the Institute campus and outside. The Institute participated in 22 exhibitions spread across the country. The Institute bagged many awards and recognitions also during the year. The Zonal Technology Management-Business Planning and Development Unit at CIFT was awarded a Certificate of Appreciation for the outstanding work on Establishment of Business Incubation Centre and Commercialization of Technology in Fish Processing from NAIP, ICAR, New Delhi. The Visakhapatnam Research Centre of CIFT was adjudged first in promoting the use of Official Language during the year 2011-12. Dr. Rakesh Kumar, Senior Scientist of the Institute received the 'Jawaharlal Nehru Award - 2011 for outstanding Doctoral Thesis by ICAR. The Institute provided technical guidance/consultancy on various topics related to the fisheries industry to as many as 10 interested entrepreneurs.

A series of workshops and seminars on various topics were conducted during the year on topics such as 'Gender in fisheries', 'Harvest and post harvest losses in fisheries', 'Intellectual property rights', 'Traditional knowledge and management systems in fisheries', 'Emerging technologies in fish processing', 'Energy saving in fishing vessels', 'Green fishing systems for the tropical seas', 'Business opportunities in freshwater fisheries', etc. A 21 days Winter School on 'Fish harvesting systems' was organized at Cochin during November-December, 2012 besides National trainings on 'Fish processing innovations and extension methods', 'Application of high pressure for food processing' etc. International trainings under TCS of Colombo Plan was imparted in two batches. About ten technology transfer programmes at NEH regions were carried out during the year besides programmes under Tribal Sub Plans in Kerala and Karnataka.

Details of the activities and achievements of the Institute during 2012-13 are given in the ensuing report. I hope it will be received well by all concerned. We shall be happy to get comments and suggestions for organizing our activities in the years to come.

(Dr. T.K. Srinivasa Gopal)
Director

Cochin
29 June, 2013





Executive Summary

- ◆ Fouling on high-density polyethylene (HDPE) twisted monofilament netting of 25 mm mesh size caused occlusion of mesh opening by 60% within two months of exposure to estuarine waters.
- ◆ Rubber wood canoes were found to be in good condition after 10 years of field trials which proves it as a successful substitute for conventional boat building timber.
- ◆ Cassava leaf extract can be used as a good bio-pesticide against biodeterioration of wooden logs.
- ◆ Studies on corrosion resistance of graphene and nano cerium oxide surface treated stainless steel revealed that the coating did not have much effect on corrosion resistance.
- ◆ Polyaniline-graphene-nano cerium composite for nano sensor application is being studied.
- ◆ The average CPUE of shrimps observed in the modified and 18m semi-pelagic trawls operated off Cochin was 0.16 kg/h and 0.69 kg/h respectively. The average catch in the modified net was 6.98 kg/hour and the CPUE realized for the 18m SPT was 10.5 kg/h.
- ◆ The total CPUE recorded in the cut-away top belly trawl operated along the coastal waters off Cochin was 7.0 kg/h. The CPUE for shrimps and fish were 1.05 and 1.93 kg/h respectively.
- ◆ The mean length of *Tenualosa ilisha* juveniles escaping from the bagnets installed with BRD was found to be 56.5 mm at Tribeni centre, Hoogly-Matlah estuary.
- ◆ Evaluation of empirical algorithm at a coastal site off Cochin revealed three water types based on chlorophyll a and chromophoric dissolved organic matter.
- ◆ Bench marking and development of database of existing fishing vessel designs and energy efficiency is initiated.
- ◆ Available data of the existing fishing gear designs revealed an upward trend in the size of the net used, with the length of the head rope increasing significantly higher when compared to other reports available from the region.
- ◆ Studies on the comparative efficiency of different synthetic materials revealed that there is a decrease of 42% breaking load and 36% elongation due to both wetting and knotting.
- ◆ A review of the different techniques used for preservation of coconut wood was carried out. A survey was also conducted to collect the details of traditional crafts used along the south west coast of India, covering the states of Goa, Karnataka and Kerala.
- ◆ Designed and developed 26m multi seam (14 seam) demersal fish trawl and 28m eight seam fish trawl for exploitation of fishery resources.
- ◆ A new design of bag type stake net was fabricated with HDPE attached with 50mm square mesh window as BRD for elimination of juveniles.
- ◆ Biodiversity of trawl resources and bycatch was estimated off Visakhapatnam from commercial trawlers.
- ◆ The carbon foot print was estimated from Visakhapatnam (61563 tons/year), East Godavari (51622 tons/year), Krishna (9010 tons/year), Guntur (15949 tons/year) and Prakasham (4272 tons/year).
- ◆ Fishing gear survey was conducted at Visakhapatnam, Kakkinada, Bhimili, Uppada, Vasavanipalem, Odalarevu, Golgonda, Jogumpeta, Ammapeta and Pappusettypalem fishing villages of Andhra Pradesh. Three main types of trawls operated by commercial trawlers and three types of ring seines operated by motorized boats were surveyed and published.
- ◆ Data collected during various deep-sea fisheries expeditions of Fisheries and Oceanographic Research Vessel (FORV) Sagar Sampada was analyzed. A total of 155 species belonging to 88 families and 33 orders are identified from the depths ranging from 50 -1100m.
- ◆ An intermediate moisture product from *Pangasius* (*Pangasionodon hypophthalmicus*) fillet prepared by a combination of pH modification (potassium sorbate and citric acid), controlled microwave heating and drying technique remained in acceptable for more than 45 days in chilled condition.
- ◆ Dip treatment of Rohu steaks in mint decoction has revealed that 1.5% of mint decoction was effective in reducing the





- ◆ chemical and microbial spoilage indices.
- ◆ Quality characteristics of Pabda (Ompok pabda) fish processed by sous vide technique indicated that both microwave and conventionally heated samples remained in acceptable condition for more than a month under chilled condition. However, vacuum packed control samples were to be rejected after 20 days of storage.
- ◆ Flash fried skinless boneless Pangasius fillets canned in TFS cans with refined oil had good textural properties and the water content was less than 10% which is a requirement for canned product.
- ◆ Vacuum packing of gutted Pabda fish under iced condition was carried out. Results indicated that samples remained in acceptable condition till 24 days of storage in ice, whereas control samples packed in PE pouches gave less satisfactory results and were rejected after 18 days of storage in ice.
- ◆ A prototype of fish de-scaling machine was developed for descaling of fishes. For carps, the de-scaling process requires 10 min. at 30 rpm and for tilapia it is 8 min. at 25 rpm. A patent application has been filed for the design and process.
- ◆ Chitosan in combination with collagen was found to be effective against *S. aureus*.
- ◆ Chitin hydrolysate assessed for antimicrobial properties showed that a solution at 20-50 mg/mL markedly inhibited the growth of most gram-negative and gram-positive bacteria.
- ◆ Feeding trials in albino rats with Rohu bone calcium and Tuna bone calcium-incorporated feed indicated that feed with Rohu bone calcium shows more retention than feed with Tuna bone calcium.
- ◆ Bio-availability of fish calcium powder prepared from Tuna and Pangasius tested in albino rats along with supplemented vitamin D and peptide showed that incorporation of vitamin D increased the absorption of calcium in rats.
- ◆ Fish rolls prepared from frame meat of Rohu had a shelf life of 17 days whereas frozen stored product remained in acceptable condition till seven months of storage at -20 °C.
- ◆ Collagen peptide derived from Rohu fish scale was found to be a cheap alternative source for bacteriological media.
- ◆ Mineral composition of offal generated from Croaker fish (*Johnius dussumerii*) indicated that head waste is rich in calcium (342.141 ± 10.83 ppm), potassium (82.47 ± 2.49 ppm) and sodium (60.33 ± 1.70 ppm).
- ◆ Partial replacement of fish meat in fish cutlet by soy protein showed that the product with a combination of 70% meat and 30% soy had better acceptability, textural parameters and storage stability than the conventional fish cutlet.
- ◆ Hydroxyapatite prepared from Catla and Rohu scales by a heat treatment method were found to be highly crystalline hydroxyapatite particles.
- ◆ Shelf life studies of chill stored Ghol (*Protonibea diacanthus*), Mahimahi (*Coryphaena hippurus*) and Horse mackerel (*Megalapsis cordyla*) packed under air and with O₂ absorber was found to have a shelf life of 24, 24 and 20 days for active packed samples compared to only 8, 10 and 9-10 days for control samples, respectively.
- ◆ Ready to eat products from edible oyster (*Crassostrea madrasensis*) meat like oyster fry (dry), oyster masala (semi gravy) and oyster curry were prepared in retortable pouches. The Fo value for oyster fry was 8 min., oyster masala 9 min. and oyster curry 8 min. The products were found to be acceptable even after a storage period of six months.
- ◆ Bromocresol purple (BCP), Bromocresol green (BCG) and Bromothymol blue (BTB) were used for development of freshness indicators for shrimps (*Parapenaeopsis stylifera*). BCP gave better indication of freshness and correlated well with the changes in volatile bases and sensory quality.
- ◆ Application of multiple hurdle technology extended the shelf life of Indian mackerel (*Rastrelliger kanagurta*) to 16 days in vacuum packed, 12 days in potassium sorbate treated and 18 days in sous vide treatment.
- ◆ High temperature short time (HTST) processing of fish curry using Cobia fillets in clear and opaque retort pouches was found acceptable based on biochemical and sensory evaluation even after a period of six months.
- ◆ Shelf life assessment of Long tail tuna (*Thunnus tonggol*) chunks packed under air and O₂ absorber during iced storage conditions revealed that chunks were in good condition up to 9-10 days for O₂ scavenger packs.
- ◆ The shelf life of high pressure treated (200 MPa, holding time - 5 min.) Yellowfin tuna (*Thunnus albacares*) chunks was extended to 28 days during chill storage. Control was rejected on 20th day of chill storage.
- ◆ High pressure treated (250 MPa) ready to cook condiment-incorporated prawns showed better acceptability and had a shelf life of 35 days at 2 ± 1 °C.
- ◆ High pressure (300 MPa) processed shucked oyster had shelf life of 28 days during chilled storage.
- ◆ Sensory evaluation of high pressure treated prawn curry showed that at higher pressure above 400 MPa the prawns were harder in texture.
- ◆ Effect of HP treatment on microstructure of Indian white prawn





(*Fenneropenaeus indicus*) at 250 MPa showed that muscles had a firmer texture than untreated sample and fibres look tightened and round.

- ◆ Combined effect of chemical (sodium acetate and potassium sorbate) with pulsed light treatment of Yellowfin tuna steaks packed in cast polypropylene pouch had shelf life extension of 13 days than control samples.
- ◆ Catla (*Catla catla*) fillets sprayed with commercial liquid smoke was found to have superior shelf life capacity than control.
- ◆ Ready to eat product from Kardi (*Palaemon* sp.) remained tasty and crispy during storage even after one year in sealed glass container at ambient temperature.
- ◆ Fish protein hydrolysate prepared from Bombay Duck (*Harpadon neherius*) meat utilizing the endogenous proteolytic enzymes exhibited good bioactive and functional properties.
- ◆ Hydrolysate prepared from marine Catfish roe using alkalase enzyme indicated good metal chelating and metal reducing properties, but poor Di Phenyl Picryl Hydrazyl (DPPH) radical scavenging activity.
- ◆ Chitin and chitosan hydrolysate was prepared from deproteinised Jawla shrimp. Chitosan hydrolysate solution at 20-50 mg/mL markedly inhibited the growth of most gram-negative and gram-positive bacteria tested.
- ◆ Hydroxyapatite (HAP) prepared from Catla and Rohu scales were tested for their efficacy in removing the heavy metal content from aqueous solution of known concentration of heavy metals. The results indicated a significant reduction in the content of iron and toxic heavy metals.
- ◆ A comparative evaluation was carried out on the quality characteristics of Pabda (*Ompok pabda*) fish processed by sous vide technique employing two different modes of heating viz. microwave oven heating and conventional heating. Both microwave heated and conventionally heated samples remained in acceptable condition for more than a month.
- ◆ Gelation characteristics as well as microbial inoculation study of surimi from *Pangasius hypophthalmicus* as affected by microwave heating indicating significant reduction in microbial count and solubility values of heat induced gel subjected to 60 and 90 sec. durations, whereas the gel heated for 30 sec. showed values similar to unheated sol.
- ◆ Treatment with salt followed by vacuum packaging considerably improved the quality characteristics of laminated Bombay Duck during one year storage period.
- ◆ Fermented fish procured from North-East India showed moisture content of 35.94% (range 31.14 to 41.98%), and fat 20.1% (range 13.01 to 29.54%).
- ◆ The biochemical, microbiological, textural and sensory analysis of Milkfish during iced-storage indicated that the quality loss was relatively faster in ice-stored gutted Milkfish compared to whole fish.
- ◆ Changes in the textural properties of *Penaeus monodon* and *Litopenaeus vannamei* during different processing methods and changes in textural properties of *L. vannamei* and *Metapenaeus monoceros* during soaking condition were studied.
- ◆ A new product Peeled Double Deveined (PDD) *Vannamei* was

made by removing the ventral bluish structure of *Litopenaeus vannamei* to improve appearance and quality.

- ◆ The biochemical quality of Horse mackerel caught from gillnet and single day trawlers was not significantly different.
- ◆ Blanching with 0.5 and 1.0% salt for 5 min. reduced the sun drying time by 15.5 and 17hrs respectively for shrimp (*Parapeaneopsis styliifera*) compared to samples dried without blanching. The yield was 6% less for the blanched samples compared to samples dried without blanching.
- ◆ Solar drying (58-60 °C) of shrimp reduced the drying time by 9 h compared to sun drying. Yield was 39.5 and 32.5% for sun and solar dried samples. Total volatile base nitrogen content was 15.53 mg N₂/100g for fresh shrimps which increased to 24.45 and 38.09 mg N₂/100g for solar and sun dried shrimps, respectively. Total mesophilic counts reduced from an initial 5.38 log cfu g⁻¹ to 2.0 and 2.39 log cfu g⁻¹ for solar and sun dried shrimps respectively.
- ◆ Dried air bladder of Ghol (*Protonibea diacanthus* Lacepede), Koth (*Otolithoides biauritus* Cantor), Threadfins (*Eleutheronema tetradactylum* and *Polydactylus* spp.), Catfish, Eel (*Muraenesox talabonoides*) etc. had very good export market. The protein content of dried air bladder of different fishes ranged between 90-95% and ash content was 3-4%.
- ◆ Collagen prepared from Threadfin bream scales had protein content of 92% and ash content of 6%. Total aerobic plate counts were 85 cfu/g and total Enterobacteriaceae, faecal Streptococci, *S. aureus* and *E. coli* were absent.
- ◆ Keeping quality of traditional Gujarati style shark curry under frozen storage was 10 months.
- ◆ Ginger essential oils were extracted using steam distillation by Clevenger's apparatus and antimicrobial properties at different concentration against *S. aureus* was evaluated.
- ◆ Barracuda (*Sphyrna jello*) steaks treated with 0.1, 0.2 and 0.3% ginger essential oil improved the flavor, odour and extended the shelf life under refrigerated





storage condition.

- ◆ Biodegradable antimicrobial packaging film was prepared using chitosan incorporating ginger essential oil and its antimicrobial properties were evaluated against *S. aureus* and physical properties were studied.
- ◆ A Quality Index Method (QIM) scheme for sensory grading of chilled Indian Mackerel (*Rastrelliger kanagartha*) was finalized with 14 sensory descriptors and total demerit score of 33. Principal component analysis indicated retention of prime quality of fish for initial five days of chilled storage.
- ◆ A draft QIM scheme validated with an array of biochemical, microbiological and instrumental parameters was developed for Oil Sardine (*Sardinella longiceps*).
- ◆ Challenge studies with enterohemorrhagic *Escherichia coli* O157 indicated that the pathogen could survive after freezing at $-40\text{ }^{\circ}\text{C}$ (90 minutes) and subsequent cold storage condition ($-18\text{ }^{\circ}\text{C}$) for more than 24 months in fish substratum.
- ◆ Most Probable Number (MPN) method was observed to be the most suitable method for recovery and enumeration of injured *Vibrios* from high pressure processed shrimp.
- ◆ Prevalence of *Vibrio alginolyticus* in seafood was found to be 60% in different markets across Kerala. This pathogen could survive up to 18 days in Yellowfin tuna during chilled storage.
- ◆ Survival of *Listeria monocytogenes* and *Staphylococcus aureus* during sous vide processing and further chilled storage was elucidated. *L. monocytogenes* could survive nine minutes cooking at $63\text{ }^{\circ}\text{C}$ in Red Snapper fillets, whereas 4.68 log reduction was observed for *S. aureus* in Tuna fish chunks cooked for 60 min. at $60\text{ }^{\circ}\text{C}$ without any appreciable reduction during chilled storage.
- ◆ The efficacy of an altered sanitation regime using a Response Surface Methodology optimized chlorination schedule was tested for real-time application in a fish processing plant.
- ◆ Phenolic extracts of *Averrohea bilimbi* and Pomegranate epicarp which possessed broad spectrum antibacterial activity against spoilage and pathogenic bacteria in seafood were characterized by LC-MS/MS.
- ◆ Studies on survival of *Vibrios* in high pressure (250 MPa; 6 min.) indicated complete elimination of pathogenic *Vibrio* species such as *V. cholerae*, *V. parahaemolyticus* and *V. vulnificus*.
- ◆ Studies on in situ survival of microflora in high pressure treated shrimp (*Fenneropenaeus indicus*) indicated that gram positive bacteria such as *Arthrobacter* spp., *Bacillus cereus*, *Brevibacterium* spp., *Paenibacillus lautus* and *Rhodococcus* spp. could be isolated from 600 MPa treated shrimps.
- ◆ Imported frozen fishery products tested for antibacterial substances showed positive for 20% of the sample, but banned antibiotics were not detected by using LC-MS/MS method.
- ◆ A depuration system designed for edible oyster (*Crassostrea madrasensis*) could significantly reduce load of trace metals after 72 hours of depuration.
- ◆ A ready to eat novel battered and breaded snack product named as 'Oyster pablano pepper fritter' prepared from edible oyster had shelf life of 14 days in chilled storage conditions.
- ◆ Studies on elemental composition of wastes generated during fish processing revealed significant content of Ca, K, Fe and Mg in Croaker head and Pinkperch viscera, which could be further utilized.
- ◆ A 4.00 Lakh litres per day energy efficient Effluent Treatment Plant (ETP) was designed and commissioned at Cochin Fishing Harbour, for Cochin Port Trust on a consultancy basis.
- ◆ Freshly caught Croaker from single day trawler maintained the keeping quality up to 14 days in refrigerated storage condition ($1-2\text{ }^{\circ}\text{C}$). *Pseudomonas* spp. and H_2S forming bacteria formed the major spoilage bacteria.
- ◆ Cryogenic freezing method like brine freezing reduced the freezing time and improved the quality of Tiger shrimps (*Peneus monodon*) compared to air blast frozen samples. Freezing loss and thawing loss was higher for air blast frozen shrimps (2.24 and 0.86% respectively) compared to brine frozen samples (1.84 and 0.38% respectively). Salt uptake was higher for brine frozen samples.
- ◆ Quality changes of cultured Tiger prawn (*P. monodon*) and White shrimp (*L. vannamei*) processed by IQF, plate freezing and air blast freezing methods were studied. Textural changes, freezing loss, thawing loss and cooking loss was least for IQF processed samples followed by plate freezing and air blast freezing. Water holding capacity was highest for IQF followed by plate freezing and air blast freezing. Textural and biochemical quality of Tiger prawn was slightly better compared to White shrimp.
- ◆ Textural changes of raw and cooked commercially important fish (Shark, Rays, Goatfish, Pinkperch, Lizardfish, Cod, Ribbonfish, Bigeye, Seabream, Longtail tuna and Dhoma) and shellfishes (Tiger prawn, Vannamei, Karikkadi, Brown shrimp, Squid, Cuttlefish and Octopus) were evaluated. Hardness, chewiness and springiness of cooked samples were better compared to raw samples. Hardness of Tiger prawn and White shrimp increased 4.0 and 4.8 times with cooking whereas





- chewiness increased 9.7 and 14.2 times respectively.
- ◆ Quality of fish mince from the initial and final section of the refiner of Pinkperch (*Nemipterus japonicus*) surimi processing was evaluated. Protein content of mince ranged between 14-16% and fat content ranged between 0.54-2.67%. Pathogens of human significance was absent in both the samples.
 - ◆ Seafood effluent discharge elevated the levels of microbial pollution indicators in the bar mouth of Bhidia landing centre.
 - ◆ Bromocresol purple gave better indication of freshness for shrimp and Cuttlefish compared to Bromothymol blue, Bromocresol green and mixed indicators.
 - ◆ Long tail tuna packed under control air was in good condition up to 5-6 days when compared to 9-10 days for O₂ scavenger packs in refrigerated storage conditions.
 - ◆ Histamine formation rate in Mackerel packed with oxygen absorber were compared to vacuum pack and control air packed samples in refrigerated conditions.
 - ◆ The level of cadmium in Squid was high in ink sac followed by skin, tentacle and edible part.
 - ◆ All Scombroid species of the local fish market of Vashi contained high level of histamine up to the level above 10mg%.
 - ◆ 67.74% of sample of Vashi fish market contained > 0.2 ppm lead. But, in case of cadmium, only 6.45% of samples exceed 0.05 ppm.
 - ◆ Enterotoxigenic (ETEC) and Enteropathogenic (EPEC) *Escherichia coli* were identified in 30 and 3.5% of the 225 *E. coli* isolates from 54 seafood samples.
 - ◆ A Methicillin resistant *Staphylococcus aureus* (MRSA) was isolated from fish and PCR amplification showed presence of *mecA* gene.
 - ◆ Out of 60 *Vibrio cholerae* non-O1 and non-O139 strains isolates from seafood studied, all strains were found negative for *ctx* and *zot* genes. Presence of *ace* was detected in 12.8% strains and regulatory *tox* genes in 91% strains.
 - ◆ *Yersinia enterocolitica* could not be detected in any of the 21 seafood samples collected from retail fish markets of Ernakulam district.
 - ◆ Thermophilic *Campylobacter* (*C. upsaliensis*) was detected in one out of 48 seafood samples from retail outlets of Ernakulam district.
 - ◆ *tdh* gene was not detected in any of the 153 *V. parahaemolyticus* isolates from 35 seafood samples.
 - ◆ Real time PCR-based methods were standardized for quantitative detection of *Listeria monocytogenes* and *Shigella* spp. in seafood.
 - ◆ Antimicrobial resistance to Ceftriaxone, a third-generation Cephalosporin antibiotic was found in one *L. monocytogenes* isolate from fish.
 - ◆ Three Enterotoxigenic *E. coli* (ETEC) isolates from fish were resistant to Moxifloxacin, a fourth-generation synthetic Fluoroquinolone antibacterial agent, while six isolates were resistant to Cephodaxime, a third-generation Cephalosporin antibiotic.
 - ◆ Multi-drug resistance (MDR) against six drugs (Cefpodoxime, Ticarcillin, Augmentin, Colistin, Ceftriaxone and Moxifloxacin) was found in 12% of the 60 non-O1, non-O139 *V. cholerae* isolates. But O1 strains were found sensitive to all of the antibiotics tested.
 - ◆ Sixteen multiple drug resistant strains of *Staphylococcus aureus* were isolated from fish sold in retail outlets at Ernakulam, Alappuzha and Kottayam districts.
 - ◆ Microbial profile of farmed Gourami fish (*Osphronemus goramy*) showed dominance of Genera *Enterobacter*, *Aeromonas*, *Exiguobacter*, *Pseudomonas*, *Bacillus* and *Staphylococcus*.
 - ◆ Microflora of farmed Catfish (*Pangasianodon hypophthalmicus*) was dominated by Genera *Pseudomonas*, *Aeromonas*, *Burkholderia*, *Stenetrophomonas*, *Micrococcus*, *Staphylococcus* and *Bacillus*.
 - ◆ Spoilage microflora of farmed Catfish was identified as Genera *Pseudomonas*, *Aeromonas* and *Burkholderia*. Pathogenic bacteria belonging to ETEC, *Aeromonas* and *Enterococcus* were detected.
 - ◆ Studies on survival of *Salmonella* in seafood at different temperature exposure (-20 °C, 4 °C, room temperature (RT) and 45 °C) showed that at 4 °C, there is a continual reduction in the cell count and cell reduction was sharper at -20 °C from Day 1 to 3 and viable *Salmonella* was not detected after Day 5.
 - ◆ Studies on differential expression of *Salmonella enterica* serovars Weltevreden virulent genes when compared to endogenous reference gene (*GAPDH*) showed that there was up-regulation of *rpo* gene and down-regulation of *fimA*, *inv*, and *stn* genes at RT. At high temperature (45 °C), 15-fold increase in *fimA* expression on Day 1 and expression of *rpoE*, *invA* and *stn* genes was down regulated 100 fold during one week incubation.
 - ◆ Exotic viral shrimp pathogens such as YHV and TSV could not be detected in any of the 61 and 48 shrimp/larvae samples tested.
 - ◆ Bacteria tolerant to 20% salt were identified as Genera *Kocuria*, *Haererehalobacter*, *Staphylococcus* and *Bacillus*.
 - ◆ Relative quantitative real-time RT-PCR assay for expression profiling of upregulated genes from cDNA SSH





library of *Mangroveibacter* spp. revealed that Glycine betaine/L-proline transport system has a major role in *Mangroveibacter* spp. for overcoming salt-stressed conditions.

- ◆ Of the 89 hydrocarbon degrading bacteria isolated from petroleum contaminated fishery environment under different pH and salt concentrations, the dominant genera were identified as *Kocuria*, *Haererehalobacter*, *Staphylococcus* and *Bacillus*.
- ◆ One potential plastic degrading bacterium was isolated from partially degraded plastic collected from landing centres and was identified as *Gordonia* spp.
- ◆ Comparative genomics analysis of *L. monocytogenes* and non-pathogenic *Listeria innocua* using bioinformatic tools revealed the presence of 41 genes including the genes encoding Listeriolysin (hly), Phosphatidyl inositol specific phospholipase C (plcA), zinc metalloprotease precursor (mpl), actin-assembly protein precursor (actA), DNA topoisomerase III etc. which were exclusively present in *L. monocytogenes*.
- ◆ All the *Salmonella* (n=12) isolated from marine fish were found positive for the presence of the virulence genes namely *invA* and *stn* gene.
- ◆ A low percentage (3.9%) of *E. coli* isolated from fish showed resistance to antibiotic Meropenem but Meropenem resistant *E. coli* were found resistant to Norfloxacin, Ciprofloxacin, Gentamicin, Amoxicillin, Penicillin, Methicillin, Nalidixic acid and Tetracycline.
- ◆ *Vibrio* isolates (75%) showed chitinase activity from Day 2, on media with 3% and 6% NaCl, at pH 7 and 9 and at temperatures 22 °C and 37 °C.
- ◆ All O1 and O139 *V. cholerae* produced chitinase; but chitinase production was variable in non-O1/non-O139 *V. cholerae*.
- ◆ Natural microbial culture media supplement from Rohu scales was prepared. Incorporation of peptide extract at 1% level in culture media supplemented the growth of *E. coli*.
- ◆ Plant extract was prepared from orange peel and mint leaf powder and the mint extract was shown to exhibit higher antioxidant and antibacterial activities.
- ◆ Microbiological analysis revealed that 20% of the fishes in the Vashi market were unfit for human consumption due to high level of *E. coli* contamination. Faecal Streptococci (FS) and Sulphite Reducing Clostridia (SRC) was found in very high level in the water used in the local fish market.
- ◆ Biochemical quality and microbial flora associated with Portunid crabs, Blue swimming crab (*Portunus pelagicus*) and Three-spotted crab (*P. sanguinolentus*) were evaluated. Total volatile bases were observed higher for Three spotted crab compared to Blue swimming crab. Among the microflora associated, *B. thermosphacta* dominated followed by *Pseudomonas* spp., H_2S forming bacteria, faecal Streptococci and *Lactobacillus* spp.
- ◆ Quality evaluation of air blast frozen male and female Blue swimming crab in different style (whole and cut crab) indicated microbial load of cut crab as slightly higher compared to whole crab. Female crab had better microbial quality.
- ◆ Biodegradable antimicrobial packaging film was prepared using chitosan incorporating ginger essential oil and its antimicrobial properties were evaluated against *S. aureus* and physical properties were studied.
- ◆ A total of 77 samples consisting of fresh, frozen and dried fish and shellfishes, ice and water were monitored for microbial quality like mesophilic bacterial counts, total Enterobacteriaceae, *E. coli*, *S. aureus*, Faecal Streptococci, *Salmonella*, *V. cholerae*, *V. parahaemolyticus* and *Listeria monocytogenes*.
- ◆ The *E. coli* isolates were confirmed by streaking on to EMB agar (small, dark with green metallic sheen colonies) and IMViC tests and *S. aureus* on Mannitol Salt Agar (Oxoid) and Rabbit coagulase plasma (Difco) and faecal Streptococci by catalase test. The isolates were preserved in liquid paraffin for further PCR characterization.
- ◆ *S. aureus* occurrence was 43.52% in seafood of which 12.77% were coagulase positive strains.
- ◆ Nearly 86.6% of the coagulase positive *S. aureus* bacteria were positive for beta lactamase production.
- ◆ Evaluation of biochemical composition of common food fishes and shellfishes indicated that squid and Cuttlefish have higher levels of protein; ie. 24.12 and 25.45%, respectively. Under the category Finfishes, Tuna had the highest level of protein (~20%) and fat (~4%). Protein content in oysters and mussels were 17.5 and 17.25% respectively. Clams had the lowest level of protein (7.25%).
- ◆ The amino acid profiling showed that Cuttlefish, oysters and mussels are good sources of all essential amino acids. Glycine was found to be the prominent amino acid in mussel (21.25%), oyster (18.50%) and Cuttlefish (16.56%). Fatty acid profile of Green mussel, clam and Tuna indicated the presence of mono and poly unsaturated fatty acids in rich proportions.
- ◆ Omega-3 fatty acids compositional studies on lipid moiety of Tuna, Green mussel and clam have shown that they are rich in docosahexaenoic acid (DHA).
- ◆ Proximate composition and nutrient profile of edible Jellyfish (*Rhopilema* sp.) caught from Arabian sea off Cochin revealed essential amino acids (especially Valine, Isoleucine, Leucine





and Threonine) and non-essential amino acids (Alanine, Glycine, Glutamic acid and Aspartic acid) in considerable quantities, suggesting that the species may be effectively utilized in poultry, fish and animal feed formulations.

- ◆ Jellyfish is rich in elements such as Fe, Mn, Zn and Se.
- ◆ In vitro investigations on the antioxidant potential of Cuttlefish ink revealed its utility in attenuating oxidative deterioration and nutraceutical formulations.
- ◆ A non-enzymatic method and an enzymatic method were developed for the preparation of Oyster peptide extract possessing antioxidant and anti-inflammatory activities.
- ◆ In vitro and in vivo studies on antioxidant defense of Opex (Oyster peptide extract) revealed its potential utility in ameliorating neurological dysfunction associated with reactive oxygen species-induced oxidative stress in experimental animals.
- ◆ A method has been developed for the isolation and purification of astaxanthin from deep sea shrimp and Blood-spotted swimming crab (*Portunus sanguinolentus*) having good antioxidant activity.
- ◆ A simple and cost effective method was developed for the preparation of fatty acid ethyl esters from sardine oil.
- ◆ A multi residue QuEChERS based method for analysis of 22 Organo Chloro Pesticides (OCPs), 15 Poly Aromatic Hydrocarbons (PAHs) and 82 multiclass currently used pesticides in fatty fish muscle involving a triple partitioning extraction between water, acetonitrile and hexane followed by dispersive clean-up was developed that considerably reduced lipid co-extracts prior to GC-MS/MS analysis.
- ◆ A modified HPLC method for the determination of amino acid composition in fish and fishery products was developed.
- ◆ Studies on the antiaging effect of dietary chitosan supplementation in young and aged rats have shown that the dietary intake of chitosan was capable of restoring the depleted myocardial antioxidant defense and suggest that dietary chitosan is an effective therapeutic agent in treatment of age-associated disorders.
- ◆ Oral intake of glutamine counteracted the Ibuprofen-induced oxidative stress in ulcerated rat mucosa.
- ◆ The dietary chitosan intake ameliorated the age-associated hypercholesterolemic aberrations in experimental rats.
- ◆ A simple modified method for the purification and isolation of collagen from aquatic sources was developed.
- ◆ Succinyl chitosan was synthesized and characterized with the help of IR spectroscopy and atomic force microscopy. This synthetic polymer may serve as an effective tool in micro/nano encapsulation of nutraceuticals for controlled and efficient drug delivery.
- ◆ The gel strength of surimi prepared from Threadfin bream was highest followed by Bigeye, mixed surimi from Croaker and Lizardfish, Ribbonfish and Goatfish. Mixing different varieties of fish improved the gel strength of surimi.
- ◆ Oil recovery from surimi waste was more in heat extraction method (50.62%) compared to solvent extraction method (4%). Fat oxidation and hydrolysis reduced significantly for the surimi oil with natural antioxidant.

- ◆ Development of cost effective and eco-friendly slurry ice machine using renewable energy is in progress.
- ◆ Fabricated a prototype of solar fish dryer having a capacity of 5 kg using solar PV panels.
- ◆ Designed and fabricated a 10 kg capacity fish meal plant.
- ◆ Designed and developed an Electronic Power Generator using solar pv panels.
- ◆ Designed and fabricated a portable and battery operated High Speed Digital Water Current Meter for water current measurements in Hoogly Estuary, West Bengal.
- ◆ Re-fabricated the head cutting machine of Tuna with reduced RPM and other modifications in feeding and collection mechanisms.
- ◆ Data collected from fishermen respondents at Thaikkal fishing village in Alappuzha district and Thayyil fishing village in Kannur district revealed that fishermen were involved in mainly three categories of fishing such as 'Thangu vala' fishing (20 m ring seiners), disco vala fishing (14.5 m marine plywood 'vallams') and gillnet fishing with smaller 'vallams' (9 m).
- ◆ Fishermen respondents were interested in technology interventions in the subject areas such as hygienic fish handling in the landing centres, reduction of post harvest loss, use of responsible fishing methods, use of improved packing methods for transport/sale, and production of value added fishery products. The extent of awareness and adoption of 10 selected improved practices were studied among the fishermen respondents.
- ◆ Data were also collected from 34 fisherwomen in Njarakkal fishing village (Ernakulam) and 10 fisherwomen respondents in Quilandi fishing village (Kozhikode). It was seen that all the respondents were interested in food/fish based micro enterprises and expressed their interest in attending a training on the production of value added fishery products.
- ◆ Rapid Rural Appraisal (RRA) techniques were used in the four centres and the technological interventions were determined.





- ◆ Lack of access to the research/extension organizations and lack of awareness on availability of technologies were reported as constraints in obtaining technologies.
- ◆ The social participation of the fishermen was observed to be restricted to membership in Co-operative Societies and the major sources of information for improved technologies were reported to be their friends and fellow fishermen.
- ◆ Escalating fuel costs, inadequate fuel subsidy, diminishing catches, lack of adequate measures for safety at sea and poor landing centre facilities were reported as operational constraints.
- ◆ The fishermen/fisherwomen respondents preferred participatory extension models involving the fisherfolk/voluntary organizations. The other preferred technology transfer models were mobile based extension/advisory services, and horizontal transfer through peer groups/progressive fishermen.
- ◆ Under the study on the economic efficiency of the fishing units, it was seen that 17% fisherfolk of Alappuzha district and 23% of fisherfolk of Ernakulam district were operating ring seines. The variables for assessing the economic efficiency of fishing units were finalized.
- ◆ A Canonical discriminant function analysis was done on socio-economic variables and technology adoption indicators from data collected among fishermen operating OBM crafts in four districts of Kerala.
- ◆ Using a Probability Proportional to Size sampling design, a sample of 63 fish processing plants were selected, and the energy use and GHG emission associated with Kerala fish processing sector were estimated. The CO₂ equivalent per kg of the finished product was computed as 0.487 kg at 50% production capacity and 0.397 kg at 33% production capacity.
- ◆ von Bertalanffy growth model was fitted to the growth data on carps stocked at Kanjirapuzha reservoir and annual growth rates of Catla and Mrigal obtained were 0.69 and 0.60. Virtual population analysis was done on the data on length-weight of Catla and Mrigal, using Jones Length Cohort Analysis.
- ◆ Biomass for exploitation available in the reservoir for Catla was estimated as 33 tonnes and Mrigal was estimated as 209 tonnes.
- ◆ Density-dependent growth model suggested by Lorenzen (1996) was employed to suggest appropriate stocking regime to Kanjirapuzha reservoir.
- ◆ A two phase sampling design was developed for the study on fuel efficiency of mechanized fishing system and to classify the mechanized fishing fleet spread along the nine coastal districts and to standardize a mechanized fishing system for fuel efficiency. In the first phase, utilizing a large sample, a database on dimensions, hardware components and vessel operating behavior of the existing mechanized fishing fleet of Kerala was created.
- ◆ Response surface methodology was used to study the optimum process parameters for extraction of glucosamine hydrochloride.
- ◆ Based on two-stage sampling methodology developed for estimation of seafood waste from processing sector, quantity of waste generated annually was estimated.
- ◆ Conjoint model was fitted to consumer preference data comparing innovative fish products and other snack products. The part-worth utilities estimated for various product combinations showed high preference for fish-based snack food.
- ◆ Harvest losses in marine fisheries was estimated from Ernakulam district as 1.14% for traditional sector, 3.65% for motorized sector, 14.15 for mechanized trawlers undertaking up to seven days fishing and 18.73% for trawlers fishing more than seven days. Estimates were also computed by utilizing information on number of hauls during the fishing trip which were more precise than the usual estimator.
- ◆ Post harvest losses in pre-processing sector was estimated for Ernakulam and Alappuzha districts as 0.38% whereas the losses amounted to 1.19% in processing sector. Loss estimates computed for dry fish production stood at 36.97% and wholesale marketing of dry and fresh fish recorded 7.56% and 3.79% losses. From retail marketing of fresh and dry fish, 3.13% and 8.23% losses were reported whereas road-side market channel reported losses of 2.54% and 5.43% for fresh and dry fish, respectively.
- ◆ The extent of harvest losses at landing centres of Nagarjunasagar reservoir was assessed as 8 to 10%. The causes were discards of spoiled fishes due to physical damages in entangling, discards of dead fishes in the nets, spoilage due to adverse weather, spoilage due to non-usage of ice, spoilage due to delay in taking out the already caught fishes from gillnets, etc.
- ◆ Preliminary study and analysis of the data of boat building facilities throughout Kerala has been made.
- ◆ Data collection based on general technology changes with respect to size, type and power of boats, construction materials, equipment use, and operational methods on-board fishing vessels were made.
- ◆ Documentation of profiling of mechanized fishing system presently in use with respect to hull characteristics, construction methods, installed power, propulsion characteristics and on-board equipments was done.





- ◆ Survey conducted among fishermen engaged in gillnet fisheries using FRP crafts with out-board engines of 9-10 Hp in Vasuvanipalem and Peddajalaripeta fishing villages of Visakhapatnam revealed that the mean average investment on the fishing system was ₹ 3.12 lakhs with an average number of fishing days of 289 per year. Investigations on fishermen awareness and adoption of various fishing related innovations and practices showed that majority of them belong to medium level of awareness and adoption.
- ◆ As a part of assessing the role, functioning and gendered impacts of stakeholder organizations in fisheries, a study was conducted on fisherwomen Co-operative Societies of Visakhapatnam. During the survey it was found that membership in Co-operative Societies is imperative for fisherwomen to get access to many government schemes. The livelihood outcome of fisherwomen Co-operatives Society members showed an average income of ₹ 2727.30 per month from fish drying and curing activities.
- ◆ Study was conducted on the impact of introduction of Pacific white shrimp in Andhra Pradesh. Data was collected from aqua farmers, processors/exporters and administrator regarding perceived reason for wide spread adoption of Pacific white shrimp and its perceived socio-economic and environmental impacts.
- ◆ Surveyed the gillnetters of Veraval and collected data regarding fuel consumption.
- ◆ Questionnaires were prepared to collect the information about economics of dry fish like Ribbonfish, Horse Mackerel and Croakers by traditional sun drying method at Veraval.
- ◆ The mean benefit/cost (B/C) ratio observed during experimental fishing in the PFZ and NPFZ locations were 1.42 ± 0.12 and 1.21 ± 0.11 respectively.



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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 29th 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 1st October, 1967.

The Institute is the only national centre in the country where research in all disciplines relating to fishing and fish processing is undertaken. Research Centres at present function at 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 Senior 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 (ATIQC). 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 and engines. 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 2012-2013 - In Lakhs)

Particular	Non-Plan		Plan	
	Allocation	Expenditure	Allocation	Expenditure
Establishment charges	2087.00	2079.36	-	-
Overtime allowances	0.50	0.40	-	-
Traveling allowances	18.00	17.99	50.00	50.00
Works (Maintenance)	92.00	101.10	-	24.04
Other charges (Equipments)	30.00	29.97	95.00	94.89
Other charges (Contingency)	134.00	122.89	440.00	440.04
Furnitures and fixtures	10.00	9.98	25.00	24.93
library books	2.00	1.99	30.00	29.98
Other items	1.00	0.99	-	-
Vehicles and Vessels	-	-	14.00	13.64
Infonnation Technology	-	-	25.00	24.99
NEH Programmes	-	-	50.00	50.00
Tribal Sub Plan	-	-	10.00	10.00
Total	2374.00	2364.67	739.00	738.47

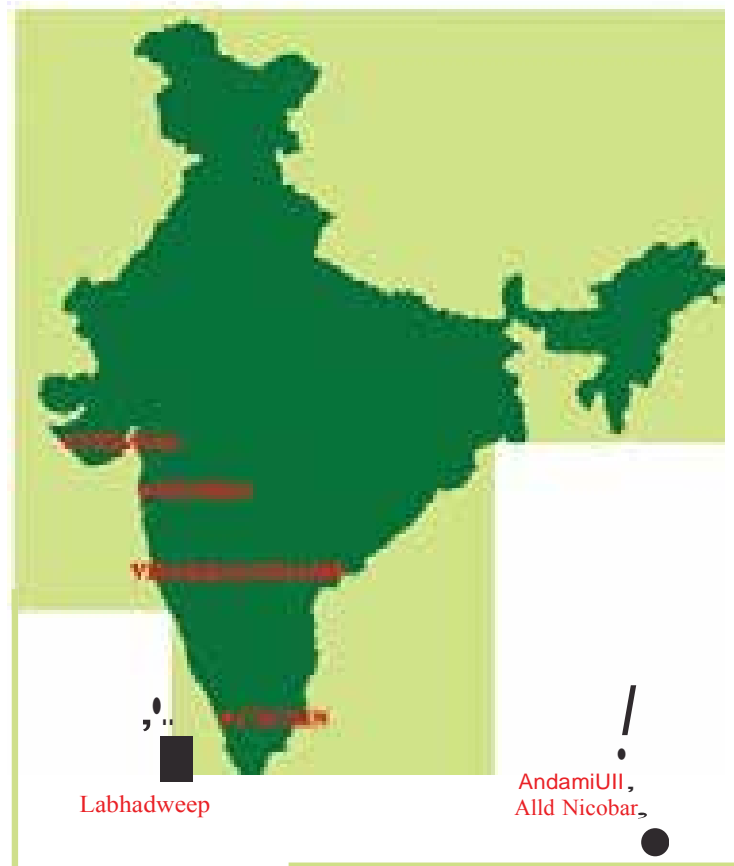
Staff Position

(As on 31 March, 2013)

Category	Sanctioned	Filled
Scientific	95	59
Technical	132	108
Administrative	81	69
Supporting	71	50
Auxiliary	06	03
Total	385	289



Address of Headquarters and Research Centres



COCHIN (Headquarters)

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ctft@cftmall.org
Website : www.cift.res.in

VISAKHAPATNAM

Research Centre of CIFT
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Andhra University P.O.
Visakhapatnam - 530003, Andhra Pradesh
Ph: 0891-2567856, Fax: 0981-2567040
Email: cift@itpvis.ap.nic.in

VERAVAL

Research Centre of CIFT
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Veraval-362 269, Gujarat
Ph : 02876-231297, Fax : 02876-231576
Email : ciftvrc_ad1@Sancharnet.in

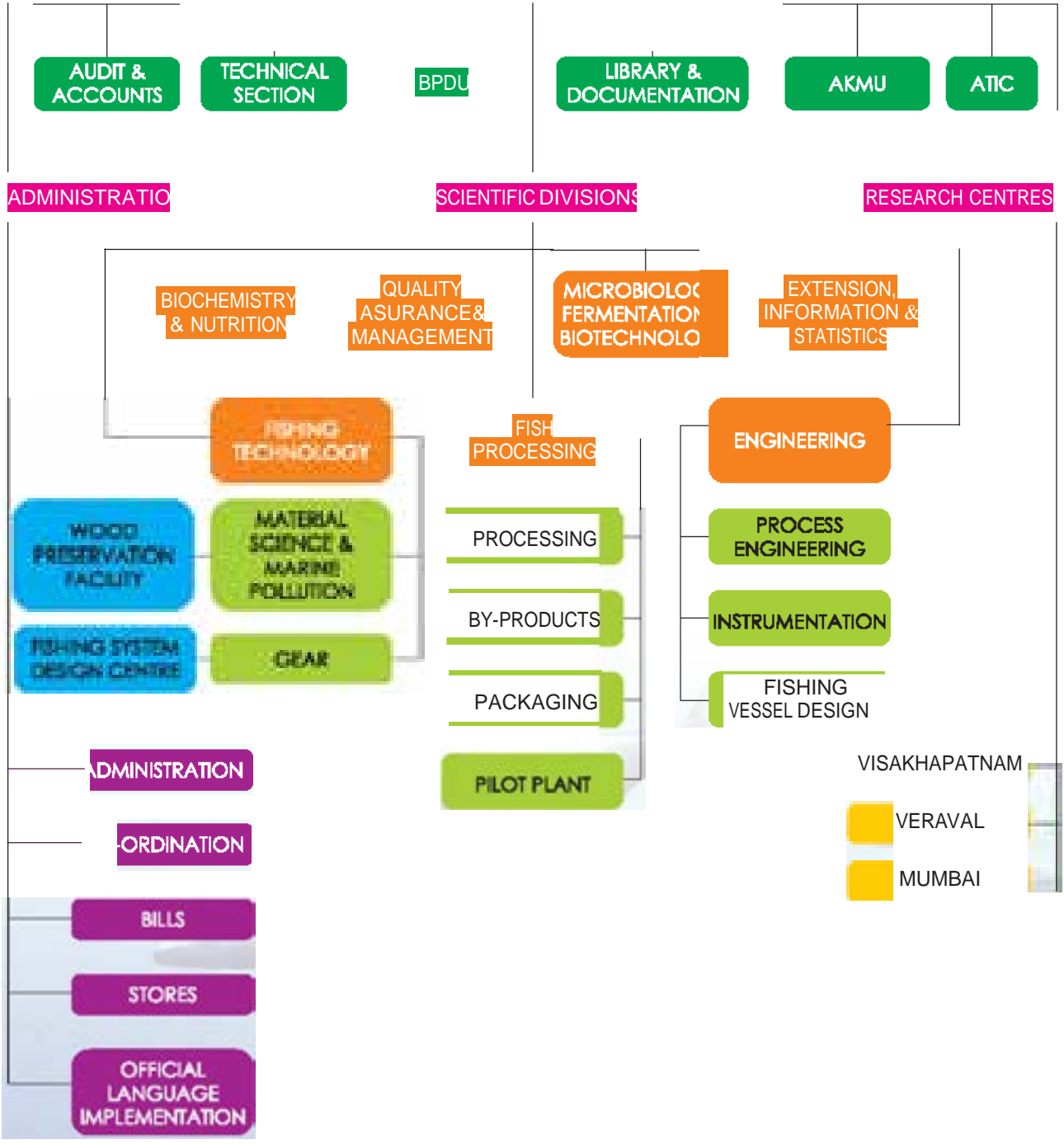
MUMBAI

Research Centre of CIFT
CJOCO Administrative Building
(Ground Floor), Sector-1
Vashi, Navi Mumbai -400 703, Maharashtra
Ph: 022-27826017; Fax: 022-27827413
Email: ciftmum@bom.nic.in



Organogram

DIRECTOR



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_a... 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 design 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 bilge deterioration, fouling and corrosion for increasing the life span, substantially reducing maintenance cost of fishing vessels.
- + Aluminium-magnesium alloy sheathing with cathodic protection and prescribed coating system was developed as a cost-effective substitute for copper sheathing for wooden hulls as protection against marine borers. This technology is widely used in the small-scale mechanized vessels.
- + Epoxy resin-based coating developed has improved the life span of cast iron propeller, making it a cost-effective substitute for bronze propeller in fishing boats.
- + Spheroidal graphite cast iron with nickel (21-24%) was recommended as substitute for conventional manganese-bronze for propellers of fishing boats, resulting in cost savings of 25-30%.
- + Superior cost-effective antifouling paint formulations incorporating Cuprous oxide and modified indigenous resins were developed for protection against fouling in fishing boats.
- + CIFT has developed technologies for the chemical preservation and upgradation of low cost timbers to make them more durable. These have extended the service life of fishing crafts and contributed towards the efforts against deforestation.
- + Technology was evolved for upgradation of cheaper secondary species of wood as substitute for boat scantling, by impregnation with styrene-polyester monomers, fortification with Creosote/Tributyl tin oxide and polymerization with gamma irradiation.
- + Fibre glass canoes and fibre glass sheathed canoes made of rubber wood introduced by CIFT have become very popular.
- + Aluminium boats for reservoir fisheries is another innovation.
- + CIFT has made immense contribution towards the standardization of the netting and netting twine used for fishery purposes. These developments have led to an increase in the productivity of the fishing gear and increase in net profits due to low maintenance and long service life of the nets.
- + CIFT has made significant contributions in the development of fishing gear and methods for the traditional sector, traditional motorized sector, small-scale mechanized sector and large-scale industrial sector in Indian fisheries, which is reflected in the increase in fish production.
- + Improvements were made in the design and durability of lobster traps as substitute for traditional traps of short life span and low efficiency, for harvesting of spiny lobster.
- + A mini-trawl for operation from traditional crafts powered by out-board 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 out-board 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 finfishes 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 designs have been well accepted by the trawler fishermen of Gujarat, Karnataka and Kerala.
- + Otter boards are sheer devices used in trawls for keeping the trawl mouth horizontally open. Different sizes of flat rectangular boards and vertically cambered otter boards have been introduced by CIFT for the benefit of small-scale mechanized fleet, during the course of its 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 stainless steel spoon and fish head jigs were developed.
- + Marine gillnet 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 shell waste is being used by these industries for conversion to chitin and chitosan. In addition to creating employments, 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.
- + Data base 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 antibiotic residues to a level of 0.1 ppm. About 65 seafood factories in Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat exporting seafood to EU and US are direct beneficiaries of this technology.
- + A two step nested PCR method for the detection of White Spot Syndrome Virus in shrimps was developed, standardized, assessed and introduced for commercial use. This method 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 to the farms.

- + A RT-PCR method to test the presence of the devastating Yellow Head Virus in shrimp farms was developed, assessed and commercialized. This is the only test method for YHV now available in India. The method is being currently used for screening frozen shrimp for YHV, being exported to the US, to meet the phytosanitary regulations of the **WFO**.
- + An improved ELISA method for detection of residues of Chloramphenicol, a 'zero tolerant' antibiotic, in processed seafood for export to EU, US and Japan was evolved. This improved method was assessed and commercialized in 2003. It is now regularly used to monitor Chloramphenicol level in farmed and processed shrimps. Hundreds of shrimp farmers and seafood exporters have gained by the technology.
- + The 'Chloritest paper' developed for detection of ppm levels of Chlorine in process water, an essential requirement to implement sanitation and hygiene practice in food processing industry, was transferred to M/s Glaxo Laboratories. This has resulted in the 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:
 - SSTilting Kettle
 - Oil fryer for battered and breaded products
 - 15.5 M fuel efficient steel fishing vessel
 - Fiberglass canoes
 - Environmental data acquisition system
 - lJ Temperature-salinity meter
 - lJ Shi bome 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:

- lJ Idle capacity in fish processing plants in India
- lJ 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
- lJ Price spread in domestic fish markets of Kerala and Gujarat
- lJ Fuel utilization pattern by the fishing industry in India
- lJ Assessment of harvest and post harvest losses in fisheries
- lJ Estimation of inland fish landings in reservoirs
- lJ 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:
 - lJ Socio-economic profile of fisherfolk in different parts of the country and development of socio-economic status scale
 - lJ The areas and extent of participation of women in fisheries related activities
 - lJ The types and activities of **Co-operatives and other organizations** in fisheries and the role played by them in small scale fisheries
 - lJ 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
 - lJ Studies on ban on monsoon **trawling, costal zone management and socio-legal issues**





Research Achievements

Fishing Technology Division

Chief findings

- + Fouling on high-density polyethylene (HOPE) twisted monofilament netting of 25 mm mesh size caused occlusion of mesh opening by 60% within two months of exposure to estuarine waters.
- + Rubber wood canoes were found to be in good condition after 10 years of field trials which proves it as a successful substitute for conventional boat building timber.
- + Cassava leaf extract can be used as a good bio-pesticide against bio-deterioration of wooden logs.
- + Studies on corrosion resistance of graphene and nano cerium oxide surface treated stainless steel revealed that the coating did not have much effect on corrosion resistance.
- + Polyaniline-graphene-nano cerium composite for nano sensor application is being studied.
- + The average CPUE of shrimps observed in the modified and 18m semi-pelagic trawl operated off Cochin was 0.16 kg/h and 0.69 kg/h respectively. The average catch in the modified net was 6.98 ± 2.48 (S.E.) kg/hour and the CPUE realized for the 16m SPT was 10.5 ± 3.38 (S.E.) kg/h.
- + The total CPUE recorded in the cut-away top belly trawl operated along the coastal waters off Cochin was 7.0 kg/h. The CPUE for shrimps and fish were 1.05 and 1.93 kg/h respectively.
- + The mean length of *Tenua/osa ilisha* juveniles escaping from the bagnets installed with BRD was found to be 56.5 mm at Tribenicentre, Hoogly-Matla estuary.

Report of work done

Assessment of photodegradation in synthetic netting

The weathering resistance of nylon 210 x 2 x 2 twine was tested in ATLAS XENOTEST ALPHA+ equipment for 200 h. The exposure conditions in the chamber were: Relative humidity - 50%, Irradiance - 45 W/m², Chamber temperature - 35 °C and Back standard temperature - 50 °C. The samples were exposed to a cycle of 51 min. in light phase followed by nine min. water spray and continued for 200 h. The sub-sample retrieved after every 50 h was tested for change in break load and elongation at break. After 200 h exposure in the Xenotest, the material showed 26.8% decrease in break load and 14.6% decrease

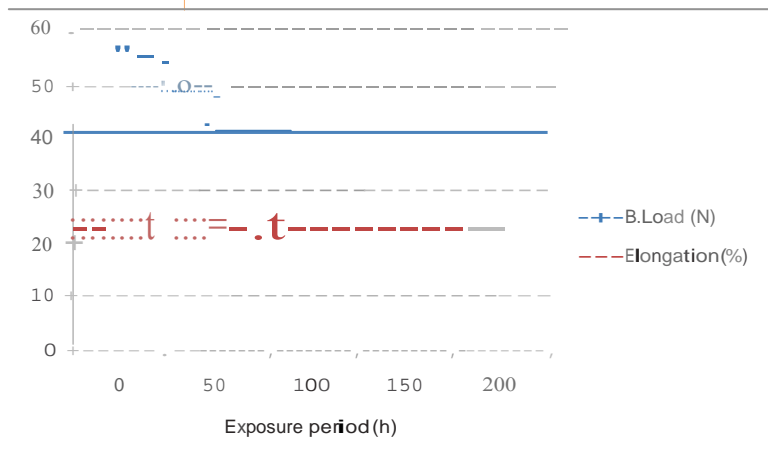
Research projects handled

- Studies on fortified natural biocides and corrosion resistant composite materials for protection of fishing craft and gear
- Responsible fishing systems for the marine sector
- Development of appropriate fishing systems for rivers
- Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- A value chain on oceanic tuna fisheries in Lakshadweep sea
- *In situ* time series measurements of bio-optical parameters off Kochi coast
- Green fishing systems for the tropical seas
- Techno-economic feasibility of coconut wood canoes for the small scale fisheries sector in the south-west coast of India and Lakshadweep

in elongation.

Assessment of nature of fouling on synthetic webbing used for passive gear

Continued the study of fouling settlement on



Break load and elongation of nylon twine exposed to weathering in Xenotest

high density polyethylene (HOPE) twisted monofilament netting of 18 x 18 cm (mesh size 25 mm) used for cage culture by exposing samples in





the estuarine conditions at the test site in Cochin harbor waters in April, 2012. Sub samples (n=4) retrieved monthly were assessed for the biomass (wet and dry weight) of foulers and the occlusion of mesh opening due to fouling growth. From July, 2012 onwards, there was a drop in salinity and hence a reduction in fouling growth. Fouling settlement resulted in a fouling biomass of 31.5 g (wet weight) on netting of 18 x 18 cm size and fouling settlement resulted in occlusion of mesh opening by 60% on an average within two months of exposure.

Suitable corrosion protection measures for fishing hooks

Fishing hooks (No. 7 T hook) were treated with cerium oxide at two concentrations, viz., 0.002 and 0.004% and exposed to salt spray for 300h along with untreated control as per ASTM B – 117 to assess weight loss, corrosion rate and change in mechanical strength after different periods of exposure to salt spray. Hooks treated with cerium showed slightly higher corrosion resistance in the initial phases of salt spray than the control. After 100h of salt spray exposure, the cerium treated hook showed a corrosion rate 7% lower than that of control hook. Cerium treatment showed better corrosion inhibition in the initial 100h of exposure.

Performance monitoring of rubber wood/coconut wood canoe

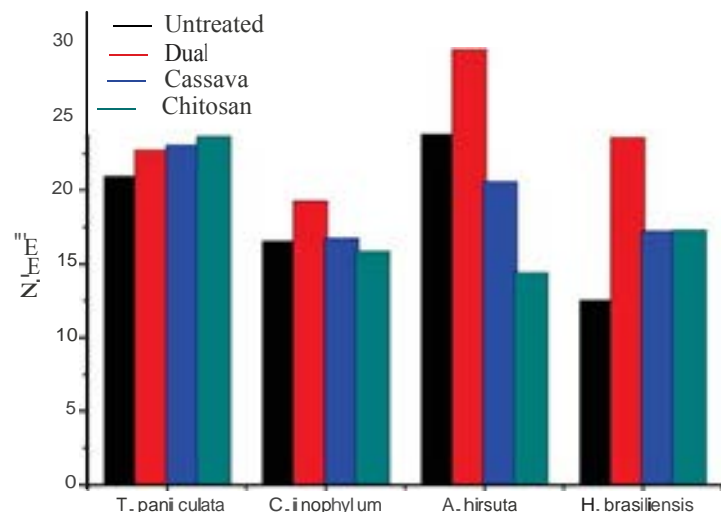
The treated rubber wood canoe and FRP sheathed rubber wood canoes put on field trials through Fishermen Co-operative Societies viz., Vechoor Lime Shell Co-operative Society, Kottayam, Aryad Lime Shell Co-operative Society, Alappuzha, Thalassery Ulnadan Matsyathizhilali Kshema Sahakarana Sangham, Kannur, Kumbalam Ulnadan Matsyathozhilali Kshema Sahakarana Sangham, Emakulam in 2002-03 were continued to be monitored by conducting tri-monthly inspections. Signs of minor biodeterioration seen after eight years of operation were rectified. No further problems were noticed after the repairs and all the canoes were found to be in good condition even after 10 years of field trials. So it is proved that rubber wood can be used successfully for fishing canoe construction and upto eight years no major maintenance is

required.

Three canoes (length: 6.4m, breadth: 0.83m and depth 0.42m}, constructed with coconut wood were handed over for experimental operations to the Kumbalam Inland Fishermen Development Welfare Co-operative Society. The canoes were monitored every month for performance. No signs of bio-deterioration were noticed in any of the canoes which are subjected to daily operations for the past 18 months.

Effect of Cassava extract based bio-pesticide against bio-deterioration

The effect of a bio-pesticide extracted from Cassava (*Manihot utilizema*) leaves was tested on *Artocarpus hirsuta*, *Calophyllum inophyllum*, *Hevea brasiliensis* and *Terminalia paniculata* and efficacy of these treatments with reference to the standard method of treatment viz., dual treatment and to another new preservative viz. Chitosan copper complex were studied. The logs with retention levels of 30kg/m + 288 k&M (dual treatment), 350 k&M⁵ (Cassava extract) and 30.6 k&M (Chitosan copper complex) respectively, were exposed to marine conditions at the Institute test site. The results of the marine exposure studies showed that Cassava leaf extract treated samples showed good resistance against bio-deterioration with loss of only 18.53% compressive stress when compared to dual treated panels.



Effect of Cassava extract based bio-pesticide against bio-deterioration

Development of new aluminium/magnesium metal matrix composites using nano rare earth oxides like samarium and cerium oxide

Studies on corrosion resistance of graphene and nano cerium oxide surface treated stainless steel: Atomic force micrograph evaluation of nano particulate graphene and nano sized cerium oxides treated stainless steel SS304 in different concentrations individually and as mixtures, showed that the nano cerium oxide and graphene was distributed uniformly in the surface and the distribution depends on the concentration of the material used. The

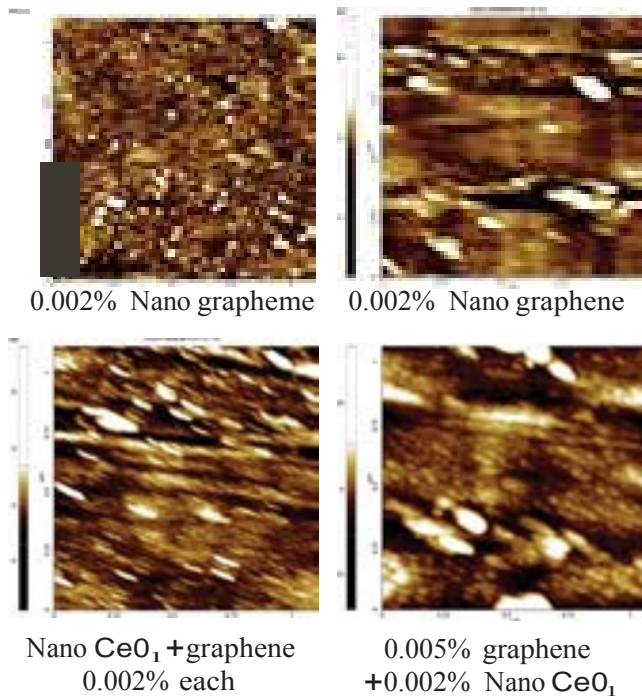


treated steel when subjected to electrochemical impedance analysis, showed that mixed treatment of nano sized cerium oxide and graphene exhibited higher corrosion resistance than when individually treated. Significant increase in corrosion resistance

was exhibited when the coupons were coated with nano cerium oxide:graphene in the ratio, 0.002%:0.005%. The results of the polarization resistance in the high frequency region showed that the surface layer gets weaker due to the treatments. In brief, the coating has not shown much effect on corrosion resistance. Probably due the different metals present in the system like, chromium, molybdenum, etc. it may be losing their stability.

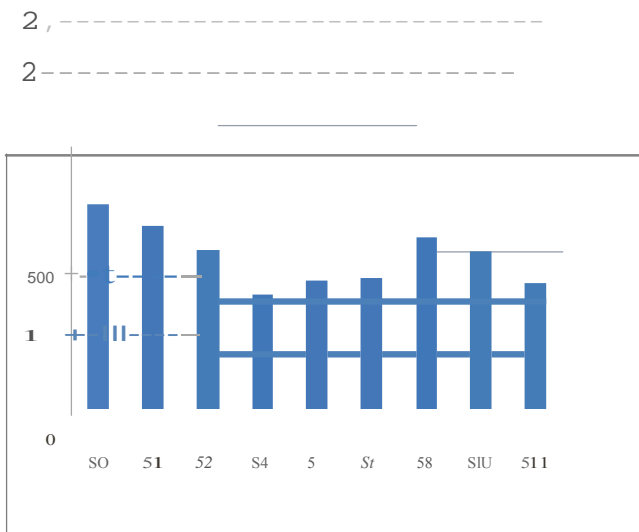
Surface modification of boat building steel using graphene and nano sized cerium oxide: Boat building steel (BIS 2062) was procured, polished up to 1000 grit and was surface treated with graphene and nano cerium oxide at varying concentrations from 0.01% to 0.02%. The panel surfaces were observed using atomic force microscope.

The AFM analysis revealed that the nano cerium oxide and mixture of nano cerium oxide and graphene adhered well to boat building steel. Treatment with nano cerium oxide alone exhibited excellent surface coverage when compared to graphene. The coupons when subjected to linear sweep voltammetry showed that 0.01% nano

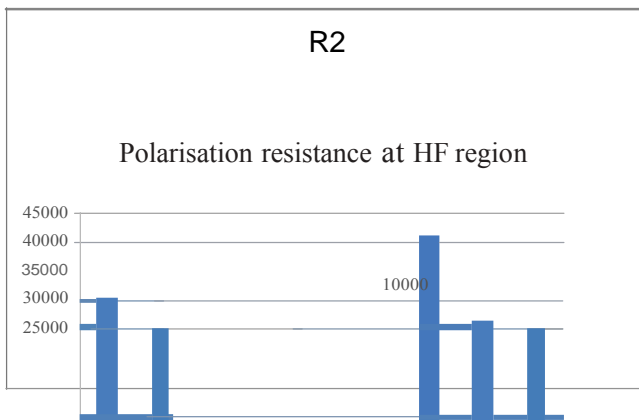


Changes in the surface properties of graphene and nano cerium treated stainless steel

R1



R2



0.01% Nano CeO₂

15000
5000
0

Polarisation resistance at LF region

+0.01%

graphene

0.01% Nano CeO₂+

0.01% graphene

0.02% graphene

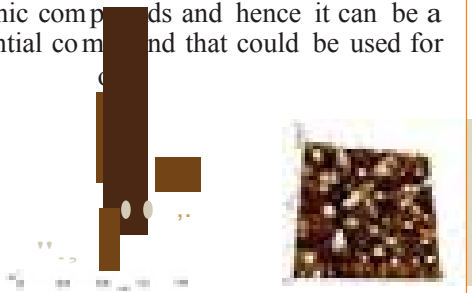
+0.01 Nano CeO₂



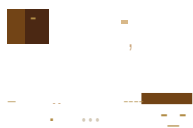
cerium oxide and 0.02% graphene mixture treated panels have comparatively good corrosion resistance, followed by 0.02% nanographene and CeO_2 + 0.01% graphene steel. The EIS evaluation revealed improvement mostly to the upper-most layer due to the mixture treatment but internal layers did not show much improvement compared to control.

Preliminary studies on the development of nano biosensors for the detection of important contaminants or pollutants: A preliminary attempt to synthesize gold nano rods were carried out and the prepared material was evaluated using AFM and spectrochemical methods. Gold nano rods were synthesized as per Sau and Murphy (2004) and the topography was analyzed using AFM. The aspect ratio of the prepared gold nano rods were 3 to 4 and exhibited UV Vis spectrum. The gold nanorods were tested for its thermochromic effect by storing the material in -20°C . The gold nanorods turned spherical at -20°C and changed colour from pink to colourless. The same was confirmed by spectroscopic and AFM analysis. The material changes were irreversible in nature

organic compounds and hence it can be a potential compound that could be used for

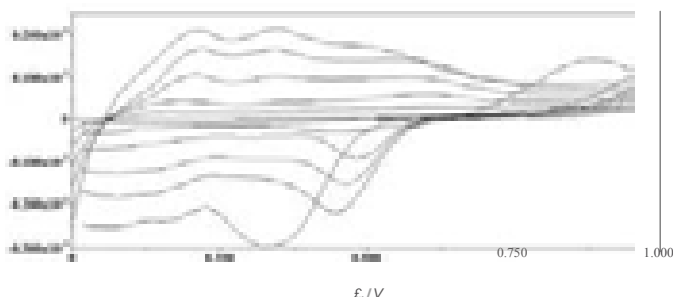


development of biosensors.



AFM images of gold nano rods at room temperature and nano spheres kept at -20°C .

Polyaniline-graphene-nano cerium composite for nano sensor applications: Polyaniline is a known conducting polymer and is used extensively for electrochemical sensor applications, due to its film forming ability and proton doping ability. Attempts were made to incorporate nano sized cerium oxide and nano sized graphene in the polyaniline film through cyclic voltammetry. Poly



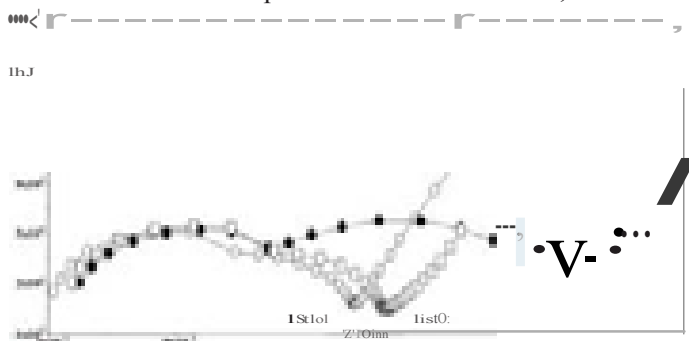
Cyclic voltammetry of polyaniline formation during 1 to 50 cycles of scanning from 0 to 0.900V with reference to Ag/AgCl reference electrode

potential 0.005 V/s, Electrodes: Pt, Ag/AgCl and glassy carbon electrode as counter, reference and working electrode respectively. The electrolyte used was 0.2M aniline in 1M HCl and 0.002g in 100 each of graphene and nano cerium oxide on glassy carbon electrode.

Electrochemical impedance spectra was analyzed for polyaniline (PANI), polyaniline-graphene composite and polyaniline-graphene-nano cerium oxide composite separately and is shown in the figure below. The results showed that the resistance decreased from PANI, PANI-graphene and PANI-graphene-nano cerium oxide. This shows that the composite is

applications. Efforts were made to optimize the pH of the buffer medium, scanning speed and sensing of nitrogenous solutions.

Initially ammonia was sensed with increasing concentrations but repeated trials could not provide consistent results, and hence



aniline were prepared from aniline over glassy carbon electrode through cyclic voltammetry by following conditions like, 100 cycles, scanning range 0 to 0.900V, step

EIS Nyquist plots of polyaniline (O), polyaniline--
graphene incorporated (e) and polyaniline-
graphene-nano cerium oxide (D) composites
synthesised electrochemically
over glassy carbon
electrode

Improved bottom trawl to reduce bycatch

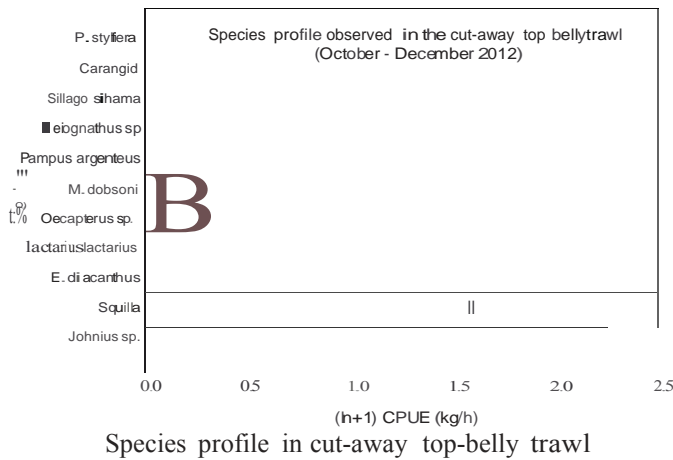
A 44.8 m cut-away top-belly shrimp trawl aimed to reduce the incidence of fish (bycatch) was field tested. Comparative field trials were carried out on-board departmental research vessels along the coastal waters off Cochin. Ten experimental fishing operations were carried out using the cut-away top belly trawl



CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY



along the coastal waters off Cochin. The average CPUE recorded during the fishing experiments was 14.14 kg/h. The highest CPUE was noticed for *Johnius* sp. With an average catch of 8.5 kg/h. The average shrimp catches in the trawl was 0.25 kg/h, with *M. dobsoni* forming the major catch. *Squilla* sp. was the second most abundant catch in the trawl with an average CPUE of 3.83 kg/h. Two shrimp species, *M. dobsoni* (0.23 kg/h) and *P. stylifera* (0.02 kg/h) were among the top ten species contributing to the total mean biomass in the catches.



Species profile in cut-away top-belly trawl

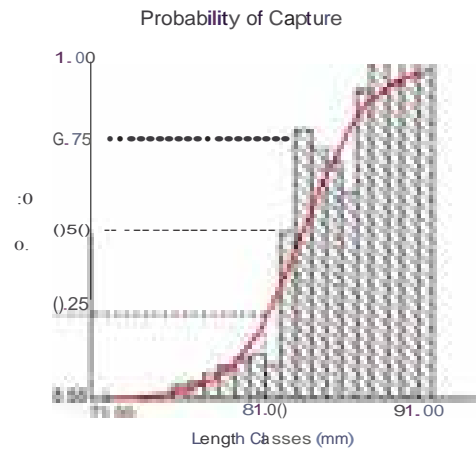
Improved semi-pelagic trawl systems

A modified semi-pelagic trawl was used for the experiments on-board the departmental fishing vessel MFV Matsyakumari II along the coastal waters off Cochin. A total of 11 and nine hauls, respectively were carried out using the modified SP trawl (with a wing mesh size of 400 mm compared to the 200 mm mesh of the 18m SPT trawl) and 18m SPTS respectively along the coastal waters off Cochin. The operations were carried out in the depths ranging from 15 to 25m. Suberkrub otterboards were used for the operations and the average duration of each tow was 1.75 hours for both the trawl designs. The average catch in the modified net was 6.98 ± 2.48 (S.E.) kg/hour and the CPUE realized for the 18m SPT was 10.5 ± 3.38 (S.E.) kg/h. No significant difference in the CPUE was observed in the mean CPUE realized from the two trawl designs ($F(1,18) = 1.22, p = 0.283$). *Mene maculata* was the major catch in both the trawl systems with average CPUE of 4.43 kg/h and 7.66 kg/h respectively in the modified SPT and 18m SPT. The average CPUE of shrimps was 0.16 kg/h and 0.69 kg/h respectively in the modified SPT and 18m SPT.

Selectivity estimates of trawl resources

A codend cover of 10 mm was attached to the modified SPT trawl of 30mm size codend to find the selection parameters and the species profile showed that juveniles of *Lagocephalus spadiceus* and *Sardinella longiceps* were the major species that escaped from the codend. The codend selectivity parameters of *L. spadiceus* was analyzed using selectivity routine of FISAT (FAO) software. *L. spadiceus* (Half-smooth Golden Pufferfish) is a menace often causing severe damage to the gillnets and ring seines in the coastal waters off Kerala. There are reports of increasing biomass of this

species due to the impact of fishing along the Indian waters. They form a bycatch during the trawling operations and are discarded. Recently there are reports that they are being exported to different south east asian countries as food. The selection curve and the selection parameters for *L. spadiceus* is shown in the figure.



Selection curve for *Lagocephalus spadiceus* in 30 mm diamond mesh codend
 L25 = 81.47 mm; L50 = 83.82 mm;
 L75 = 86.18 mm

Field trials with long lines

A long line hydraulic winch was installed on-board the vessel 'Bharat Sagar' for conducting the long line experiments. Long lining operations were carried out along the west coast of India during January 2013 to March 2013. The long lines were set



Tuna and shark catches landed during

the long line experiments



using the hydraulic linesetter installed on the vessel. The hauling operation was carried out using the line hauler successfully. The voyage was for about 20 days each. A total 4 tonnes of Yellowfin tuna and 1 tonne of Shark and other large pelagic fishes were caught in line fishing.

Designing and installation of Bycatch Reduction Device (BRD) for bagnets

A Bycatch Reduction Device (BRD) consisting of square mesh windows of size 1m x 0.75m made of 50 mm mesh was fixed near the codend of bagnets as a technical measure to facilitate the escapement of juveniles of Hilsa and other commercially important species. A small mesh cover was used to retain and quantify the juveniles escaping through the window.

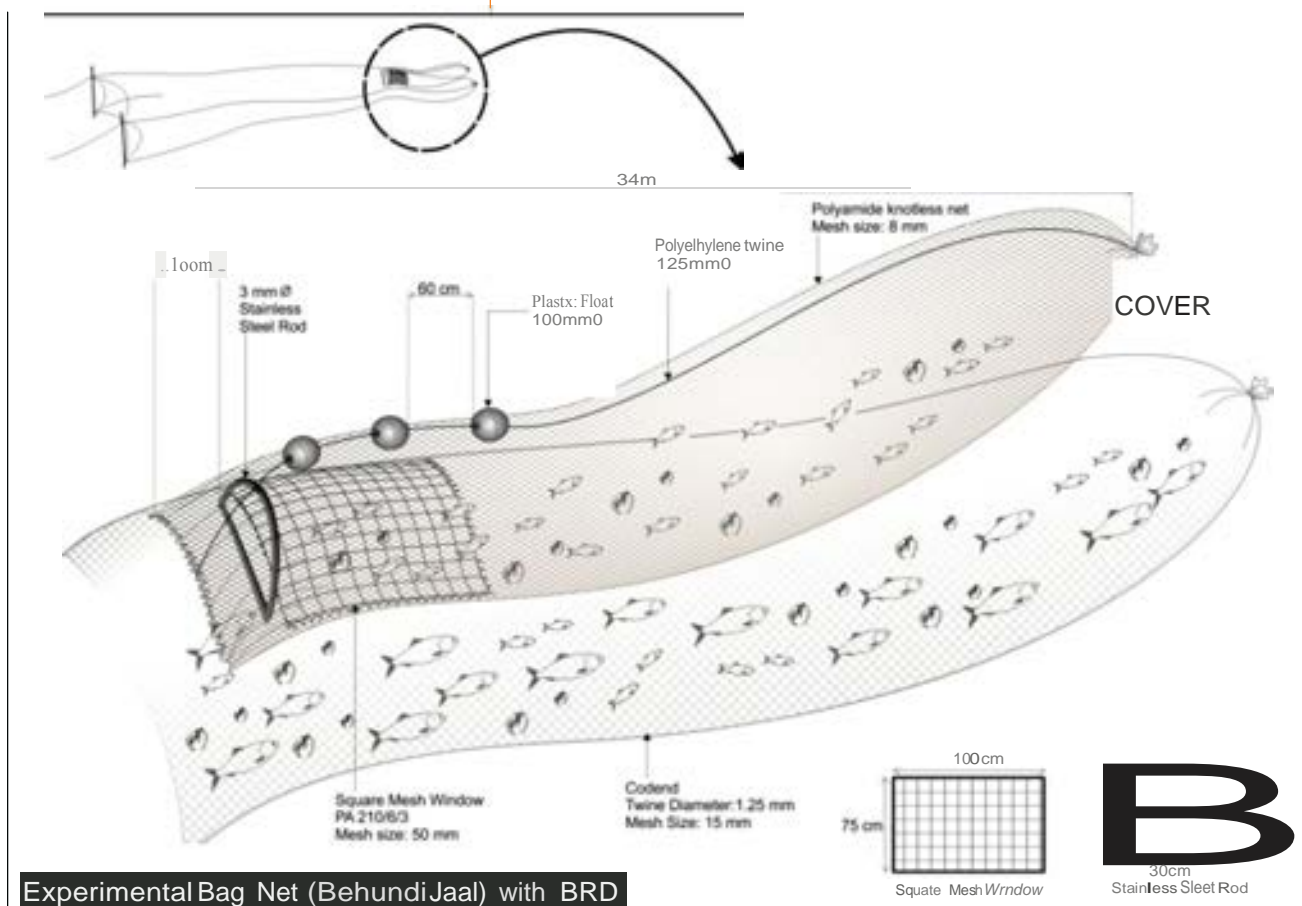
The BRD is being field tested at Godakhali, Frasergunj and Tribeni areas of the Hoogly Matlah estuary. The mean escapement of all the species from the BRD was found to be 0.65 kg and juveniles of Hilsa formed 11.60% of the total catch

excluded. The length of the excluded Hilsa ranged from 37-55 mm. A total of 41 species was found to escape through the BRD and the major species that escaped were *Matuta planipes* (0.39 kg), followed by juveniles of *Cynoglossus* sp. (0.26 kg).

The major species observed in the codend of the bagnet was *Macrobrachium mirabile* with an average catch of 0.99 kg, followed by the juveniles of *Cynoglossus* sp. and *Tenua/osa ilisha* with an average catch of 0.36 and 0.29 k.g respectively. BRD installed bagnets are also under trials at the Narmada river at Bharuch district, Gujarat.

Performance evaluation of 45m mydophid trawl in FORV Sagar Sampada

Performance evaluation of the newly fabricated four equal panel 45m mydophid trawl was carried out from FORV Sagar Sampada during 12 February, 2013 to 2 March, 2013 (Cruise No. 313) along 18°-20° N lat and 65°-68° E. Deep Scattering Layer (DSU) was observed between 312 to 380m depth during the operation. Acoustic survey of nine stations were performed using SIMRAD EK60 and EA60 echosounders with transducers of 38KHz and 120 KHz respectively. Each operation was carried out for one hour with the help of echo integrator ITI interfaced with GPS which enabled to know the latitude and longitude positions and two sensors interfaced with net to interpret the fishing depth and temperature at the trawling depth. With the help of IT! sensors, vertical trawl

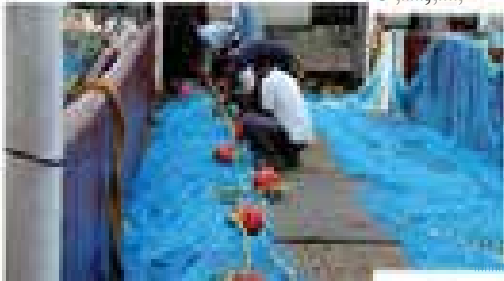


Perspective of the square mesh BRD installed in the codend of bagnet





Cruise team with myctophid trawl net



Hauling of net for shooting



Sorting of myctophids collected from FORV Sagar Sampada

opening and height of head rope from surface were measured and the fishing depth was maintained at DSL.

Preliminary results showed that four species of myctophids viz., *Benthosema pterortum*, *B. fibulatum*, *Diaphus theoleri* and *Bolinichthys* sp. were the major species in the catches. *Benthosema fibulatum* was observed in four stations among the nine stations surveyed and *D. theoleri* was observed in three stations. *D. theoleri* contributed significantly in large quantity than other myctophid species to the total catch from all stations.

Design of prototype 28.4 m myctophid trawl

A new four equal panel 28.4m myctophid trawl was designed by scaling down the existing 45m myctophid trawl net by considering the biological characteristics and behaviour of myctophids, fishing conditions and available towing force of commercial deep sea trawlers as well as CIFT Research Vessel Matsyakumari II. Performance evaluation of the newly fabricated nets will be conducted along the south west coast of India.

A value chain on oceanic Tuna fisheries in Lakshadweep sea

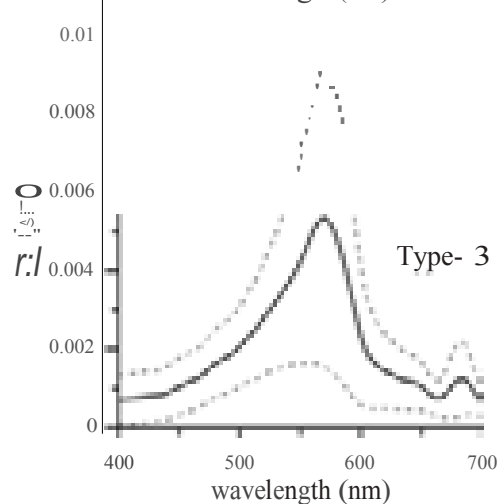
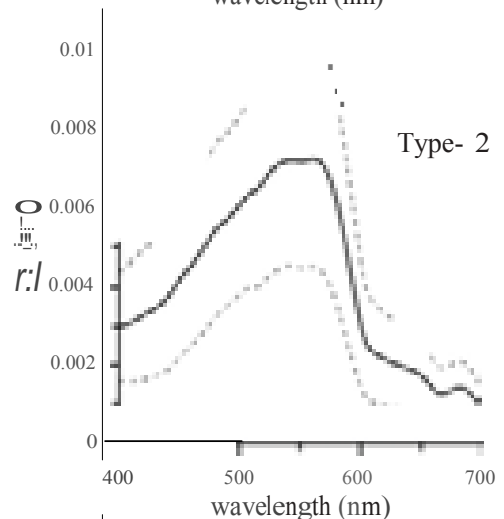
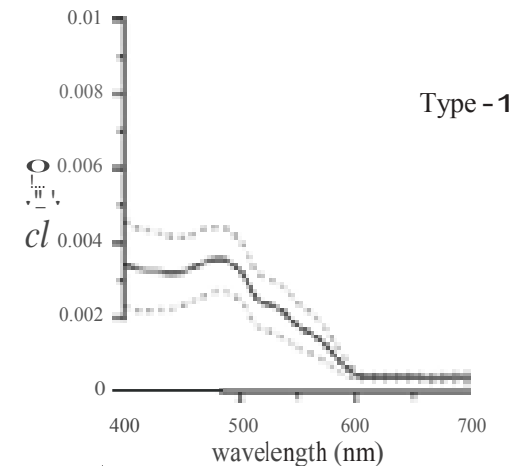
A stainless steel hand winch capable of shooting and hauling 100 long line hooks with branch lines were installed on-board Pablo boats at Minicoy island in Lakshadweep sea. Five winches were fitted to the boats for long lining and trial runs were conducted at Minicoy.

An awareness programme on value added products from Tuna waste was organized by CIFT on 26 March, 2013 at the Dweep Panchayat Village, Minicoy. About 50 members from various self-help groups (SHG) of Minicoy attended the programme.

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

Evaluation of empirical algorithms in different water types at a

coastal site off Kochi, west coast of India: The validation results of the analysis of samples collected from eight stations, revealed three water types based on Chlorophyll a (Chla) and Chromophoric dissolved organic matter (CDOM) concentrations. The average spectral shape



Remote sensing reflectance in different water types



of remote sensing reflectance (Rrs), in Type-1 waters, showed almost a flatter curve between 400 to 450 nm which then increased to peak at 482 nm. Beyond this wavelength Rrs decreased gradually till 608 nm. After 608 nm, the curve flattened again till 700 nm indicating no reflectance in the region. This water type was associated with the average concentration of Chla as $0.25 (\pm 0.17) \text{ mg-m}^{-3}$, P650 as $0.3 (\pm 0.1) \times 10^4 \text{ m}^{-1} \text{ sr}^{-1}$ and CDOM as $0.94 (\pm 0.5) \text{ ppb QSDE}$.

The spectral Rrs in Type-2 waters was found to be distinct from that of Type-1. It was observed that the average Rrs increased gradually from shorter wavelength (400 nm) and showed almost flat peak between 532 nm and 566 nm with marginally higher value at 560 nm. Beyond 560 nm a steep decrease was observed till 610 nm. After this the decrease was gradual till 670 nm. A secondary maximum was also observed at 681 nm. This water type was associated with the average concentration of Chla as $7.4 (\pm 4.8) \text{ mg-m}^{-3}$, P650 as $2.8 (\pm 1.7) \times 10^4 \text{ m}^{-1} \text{ sr}^{-1}$, and CDOM as $1.69 (\pm 0.5) \text{ ppb QSDE}$. The Rrs spectra in Type-3 waters showed similarity to that of the Type-2 at the longer wavelength. In this class, a steep increase in Rrs was observed from 400 nm till 570 nm. The peak Rrs was more prominent. The spectral behavior of Rrs from 570 nm to 700 nm in this class was similar to that of class-2. However, the secondary maximum was more prominent (684 nm) and higher in magnitude. This water type was associated with the average concentration of Chla as $11.5 (\pm 6.8) \text{ mg-m}^{-3}$, P650 as $3.2 (\pm 1.7) \times 10^4 \text{ m}^{-1} \text{ sr}^{-1}$ and CDOM as $2.23 (\pm 0.37) \text{ ppb QSDE}$.

Phytoplankton community characteristics in the coastal waters of South eastern Arabian sea: The salient findings revealed that the region had 73 genera of phytoplankton from 19 orders and 41 families and the numerical abundance of phytoplankton varied from 14.235×10^3 to $55.075 \times 10^6 \text{ cells l}^{-1}$. Centric diatoms dominated in the region and the largest family identified was Thalassiosiraceae with main genera as *Skeletonema* spp., *Planktonella* spp. and *Thalassiosira* spp. The annual variations in abundance of phytoplankton showed a typical one-peak cycle, with the highest recorded during pre-monsoon season and the lowest during monsoon season.

Bench marking and development of database of existing fishing vessel designs and energy efficiency

The principal dimensions like length, breadth, depth and draft of the vessel were collected to group the vessels in to different size ranges. The details of the engine power, fish hold capacity, number of crew on-board, type of fishing done from the boat, average fuel consumed during the trip etc. were also collected using pre-tested questionnaires. Regional, seasonal and operational variations of fuel consumption patterns for the fishing vessels were observed.

Characterization of bycatch generated by traditional trawl systems along Cochin coast

Traditional trawl designs operated along the Cochin waters were field tested on-board departmental fishing vessels for characterization of bycatch. A total of 12 fishing operations were carried out with an average tow duration of 1.5 hours. The average catch from a single haul was 20.99 kg and 17 species on an average contributed 90% of the total catch in terms of weight. *M. dobsoni* was the species that contributed most in terms of weight and number (16.69% and 2.94% respectively). The other major shrimp species contributing to the catches were *P. stylifera* (7.42% by weight and 15.96% by number to each haul), average contribution of *M. affinis* in each haul was 5.19% in terms of weight and 3.99% in terms of number. Shellfishes mostly consisting of *Turite/la* sp. and *Murex* sp. contributed substantially to the total catches. The combined weight of shellfishes in each haul was 8.83 kg (42.04%). Fishes contributed about 10% in each haul with average weight of 1.86 kg per haul.



Fish Processing Division

Chief findings

- + An intermediate moisture product from Pangasius (*Pangasionodon hypophthalmicus*) fillet prepared by a combination of pH modification (potassium sorbate and citric acid), controlled microwave heating and drying technique remained acceptable for more than 45 days in chilled condition.
- + Dip treatment of Rohu steaks in mint decoction has revealed that 1.5% of mint decoction was effective in reducing the chemical and microbial spoilage indices.
- + Quality characteristics of Pabda (*Ompok pabda*) fish processed by *sous vide* technique indicated that both microwave and conventionally heated samples remained in acceptable condition for more than a month under chilled condition. However, vacuum packed control samples were to be rejected after 20 days of storage.
- + Flash fried skinless boneless Pangasius fillets canned in TFS cans with refined oil had good textural properties and the water content was less than 10% which is a requirement for canned product.
- + Vacuum packing of gutted Pabda fish under iced condition was carried out. Results indicated that samples remained in acceptable condition till 24 days of storage in ice, whereas control samples packed in PE pouches gave less satisfactory results and were to be rejected after 18 days of storage in ice.
- + A prototype of fish de-scaling machine was developed for de-scaling of fishes. For carps, the de-scaling process requires 10 min. at 30 rpm and for Tilapia it is 8 min. at 25 rpm. A patent application has been filed for the design and process.
- + Chitosan in combination with collagen was found to be effective against *S.aureus*.
- + Chitin hydrolysate assessed for antimicrobial properties showed that a solution at 20..50 mg/ml markedly inhibited the growth of most gram-negative and gram-positive bacteria.
- + Feeding trials in albino rats with Rohu bone calcium and Tuna bone calcium-incorporated feed indicated that feed with Rohu bone calcium shows more retention

Research projects handled

- ❑ Species specific interventions in value addition of commercially important and emerging species of freshwater fish
- ❑ Utilization of fish processing waste for the development of innovative products
- ❑ Innovative packaging techniques for processing and preservation of fish products
- ❑ Studies on high pressure processing (HPP) of high value perishable commodities
- ❑ A value chain on oceanic tuna fisheries in Lakshadweep sea
- ❑ Isolation and characterization of collagen and gelatin from aquatic sources and development to food grade and pharmaceutical products of commercial importance

than feed with Tuna bone calcium.

- + Bio-availability of fish calcium powder prepared from Tuna and Pangasius tested in albino rats along with supplemented vitamin D and peptide showed that incorporation of vitamin D increased the absorption of calcium in rats.
- + Fish rolls prepared from meat of Rohu had 17 days of storage life under chilled condition, whereas frozen stored product remained in acceptable condition till seven months of storage at -20°C.
- + Collagen peptide derived from Rohu fish scales was found to be a cheap alternative source for bacteriological media.
- + Mineral composition of offal generated from Croaker fish *Uohnius dussumeri* 1 indicated that head waste is rich in calcium (342.141 ± 10.83 ppm), potassium (82.47 ± 2.49 ppm) and sodium (60.33 ± 1.70 ppm).



- + Partial replacement of fish meat in fish cutlet by soy protein showed that the product with a combination of 70% meat and 30% soy had better acceptability, textural parameters and storage stability than the conventional fish cutlet.
- + Hydroxyapatite prepared from Catla and Rohu scales by a heat treatment method were found to be highly crystalline hydroxyapatite particles.
- + Shelf life studies of chill stored Ghol (*Protonibea diacanthus*), Mahimahi (*Coryphaena hippurus*) and Horse mackerel (*Megalaops cordyla*) packed under air and with O_2 absorber was found to have a shelf life of 24, 24 and 20 days were observed for active packed samples compared to only 8, 10 and 9-10 days for control samples, respectively.
- + Ready to eat products from edible oyster (*Crassostrea madrasensis*) meat like oyster fry (dry), oyster masala (semi gravy) and oyster curry prepared in retortable pouches were found to be acceptable even after a storage period of six months.
- + Bromocresol purple (BCP), Bromocresol green (BCG) and Bromothymol blue (BTB) were used for development of freshness indicators for shrimps (*Parapenaeopsis stylifera*). BCP gave better indication of freshness and correlated well with the changes in volatile bases and sensory quality.
- + Application of multiple hurdle technology extended the shelf life of Indian mackerel (*Rastrelliger kanagurta*) to 16 days in vacuum packed, 12 days in potassium sorbate treated and 18 days in *sous vide* treatment.
- + High temperature short time (HTST) processing of fish curry using Cobia fillets in clear and opaque retort pouches was found acceptable based on biochemical and sensory evaluation even after a period of six months.
- + Shelf life assessment of Long tail tuna (*Thunnus tonggol*) chunks packed under air and O_2 absorber during iced storage conditions revealed that chunks were in good condition up to 9-10 days for O_2 scavenger packs.
- + The shelf life of high pressure treated (200 MPa holding time-5 min.) Yellow fin tuna (*Thunnus albacares*) chunks was extended to 28 days during chill storage. Control was rejected on 20th day of chill storage.
- + High pressure treated (250 MPa ready to cook) incorporated prawns showed better acceptability and had a shelf life of 35 days at $2 \pm 1^\circ C$.
- + High pressure (300 MPa) processed shucked oyster meat had a shelf life of 28 days during chilled storage.
- + Sensory evaluation of high pressure treated prawn curry showed that at higher pressure above 400 MPa the prawns are harder in texture.
- + HP treatment on microstructure of Indian white prawn (*Fenneropenaeus indicus*) at 250 MPa showed that muscles had a firmer texture than untreated sample and fibres look tightened and round.
- + Combined effect of chemical (sodium acetate and potassium sorbate) with pulsed light treatment of Yellow fin tuna steaks packed in cast polypropylene pouch had shelf life extension of 13 days than control samples.
- + Catla (Cat/a cat/a) fillets sprayed with commercial liquid smoke was found to have superior shelf life capacity than control.

Report of work done

Shelf life evaluation of intermediate moisture product from Pangasius fillet

Intermediate moisture containing product from Pangasius Catfish (*P. hypophthalmicus*) fillet was prepared by a combination of pH modification (potassium sorbate and citric acid), controlled microwave heating and drying technique. Moisture content in the range of 40-50% was achieved by varying the treatment durations. The product was further tray packed under vacuum and stored at two different conditions, viz. room temperature and chill storage at $-50^\circ C$. The microbiological parameters were analyzed at regular intervals for total mesophilic and psychrotrophic bacteria, enterobacteriaceae, total anaerobic sulphite reducing *Clostridia*, *Pseudomonas* spp., and total latics in addition to common pathogen spoilage organisms like *E. coli*, *Streptococcus*, *Vibrio parahaemolyticus*, *Salmonella*, *Listeria* and *Staphylococcus*. The biochemical parameters including pH, protein solubility, IVBN, NPN, alpha amino Nitrogen FFAPV, TBA and haeme iron content were analyzed. The results indicated that the chill stored samples remained in acceptable condition for more than 45 days, whereas



the samples stored at room temperature had a shelf life of 12-15 days.

Effect of mint decoction treatment on the quality of Rohu steak and fillet portion

Mint decoction (0.5%, 1% and 1.5%) were prepared by boiling dried mint powder in water for five minutes. The decoction obtained was filtered through a muslin cloth twice and the filtrate was used for dip treatment studies. Rohu steaks and fillet portions were dipped in the decoction for 15 minutes. The samples were packed in polythene pouches and kept at -4 °C for three days. The sensory properties, TVBN, TBA and TPC were analyzed to determine the effect of mint decoction during the period. Dipping in 1.5% decoction negatively affected the general appearance of the steaks and fillets as the higher concentration of mint imparted a greenish tinge to the fish meat. However, higher concentration of decoction reduced the microbial load, TVBN and TBARS values in both steaks and fillet portions. The TVBN content in treated steaks and fillet portions on third day was 6.2, 8.4 and 14 mg% and 7, 12.6 and 18.9 mg% for 1.5%, 1% and 0.5% decoction respectively. The steaks showed a value of 0.608, 0.426 and 0.312 mg malonaldehyde/Kg sample in 0.5%, 1% and 1.5% decoction treated sample respectively and in fillet portions, the values for the similar treatment was 0.712, 0.487 and 0.398 mg malonaldehyde/Kg sample. Total Plate Count ITPO in 0.5% decoction treated steaks and fillet was higher compared to 1% and 1.5% decoctions. The study revealed that 1.5% of mint decoction was effective in reducing the spoilage indices studied like TVBN, TBARS and TPC in fillet portions and steaks of Rohu fish. However, considering the negative impact of higher concentration of decoction on the colour and appearance of the sample, a concentration of 1% mint decoction was found suitable.

Effect of spice extracts on the shelf life extension of Pangasius fillet under chilled storage

The effect of spice extracts (Ginger, mint and chilli) on preservation of *Pangasius (P. hypophthalmicus)* fillet during chilled storage was evaluated. Spice extracts were prepared at 20% concentration (20 g in 100 mL of water) and boiled for five minutes. After cooling, extracts were filtered. Then the fillets were subjected to dip treatment for 30 min. and stored in chilled condition (4 °C). The samples were withdrawn at periodic intervals for biochemical and sensory evaluation. Fillet treated with spice extracts had lower TVBN, TMAN, PV and TBARS than the control. Sensory evaluation revealed that storage period up to ninth day had no significant difference on the overall acceptability of fillet. Further, gradual decrease in overall acceptance was observed in control and fillet treated with chilly extracts. However, fillet treated with ginger and mint extract were found to be acceptable up to 15 days.

Canning of Pangasius in tin freesteel (TFS) cans

The protocol for canning *Pangasius (P. hypophthalmicus)* in TFS cans was worked out. Steaks from skinless and boneless fillets were cold blanched and flash fried for different time intervals of 1, 2 and 3 minutes. The steaks were then canned with refined oil as medium. The cans were heat processed to F_0 value of 8 min. Sensory evaluation,

bacteriological quality, texture profile analysis and thermal process validation of canned products were carried out. The canned product with steaks flash fried for 3 min. gave the best results on sensory evaluation. The product had good textural properties and the water content was less than 10% which is a requirement for canned product.

Quality and shelf life of Pabda processed by *sous vide* technique

A comparative evaluation was carried out on the quality characteristics of Pabda (*Ompok pabda*) processed by *sous vide* technique employing two different modes of heating viz - microwave oven heating and conventional heating. The core temperature of the samples were allowed to reach at 70 °C and maintained at different temperatures. The time-temperature combinations were selected based on a separate preliminary experiment. The fish samples were vacuum packed before heating and separate control was maintained for comparison. After heating, the samples were quick chilled in crushed ice and were further stored at 5 °C. The microbiological parameters were analyzed at regular intervals for total mesophilic, psychrophilic and thermophilic count, Enterobacteriaceae in addition to common pathogenic/spoilage organisms like *E. coli*, *Streptococcus*, *Vibrio parahaemolyticus*, *Salmonella*, *Listeria* and *Staphylococcus*. The biochemical parameters analyzed included TVBN, NPN, alpha amino Nitrogen, FFA, PV, TBA, Histamine, drip loss, pH and haeme iron content. Results



1. Microwave blanched gilled *Ompok* fillet



indicated that both microwave heated and conventionally heated samples remained in acceptable condition for more than a month. However, conventionally heated samples excelled in quality during the Initial 15 days of storage and thereafter showed similar trend for both the samples. On the other hand control vacuum packed samples were to be rejected after 20 days of storage under chilled condition.

Preparation and characterization of chitin and chitosan hydrolysate

Chitin and chitosan hydrolysate was prepared from deproteinised Jawla shrimp. The shell sediment after deproteinisation was autoclaved for 15 minutes. Further, hydrolysis was performed by a combination of chemical (H_2O_2 and ferric chloride) and serial enzymatic degradation process using protease, papain and chitosanase enzyme. The solubility of hydrolysate powder in distilled water was found to be about 95% at room temperature. The hydrolysate was further screened for their antimicrobial properties. The results showed that chitosan hydrolysate solution at 20-50 mg/ml markedly inhibited the growth of most gram-negative and gram-positive bacteria tested. Further characterization of prepared hydrolysate is in progress.

Quality analysis of fish processing waste

The proximate composition of Threadfin bream (*Nemipterus japonicus*) and Croaker *Uohnius dusumerii* fish waste (Head, viscera, swim bladder and bone) were analyzed and compared. The moisture content was high in Croaker viscera (81.1%) compared to Croaker head (75.8%) and swim bladder (73.7%). The same has been observed in Threadfin bream with the viscera of high moisture content (78%) than bone waste (76.8%) and head (73.9%). The protein content was high in Croaker swim bladder (21%) and the least was found in Croaker viscera (13.15%). The crude fat was high in Threadfin bream viscera (87.9%) and it was low in Croaker head (67.26%). The ash content was high in Threadfin bream

head (7.2%) and it was low in Croaker swim bladder (0.7%). Non protein nitrogen was high in viscera and swim bladder of Croaker. Biochemical analysis of the samples have indicated that the spoilage indices viz., TMA, TVBN and FFA were low indicating the freshness of the samples. However peroxide value of the visceral portions in both the species were high.

The fatty acid composition of Thread fin waste was analyzed. The saturated fatty acid was 43.80%, 38.10% and 33.67% in skin waste, viscera and head respectively. The unsaturated fatty acid was high in head region (66.33%) followed by viscera (61.89%) and skin waste (56.19%). The omega 3 fatty acid was high in head (33.52%) followed by viscera (30.24%) and skin waste (26.76%). In omega 3 fatty acid the DHA was high in head (20.07%) followed by skin (16.10%) and viscera (15.50%). The EPA was high in viscera (9.26%) than skin (6.71%) and head (7.94%).

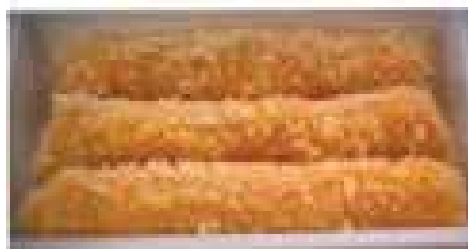
Utilization of processing discards for developing value added products

The filleting frame of Rohu was cooked and meat extracted for preparation of fish rolls. Chilled storage studies of rolls prepared was carried out to assess the shelf life. Initially the ingredient combination for both filling material and base coating was selected by a preliminary study. Fish rolls were made in the selected combination and shelf life evaluation was carried out for both flash fried and control samples during storage. It was observed that the samples remained in acceptable condition for 17 days. Frozen storage studies are also carried out for the same product. Biochemical and sensory parameters of the product was assessed periodically. The product was found to be acceptable even after seven months of storage at $-20^\circ C$.

Edible fish powder prepared from *Ambassys*, a trash fish landing from the CIFT research vessel was found to have eight months storage stability and was found suitable for preparing fish chutney powder.

Utilization of collagen peptides as bacteriological media

Experiments were conducted to study the effectiveness of fish scale waste as bacterial media. The collagen peptide derived from Rohu fish scales was used as basic material for the preparation of the bacterial media. Collagen peptide was prepared from Rohu scales using the enzyme alkalase and the peptide fractions were characterized based on molecular and bioactive properties. The Fish Scale Peptide (FSP) 1X and 2X concentration was prepared and compared with the commercial bacteriological media Peptone (Himedia). Nutrient agar was prepared by using FSP. Aerobic Plate Count was performed using the above formulation with a standard *Safmonella* culture. After incubation at $37^\circ C$ the colonies were counted; the FSP media 1X, 2X and Himedia Peptone colony counts



Fish rolls from Rohu frame meat

were 335,520 and 320 respectively. The FSP 1X gave the same result as the commercial media. In case of FSP 2X the colony forming unit (CFU) nearly doubled the time of the colonies in the commercial media. This indicates that FSP is a cheap alternative source for bacteriological media.

Hydroxyapatite from fish scales

Hydroxyapatite was prepared from Catla and Rohu scales by a heat treatment method at different combinations of temperatures and durations based on a statistically validated model. The final product was further characterized by X-ray diffraction, scanning electron microscopy (SEM-EDAX)

and Fourier transform infrared (FTIR) analysis. X-ray diffraction patterns showed a gradual increase in the degree of sharpness of peaks with increasing heat treatment temperature. FTIR spectroscopy and SEM analysis confirmed that the samples were highly crystalline hydroxyapatite particles.



Hydroxyapatite from Rohu scales

Development of antimicrobial and antioxidant packaging material for packing fish products

Studies were undertaken to develop freshness indicators for chilled stored fish and shellfish. 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 freshness indicator development was continued for shrimps (*Parapenaeopsis stylifera*). For this, indicators like Bromocresol purple (BCP), Bromocresol green (BCG) and mixed indicators impregnated to sterile filter paper was used. Peeled and deveined shrimps packed in HIPP trays and stored in ice were in good acceptable condition up to seven days. Among the indicators, BCP gave better indication of freshness compared to other indicators. Colour changes of BCP correlated well with the sensory qualities, volatile bases and total mesophilic counts with storage days.

Application of multiple hurdle technology for enhancing the shelf life of Indian Mackerel

The effect of vacuum packaging, *sous vide* treatment and antimicrobial dip treatment with potassium sorbate on Indian Mackerel (*Rastrelliger kanagulta*) steaks was studied. The untreated fish steaks were packed in air and one lot was packed under vacuum. The batch subjected to *sous vide* process was packed in air and treated at 80 °C for 3 min. and immediately chilled. The last lot was

subjected to dip treatment in 2% potassium sorbate for 30 min. and packed in air in polythene/polyester laminate pouches. Shelf life determination showed that control samples had a shelf life of 10 days, vacuum packed 16 days, potassium sorbate treated 12 days and *sous vide* 18 days.

Standardization of Cobia fish curry using HTST technology

High temperature short time (HTST) processing of fish curry using Cobia fillets were undertaken in retort pouches. Fish curry was processed to F_0 values of 8 at two different temperatures of 121 °C and 126 °C. The fish was found suitable for developing thermal processed curry products and the heat penetration characteristics were determined. The total process time was 30.72 min. for curry processed at 121 °C and it was 27.20 min. at 126 °C. HTST processing of fish curry using Cobia fillets were undertaken in clear retort pouches. The fish was found acceptable based on biochemical and sensory evaluation even after a period of three months.

Active/vacuum packaging technologies for preservation of fish products

Shelf life assessment of Long tail tuna (*Thunnus tonggol*) chunks packed under air and O_2 absorber were studied during iced storage conditions. Initially, *Pseudomonas* spp., H_2S producing bacteria, *Brochothrix thermosphacta* and *Lactobacillus* spp. counts were 2.6, 2.3, 2.48 and 2.18 log du/g respectively which increased with the storage period. The counts of *Pseudomonas* spp. and H_2S producing bacteria was higher for air packed samples whereas the counts of *B. thermosphacta* and *Lactobacillus* spp. were higher for O_2 absorber packs during storage period. Sensorily, the eating quality of Long tail tuna packed under control air was in good condition up to 5-6 days compared to 9-10 days for O_2 scavenger packs which correlated well with the biochemical and total mesophilic counts.





Quality Assurance and Management Division

Chief findings

- + A Quality Index Method (QIM) scheme for sensory grading of chilled Indian Mackerel (*Rastrelliger kanagurta*) was finalized with 14 sensory descriptors and total demerit score of 33. Principal component analysis indicated retention of prime quality of fish for initial five days of chilled storage.
- + A draft QIM scheme validated with an array of biochemical, microbiological and instrumental parameters was developed for Oil Sardine (*Sardinella longiceps*).
- + Challenge studies with enterohemorrhagic *Escherichia coli* 0157 indicated that the pathogen could survive after freezing at -40 °C (90 minutes) and subsequent cold storage condition (-18 °C for more than 24 months in fish substratum).
- + Most Probable Number (MPN) method was observed to be the most suitable method for recovery and enumeration of injured *Vibrios* from high pressure processed shrimp.
- + Prevalence of *Vibrio alginolyticus* in seafood was found to be 60% in different markets across Kerala. This pathogen could survive up to 18 days in Yellowfin tuna during chilled storage.
- + Survival of *Listeria monocytogenes* and *Staphylococcus aureus* during *sous vide* processing and further chilled storage was elucidated. *L. monocytogenes* could survive nine minutes cooking at 63 °C in Red Snapper fillets, whereas 4.68 log reduction was observed for *S. aureus* in Tuna fish chunks cooked for 60 min. at 60 °C without any appreciable reduction during chilled storage.
- + The efficacy of an altered sanitation regime using a Response Surface Methodology optimized chlorination schedule was tested for real-time application in a fish processing plant.
- + Phenolic extracts of *Averrhoa bilimbi* and Pomegranate epicarp which possessed broad spectrum antibacterial activity against spoilage and pathogenic

Research projects handled

- Development of a Quality Index Scheme for commercially important Indian fishes
- Studies on effect of different processing methods, additives and natural preservatives on spoilage and pathogenic bacteria in fish and fishery products
- Food safety interventions for women in fishery based micro-enterprises in coastal Kerala

bacteria in seafood were characterized by LC-MS/MS.

- + Studies on survival of *Vibrios* in high pressure (250 MPa; 6 min.) indicated complete elimination of pathogenic *Vibrio* species such as *V. cholerae*, *V. parahaemolyticus* and *V. vulnificus*.
- + Studies on *in situ* survival of microflora in high pressure treated shrimp (*Fenneropenaeus indicus*) indicated that gram positive bacteria such as *Arthrobacter* spp., *Bacillus cereus*, *Brevibacterium* spp., *Paenibacillus lautus* and *Rhodococcus* spp. could be isolated from 600 MPa treated shrimps.
- + Imported frozen fishery products tested for antibacterial substances showed positive for 20% of the sample, but banned antibiotics were not detected by using LC-MS/MS method.
- + A depuration system designed for edible oyster (*Crassostrea madrasensis*) could significantly reduce load of trace metals after 72 hours of depuration.
- + A ready to eat novel battered and breaded snack product named as 'Oyster pablano



pepper fritter' prepared from edible oyster had a shelf life of 14 days in chilled storage conditions.

- + Studies on elemental composition of wastes generated during fish processing revealed significant content of Ca, K, Fe and Mg in Croaker head and Pinkperch viscera, which could be further utilized.
- + A 4.00 Lakh litres per day energy efficient Effluent Treatment Plant (ETP) was designed and commissioned at Cochin Fishing Harbour, for Cochin Port Trust on a consultancy basis.

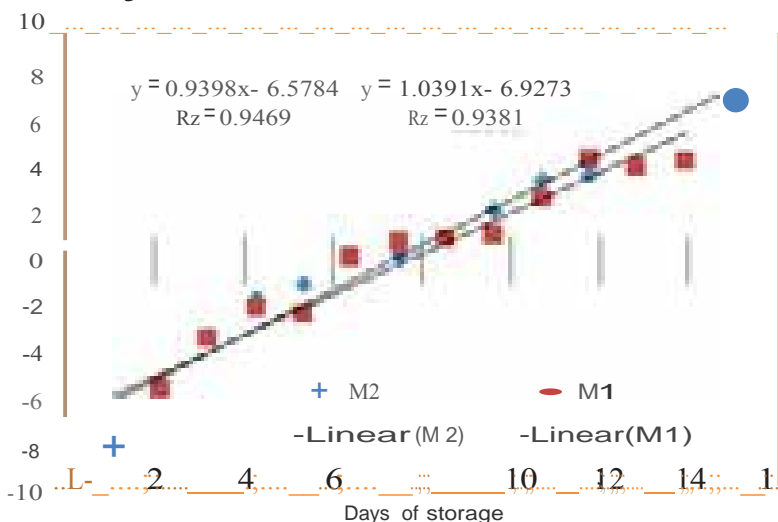
Report of work done

Development of Quality Index Method (QIM) scheme for sensory assessment of Indian Mackerel

A QIM scheme for sensory grading of chilled Indian Mackerel (*Rastrelliger kanagartha*) was finalized. Principal component analysis was performed to the demerit score of 21 sensory descriptors to develop a single index score during the storage period of 14 days. The score of the first principal component which explained 85% of the total variability in the data has been taken to analyze the correlation between storage days and the cumulative demerit score obtained in each storage day. A linear trend was obtained between PCA1 Vs cumulative score and PCA1 Vs storage days. The PCA score was negative up to 5 days of storage and it indicates the retention of prime quality of Indian Mackerel under chilled condition for first five days of storage. From 6th day onwards the principal component score started increasing linearly from 0.43 to 6.99 till the end of storage period. The finalized QIM scheme has 14 descriptors with a total demerit score of 33.

Among the chemical indices taken for validation of QIM scheme, TBA value increased linearly up to 8th day and increased exponentially during rest of the

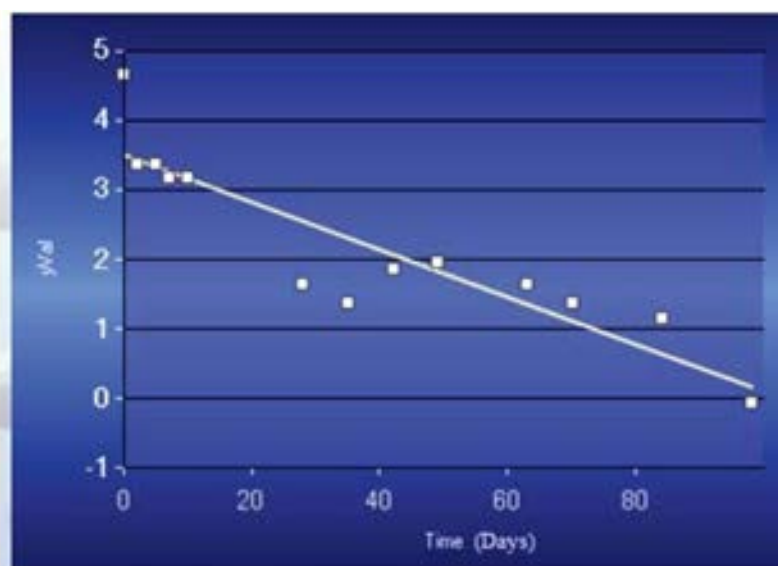
storage period. Hardness increased up to 1st day of storage and then decreased. Psychrophilic count was found to be static up to 1st day of storage and started increasing afterwards. Similarly, Enterobacteriaceae count and H₂S producer count started increasing from day onwards.



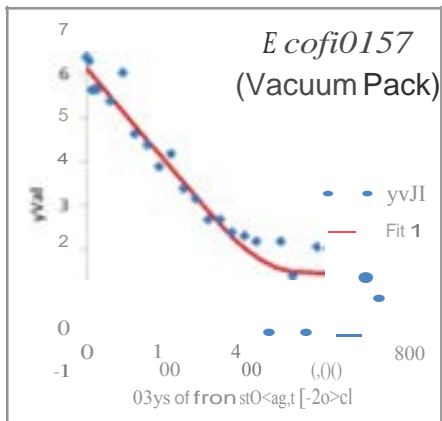
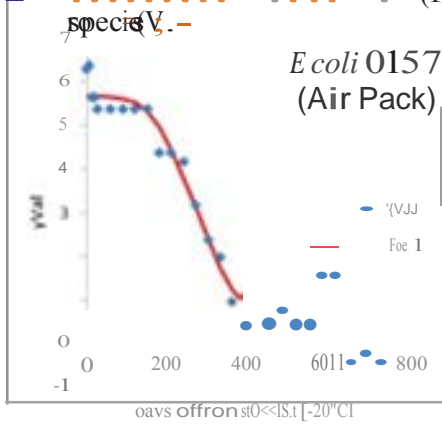
PCA plot of sensory descriptors for QIM scheme of Mackerel

Predictive modeling of survival of food-borne pathogens in fishery products

The survival of emerging food-borne pathogens in fishery products like Enterohemorrhagic *Escherichia coli* (E. coli O157) and *Vibrio parahaemolyticus* 03:K6 was studied in different packaging environments and processing conditions. The survival pattern of these pathogens was modeled for predictive applications in risk assessment framework. The decay of inoculated *V. parahaemolyticus* 03:K6 in Yellowfin tuna chunks during frozen storage (-18°C) over a period of 98 days was modeled using Baranayi and Roberts Model



Predictive modelling of *Vibrio parahaemolyticus* 03:K6 in frozen Yellowfin tuna chunk



Predictive modelling of *Escherichia coli* 0157 in frozen Yellowfin tuna chunks

to 0 as the datasets were suitable only for Baranayi and Roberts Model with no lag. The generated model had adjusted R2 statistics of fitting as 0.696532, standard error of fitting as 0.35466 and decay rate of 0.112166. Simi larly, Baranayi and Roberts complete model was used for *E. coli* 0157 inoculated in Yellowfin tuna chunks, separately frozen in both air pack and vacuum pack and stored at -20 °C over a period of 24 months. Model of *E. coli* 0157 stored in air pack had better fit (R²_stat: 0.960973; se (fit): 0.439341) than the vacuum pack model (R²_stat: 0.896402; se (fit): 0.611537). Using these predictive models, Probable level of contamination of a product prior to freezing as well as

suNival of the pathogen during frozen storage can be estimated. Inputs from these primary models developed shall be incorporated in secondary models for predicting suNival of pathogen in multiple barrier modes.

Survival of Vibrios in high pressure processing

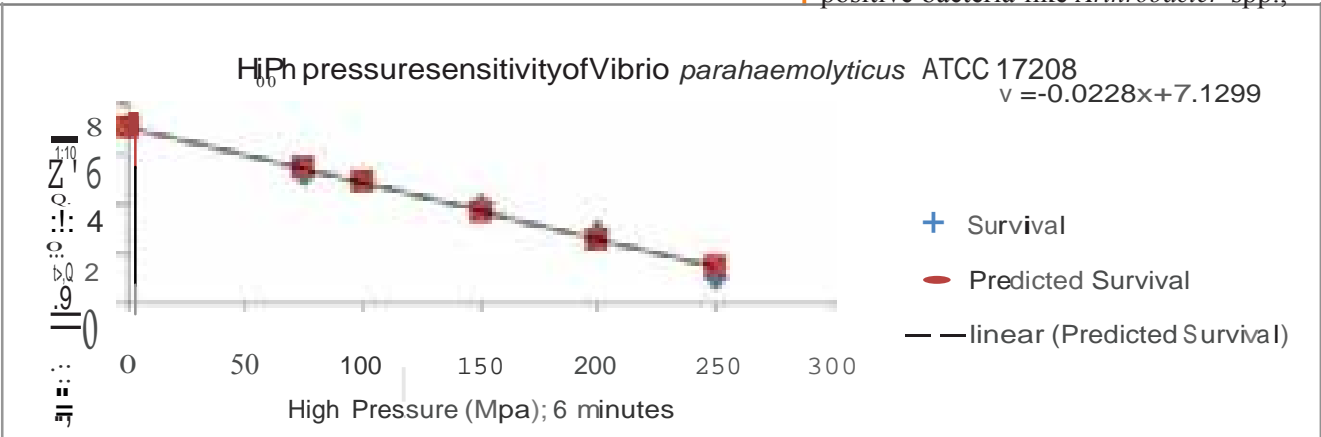
SuNival of Vibrios in *Fenneropenaeus indicus* subjected to an optimized high pressure processing regime (250 MPa; 6 min.) was studied. *Vibrio* species were isolated and identified up to species level before and after HP treatment. Complete elimination of nine

cholerae, *V. parahaemolyticus*, *V. vulnificus* B1, *V. hepatarius*, *V. corallilyticus*, *V. mediterranei*, *V. ponticus* and *V. harveyi*) was observed. Highest percentage of survival (63%) was attained by *V. furnisii*, *V. mimicus* and *V. proteolyticus*, followed by *V. aestuarinus* (32.6%) and *V. scophthamini* (29.03%).

High pressure destruction kinetics of *V. cholerae*, *V. parahaemolyticus* (ATCC 17208) and *V. parahaemolyticus* 03:K6 was studied in sterile shrimp substratum. When treated at different high pressure levels {150, 250, 350, 450 and 550 MPa}, *V. cholerae* could only be isolated from 150 MPa, where 2.27 log reduction was observed from the initial value. *V. parahaemolyticus* 03:K6 had slightly higher resistance to HPP compared to *V. parahaemolyticus* ATCC 17208. The pressure D value with 6 minute exposure was found to be 51.76 MPa for *V. parahaemolyticus* 03:K6, whereas it was 43.81 MPa for *V. parahaemolyticus* ATCC 17208.

A rapid MPN-PCR method was developed during the study which indicated 1.7 log reduction of thermostable direct hemolysis (tdh) positive *V. parahaemolyticus* in shrimp after exposure to high pressure treatment (250 MPa, 6 min.).

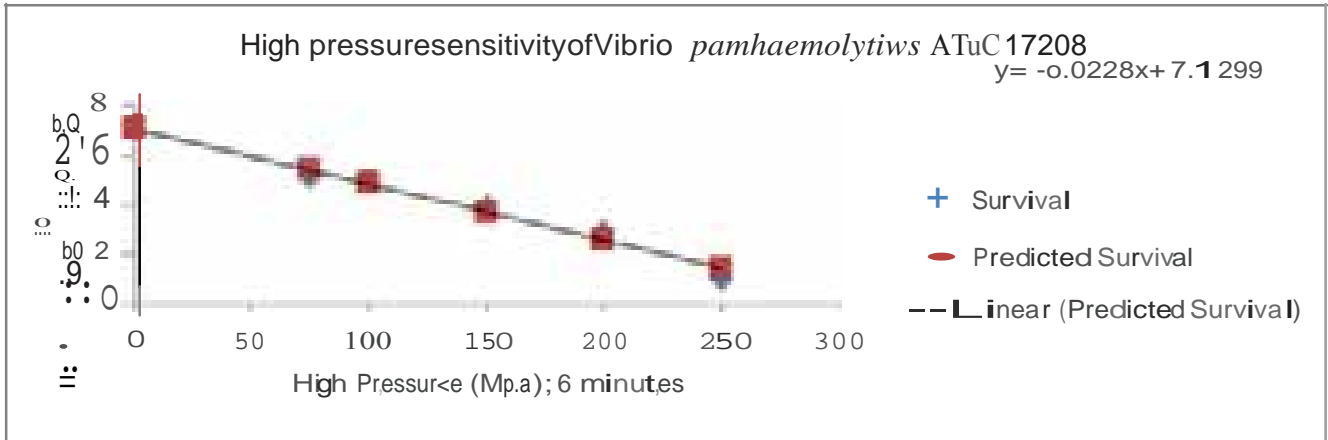
Survival of microflora in high pressure processed shrimp {250, 400, 600 MPa for 6 min.) was elucidated. Gram positive bacteria like *Arthrobacter* spp.,





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Bacillus cereus, *Brevibacterium* spp., *Paenibacillus lautus* and *Rhodococcus* spp. could resist pressure upto 600 MPa.

Survival of food-borne pathogens in *sous vide* processing

Effect of *sous vide* processing on survival of *Listeria monocytogenes* was studied. *L. monocytogenes* was inoculated at levels of 5×10^5 *dulg* in Pangasius fillets and subjected to *sous vide* processing (60 °C for 60 min.). Samples were drawn at intermittent intervals (2, 15, 30, 45, 60 min.) during the cooking process to optimize the *sous vide* method. Total elimination of the pathogen was observed in 30-60 min. cooked samples. In another experiment, *L. monocytogenes* was inoculated in Red Snapper fillets and its survival was studied during *sous vide* processing. Cooking time was fixed at 3, 9 and 17 minutes at a temperature of 63 °C and recovery of the pathogen was monitored during subsequent chilled storage. Complete elimination (60 reduction) of this pathogen was noticed in 17 minutes cooked samples, pathogen survived in 3



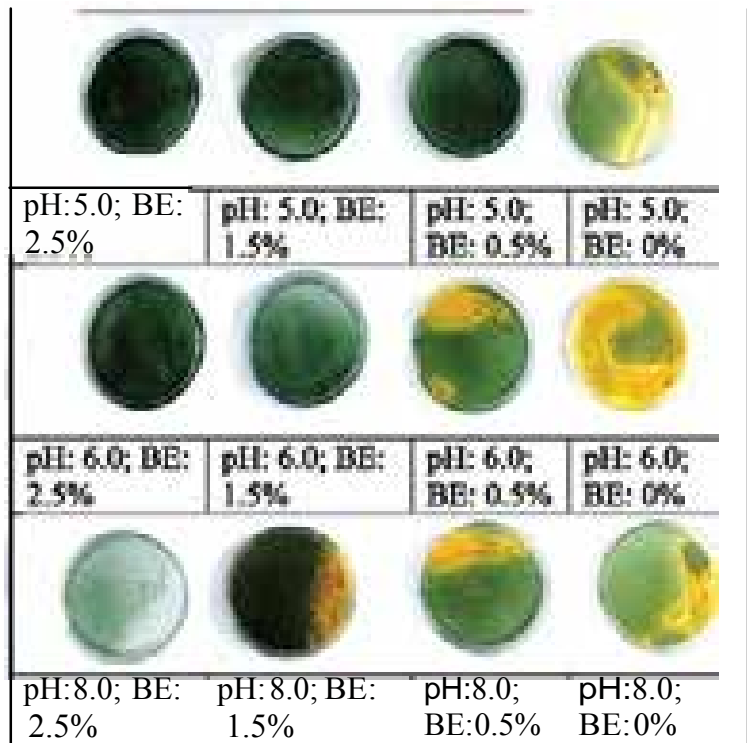
Challenge studies with food-borne pathogens

and 9 minute cooked samples.

Incidence and survival of *Vibrio alginolyticus* in fish and fishery products

Incidence of *Vibrio alginolyticus* in fish and fishery products was studied in different fish markets of Ernakulam. A high prevalence rate of 60% was observed for this pathogen in different categories of fishery products (n=30). Survival of *V. alginolyticus* in Yellowfin tuna meat during chilled storage (Q-20Q was studied. The load of *V. alginolyticus* reduced by 99.9% after 28 days of chilled storage.

Survival of *V. alginolyticus* in Yellowfin tuna homogenate was studied at different pH (5.0, 6.0 and 8.0) and in presence of different concentration of Bilimbi (*Averrhoa bilimbi*) extract (0.5, 1.5 and 2.5%) was studied. A multiple barrier of low pH (5.0) and 0.5% Bilimbi extract could inhibit the growth of *V. alginolyticus*.



Survival of *V. alginolyticus* at different pH and concentrations of Bilimbi Extract



Chemical hazard assessment of aquaculture farms

Chemical hazards associated with aquaculture products pose a serious food safety risk for consumers. In three shrimp farms of Edavanakkadu area of Cochin, randomly selected samples of shrimp (*Penaeus monodon*), water and sediment were drawn at regular intervals and analyzed for presence of antibiotics, heavy metals and pesticides. The shrimp samples were found to be free from Chloramphenicol, but 1-aminohydantoin (AHD), a metabolite of the prohibited antibiotic Nitrofurantoin was detected in samples from all the three farms in the range of 0.6-10.3 ppb. The content of heavy metals such as Cd, Co, Cr, Cu, Mn, Ni, Pb and Zn were evaluated in the samples of shrimp, water and sediments using ICP-OES. In shrimp tissue, cadmium and lead were detected in the range of 0.024-0.13 and 0.13-0.18 ppm respectively. Elementary load of the sediment was found to be comparatively higher viz. Cd (1.354.5 ppm), Cr {61.75-178.8 ppm}; Cu (6.43-26.8 ppm); Ni (31.58-53.98 ppm) and Pb (6.09-15.66 ppm). Load of trace elements in water was as per prescribed limits. The water quality parameters i.e. temperature, pH, salinity, dissolved oxygen, BOD, COD, total alkalinity and total hardness were also evaluated and were found to be within required limits. Presence of Nitrofurantoin metabolite in shrimp samples of all selected shrimp farms indicates failure in compliance to regulations of Coastal Aquaculture Authority of India and poses serious health risk for consumers.

Occurrence of *Salmonella* Bareilly in Nakauchi scrapes imported from India

Multistate outbreak of *Salmonella* Bareilly and *Salmonella* Nchanga infections were reported in USA after consumption of Nakauchi scrapes imported from India during January to June 2012. Nakauchi scrapes are nothing but minced and frozen backmeat of Tuna. A total of 390 persons belonging to 27 states of USA were reported to be infected with these outbreak strains of *Salmonella*. The outbreak was traced back to the Nakauchi scrapes made from ground Tuna meat, manufactured in Kerala, India. After Centre of Disease Control (CDC) officially implicated the outbreak to Nakauchi scrapes, the manufacturer recalled the products on April 13, 2012 and later on the recall was expanded to include *Tuna strips* on May 10, 2012.

A detailed investigation was carried out by USDA in India and advisories were issued to consumers not to consume this product or other sushi, sashimi, ceviche, or similar dishes that might contain Nakauchi scrape tuna as an ingredient. India was alerted by the INFOSAN emergency contact point of WHO to find out the root cause of this contamination. Dr. S.K. Panda, Senior Scientist, CIFT along with officials from Export Inspection Agency inspected the facility on 27th April, 2012 to find out the possible source of contamination. The food safety audit included implementation of HACCP as per approved HACCP plan, implementation of SSOP measures, traceability, in-house *Salmonella* testing capabilities and documentation. Major deviations observed during the audit were lack of specific HACCP plan for Nakauchi production process, inadequate measures for



Rejected cartons of Yellowfin tuna

provision of safe water and ice, poor sanitary condition of the machineries and implements and procedural errors in *Salmonella* testing. Samples of Nakauchi scrapes, water and swab samples from food contact surfaces randomly picked from the unit were brought to the laboratories of CIFT for verifying the presence of *Salmonella*. *Salmonella* was detected in two out of three audit samples indicating complete breakdown of food safety measures in the implicated processing unit. Serological confirmation of the isolates by Central Research Institute, Kasauli revealed presence of *Salmonella* Weltevreden and *Salmonella* Typhimurium.

A detailed report outlining the inadequacies noticed as well as suggestive measures was submitted to Export Inspection Council, New Delhi. The following corrective actions are suggested to prevent recurrence of this hazard in Indian seafood products:

- + Regular monitoring of safety of water and ice used in seafood manufacturing with ample frequency
- + Weekly review of hygiene status and sanitary conditions of all activities related to food manufacture



- + Internal audit of in-house testing protocols and updation of microbiological testing procedures
- + Exclusion of asymptomatic carriers of *Salmonella* from food handling activities
- + Verification of current sanitation regime with an external agency
- + Scheduled knowledge enhancement programmes and hygiene drills for food handlers

Characterization of antibacterial

substances from plant sources

Phenolic extract of *Averrohea bilimbi* which showed broad spectrum antibacterial activity was characterized by LC-MS/MS. An IDA experiment was setup with EMS to EPI, where EMS range is from 100 dalton to 1200 daltons with a scan speed of 4000 daltons/sec. ER scan speed was fixed at 250 daltons/sec. and for EPI, mass range was 50-1200 daltons and scan speed was 4000 daltons/sec. The predominant masses were checked. The mass of flavanoids from the targeted list was calculated using Analyst software. It was matched with exact mass from calculator and mass identified from IDA run.

The extract contained three compounds of significance, which were identified as 3,4-Pyrrolidinedicarboxylic acid 1-(phenylmethyl) cis- {9CI} (MW 249.26), Quercetin {MW 302.236} and 1-Bromotetradecane {MW 277.28}.



Microbiology, Fermentation and Biotechnology Division

Chief findings

- + Enterotoxigenic (ETEO) and Enteropathogenic (EPEQ) *Escherichia coli* were identified in 30 and 3.5% of the 225 *E.coli* isolates from 54 seafood samples.
- + A Methicillin resistant *Staphylococcus aureus* (MRSA) was isolated from fish and PCR amplification showed presence of *mecA* gene.
- + Out of 60 *Vibrio cholerae* non-01 and non-0139 isolates from seafood studied, all strains were found negative for *ctx* and *zot* genes. Presence of *ace* was detected in 12.8% strains and regulatory *tox* genes in 91% strains.
- + *Yersinia enterocolitica* could not be detected in any of the 21 seafood samples collected from retail fish markets of Ernakulam district.
- + Thermophilic *Campylobacter* (*C. upsaliensis*) was detected in one out of 48 seafood samples from retail outlets at Ernakulam district.
- + *tdh* gene was not detected in any of the 153 *V. parahaemolyticus* isolates from 35 seafood samples.
- + Real time PCR-based methods were standardized for quantitative detection of *Listeria monocytogenes* and *Shigella* spp. in seafood.
- + Antimicrobial resistance to Ceftriaxone, a third-generation Cephalosporin antibiotic, was found in one *L.monocytogenes* isolate from fish.
- + Three Enterotoxigenic *E. coli* (ETEO) isolates from fish were resistant to Moxifloxacin, a fourth-generation synthetic Fluoroquinolone antibacterial agent, while six isolates were resistant to Cephodoxime, a third-generation Cephalosporin antibiotic.
- + Multi-drug resistance (MDR) against 6-drugs (Cephodoxime, Ticarcillin, Augmentin, Colistin, Ceftriaxone and Moxifloxacin) was found in 12% of the 60 non-01, non-0139 *V.cholerae* isolates. But 01 strains were found sensitive to all of the antibiotics tested.
- + Sixteen multiple drug resistant strains of *Staphylococcus aureus* were isolated from fish sold in retail outlets at Ernakulam, Alappuzha and Kottayam districts.

Research projects handled

- Diversity of seafood-borne pathogenic and commensal bacteria and bioscreening for novel genes and biocatalysts
 - 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
 - Utilization of fish processing waste for development of innovative products
 - Nutritional profiling and hazard assessment of fish and fishery products of marine and lacustrine environments of east-coast India
 - 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
 - Oceanic tuna fisheries in Lakshadweep sea: A value chain approach
 - Development of multiplex microarray for detection of food borne and shrimp pathogens
-
- + Microbial profile of farmed Gourami fish (*Osphronemus goramy*) showed dominance of Genera *Enterobacter*, *Aeromonas*, *Exiguobacter*, *Pseudomonas*, *Bacillus* and *Staphylococcus*.
 - + Microflora of farmed Catfish (*Pangasianodon hypophthalmicus*) was dominated by Genera *Pseudomonas*, *Aeromonas*, *Burkholderia*, *Stenotrophomonas*, *Micrococcus*, *Staphylococcus* and *Bacillus*.



- + Spoilage microflora of farmed Catfish was identified as Genera *Pseudomonas*, *Aeromonas* and *Burkholderia*. Pathogenic bacteria belonging to ETEC, *Aeromonas* and *Enterococcus* were detected.
- + Studies on survival of *Salmonella* in seafood at different temperature exposure (-20 °C, 4 °C, room temperature (RT) and 45 °C) showed that at 4 °C, there is a continual reduction in the cell count and cell reduction was sharper at -20 °C from Day 1 to 3 and viable *Salmonella* was not detected after Day 5.
- + Studies on differential expression of *Salmonella enterica* serovars Weltevreden virulent genes when compared to endogenous reference gene (GAPDH) showed that there was up-regulation of *rpo* gene and down-regulation of *fimA*, *inv*, and *stn* genes at RT. At high temperature (45 °C), 15-fold increase in *fimA* expression on Day 1 and expression of *tpoE*, *invA* and *stn* genes was down-regulated 100 fold during one week incubation.
- + Exotic viral shrimp pathogens such as YHV and TSV could not be detected in any of the 61 and 48 shrimp/larvae samples tested.
- + Bacteria tolerant to 20% salt were identified as Genera *Kocuria*, *Haererehalobacter*, *Staphylococcus* and *Bad/Ius*.
- + Relative quantitative real-time RT-PCR assay for expression profiling of upregulated genes from eDNA SSH library of *Mangroveibacter* spp. revealed that Glycine betaine/L-proline transport system has a major role in *Mangroveibacter* spp. for overcoming salt stressed conditions.
- + Out of the 89 hydrocarbon degrading bacteria isolated from petroleum contaminated fishery environment under different pH and salt

concentrations, the dominant genera were identified as *Kocuria*, *Haererehalobacter*, *Staphylococcus* and *Bacillus*.

- + One potential plastic degrading bacterium was isolated from partially degraded plastic collected from landing centres and was identified as *Gordonia* spp.
- + Comparative genomics analysis of *Listeria monocytogenes* and non-pathogenic *L. innocua* using bioinformatic tools revealed the presence of 41 genes including the genes encoding Listeriolysin (h/y), Phosphatidylinositol specific phospholipase C (*pleA*), zinc metalloprotease precursor (*mpl*), actin-assembly protein precursor (*actA*), DNA topoisomerase III etc. which were exclusively present in *L. monocytogenes*.

Report of work done

Diversity of pathogenic bacteria in seafoods

Psychrotrophic pathogen *Yersinia enterocolitica* could not be detected in any of the 21 seafood samples collected from Varappuzha and Aroor fish markets at Emakulam district. Of the 225 *Escherichia coli* isolates from 54 samples collected from Emakulam, Aroor and Kottayam markets in Kerala, 68 isolates were identified as enterotoxigenic (ETEO) and eight were identified as Enteropathogenic (EPEC) *E. coli*. *Vibrio parahaemolyticus* (153 isolates) isolated from 35 seafood samples from retail outlets in Kerala did not carry the *tdh* gene, a marker for its virulence potential. Twenty one samples comprising of farmed *Litopenaeus vannamei* (raw and cooked), farmed *Penaeus monodon*, and marine shrimp (*Metapenaeus* sp.) from Visakhapatnam (A.P.) were negative for the presence of *V. parahaemolyticus* except one sample of *Metapenaeus* sp. Non-proteolytic *C. botulinum* was not detected in any of the 18 seafood samples comprising of farmed fish, pasteurized crab meat and fish products screened. The prevalence of *Staphylococcus aureus* in 55 samples of seafood from retail fish markets of Emakulam, Alappuzha and Kottayam districts was found to be 57% and 42.8%, respectively with an overall prevalence of 56.3%.

Molecular diversity of pathogenic bacteria in seafoods

A total of 60 *V. cholerae* non-01 and non-0139 isolates from seafood were tested for virulence markers; *ctx*, *zot* and *ace* genes, and a regulatory (*tox*) gene. All the non-01, non-0139 strains were negative for *ctx* and *zot* genes. Presence of *ace* was detected only in 12.8% isolates and regulatory, *tox* gene in 91% of the isolates.

Studies on molecular diversity of *E. coli* in seafood revealed that pathogenic *E. coli* was present in 31 out of 54 samples. Among 225 isolates, 68 isolates were identified as Enterotoxigenic (ETEO) while eight isolates as Enteropathogenic (EPEC) *E. coli*.

Methicillin resistant *Staphylococcus aureus* (MRSA) in seafood

MRSA was found in 3.8% of 55 samples of fish collected and isolates were further confirmed by PCR amplification of *mecA* gene.



Thermophilic *Campylobacter* from seafood

A total of 48 seafood samples were screened. Thermophilic *Campylobacter*, identified as *Campylobacter upsaliensis* was present in one sample. A PCR method was standardized for identification of *C. jejuni* in seafood that targets *hipO* gene of the organism. An amplified product of 323 bp was obtained in case of *C. jejuni* isolates.

Quantitative detection of *Listeria monocytogenes* and *Shigella* spp. in seafood

A real-time PCR targeting *hly* gene that could detect as low as 2.5 du of *L. monocytogenes* was developed. Real-time PCR method was employed for quantification of *Listeria* cells in the biofilm. Based on Ct values, freshwater fish isolate of *L. monocytogenes* (Ct value of 17.85) and *L. monocytogenes* ATCC 19115 (Ct value of 17.99) were found to be stronger biofilm producer than other isolates confirming the result obtained through colourimetric detection. Real-time PCR assay targeting *iapA* gene specific to Genus *Shigella* was developed for quantitative detection of *Shigella* spp. in seafood. A linear plot of Ct values against the log concentration (2 to 2×10^6 cfu/ml) revealed that the cell detection was consistently linear up to 2 cfu/mL.

Diversity of commensal and spoilage bacteria in freshwater fish

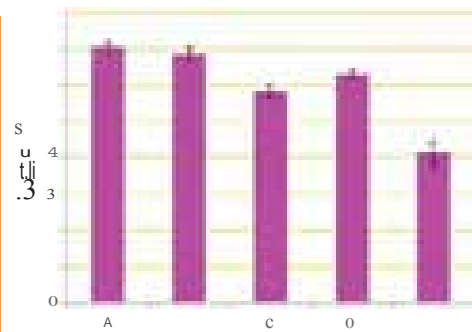
Microbial profile of farmed Gourami (*Osfhronemus goramy*) showed dominance of Genera *Enterobacter*, *Aeromonas*, *Exiguobacter*, *Pseudomonas*, *Bacillus* and *Staphylococcus* and that of farmed Catfish (*Pangasianodon hypophthalmicus*) showed dominance of Genera *Pseudomonas*, *Aeromonas*, *Burkholderia*, *Stenotrophomonas*, *Micrococcus*, *Staphylococcus* and *Bacillus*. Spoilage bacteria of farmed Catfish was identified as Genera *Pseudomonas*, *Aeromonas* and *Burkholderia*. Pathogenic bacteria ETEC, *Aeromonas* and *Enterococcus* were also isolated.

Microbial attributes of marinated farmed Catfish

Spoilage microflora associated with marinated Catfish stored under air and vacuum was studied. The dominant flora was identified as Genera *Pseudomonas*, *Aeromonas* and *Burkholderia*.

Effect of high pressure treatment on *Staphylococcus aureus* in Indian white prawn

Indian white prawn (*Fenneropenaeus indicus*) spiked with 10^7 cfu/g of *S. aureus* ATCC 25923 treated with 5% sodium acetate solution at 350 MPa reduced the population of *S. aureus* by 1.22 Log₁₀ (cfu/g) compared to untreated control. 250 MPa pressure treatment had minimum effect on this pathogen. High pressure treatment combined with sodium acetate (5%) treatment for 1 min. reduced *S. aureus* by 0.716 and 2.942 Log₁₀ (cfu/g) at 250 and 350 MPa pressure level, respectively.



Effect of high pressure processing on *Staphylococcus aureus* in spiked Indian white prawn samples, A - Control; B - 250 MPa pressure; C - 350 MPa pressure; D - 250 MPa pressure and sodium acetate; E - 350 MPa pressure and sodium acetate

Effect of high pressure on microbial flora of oyster

High pressure treatment at 300 MPa for 5 min., reduced the total viable count of oyster by 1.28 Log₁₀ du/g from its initial population of 5.1 Log₁₀ cfu/g. On iced storage, the untreated sample reached the 7 Log₁₀ on 16th day whereas, treated sample reached 7 Log₁₀ by 28th day of storage.

High pressure destruction kinetics of *L. monocytogenes*

Studies on pressure destruction kinetics of *L. monocytogenes* in artificially spiked (10^7 du/g) Indian white prawn revealed a Pressure D values of 11.806, 5.92 and 5.099 min, respectively at 300, 350 and 400 MPa pressure level at 30°C.

Antimicrobial resistance in pathogenic bacteria from seafoods

Chloramphenicol resistance of bacteria from shrimp hatchery: Nineteen percentage of the bacterial isolates (n = 32) isolated from water from post-larvae tank in *L. vannamei* shrimp hatchery showed resistance to Chloramphenicol and 13% isolates showed intermediate resistance. The minimum inhibitory concentration (MIC) of Chloramphenicol to inhibit the growth of resistant bacteria was high, ranging between 120 pg and 240 pg.

Antibiotic resistance in Enterotoxigenic (ETEC) *E. coli*: Antibiotic profile of eight



ETEC isolates revealed that three isolates were resistant to Moxifloxacin, while six isolates as resistant to Cephodaxime.

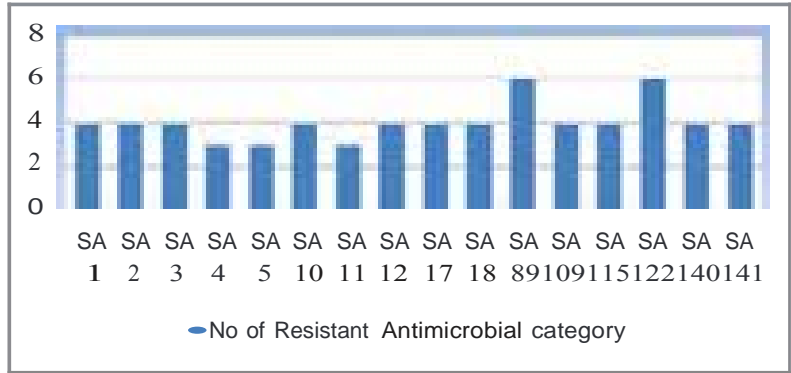
Antimicrobial resistance in *L. monocytogenes*: Fifteen *L. monocytogenes* isolates from seafood were studied. Sensitivity to Gentamicin, Ciprofloxacin, Cloxacillin, Cefoperazone, Penicillin G, Chloramphenicol, Norfloxacin, Cotrimoxazole, Tobramycin, Amoxicillin, Amikacin, Netillin, Ampicillin, Erythromycin and Vancomycin was found in all the isolates. One fish isolate was resistant to Ceftriaxone while three isolates showed intermediate resistance to the antibiotic. Four isolates showed sensitivity to Nalidixic acid, while others were found resistant.

Multidrug resistance in *Staphylococcus aureus*: A total of 168 Staphylococci isolates were studied. Among the 20 antibiotics tested, 16 multiple drug resistant strains were isolated. These strains exhibited resistance to three to six antibiotics such as Oxacillin, Ofloxacin, Vancomycin, Erythromycin, Clindamycin, Chloramphenicol, Linezolid and Teicoplanin.



PCR assay for detection of Methicillin resistant *S. aureus* Lane 1 and Lane 4 - *S. aureus* ATCC 33591 positive control; Lane 2 and Lane 5 - *S. aureus* Fish strain; Lane 3 and Lane 6 - *S. aureus* ATCC 25923 negative control for mecA; Lane M - Molecular weight marker; Lane 7 - *S. aureus* ATCC 12228

Multidrug resistance in *Vibrio cholerae*: The antibiotic sensitivity of *V. cholerae* O1 (n-5), and non-O1, non-O139 (n-55) isolates from seafood was tested against 20



Multidrug resistance in *Staphylococcus aureus*

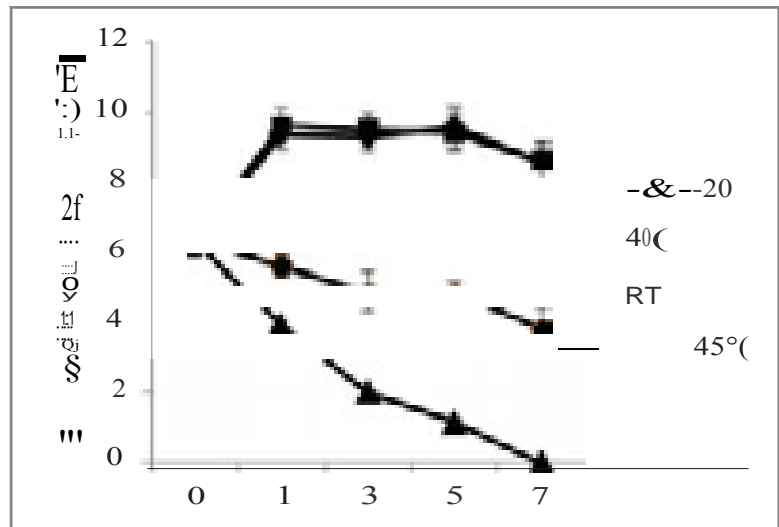
antibiotics. Among the non-O1, non-O139 isolates, 24%, 35%, 67% and 76% were resistant to Cefpodoxime, Ticarcillin, Augmentin, and Colistin, respectively. Multidrug resistance against six drugs; Cefpodoxime, Ticarcillin, Augmentin, Colistin, Ceftriaxone and Moxifloxacin was found in 12% of the non-O1, non-O139 *V. cholerae* strains. But O1 strains were found sensitive to all the antibiotics tested.

Effect of desiccation on *L. monocytogenes* in biofilms

The effect of desiccation on the survival of *L. monocytogenes* biofilms on glass slides when stored aseptically at 30 °C was studied. The initial load of the biofilm was 5.824 Log₁₀ dulcm² which was reduced by 99.99% on Day 15. Survival of the pathogen was noticed up to 25 days in the biofilm.

Differential expression of *Salmonella enterica* serovar Weltevreden virulent genes

Virulent gene expression studies on *Salmonella enterica* serovar Weltevreden in seafood at different temperature exposure (-20 °C, 4 °C, room temperature (RT) and 45 °C) were carried out. At RT and 45 °C, cell count increased from 6 Log₁₀ to 9 Log₁₀ on Day 1 thereafter cells almost maintained a plateau till 5th day and on 7th day there was 1 Log₁₀ reduction and correspondingly. At 4 °C, there was a continual



Survival of *Salmonella* in spiked fish samples under different storage conditions



reduction in the cell count from 6 Log₁₀ to 3.8 Log₁₀ in 7 days. Cell reduction was sharper in case of temperature exposure at -20 °C from Day 1 to 3. The count was 1 Log₁₀ on Day 5 and no viable *Salmonella* was detected on Day 7.

Differential expression of *S. enterica* serovars Weltevreden virulence genes in seafood at 4 °C using relative quantitative realtime RT-PCR with GAPDH gene as the endogenous control revealed that there is an up-regulation of *rpo* gene and down-regulation of *fimA*, *inv*, and *stn* genes. At high temperature (45 °C), a 15-fold increase in *fimA* expression was noticed on Day 1 and subsequent down-regulation on 3rd, 5th and 7th day. Expression of *rpoE*, *invA* and *stn* genes was down-regulated more than 100 fold during one week incubation at 45 °C temperature.

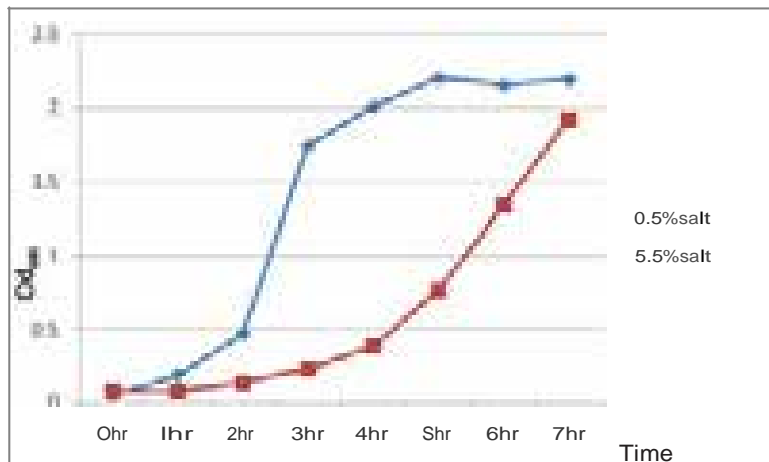
Shrimp viruses in processed shrimp and post-larvae

Out of 84 processed shrimp and post-larvae samples tested, 13 were positive for WSSV. MBV was detected in one out of 10 samples. Exotic viral shrimp pathogens such as YHV and TSV could not be detected in any of the 61 and 48 shrimp/larvae samples tested.

Bioscreening of aquatic bacteria for novel genes/biocatalysts

Characterization of halotolerant bacteria: Sixteen bacterial strains tolerant to 15% salt and 13 tolerant to 20% salt were isolated from aquatic environment. 16S rRNA sequencing of three of the 13 strains identified them as belonging to Genera *Haererehalobacter*, *Staphylococcus* and *Kocuria*. Growth curve analysis of these strains at varying salt concentrations revealed a lag phase of six hours followed by a log phase between 6 and 24 hours and reaching an OD₆₀₀ of 2.5 at 30 hours.

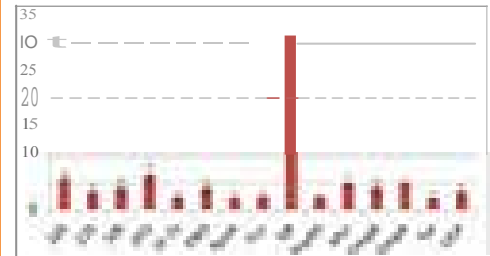
Identification of genes involved in salt tolerance: Salt responsive ESTs were identified using a eDNA SSH library from *Mangroveibacter* spp. grown under normal (0.5%) and salt-stressed (5.5%) conditions. A total of 160 clones that comprised of 25 contigs and 12 singletons with 37 uni-ESTs which are directly or indirectly involved in salt stress were obtained. The genes that were identified as up-regulated in salt



Growth curve of *Mangroveibacter* spp. under salt stressed and normal conditions



stress were further validated by quantitative real-time RT-PCR analysis. Glycine betaine/L-proline transport gene showed the highest up-regulation (-31.63 fold) in RT-qPCR analysis and it can be assumed that this transport system has a major role in *Mangroveibacter* spp. under salt stressed conditions.



Increase in expression of target and reference gene in *Mangroveibacter* spp. under salt stress by RT-qPCR analysis

Fish protein hydrolysate using thermostable bacterial alkaline protease:

Fish Protein Hydrolysate (FPH) prepared using alkaline proteases derived from a strain of *Bacillus* spp. isolated from Tuna gut was found to have degree of hydrolysis ranging from 40-55% at 50 °C for 6 and 12h.

Chitinase production in aquatic bacteria:

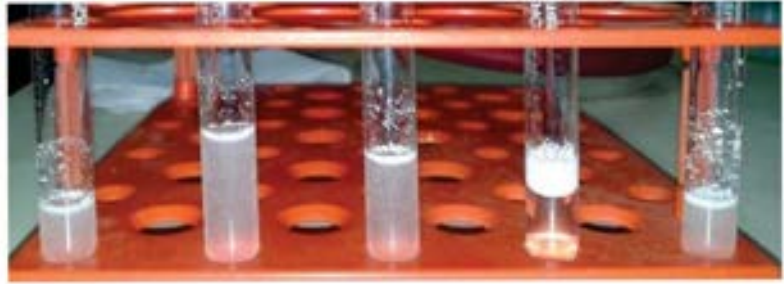
Studies on chitinase production by *V. cholerae* O1 (n=2), O139 (n=1) and non O1/non O139 (n=8) isolated from fishery environment showed that all O1 and O139 isolates produced chitinase. Two isolates of non-O1/non-O139 *V. cholerae* were positive for chitinase production whereas, six isolates of non-O1/non-O139 *V. cholerae* were negative.

The chitinase activity of marine *Vibrio* spp. was studied at different pH and salt level. Chitinase activity was observed up to 6% salt. However, growth was noticed at 9% and 12% salt. Studies on the chitinase activity at different pH viz., 4, 7, 9 and 11 showed that the *Vibrio* isolates exhibited chitinase activity only at pH 7 and 9.

Hydrocarbon degrading aquatic bacteria: Eighty nine hydrocarbon degrading bacteria were isolated from

petroleum contaminated fishery environment under different conditions such as pH and salt concentrations. They were identified as Genera *Kocuria*, *Haererehalobacter*, *Staphylococcus* and *Bacillus*.

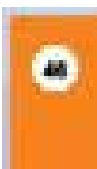
Plastic degrading bacteria from aquatic environment: Eight bacterial strains with high plastic degrading ability were identified from 78 bacterial strains isolated from partially degraded plastic collected from landing centres. Plastic degrading potential was confirmed by Bacterial adhesion to hydrocarbon (BATH) assay and by growth curve analysis with HOPE as primary carbon source. The bacterial strain showing highest activity was identified as *Gordonia* spp. belonging to Actinomycetes group.



Utilization of plastic by aquatic bacteria

Comparative genomics of *UBteti* monocytogenes and *LiniJOCUfl*.

Forty one genes that were exclusively present in *L. monocytogenes* but absent in *L. innocua* were identified by comparative genomic analysis using bioinformatic tools. They include genes encoding Listeriolysin (h/y), Phosphatidylinositol specific phospholipase C (*pleA*), zinc metalloprotease precursor (*mp/*), actin-assembly protein precursor (*actA*) and DNA topoisomerase III.





Biochemistry and Nutrition Division

Chief findings

- ❖ Evaluation of biochemical composition of common food fishes and shellfishes indicated that squid and Cuttlefish have higher levels of protein; ie. 24.12 and 25.45%, respectively. Under the category Finfishes, Tuna had the highest level of protein (~20%) and fat (~4%). Protein content in oysters and mussels were 17.5 and 17.25% respectively. Clams had the lowest level of protein (7.25%).
- ❖ The amino acid profiling showed that Cuttlefish, oysters and mussels are good sources of all essential amino acids. Glycine was found to be the prominent amino acid in mussel (21.25%), oyster (18.50%) and Cuttlefish (16.56%).
- ❖ Fatty acid profile of Green mussel, clam and Tuna indicated the presence of mono and poly unsaturated fatty acids in rich proportions.
- ❖ Omega-3 fatty acids compositional studies on lipid moiety of Tuna, Green mussel and clam have shown that they are rich in docosahexaenoic acid (DHA).
- ❖ Proximate composition and nutrient profile of edible Jellyfish (*Rhopilema* sp.) caught from Arabian sea off Cochin revealed essential amino acids (especially Valine, Isoleucine, Leucine and Threonine) and non-essential amino acids (Alanine, Glycine, Glutamic acid and Aspartic acid) in considerable quantities, suggesting that the species may be effectively utilized in the poultry, fish and animal feed formulations.
- ❖ Jellyfish is rich in elements such as Fe, Mn, Zn and Se.
- ❖ In vitro investigations on the antioxidant potential of Cuttlefish ink revealed its utility in attenuating oxidative deterioration and nutraceutical formulations.
- ❖ A non-enzymatic method and an enzymatic method were developed for the preparation of Oyster peptide extract possessing antioxidant and anti-inflammatory activities.
- ❖ In vitro and in vivo studies on antioxidant defense of Opex (Oyster peptide extract) revealed its potential utility in ameliorating neurological dysfunction associated with reactive oxygen species-induced oxidative stress in experimental animals.
- ❖ A method has been developed for the isolation and purification of astaxanthin from deep sea shrimp and Blood-spotted swimming crab (*Portunus sanguinolentus*) having good antioxidant activity.
- ❖ A simple and cost effective method was developed for the preparation of fatty acid ethyl esters from sardine oil.
- ❖ A multi residue QuEChERS based method for analysis of 22 Organo Chloro Pesticides (OCPs), 15 Poly Aromatic Hydrocarbons (PAHs) and currently used 82 multiclass

Research projects handled

- ❑ Bio-monitoring and bio-evaluation of marine resources and formulation of nutraceuticals in human nutrition and health
- ❑ Nutritional and pharmacological evaluation of marine molecules in alleviating diseases and disorders
- ❑ Isolation and characterization of collagen and gelatin from aquatic sources and development to pharmaceutical and food grade products of commercial importance
- ❑ Nutrient profiling and evaluation of fish as a dietary component
- ❑ A value chain on oceanic tuna fisheries in Lakshadweep seas
- ❑ Utilization strategy for oceanic squids (Cephalopods) in Arabian sea: A value chain approach

pesticides in fatty fish muscle involving a triple partitioning extraction between water, acetonitrile and hexane followed by dispersive clean-up was developed that considerably reduced lipid co-extracts prior to GC-MS/MS analysis.

- ❖ A modified HPLC method for the determination of amino acid composition in fish and fishery products was developed.
- ❖ Studies on the antiaging effect of dietary chitosan supplementation in young and aged rats have shown that the dietary intake of chitosan was capable of restoring the depleted myocardial antioxidant defense and suggest that dietary chitosan is an effective therapeutic agent in treatment of age-associated disorders.
- ❖ Oral intake of glutamine counter-acted the Ibuprofen-induced oxidative stress in



ulcerated rat mucosa.

- ❖ The dietary chitosan intake ameliorated the age-associated hypercholesterolemic aberrations in experimental rats.
- ❖ A simple modified method for the purification and isolation of collagen from aquatic sources was developed.
- ❖ Succinyl chitosan was synthesized and characterized with the help of IR spectroscopy and atomic force microscopy. This synthetic polymer may serve as an effective tool in micro/nano encapsulation of nutraceuticals for controlled and efficient drug delivery.

Report of work done

Nutritional profiling of fish/shellfish

The nutritional profiling of marine finfish/shellfish was carried out. The amino acid profile of Cuttlefish, oyster and mussels were done and found that they are all good sources of all essential amino acids. Glycine was found to be the prominent amino acid in mussel (21.25% of total amino acids), followed by oyster (18.50%) and Cuttlefish (16.56%). The next prominent amino acid was Glutamine in mussel (12.90%), oyster (10.16%) and Cuttlefish (15.95%). A similar trend was found in the case of Aspartate also in mussel (12.96% of total amino acids) followed by oyster (11.15%) and Cuttlefish (13.10%). Other non-essential amino acids are also found in significant quantities. The least value was obtained for Cystine in Cuttlefish (0.09%), mussel (0.16%) and oyster (0.35%). Similarly the lowest value for Arginine is obtained in oyster (0.23%) and Proline exhibited by Mussel (0.19%). The amino acid profile of these three species is given in the Table (expressed in % of total amino acids). The results indicated that these shellfishes contain all the essential and non-essential amino acids in required quantities for human health.

Amino acid composition of different Tuna species

The amino acid composition of Yellowfin (YF), Skipjack (SJ) and Little tunny (LT) Tuna liver, gut and head were studied. It is observed that liver and head samples of Yellowfin and Skipjack tuna are containing essential and non-essential amino acids in significant proportion. Interestingly, the basic amino acid Arginine is found in rich quantities in Tuna organs. It's level is very much comparable to that of the

carboxylic amino acids (Aspartate and Glutamate). Glutamate was present at lower levels in Tuna gut samples. Cysteine and Proline recorded very low levels when compared to other amino acids. The details are provided in the Table.

Amino acid composition of common Indian food shellfishes (g/16g N₂)

Amino acids	Cuttlefish	Oyster	Mussel
Asp	13.10	11.15	12.96
Thr	3.93	6.08	4.68
Ser	4.64	4.78	4.61
Glu	15.95	10.16	12.90
Pro	0.63	0.79	0.19
Gly	16.56	18.50	21.25
Ala	4.82	2.24	3.84
Cys	0.09	0.35	0.16
Val	5.42	7.19	6.75
Met	2.55	0.66	0.29
Ileu	3.91	4.12	4.55
Leu	7.10	3.96	6.00
Tyr	0.93	1.20	1.18
Phe	4.08	3.60	4.67
His	4.73	10.86	4.80
Lys	8.35	12.61	8.52
Arg	1.95	0.23	1.55
Try	1.21	1.48	0.97

Amino acid composition of Yellowfin (YF), Skipjack (SJ) and Little tunny (LT) Tuna liver, gut and head (g/16g N₂)

Amino Acid (%)	Head (YF)	Head (SJ)	Head (LT)	Gut (YF)	Gut (SJ)	Gut (LT)	Liver (YF)	Liver (SJ)	Liver (LT)
Asp	7.03	6.67	7.68	8.17	5.56	7.07	9.35	8.69	12.96
Thr	0.25	3.03	2.87	3.14	2.11	2.96	3.32	2.79	4.74
Ser	2.20	2.46	2.41	2.82	1.86	2.77	2.67	2.16	4.45
Glu	23.63	17.23	13.84	3.12	3.24	1.75	9.47	9.28	13.36
Pro	0.73	0.86	0.82	0.99	0.59	0.85	1.05	0.73	0.05
Gly	7.13	8.53	5.79	2.75	3.07	3.30	2.89	2.77	11.02
Ala	4.25	5.05	4.72	6.84	2.88	2.99	5.32	4.56	6.63
Cys	-	3.82	-	-	-	-	-	-	-
Val	3.32	2.66	2.46	5.11	0.71	0.42	1.00	0.62	10.76
Met	0.43	0.16	4.04	0.90	1.97	2.52	2.76	2.26	1.38
Ile	1.55	1.97	1.80	2.77	2.75	3.88	4.68	4.19	4.73
Leu	3.96	4.64	4.40	5.92	0.94	0.90	0.78	0.84	7.14
Tyr	0.62	0.26	0.60	1.26	2.82	4.01	4.51	3.10	1.76
Phe	1.53	2.61	1.67	3.06	4.32	5.29	4.00	3.30	4.49
His	7.84	11.33	13.56	14.98	8.17	14.16	11.19	11.36	9.64
Lys	14.04	10.55	10.88	9.80	12.47	11.60	10.07	10.33	5.12
Arg	11.49	8.16	12.47	8.37	8.36	7.71	8.64	6.44	1.77

Fatty acid profile of Tuna, Green mussel and clam

Fatty acid profile of Tuna, Green mussel and clam indicated that percentage of PUFA of total fatty acids were more in Green mussel and clam when compared to Tuna. However percentage of MUFA of



total fatty acids were comparatively more in Tuna than Green mussel and clam. Detailed fatty acid profile is presented in the Table. Values are expressed as percentage of fatty acids of total fatty acid.

Fatty acid	Tuna	Green mussel	Clam
C12	0.01	0.22	0.35
C13	ND	0.68	1.19
C14	8.87	4.61	1.95
C15	0.99	6.29	6.63
C16	18.53	21.77	16.23
C17	0.47	2.10	3.86
C18	5.35	3.97	5.70
C20	0.71	1.31	1.63
C21	0.09	ND	ND
C23	0.46	2.25	4.49
C24	0.09	ND	ND
Total SFA	35.66	43.2	42.03
MUFA			
C14:1	0.11	ND	0.44
C16:1	11.71	5.01	3.02
C17:1	0.16	0.32	0.64
C18:1	8.44	2.77	4.00
C20:1	0.29	2.94	0.84
C22:1	0.70	1.50	2.87
C24:1	0.07	ND	0.16
Total MUFA	21.48	12.54	11.97
PUFA			
C18:2	1.13	2.26	1.41
C18:3	1.37	2.14	1.95
C20:2	0.15	ND	2.79
C20:3	0.19	ND	1.41
C20:4	2.51	5.53	8.00
C20:5	21.66	14.14	9.93
C22:2	ND	ND	0.49
C22:6	15.83	20.19	19.89

Fatty acid profile of Crab, Cuttlefish, Krill and White prawn

Fatty acid composition of Crab, Krill and White prawn (*Fenneropenaeus indicus*) were analyzed. Interestingly, the contents of

Fatty acid profile of Crab, Krill and White prawn

Fatty acid	Crab	Krill	White prawn
C14	4.1	8.6	1.3
C16	30.1	17.9	22.8
C16:1	7.5	7.5	6.3
C17	2.7	1.3	2.6
C18	3.9	1.1	6.6
C18:1	11.8	10.3	13.5
C18:2	2.7	0.2	3.5
C18:3	-	1.3	1.5
C20:4	9.1	5.3	10.3
C20:5	15.5	17.7	18.2
C22:6	12.6	14.3	13.3

eicosapentaenoic acid (C20:5) and docosahexaenoic acid were significantly high in these fatty shellfishes. The monounsaturated fatty acid C18:1 is the other major fatty acid present in the samples. Detailed fatty acid profile is presented in the Table.

Proximate composition and nutrient profiling of Jellyfish - an under-utilized resource

Presently dried Jellyfish (*Rhopilema* sp.) are being exported to China and Japan from Tamil Nadu coast of India. However majority of the Jellyfish bycatch remain non-utilized and cause pollution in the beaches. Proximate composition and nutrient profile of edible Jellyfish caught from coastal waters of Cochin was evaluated. It was observed that moisture, ash and crude protein content of Jellyfish was 96.11, 71.08 and 7.50% respectively. It does not contain any appreciable amount of fat. Amino acid composition of Jellyfish was determined in amino acid analyzer. It was observed that essential amino acids like Valine, Isoleucine, Leucine and Threonine are present in considerable amount. Other than essential amino acids, Jellyfish was found to be rich in Alanine, Glycine, Glutamic acid and Aspartic acid. Detailed composition of amino acids is presented in the Table.

Amino acid composition of Jellyfish

Amino acids	Content (g/16 g N ₂)
Aspartic acid	13.37
Threonine	1.84
Serine	3.55
Glutamic acid	19.23
Glycine	14.96
Alanine	25.13
Valine	3.25
Metionine	0.34
Isoleucine	2.69
Leucine	1.76
Tyrosine	0.53
Phenyl alanine	0.64
Histidine	3.97
Lysine	8.11
Arginine	0.35

Macro nutrient composition of Jellyfish was determined using a flame photometer and micronutrient composition in an ICP AES. Jellyfish was found to be rich in Fe, Mn, Zn



and Se. The detailed composition is given in the Table.

Mineral composition of Jellyfish

Nutrient	Content ($\mu\text{g g}^{-1}$ dry weight)
Na	393.00
K	145.00
Ca	413.00
Fe	43.83
Mn	15.12
Zn	19.89
Se	2.80

Amino acid and fatty acid composition of Cuttlefish ink

Cuttlefish ink was collected from a processing plant at Cochin for the study. Ink was stored at $-20\text{ }^{\circ}\text{C}$. Sample was about three months old, but stored frozen since extraction. Amino acid content and fatty acid content were determined in the samples. The results are given in the Tables.

Amino acid content of Cuttlefish ink

Amino acid	g/100g sample
Asp	0.91
Thr	0.55
Ser	0.54
Glu	1.19
Gly	0.39
Ala	0.52
Cys	0.00
Val	0.48
Iso	0.42
Met	0.02
Leu	0.62
Tyr	0.14
Phe	0.62
His	0.04
Lys	2.18
Pro	0.02
Arg	0.14
Try	3.13

Preliminary studies revealed that Cuttlefish ink possess anti-oxidant activity as determined by DPPH free radical scavenging assay.

Preparation of Oyster peptide extract

Oyster peptide extraction by non-enzymatic method from bulk quantity (9kg oyster meat) was carried out. Following extraction, concentration, determination, peptide estimation, HPLC analysis, its ability to inhibit

Fatty acid content of Cuttlefish ink

Component	mg/ml
C10	0.257
C11	0.060
C12	0.065
C13	0.053
C14	0.339
C15	0.104
C16	2.189
C16:1	0.201
C17	0.876
C17:1	0.064
C18	0.279
C18:1	5.015
C18:2	0.094
C20:1	0.130
C20:2	0.087
C20:3	0.166
C20:4	2.254
C20:3	1.006
C20:5	3.458
C23	0.197
C22:6	0.291
C24:1	0.044

in vitro lipid peroxidation in rat liver and brain was estimated. Oyster peptide extraction by enzymatic method was also carried out from 100g oyster meat using a combination of two enzymes, pepsin and trypsin.

Response surface methodology was applied to determine the optimum pH, enzyme substrate ratio, temperature for oyster protein hydrolysis using enzymes. The conditions of digestion that gave the maximum response i.e. DPPH free radical scavenging were used for oyster peptide extract preparation. The extract tested positive for antioxidant, anti-inflammatory and anti-bacterial activities. In the non-enzymatic method a concentration of 800 mg/mL revealed 565.8 mg/mL peptide. ROS like singlet oxygen, hydroxyl radical, and superoxide anion can change several intracellular processes and induce impairment of biological systems including lipid peroxidation that can affect cell survival.

A study was also carried out to test the antioxidant activity of the extract and its potential to inhibit lipid peroxidation.

The extract was screened for antioxidant activities by free radical scavenging assays DPPH and ABTS* scavenging activity as given in Table. Opex exhibited strong DPPH and ABTS free radical scavenging property.

DPPH and ABTS free radical scavenging by Oyster peptide extract

	DPPH	ABTS
Control	100.0 \pm 0.02	100.0 \pm 0.02
Opex (mg/ml)		
10	41.49 \pm 0.00	52.54 \pm 0.02
20	56.02 \pm 0.02	63.61 \pm 0.08
30	68.00 \pm 0.06	68.69 \pm 0.08
40	72.27 \pm 0.01	71.68 \pm 0.01
50	78.77 \pm 0.04	78.17 \pm 0.01
IC50 (mg/ml)	16.0	9.4
BHT- IC50 (mg/ml)	35.9	40.1

In vitro and in vivo studies on antioxidant defense of Opex against lipid peroxide were determined by evaluating the protective effect of Opex as given in Table.

The extracts significantly inhibited hydrogen peroxide induced lipid peroxidation in the rat brain and oxidation induced by the AA/ Fe_2^+ system.

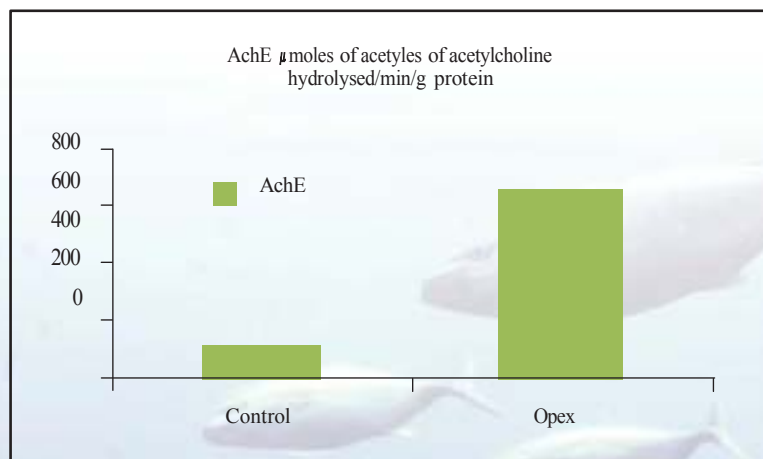
Levels of TBARS in rat liver and brain homogenate

	Lipid peroxidation due to Fe ₂ + / Ascorbate	Lipid peroxidation in the rat brain
	TBARS mmol/g tissue	TBARS mmol/g tissue
AA/Fe ₂ + Opex (mg/ml)	9.65 ± 5.21	9.86± 0.42
Nil	9.65 ± 5.21	9.86± 0.42
10	7.47± 4.02	5.54 ± 0.22
20	5.92 ± 4.13	4.91 ± 0.18
30	3.64 ± 3.06	3.74 ± 0.12
40	2.12 ± 2.61	1.93 ± 0.09
50	1.60 ± 0.44	0.68 ± 0.05
BHT (20mg/ml)	7.59± 1.20	6.01± 1.27

Effect of Oyster peptide extract on Acetylcholine esterase activity in vitro rat brain

Oyster peptide extract was prepared by a non-enzymatic method from edible oyster (*Crassostrea madrasensis*) and freeze-dried. Acetylcholine esterase (AChE) is an enzyme that degrades the neurotransmitter Acetylcholine, producing choline and an acetate group. The reduction of AChE activity is a common feature associated with Alzheimer dementia and appears to be related mainly to the impairment of attention. The effect of the extract on the in vitro Acetylcholine esterase activity of rat brain was studied.

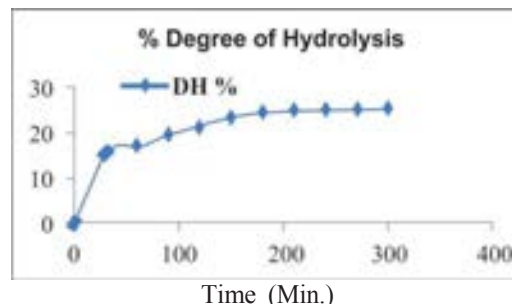
Rat brain homogenate was incubated with Acetylcholine in presence and absence of Oyster peptide extract and the Acetylcholine esterase activity was measured. In control and blank experiments, Oyster peptide extract and rat brain homogenate respectively were excluded from the enzyme assay. The extract significantly increased the activity of rat brain AChE activity of 660.6 μ moles of Acetylcholine hydrolysed/min./g protein when compared to the control whose AChE activity was 112.3 μ moles of Acetylcholine hydrolysed/min./g protein.



Acetylcholine esterase activity of Opex (Oyster peptide extract): Degree of hydrolysis

Oyster peptide was prepared by digesting with pepsin. Oyster homogenate containing about 8g protein was mixed with pepsin (0.0012 Anson units/g protein) and incubated for 5 h at 37 °C at pH 2.2. Degree of hydrolysis was determined by the method of Nielsen et al.

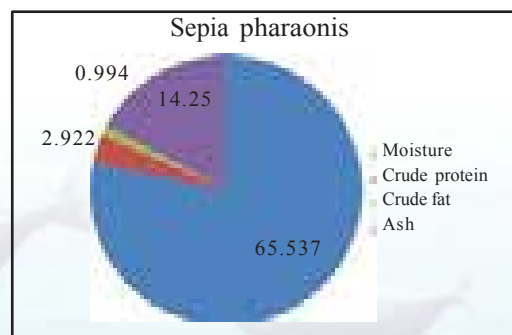
(2001) in which a α-amino groups released by hydrolysis react with ninhydrin to form a compound that absorbs at 570 nm. Samples were drawn at regular intervals during the reaction and inactivated by heating in a boiling water bath. Ninhydrin reaction is also performed using Leucine standard in the samples.



Percentage degree of hydrolysis of Oyster peptide extract with time

Isolation and partial characterization of Glycosaminoglycans (GAGs) from Cuttlefish ink

Following analyses were carried out in Cuttlefish ink: 1). Proximate composition of cuttlefish ink, 2). Isolation of GAGs from Cuttlefish ink (Yield - 2.4%), 3). Estimation of total carbohydrate content in the crude extract. Electrophoresis of GAG extract yielded two bands that were in the range between 6500 and 14200 indicating low molecular weight substances. Anti-oxidant activity by DPPH free radical scavenging assay gave an IC50 value of 28.7 mg.



Proximate composition of Cuttlefish ink

Astaxanthin is extracted from *Aristeus alcocki*, a deep sea shrimp and Blood-spotted swimming crab (*Portunus sanguinolentus*). Antioxidant activity of astaxanthin was determined by DPPH method. Astaxanthin from both the species exhibited good antioxidant activity.

Development of a simple and cost effective method for the preparation of fatty acid ethyl esters from Sardine oil

A simple, cost effective method was

developed and standardized for the preparation of fatty acid ethyl esters from Sardine oil. Commercially available Sardine oil, sunflower oil and coconut oil were procured locally and used for the study. The trans-esterification process involves the reaction of oils with a mixture of ethanol and sodium hydroxide under controlled conditions (Inert atmosphere and optimum temperature). After trans-esterification, the alkali content was completely removed by repeated washings with potable water. Samples obtained were analyzed for the fatty acid composition using Gas chromatography-Mass Spectrometer. Results indicated that Sardine oil contains high amount of n-3 polyunsaturated fatty acids (n-3 PUFA) especially eicosapentaenoic acid (EPA) [C20:5] and docosahexaenoic acid (DHA) [C22:6] as compared to sunflower and coconut oils. The plant oils (Sunflower oil and coconut oil) are rich in lenoleic acid (C18:2) when compared to Sardine oil. This process can be effectively used for the preparation of fatty acid ethyl esters required for incorporation in animal feed, anti-inflammatory ointments and nutritional supplements. The economic evaluation of the process was also carried out.

Multi residue analysis of multiclass pesticides and poly aromatic hydrocarbons in fatty fish using a modified QuEChERS methodology and gas chromatography-tandem mass spectrometry

A simple and effective multi residue method for analysis of 22 OCPs, 15 PAHs and 82 multiclass pesticides in fatty fish involving a triple partitioning extraction between water, acetonitrile and hexane followed by dispersive clean-up was developed. This would reduce lipid co-extracts prior to GC-MS/MS analysis. CaCl_2 was used innovatively, in dispersive clean-up to remove lipid from fish extract (This work was done using the instrument facility of

NRL, NRC Grapes Pune).

The effect of the modified QuEChERS cleanup in removal of matrix related interference is shown in the chromatogram of cleaned and not cleaned extracts.

GC-MS/MS analytical method developed for multi residue analysis

The analysis of samples was performed using a GC hyphenated to triple quadrupole mass spectrometer. Carrier gas flow rate was set at constant flow rate of 1.2 mL/min. The oven temperature programme was set at initial temperature of 70 °C (1 min. hold), ramped to 150 °C at 25 °C/min. (0 min. hold), then at 3 °C/min. up to 200 °C (0 min. hold) and finally to 285 °C at 8 °C/min. (9 min. hold) resulting in a total run time of 40.49 min. The transfer line temperature was maintained at 285 °C. The post-run was carried for 3 min. during which oven temperature was maintained at 285 °C. Equilibration time was set at 0.1 min.

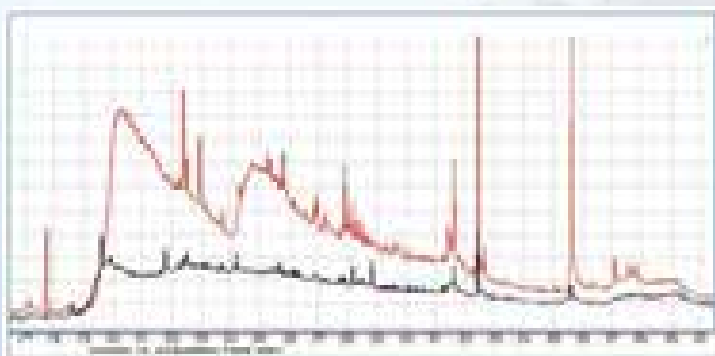
The mass spectrometer was operated in multiple reactions monitoring (MRM) mode with acquisition starting from 4.4 min. The electron impact ionization (EI+) was achieved at 70 eV and the ion source temperature was set at 280 °C. The specific MRM transitions for all the test compounds and other parameters were validated. The method was validated for repeatability and reproducibility. Limit of quantification as low as 10 ppb was achieved. Recovery studies were carried out at three fortification levels (10, 25, 50 ppb) to check the efficiency of the developed method. Recovery values ranged from 60-100%.

A modified HPLC method for the determination of amino acid composition in fish and fishery products

An easy and reliable two solvent method for the determination of amino acid profile of fish/shellfish was developed based on pH gradient (pH 3.2-9.8) and ionic gradient. A sulphonated polyvinyl styrene cationic exchange column was used for the separation of amino acids and post column derivatization through reaction coils with sodium hypochlorite and o-phthalaldehyde for the detection of amino acids in fluorescence detector. Calibration of the method was done with injecting different concentrations of amino acid standards. The method was used to analyze both non-protein and proteinaceous amino acids in fish and fishery products.

Evaluation of bio-inorganics in fish/shellfish - Levels of selenium and mercury

It is reported that selenium protects against cancer for which an adequate intake of selenium is required. About 30 samples consisting mainly of crustaceans (Crabs and prawns), plams, mussels, Squid and Tuna (Both white and dark meat) were screened for Se and Hg. The results indicated that crab meat is an important source of Se (3.21 to 4.494 ppm); followed by various prawn species (2.28 to 4.35 ppm). Similar levels were found in mussels and oyster. Tuna meat is also an important source of Se. It is interesting to find that level of Hg is in tune with Se except in Prawn species where there is no mercury and no such relation is found. A knowledge on the levels of Se in seafoods will facilitate in the formulation of many nutraceutical products.



Overlaid full-scan chromatogram of control matrix without clean-up (red) and with clean-up (black) showing effect of clean-up on co-extractive removal

Chemical contaminant profiling

Chemical contaminants like heavy metals, pesticides and antibiotic residues have been monitored in various fish/shellfish samples. Heavy metals like Cu, Zn, Mn, Cr, Hg and Se were monitored in few samples of mussels, clams and oysters. Cu was found in the range of 1.13-3.33 ppm in clams, 2.4-2.9 ppm in mussels and 6.13-7.78 ppm in oysters. However, the level of Zn is quite high in oysters (96 ppm average). Cd and Pb could not be detected in any of the molluscan shellfish. Incidence of PAH (Polyaromatic hydrocarbons) were detected in crab, clam and oyster meat to very low level (insignificant level). Shellfish such as oyster, clams, mussels and Cuttlefish samples were examined for the presence of Nitrofurans metabolites using LCMS-MS. None of the samples showed any positive result.

Antianging effect of dietary chitosan supplementation in young and aged rats

The antiaging effect of dietary chitosan on changes in myocardial antioxidant status was investigated. Its administration significantly ($P < 0.05$) attenuated the oxidative stress in the heart tissue of aged rats through the counteraction of free radical formation by maintaining the enzymatic (glutathione peroxidase - GPx and glutathione reductase - GR) and non-enzymatic (reduced glutathione - GSH) status at levels comparable to that of normal young rats as given in Table. The overall antiaging effect of dietary chitosan intake is probably related to its ability to inhibit the increased accumulation of lipids both in the systemic circulation and in the myocardium by its antilipidemic property, or to normal maintenance of the activities of glutathione-dependent antioxidant enzymes and the level of GSH, which protect myocardial membrane against oxidative stress by decreasing lipid peroxidation reactions. The results conclude that dietary intake of chitosan restores the depleted myocardial antioxidant status and suggest that it could be an effective therapeutic agent in treatment of age-associated disorders where hypercholesterolemia and oxidative stress are the major causative factors.

Effect of dietary chitosan supplementation against Isoprenaline-induced oxidative stress in rat myocardium

Despite considerable advances in diagnosis and management over the last three decades acute myocardial infarction continues to be a major public health problem. It is predicted that ischemic heart diseases will constitute the major disease-burden worldwide by the year 2020. In the present study, an attempt has been made to examine the effects of dietary chitosan supplementation on lipid peroxidation and cardiac antioxidant defense system in Isoprenaline-induced myocardial infarction in rats, an animal model of myocardial infarction in man. Dietary chitosan intake significantly attenuated the Isoprenaline-induced lipid peroxidation and maintained the level of reduced glutathione at near normal level. Its administration demonstrated an antioxidant effect by maintaining the activities of myocardial glutathione dependent antioxidant enzyme (glutathione peroxidase and glutathione-S transferase) and antiperoxidative enzyme (superoxide dismutase and catalase) at level comparable to that of controls. The results of the present study indicate that the salutary effects of dietary supplementation of chitosan is probably related to a counteraction of free radicals and/or to normal maintenance of the activities of free radical enzymes and the level of GSH, which protect myocardial membrane against oxidative damage by decreasing lipid peroxidation.

Effect of dietary chitosan supplementation on the levels of total cholesterol, lipid peroxides, GSH, GPx and GR in the heart tissue of young and aged rats

Parameters	Young rats			Aged rats		
	Group Ia	Group Ib	Group Ic	Group IIa	Group IIb	Group IIc
Total cholesterol	2.72±0.17 a, b	2.56 ±0.14 a	2.43±0.16 a	3.68±0.32 c	3.29± 0.21 d	3.04±0.25 b, d
Lipid peroxides	1.08±0.07 a	0.98±0.06 a	0.97±0.07 a	2.58±0.14 b	1.96±0.09 c	1.54±0.11 d
GSH	10.9±0.84 a	12.3±1.02 a, b	14.5±1.17 c	7.54±0.61 d	8.76±0.69 d, e	9.52±0.85 a, e
GPx	5.25±0.35 a	5.51±0.41 a, b	5.98±0.37 b	3.12±0.18 c	4.05±0.26 d	4.56±0.34 d
GR	0.43±0.2 a	0.52±0.04 b	0.58±0.03 c	0.22±0.01 d	0.29±0.03 e	0.36 ±0.02 f

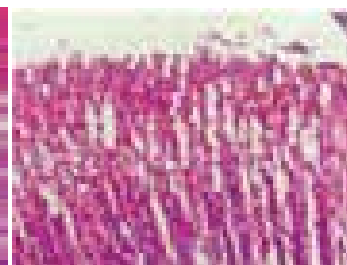
Group I consisted of 18 normal young rats and Group II consisted of 18 normal aged rats. Each group was further subdivided into three groups (six rats each): one control group (Group Ia and Group IIa) and two experimental groups based on the duration of supplementation of chitosan at 2% level along with feed 30 days (Group Ib and Group IIb) and 60 days (Group Ic and Group IIc). Results are mean + SD for six animals. Values expressed: Total cholesterol, milligrams per gram wet tissue; lipid peroxides, nanomoles MDA released per milligram protein; GSH, micrograms per milligram protein; GPx, micrograms GSH oxidized per minute per milligram protein; GR, nanomoles NADPH oxidized per minute per milligram protein. Values that have a different letter (a, b, c, d, e, f) differ significantly with each other ($P < 0.05$; Duncan's multiple range test)

Ant ulcer effect of glutamine on Ibuprofen-induced oxidative stress in rat mucosa

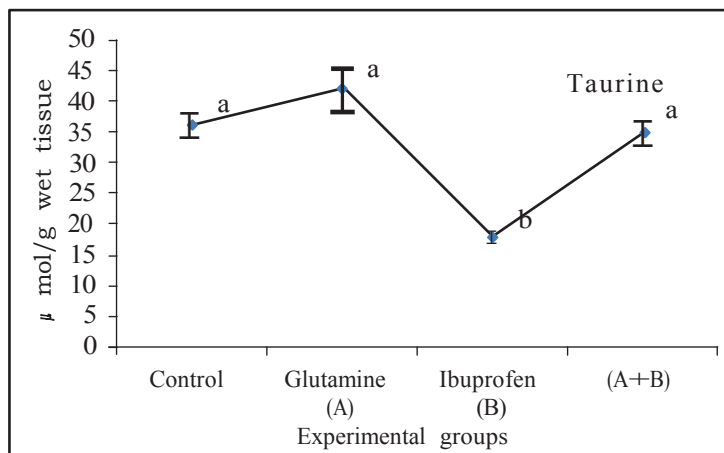
The antiulcer effect of oral glutamine intake against Ibuprofen-induced peptic ulcer was studied. Prior oral intake of glutamine attenuated the Ibuprofen-mediated oxidative stress in the gastric mucosa of experimental rats and maintained the antioxidant defense at near normalcy. Its administration maintained the mucosal taurine at



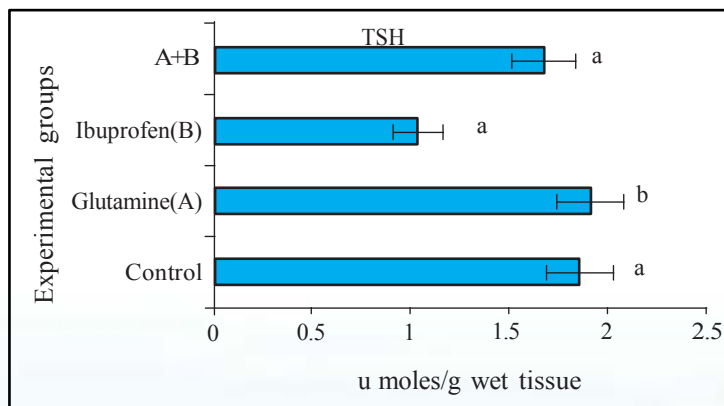
Distorted histological architecture of gastric mucosa of Group-III Ibuprofen-intoxicated rats (B)



Mildly aberrated histological architecture of gastric mucosa of Group-IV rats (A+B)

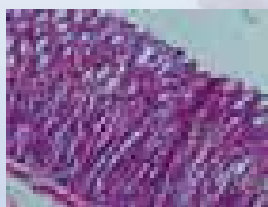


Level of taurine in gastric mucosa of control and experimental groups of rats

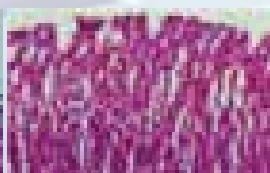


Level of total sulfhydryl (TSH) content in gastric mucosa of normal and experimental groups of rats

(A): Glutamine, 75 mg/kg body wt/day, p.o. for 15 days; (B): Ibuprofen, 50 mg/kg body wt, p.o. twice in a day at an interval of 12 h. Results are mean \pm SD for six animals; One-way ANOVA; Duncan's multiple comparison test. Values that have a different superscript letter (a, b, c) differ significantly ($p < 0.05$) with each other.



Normal histology of gastric mucosa of control rats



Conserved histological architecture of gastric mucosa of Group-II rats (A)

higher level. The antiulcer effect of glutamine is mainly ascribable to its ability to stimulate the synthesis of sulfhydryl group containing antioxidant reduced glutathione. The histopathological observations also confirmed the antiulcer property of glutamine.

Synthesis of succinyl chitosan and preparation of wound healing gel

Chemical modification of chitosan was attempted to prepare hydrogels with possible biomedical applications. Succinyl group was introduced in chitosan by a simple reaction with succinic anhydride. Different ratio of chitosan to succinic anhydride was tried for optimization of reaction and it was observed that 5:1 ratio gives optimum yield and solubility. To see the effect of molecular weight of chitosan succinylation was done for medium and low molecular weight chitosan. Low molecular weight succinyl chitosan and succinyl chitosan showed comparable solubility (1mg/mL). However low molecular weight succinyl chitosan was more hygroscopic. Solubility was determined by a spectrophotometric method. Succinylation of chitosan was confirmed by IR spectroscopy. The spectra shows characteristic peaks at 1636 cm^{-1} and 1558 cm^{-1} which correspond to C=O stretching and N-H bending of succinyl group. These peaks were more pronounced than that of chitosan.

Succinyl chitosan showed hydrogel like swelling property, in contact with water. It showed a water absorption of $>500\%$ of its dry weight, when kept in contact with water for six hours. Synthesized succinyl chitosan was used for micro/nano encapsulation of curcumin. A process was optimized to prepare encapsulated curcumin micro/nano particles. Encapsulation efficiency of succinyl chitosan was calculated by determining amount of free curcumin in the reaction mixture, with the help of HPLC. Encapsulation efficiency ranged from 35-48% depending on concentration of curcumin and succinyl chitosan. It was observed that with increasing concentration of curcumin encapsulation efficiency is decreasing. Optimum encapsulation efficiency was observed at a concentration of 0.5% succinyl chitosan to 20 mg curcumin in 10 mL

of ethanol. The particles were characterized with atomic force microscope (AFM). These particles were directly incorporated into a blend of succinyl chitosan-PEG hydrogel matrix to prepare a hydrogel formulation for wound healing. Different combination of succinyl chitosan to PEG and curcumin ratio were tried to get optimum viscosity. Finally three different types of formulations were prepared with different amount of succinyl chitosan, PEG and curcumin.

Levels of change in body weight and total feed consumption in the control and experimental groups of rats

Growth parameters	Group I	Group II	Group III	Group IV
Initial body weight (g)	132±8.56a	141±8.97a	138±9.25a	135±9.12a
Final body weight (g)	296±19.9a	272±17.2a, b	249±14.1b	263±18.3a, b
Total feed consumption (g)	712±55.4a	683±51.7a	652±49.3c	676±54.3a

Group I and Group III animals, fed standard diet with corn starch at 2% level for 60 days. Group II and Group IV, fed standard diet with added chitosan at 2% level for 60 days. Group III and Group IV animals, intraperitoneally (i.p.) injected with Isoprenaline [11mg (dissolved in physiological saline)/100g body weight per day for two days] for the induction of myocardial infarction after 60 days feeding. Results are mean ± SD for six animals; one way ANOVA; Duncan's multiple comparison test. Values that have a different superscript letter (a, b) differ significantly (p<0.05) with each other.

Activities of superoxide dismutase (SOD) and catalase in the heart tissue of normal and experimental groups of rats

Parameters	Group I	Group II	Group III	Group IV
SOD	5.31 ± 0.19a	5.82 ± 0.28b	2.54 ± 0.12c	4.58 ± 0.31d
Catalase	6.45 ± 0.28a, b	6.85 ± 0.36b	3.75 ± 0.25c	5.87 ± 0.36a

Values expressed: CAT, n mol H₂O₂ decomposed min⁻¹ mg⁻¹ protein; SOD, one unit of the SOD activity is the amount of protein required to give 50% inhibition of epinephrine autoxidation. Results are mean ± SD for six animals; one way ANOVA; Duncan's multiple comparison test. Values that have a different superscript letter (a, b, c, d) differ significantly (p<0.05) with each other.

Levels of lipid peroxides (LPO), GSH, GPx and GST in the heart tissue of normal and experimental groups of rats

Parameters	Group I	Group II	Group III	Group IV
Lipid peroxidation				
LPO	0.97 ± 0.06a,c	0.84 ± 0.04a	2.39 ± 0.16b	1.08 ± 0.07c
Glutathione-dependent antioxidant system				
GSH	4.53 ± 0.28a	5.12 ± 0.42a	2.15 ± 0.15b	4.68 ± 0.31a
GPx	2.55 ± 0.19a	2.79 ± 0.24a,	b 1.46 ± 0.26c	3.12 ± 0.09b
GST	1195 ± 72a,b	1288 ± 95b	688 ± 46c	1078 ± 85a

Values expressed: LPO, n mol malondialdehyde released/mg protein; GSH, μ mol g⁻¹ wet tissue; GPx, nmol GSH oxidized min⁻¹ mg⁻¹ protein; GST, μ mol 1-chloro-2,4-dinitrobenzene conjugate formed min⁻¹ mg⁻¹ protein. Results are mean ± SD for six animals; one way ANOVA; Duncan's multiple comparison test. Values that have a different superscript letter (a, b, c) differ significantly (p<0.05) with each other.

Curcumin hydrogel formulations are being evaluated in wound healing study on albino rats. Hydrogel formulations shows excellent wound healing property (better than commercial colloidal-silver hydrogel based formulation) even at a very low dose of curcumin.

Biochemical composition of Antarctic Flying Squid and Neon Flying Squid from Indian Sector of Southern Ocean

Proximate composition: The comparative analysis of the proximate compositions of Antarctic Flying Squid (*Todarodes filipova*) and Neon Flying Squid (*Ommastraphes bartramii*) collected from Indian sectors of Southern Ocean were examined. Parameters of proximate composition analyzed were moisture, ash, protein and fat from the mantle region.

Moisture was the major component in the squid muscle tissue. The estimated moisture content (%) for *T. filipova* and *O. bartramii* were 73.18 and 77.51 respectively. Protein content was determined as 23.19 and 20.62% in the samples respectively. Fat content was of very low percentage in both the samples. Ash

Photographs taken on 7th day



Untreated wound



Commercial wound healing formulation treated healed wound



Curcumin-succinyl chitosan hydrogel based formulation treated wound

content was 2.4% in *T. filipova* and 1.5% *O. bartramii*.

Proximate analysis of squid samples (g%)

Samples	Moisture	Ash	Protein	Fat
<i>T. filipova</i>	73.18	2.04	23.19	0.32
<i>O. bartramii</i>	77.51	1.58	20.62	0.21

Fatty acid analysis: Fatty acid content of the two samples were analyzed using the method described by Folch et al., 1957 and Metcalfe et al., 1966. In both samples a good percentage of essential PUFA was reported. The level of DHA and EPA was 41.92, 9.97 and 48.08, 12.49 respectively. Besides, 24% of Palmitic acid level has also been reported in both the samples. Nevertheless some percentages of other fatty acids also made their contribution to total lipids.

The results of the study show that squid contains significant levels of essential amino acids and fatty acids like poly unsaturated fatty acids particularly EPA in balanced proportions. It is imperative to understand the biochemical composition of species inhabiting the extreme environmental conditions to pave way for future research on these aspects.

Fatty acid content of squid samples (Area%)

<i>O. bartramii</i>	Area%	<i>T. filipova</i>	Area%
C14	0.721611	C14	1.022363
C15	0.44511	C15	0.303703
C16	24.86331	C16	24.36632
C16:1	0.15824	C16:1	0.509286
C17	1.24686	C17	0.60682
C17:1	0.180536	C17:1	0
C18	7.211077	C18	3.553169
C18:1	1.488285	C18:1	1.969074
C18:2	ND	C18:2	0.249111
C18:3	ND	C18:3	0.319165
C20	ND	C20	0.133914
C20:1	5.304428	C20:1	3.079589
C20:2	0.753198	C20:2	0.30402
C20:3	0	C20:3	0.460926
C20:4	3.117508	C20:4	0.852466
C20:3	0.584768	C20:3	0
C20:5 EPA	9.974547	C20:5 EPA	12.49996
C21	ND	C21	0.112092
C22:1	ND	C22:1	0.165859
C22:2	1.10804	C22:2	0.14537
C22:6 DHA	41.92667	C22:6 DHA	48.08979
C24:1	0	C24:1	0.114968

ND - Not Detected

Amino acid analysis: Amino acid content of the two samples were analyzed using the method described by Ishida et al. (1981). Glutamic acid was observed in higher amount in *T. filipova* than *O. bartramii*. But Glycine was higher in the later one. In *T. filipova* all the essential amino acids are seen in significant level except Tryptophan. Compared to *T. filipova*, *O. bartramii* has less amount of essential amino acid like Threonine, Lysine whereas the amount of Leucine was found to be high.

Amino acid analysis of squid samples (Area%)

Amino acids	<i>T. filipova</i>	<i>O. bartramii</i>
Aspartic acid	1.35	15.59
Threonine	5.91	0.53
Serine	5.00	4.85
Glutamic acid	16.20	15.94
Proline	0.02	0.03
Glycine	13.79	16.39
Alanine	4.36	3.72
Cysteine	0.37	0.37
Valine	8.04	6.66
Methionine	3.83	4.63
Isoleucine	5.91	4.32

Levels of lipid peroxidation (LPO) and reduced glutathione (GSH) in the gastric mucosa of normal and experimental groups of rats

Groups	Control	Glutamine (A)	Ibuprofen (B)	(A+B)
LPO	1.24±0.04a	0.98±0.02b	3.55±0.09c	1.33±0.06a
GSH	4.23±0.29a	5.74±0.37b	1.96±0.17c	4.18±0.25a

(A): Glutamine, 75 mg/kg body wt/day, p.o. for 15 days; (B): Ibuprofen, 50 mg/kg body wt, p.o. twice in a day at an interval of 12 h. Results are mean ± SD for six animals; One-way ANOVA; Duncan's multiple comparison test. Values that have a different superscript letter (a, b, c) differ significantly ($p < 0.05$) with each other. Values expressed: Lipid peroxidation, nmol/mg protein; Reduced glutathione, μ mol/g wet tissue. Results are mean ± SD for six animals; one way ANOVA; Duncan's multiple comparison test. Values that have a different superscript letter (a, b, c) differ significantly ($p < 0.05$) with each other.

Antilipidemic effect of dietary chitosan supplementation in young and aged rats

The effect of dietary effect of chitosan on changes in lipid profile was studied. It is observed that chitosan supplementation ameliorates the age-associated hypercholesterolemic aberrations in experimental rats. Levels of LDL cholesterol and HDL cholesterol in plasma of young and aged rats

Parameters	Young control	Young chitosan	Aged control	Aged chitosan
LDL-Cholesterol	38.2±2.35 a	36.4±2.18 a	68.7±5.24 b	52.6±3.18 c
HDL-Cholesterol	22.4±1.39 a	21.8±1.27 a	12.6±0.82 b	16.9±1.25 c,d

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

Engineering Division

Chief findings

- + Preliminary study and analysis of the data of boat building facilities throughout Kerala has been made.
- + Data collection based on general technology changes with respect to size, type and power of boats, construction materials, equipment use, and operational methods on-board fishing vessels were made.
- + Documentation of profiling of mechanized fishing system presently in use with respect to hull characteristics, construction methods, installed power, propulsion characteristics and on-board equipments was done.
- + Development of cost effective and eco-friendly slurry ice machine using renewable energy is in progress.
- + Fabricated a prototype of solar fish dryer having a capacity of 5kg using solar PV panels.
- + Designed and fabricated a 10 kg capacity fish meal plant.
- + Designed and developed an Electronic Power Generator using solar PV panels.
- + Designed and fabricated a portable and battery operated High Speed Digital Water Current Meter for water current measurements in Hoogly Estuary, West Bengal.
- + Re-fabricated the head cutting machine of Tuna with reduced RPM and other modifications in feeding and collection mechanisms.

Report of work done

Study and analysis of the data of boat building facilities

A preliminary study on the manufacturing and construction facilities available throughout Kerala for catering fishing vessel production has been made. An analysis of the data of boat building facilities with respect to the production capacity, years in business, type and size of boats and construction material, based on a Probability Proportional to Size (PPS) design has been made. This analysis has evolved a sample of 27 yards for in depth survey of design capabilities and construction standards.

Data collection based on general technology changes

Research projects handled

- [J] Enhancing fuel efficiency and safety of mechanized fishing vessel systems
- [J] Innovative packaging techniques for processing and preservation of fish products
- [J] Species specific intervention in value addition of commercially important and emersir species of freshwater fish

with respect to size, type and power of boats, construction materials, equipment use, and operational methods on-board fishing vessels was made. Detailed interviews were conducted in five landing centres and general information technology changes that has been taken place during the last 10 years with respect to fuel saving, operational characteristics, variations in size and power, use of different materials for construction, manufacturing methods, skill and efficiency of human resources involved and on-board equipment were collected. Technology changes are being recorded based on interviews and survey schedule from vessel owners, crew, inputs dealers and community/society leaders and published data.

Documentation of profiling of mechanized fishing system presently in use with respect to hull characteristics, construction methods, installed power, propulsion characteristics and on-board equipments were done. A questionnaire for collection of data on the profile of mechanized fishing systems with reference to hull form, installed power, propeller characteristics, energy utilization, on-board equipments and construction/manufacturing methods was devised and pre-tested. Data is collected based on the refined schedule emerged from the pre-test. Based on the pre-tested and refined schedule, documentation of profiling of



mechanized fishing systems are in progress. So far data from five major fishing harbours has been completed. This data will be used for evolving representative design groups for in-depth efficiency analysis.

Slurry ice machine using renewable energy

The working principle of the machine is vapour compression refrigeration. Water at room temperature is sprayed inside the insulated metallic chamber which is maintained below -10 °C by using cooling coil surrounding over it. There is a latent heat transfer when a very fine spray of water particles come across cold environment inside the cooling chamber. When droplets of water reaches the bottom of chamber, fine ice particles will be formed. Mechanical agitation is also provided for making ice. The refrigeration system can also be operated by conventional electrical supply. Fabrication works of the slurry ice machine is in progress.

Prototype of solar fish dryer having capacity 5 kg using solar PV panels

Designed and fabricated a small solar fish dryer of 5 kg capacity with electrical backup using PV cells, which can be used for domestic drying purposes. 200W PV panels are installed to store solar energy in 100Ah battery and this battery backup is utilized to run the dryer.



Prototype of solar fish dryer

Commercialized model of solar fish dryer

Installed a commercialized model solar fish dryer (OSDE-SSM) at CIFT premises. In addition to research and development activities, the dryer can also be used for demonstration as well as for providing training to the concerned Self Help Groups

(SHGs) on solar fish drying techniques. Dryer consists of insulated drying chamber with two compartments each having five nos. of SS 304 food grade trays (total 10 trays) for keeping the material for drying. Solar heat collecting panels harness the solar energy and increase the temperature of incoming air which is pumped inside the drying chamber by blower connected between panel outlet and drying chamber inlet. A number of trials were performed with variety of fishes and prawns, to calculate the drying rate, water activity, moisture content after drying, efficiencies of drying chamber and panels, colour, texture of dried products etc.



Commercialized model of solar fish dryer

Small scale fish meal plant

Designed and developed a 10 kg capacity fish meal plant out of SS 302. The equipment consists of a chopper to input the fish/fish waste, which is followed by a fish cooker. Fish cooker is screw type with variable speed using VFD technology which gives the flexibility of using different variety of fishes having different cooking time. The cooker unit consists of two chambers. The steam passes through the outer chamber and the fish is kept in the inner chamber which is not in direct contact with steam. The steam for cooking is fed from a boiler from outside. The cooker is fitted with pressure gauge; dial thermometer and safety valve to standardize the system with different variety of fishes. The machine also contains a hydraulic type oil extractor to extract oil after cooking which will be collected outside the machine. An electrical fish dryer is also incorporated to dry the slurry of the extractor, which is used as fish meal. The fabrication works are completed and the trials with fishes are in progress. The entire parts are incorporated in a single compact unit.

High speed digital water current meter

Designed and fabricated a high speed digital current meter for taking water current measurements in the Hoogly Estuary, West Bengal in a CIFT-CIFRI collaborative project. The instrument is





Small scale fish meal plant

portable and battery operated with very low power consumption. The sensor part is electromagnetically coupled rotor to reduce the threshold current values. Calibrations are made such a way that the data is displayed in digital form in em/sec.

Head cutting machine for Tuna

Re-fabricated the head cutting machine available in the Fish Processing Division. The RPM of the machine is reduced to avoid spreading of head waste. The feeding as well as collecting mechanisms were also rearranged for easy handling.

Efficiency analysis of technology changes brought about in fishing

Development and pretesting of questionnaire for collection of data for profiling of mechanized fishing systems in existence in Kerala with respect to full form, construction methods and quality, installed power, propulsion characteristics, energy utilization and use pattern and on-board equipments was done in two landing centres (Munambam and Sakthikulangara) on 30 boats. Later, data from 50 boats from five major harbours viz., Vizhinjam, Sakthikulangara, Munambam, Beypore, and Kasaragod were collected using the refined questionnaire. Hull forms of seven design groups were mapped in detail and digital models are being made for CFD analysis.

Preliminary analysis of data of 57 boat building facilities with respect to production capacity, years in business, type and size of boats and construction material has been made. Statistical analysis has evolved a sample of 27 yards for in-depth study of design capabilities and construction standards and the study has been initiated. It was observed that one of the major technology changes in harvest sector of sharp increase in installed power Vs vessel sizes has revealed that change in efficiency with respect to speed and pull is only around 63%.

Certification of engines for fishing boats

Seven diesel engines for fishing vessels were certified against their ratings as per existing 12 hour test procedure being followed by CIFT. DM10, DM20, DM14, TV2 and DM28 diesel engines manufactured by M/s Kirloskar Oil Engine Ltd. were tested at their plant at Rajkot, Gujarat for fishing vessel use. NTA855M and 6BT5.9M marine diesel engines of M/s Cummins India were tested and certified at their plant at Pune for fishing vessel use. The data collected during the tests are being validated against the rating efficiencies on-board vessels, under the ongoing study.



Testing of engines

New engine validation procedure

The propulsion efficiency use pattern and maintenance history of power plants presently in use on-board fishing vessels were collected (50 vessels) and subjected to efficiency analysis against manufacturer's claims and operator's expectation. The analysis has brought out that quality assurance standards presently followed for fishing vessel engines by manufacturers are grossly inadequate and hence a new engine validation procedure was prepared. This has been refined based on feedback from engine manufacturers, boat builders, propeller makers and vessel operators. Two procedures for engines below and above 30 Hp has been finalised. For engines below 30 Hp, a validation procedure of 144 hours has been adopted whereas for power above 30 Hp, a procedure of 264 hours has been fixed. As on now, no international standards exists

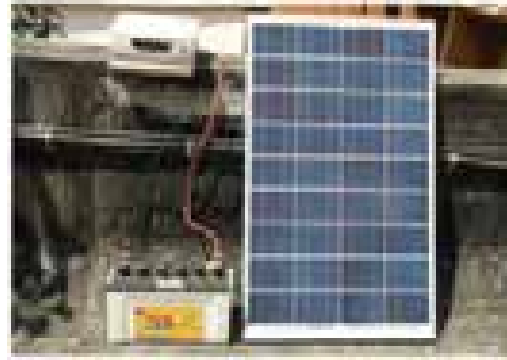


for certifying diesel engines on-board fishing vessels. Requests to validate 16 engines under the new procedure has been received.

Electronic power generator using solar panels

Designed and developed an 800W pure sine wave electronic power generator from solar energy using solar photo voltaic (PV) panels. The system converts the variable direct current (DC) output of a PV solar panel into a utility frequency alternating current (AC). Four numbers of 100W solar panels are used in the power generator. The system works with MOSFET Technology. A zero impedance solar charger controller is used which provides a regulated DC output of

13.5V and also monitors the battery voltage to prevent under/overcharging. The surge cut off of the system is 125% (about 1000W). The system has a low battery cut off of 9V. Indications are given in the



Electronic power generator using solar panels

front panel for Inverter - ON, Charger - ON, Mains - ON and Overload cut off with audio alarm. The battery back-up is 12V, 100AH tubular battery which gives a back-up time of five hours on full charge. Provision for stand-by AC is also incorporated.





Extension, Information and Statistics Division

Chief findings

- ❖ Data collected from fishermen respondents at Thaikkal fishing village in Alappuzha district and Thayyil fishing village in Kannur district revealed that fishermen were involved in mainly three categories of fishing, such as 'Thangu vala' fishing (20 m ring seiners), disco vala fishing (14.5 m marine plywood 'vallams') and gillnet fishing with smaller 'vallams' (9 m).
- ❖ Fishermen respondents were interested in technology interventions in the subject areas such as hygienic fish handling in the landing centres, reduction of post harvest loss, use of responsible fishing methods, use of improved packing methods for transport/sale, and production of value added fishery products. The extent of awareness and adoption of 10 selected improved practices were studied among the fishermen respondents.
- ❖ Data were also collected from 34 fisherwomen in Njarakkal fishing village (Ernakulam) and 10 fisherwomen respondents in Quilandi fishing village (Kozhikode). It was seen that all the respondents were interested in food/fish based micro enterprises and expressed their interest in attending a training on the production of value added fishery products.
- ❖ Rapid Rural Appraisal (RRA) techniques were used in the four centres and the technological interventions were determined.
- ❖ Lack of access to the research/extension organizations and lack of awareness on availability of technologies were reported as constraints in obtaining technologies.
- ❖ The social participation of the fishermen was observed to be restricted to membership in Co-operative Societies and the major sources of information for improved technologies were reported to be their friends and fellow fishermen.
- ❖ Escalating fuel costs, inadequate fuel subsidy, diminishing catches, lack of adequate measures for safety at sea and poor landing centre facilities were reported as operational constraints.
- ❖ The fishermen/fisherwomen respondents preferred participatory extension models involving the fisherfolk/voluntary organizations. The other preferred technology transfer models were mobile based extension/advisory services, and horizontal transfer through peer groups/progressive fishermen.
- ❖ Under the study on the economic efficiency of the fishing units, it was seen that 17% fisherfolk of Alappuzha district and 23% of fisherfolk of Ernakulam district were operating ring seines. The variables for assessing the economic efficiency of fishing units were finalized.
- ❖ A Canonical discriminant function analysis was done on socio-economic variables and technology adoption indicators from data collected among fishermen operating OBM crafts in four

Research projects handled

- ❑ Evaluation of technology transfer models in small scale fisheries sector
- ❑ Management dimensions in the fisheries sector - Policies, issues and implications
- ❑ Enhancing the fuel efficiency and safety of mechanized fishing systems
- ❑ Mobilizing mass media support for sharing agro information
- ❑ Responsible harvesting and utilization of selected small pelagics and freshwater fishes
- ❑ Assessment of sustainable livelihood interventions and entrepreneurial skills among coastal women self help groups using participatory methodologies
- ❑ Techno-economic feasibility of coconut wood canoes for small scale fisheries sector in the south west coast of India and Lakshadweep

districts of Kerala.

- ❖ Using a Probability Proportional to Size sampling design, a sample of 63 fish processing plants were selected, and the energy use and GHG emission associated with Kerala fish processing sector were estimated. The CO₂ equivalent per kg of the finished product was computed as 0.487 kg at 50% production capacity and 0.397 kg at 33% production capacity.
- ❖ von Bertalanffy growth model was fitted to the growth data on carps stocked at Kanjirapuzha reservoir and annual growth rates of Catla and Mrigal obtained were 0.69 and 0.60. Virtual population analysis was done on the data on length-weight of Catla and Mrigal, using Jones Length Cohort Analysis.





Biomass for exploitation available in the reservoir for Catla was estimated as 33 tonnes and Mrigal was estimated as 209 tonnes.

- ❖ Density-dependent growth model suggested by Lorenzen (1996) was employed to suggest appropriate stocking regime to Kanjirapuzha reservoir.
- ❖ A two phase sampling design was developed for the study on fuel efficiency of mechanized fishing system and to classify the mechanized fishing fleet spread along the nine coastal districts and to standardize a mechanized fishing system for fuel efficiency. In the first phase, utilizing a large sample, a database on dimensions, hardware components and vessel operating behavior of the existing mechanized fishing fleet of Kerala was created.
- ❖ Response surface methodology was used to study the optimum process parameters for extraction of glucosamine hydrochloride.
- ❖ Based on two-stage sampling methodology developed for estimation of seafood waste from processing sector, quantity of waste generated annually was estimated.
- ❖ Conjoint model was fitted to consumer preference data comparing innovative fish products and other snack products. The part-worth utilities estimated for various product combinations showed high preference for fish-based snack food.
- ❖ Harvest losses in marine fisheries was estimated from Ernakulam district as 1.14% for traditional sector, 3.65% for motorized sector, 14.15 for mechanized trawlers undertaking up to seven days fishing and 18.73% for trawlers fishing more than seven days. Estimates were also computed by utilizing information on number of hauls during the fishing trip which were more précised than the usual estimator.
- ❖ Post harvest losses in pre-processing sector was estimated for Ernakulam and Alappuzha districts as 0.38% whereas the losses amounted to 1.19% in processing sector. Loss estimates computed for dry fish production stood at 36.97% and wholesale marketing of dry and fresh fish recorded 7.56% and 3.79% losses. From retail marketing of

fresh and dry fish, 3.13% and 8.23% losses were reported whereas road-side market channel reported losses of 2.54% and 5.43% for fresh and dry fish respectively.

- ❖ The extent of harvest losses at landing centres of Nagarjunasagar reservoir was assessed as 8 to 10%. The causes were discards of spoiled fishes due to physical damages in entangling, discards of dead fishes in the nets, spoilage due to adverse weather, spoilage due to non-usage of ice, spoilage due to delay in taking out the already caught fishes from gillnets, etc.

Report of the work done

Evaluation of technology transfer models for small scale fisheries sector

Structured schedule has been formulated to collect data from fisherfolk so as to select suitable field centres for conducting the project work. An interview schedule has also been finalized to evaluate the various ToT models. The pre-testing of the schedule also revealed that the fishermen respondents preferred participatory extension models involving the fishermen/voluntary organizations.

Field visits were made to fish landing centres viz., Thayyil, Mopla Bay Fishing Harbour and Thalassery in Kannur district and stakeholder analysis was carried out among the fishermen operating motorized FRP crafts at Thayyil. FRP crafts of 28-32 ft L_{OA} with two OB engines of 9.9 Hp were in use. Gillnets of 800 to 1200 metres length were in operation. The mesh sizes were in the range of 48, 54, 60, 90 and 110 mm. The mean fishing days in a year was 280-300. The average annual family income was reported as `2.00 lakhs. The extent of awareness and adoption of ten practices viz., on-board hygienic fish handling, use of ice to preserve fish, use of improved fishing boat materials/designs, use of appropriate mesh size in fishing gear, use of responsible fishing methods, conservation methods for sustainable fisheries, reducing the post harvest loss/unfitness for consumption, hygienic fish handling in the landing centres, fish processing methods for preservation of fish and improved fish packaging materials for transport were studied.

Escalating fuel costs, inadequate fuel subsidy, diminishing catches, lack of adequate measures for safety at sea and poor landing centre facilities were reported as operational constraints. The preferred technology transfer models were; mobile based extension/advisory services, participatory extension approaches and horizontal transfer through peer groups/ progressive/ innovative fishermen. Lack of access to the research/extension organizations and lack of awareness on availability of technologies were reported as constraints in obtaining technologies. Visits were also made to the office of Deputy Director of Fisheries, Kannur and to the NGO viz., KAIROS for collection of secondary data pertaining to the study.

During the period, data were also collected from fishermen respondents at Thaikkal fishing village in Alappuzha district. Fishermen operating 'Thangu vala' fishing (ring seines) uses 20 m vallams with 30 to 50 crew members with in-board engines plus one carrier vallam with 9.9 Hp engine. The investment on a fishing unit was found to be about `50 lakhs. Fishermen operating disco vallam uses 14.5 m marine plywood vallams with 20 crew members and two engines, plus one carrier vallam with an engine. The investment on a disco vallam fishing unit was about `12 lakhs. Fishermen operating smaller vallams (9 m soft marine plywood vallam) uses different types of gillnets and mini trawl nets with crew ranging from 3 to 10 depending on the size





FRP boats in landing centre



Transport of fish in refrigerated vans

of the boat and nets used. The average investment on such smaller unit was found to be about ₹ 3.5 lakhs. The number of fishing days ranged from 150 to 220 per year.

Fishermen respondents were interested in subject areas such as hygienic fish handling on-board as well as in the landing centre, reduction of post harvest loss, use of responsible fishing methods, use of conservation methods for sustainable fisheries, use of improved packing methods for transport/sale and production of value added fishery products.

Data were also collected from 10 fisherwomen respondents in Quilandi fishing village in Kozhikode district. In this fishing village, there were nine active fisherwomen SHGs with 83 women members. Out of the 10 respondents, nine were from fishermen families and one family was engaged in fish marketing. All the respondents were interested in food/fish based micro enterprises and expressed their interest and need in attending a training on the production of value added fishery products. The data collected also revealed that the fishermen/fisherwomen respondents preferred participatory extension

models involving the fisherfolk/voluntary organizations.

The theoretical technology transfer models identified were also being classified under the changing extension approaches from the earlier "Trickle down approach" to the recent "Bottom-up approach" followed in extension. Simultaneously, suitability of the recent models in fisheries scenario is being studied, considering the unique features of fisheries. In the first analysis, the models falling under facilitation models were found to be more apt than the traditional diffusion models.

Later, interactive discussions were held with fishery stakeholders for appraisal of the problems experienced by them in the sector and Problems experienced by fisherwomen in Njarakkal village (N=34)

No	Social, economic and occupational problems experienced	Priority Ranks
1.	Progressively declining catch from sea affects job opportunities in fisheries	III
2.	Poor income and progressiveness in family	III
3.	Poor social status for fish vending and other fishery occupations like dry fish making	IV
4.	Lack of financial potential for starting business ventures	V
5.	Lack of skill in making new products out of fish	VI
6.	Poor marketing skill and opportunities for value added products	VII
7.	Lack of awareness about any new job opportunities in fisheries	VIII
8.	Lack of knowledge in hygienic and high quality processing methods	IX
9.	Lack of skill in potential non- fishery job opportunities	



Stakeholders meeting in progress



technology needs will be assessed for solving the problems in occupation. Initially, the sessions were organized exclusively for fisherwomen in Njarakkal in two locations and at the next phase, one session is planned for sea-going fisherfolk using crafts fitted with OBM. In second phase, separate session is planned for fisherfolk. The problems experienced as well as the technology needs expressed by the women in the coastal area are furnished in the Table.

After the review of problems experienced by fisherwomen, an effort was taken to pool the technology needs/supports required by fisherwomen. Accordingly, the following items were elicited:

Technology support sought by fisherwomen (N=34)

No	Technology supports sought by fisherwomen	Priority Ranks
1.	Skill in making new business units on value added products	I II
2.	Training in hygienic fish processing methods	III
3.	Improved marketing strategies for fisheries products	IV
4.	Training in new packaging for pickle, dry fish etc. to improve shelf life	

As per the responses collected, future technology transfer programme is to be planned for implementation. Technology transfer will be done through an integrated model newly developed for coastal women.

Enhancing the fuel efficiency and safety of mechanized fishing systems

Technology change in mechanized sector is tremendous and its consequences are both desirable and undesirable. It is high time that we analyze this for sustainable fisheries options. Hence key informant interviews and focus group discussions were conducted in the three landing centres of Kozhikode, Thrissur and Cochin and the technology changes that had taken place during the last 10 years with respect to fuel saving, operational characteristics, variations in size and installed power, propulsion characteristics, materials for construction, manufacturing methods, use of skilled

manpower, and on-board equipment were collected. The socio-economic parameters relevant to assess the change process in the social system is also being collected.

During the period, it is decided to collect data over a period of 20 years and the process is continued. The respondents included vessel owners, yards, crew, inputs dealers, and community/society leaders and published data. The work is in progress.

Analysis of the process of technology transformation taking place in the harvest sector of fisheries

Review of literature on the component has been done. Visits had been made to the Department of Fisheries and landing centres of Kozhikode district (Kerala) and East Godavari District (AP). Questionnaire preparation and sample size selection was carried out. At Visakhapatnam Research Centre of CIFT, pre-testing of the interview schedule was done among the fishermen operating motorized and traditional crafts in Mangamaripalem and Debbadipalem villages near Visakhapatnam and among the fishermen living in and around the banks of river Godavari (Yanam, Bobbarlanka). In case of Mangamaripalem and Debbadipalem, the fishermen uses 18-20 feet wooden motorized crafts with out-board engines of 10 Hp. The crew size of such type of crafts varied between 5-6 persons. Usually in most of these crafts, gillnets are used for fishing. The average investment on craft, gear and engine for such type of fishing is ₹41,666/- per annum. The social participation of the fishermen is restricted to membership in Co-operative Societies and the major information sources for improved technologies are reported to be their friends and fellow fishermen.

Analysis of the decision making behavior of fishermen and the associated factors

In order to analyze the decision making behavior of fishermen with reference to fishing related innovations, different variables were identified and a draft schedule was finalized. Basic data on two fishing villages of Visakhapatnam district were collected. From the list of fishing villages, sample size was decided.

Determining the economic efficiency of the fishing units in the selected fishing centres

The secondary data on the motorized and non-motorized fishing units in Kerala were collected. It is seen that 17% fisherfolk of Alappuzha district and 23% of fisherfolk of Ernakulam district have been operating ring seines. The variables for assessing the economic efficiency of fishing units have been finalized. The questionnaire preparation is under progress.

Management dimensions in the fisheries sector - Policies, issue and implications

As part of the project on 'Assessing the governance structures, role and functioning of stakeholder organizations in input delivery, and market intervention as well as studying the gendered impacts', different stakeholder organizations from the fisheries sector have been selected. They include, The Nagai District Fishermen Sangams Federation, Nagapattinam which is being supported by SIFFS, Thiruvananthapuram



(an NGO); fisheries co-operatives under Matsyafed, Govt. of Kerala; the boat building yards in Gujarat; Co-operative Societies, seafood processing sector, hatchery consultants, shrimp farmers, processors and administrators to assess the structural changes occurred in the industry after introduction of Vannamei shrimp.

Assessment of harvest and post harvest losses in fisheries

Harvest losses in marine fisheries was estimated from Ernakulam district by stratifying fishing crafts into mechanized, motorized and traditional sectors. Primary data on fish catch and losses for 12 months was collected from fishing crafts operating in six selected fish landing centres at Ernakulam. A sample of 150 mechanized trawlers, 200 motorized boats and 60 traditional crafts were covered during the period in Ernakulam district. Loss estimates were computed analyzing the season-wise data and pooled data. The sector-wise harvest loss estimates are as given in the Table.

Harvest losses in marine fisheries

Sector	Pre-monsoon (%) (SE)	Post-monsoon (%) (SE)	Monsoon (%) (SE)	Overall (%) (SE)
Traditional	1.93 (0.43)	0.98 (0.37)	0.83 (0.28)	1.14 (0.28)
Motorized	3.45 (0.54)	2.76 (0.13)	4.38 (0.53)	3.65 (0.17)
Mechanized (up to 7 days fishing)	12.74 (1.23)	11.09 (0.11)	9.11 (0.05)	14.15 (2.10)
Mechanized (more than 7 days)	13.78 (1.24)	14.98 (1.35)	13.35 (1.32)	18.73 (2.22)

Multiday fishing by the mechanized trawlers reported maximum loss due to capture of juveniles and their discards. Around 1500 to 2750 kg of fish gets discarded at sea by trawlers during fishing trips of more than seven days duration. The number of hauls during fishing and loss was positively correlated (0.69) at 5% level of significance. The estimate of loss due to mechanized fishing was computed by utilizing information on number of hauls which was more precise than the traditional estimates. The losses due to motorized fishing crafts was very less in comparison with trawlers. The traditional fisheries sector reported minimal or no loss during the period.

The post harvest losses in marine fisheries (at the landing centre level) were estimated as: Traditional sector - 0.09% (SE-0.0004), Motorized sector - 1.19% (SE-0.07), and Mechanized sector - 4.79% (SE-1.09). The loss estimates when compared with the estimates brought out by earlier studies indicate that the post harvest losses have come down due to efficient handling of catch.

The post harvest losses in processing and marketing sector was also computed from Ernakulam and Alappuzha during the period under report. For reporting loss in processing sector, 50 pre-processing units and 25 processing units were observed and data on raw material processed and loss were recorded fortnightly. Shortage of ice and spoilage were cited as the reasons for loss in pre-processing. At the processing stage, losses occurred due to discolouration, broken tentacles, black spot and at times, loss during glazing. Few units reported

rejections at export destination due to heavy metal detection.

Losses in the marketing sector was due to damage during transportation and spoilage due to delay in transport and weather. Two wholesale markets for fresh fish and one wholesale market for dry fish were covered by contacting 15 and eight wholesale agents, respectively fortnightly for recording losses due to marketing. Similarly 40 traders from four retail markets for fresh fish and 10 retail dry fish traders were surveyed fortnightly for reporting loss in retailing fish. The estimates for post harvest losses in processing and marketing are given below:

Post harvest losses in processing and marketing

Sector	Loss % (SE)
Pre-processing	0.38 (0.04)
Processing	1.19 (0.07)
Dry fish production	36.97 (12.88)
Wholesale market (Fresh)	3.79 (1.09)
Wholesale market (Dry)	7.56 (2.12)
Retail market (Fresh)	3.13 (0.02)
Retail market (Dry)	8.23 (0.13)
Road-side market (Fresh)	2.54 (0.11)
Road-side market (Dry)	5.43 (1.19)

Assessment of harvest and post harvest losses in reservoir fisheries

A survey was conducted at Nagarjunasagar reservoir in Andhra Pradesh during July, 2012, to study the fisheries profile and to assess the harvest losses. The Nagarjunasagar reservoir is a large impoundment in the river Krishna. The reservoir extends to Nalgonda and Guntur districts, which are divided by the Krishna. The fishermen belong to backward communities. The peak fishing season is from July to October, though fishing is taking place throughout the year, except on Sundays, which is a weekly off, during which purchase of groceries for households, purchase of net materials and repair works of fishing units are carried out.

Coracles are the only type of craft operated in the reservoir, which are locally called as 'Putti'. The mean life of the coracle is four years. The crew size is two. Gillnets are the main gears for harvest, and long lines are sometimes used during summer months, using larvae of dung beetles as baits. Cast nets are also in use. About 100 kg of gillnets are used in single day fishing. Each kg of gillnets costs around ₹ 800/-, and the



Interaction with fishermen



Craft and gear - Coracles and gillnets



Fish iced and packed in thermocole containers for transportation by rail

total investment on 100 kg of gillnets worked out to `80,000/-.

Open access fisheries is in practice, with a half yearly licence fee of `240/-. They go for single day fishing, and the fishing duration is from 3 PM to 8 AM. After setting the gillnets in the evening/night, fishermen take shelter in the banks of the reservoir. At around 4 AM, they collect the catches, and land at around 8 AM. Ice is not taken, while going for fishing, and fishes are iced only after landing. From remote landing centres, fishes are iced and transported by motorized carrier boats. The catches are then iced and packed in thermocole containers, and taken to different markets. The average annual production from the reservoir is 90 tonnes. The catch is sold in Guntur, Nalgonda, Mahabubnagar, Renga Reddy, Hyderabad and Krishna districts. They are also sent to Howrah markets through Macherla railway station. The popular commercial fishes are; *Anguilla rostrata* (Eel), *Cirrhinus mrigala* (Indian carp), *Labeo rohita* (Rohu), *Labeo calbasu*, *Catla catla*, *Pangasius pangasius* and *Wallago attu*.

The extent of harvest losses at landing centres of the reservoir was assessed as 8 to 10%. The causes were discards of spoiled fishes due to physical damages in entangling, discards of dead fishes in the nets, spoilage due to adverse weather, spoilage due to non-usage of ice, spoilage due to delay in taking out the already caught fishes from gillnets, etc.

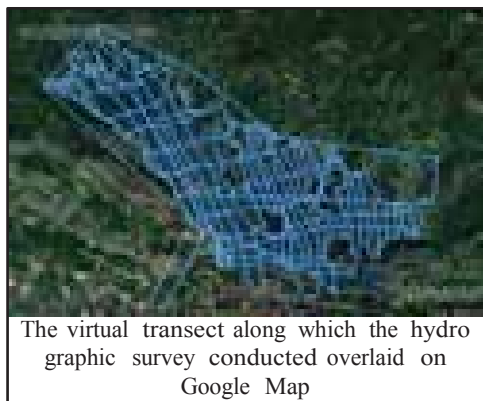
The catches are sold to money lenders at the price dictated by them. They are forced to sell the catches to money lenders, as they have taken loan from money lenders for the purchase of fishing units. Lack of access to institutional finance is a major constraint perceived by them. The other constraints reported were under stocking, remote landing centres not connected by approach roads, no means to market the fish without spoilage due to the poor connectivity, etc. Improving their access to institutional finance, removing them from the clutches of money lenders, adequate motor boats to quickly transport their catches from remote landing centres/catchment areas, formation of efficient co-operatives and assistance in marketing their catches without spoilage and at remunerative prices will help to improve the socio-economic status of fisherfolk at Nagarjunasagar.

Assessment of harvest and post harvest losses in Malampuzha and Meenara reservoirs

Data were collected from Malampuzha and Meenara reservoirs. There are 11 units of operation at Meenara and 12 units at Malampuzha. The major gear being operated are gillnets with average 50 meter length and mesh size of 8-25 cm. Major species harvested are Rohu, Catla, Mrigal, Pearlspot and Tilapia. Harvest loss in reservoir fishery is estimated as 1.5% and the major reason for the loss is the occasional delay in lifting the nets for harvesting. At post harvest level no loss is reported as fish has very high demand at landing centre itself.

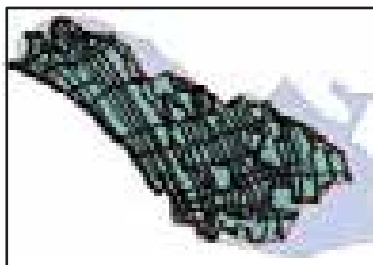
3D - Modeling of Malampuzha reservoir

Completed the hydrographic survey work along all accessible area of Malampuzha reservoir using echo-sounder and GPS on a continuous basis and generated the data set of latitude, longitude and elevation of the bathymetric area of Malampuzha reservoir using the hydrographic survey data and the data is made available in standard

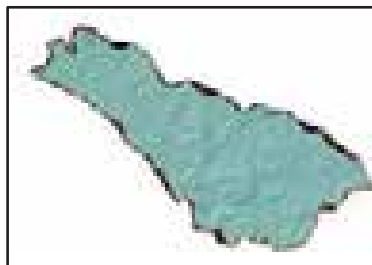


The virtual transect along which the hydrographic survey conducted overlaid on Google Map

database format. The 3D-data generated is populated in to the geodatabase designed and developed for the 3D-model of Malampuzha reservoir in a GIS platform. The Triangulated Irregular Network (TIN) data model of the Malampuzha reservoir is generated out of the 3D -



The points on which the 3D-data were observed in the background of Malampuzha



TIN data model developed for Malampuzha reservoir using the 3D-data

data to facilitate "three dimensional visualisation" of the reservoir. Also, conducted ground truth survey in the Malampuzha reservoir area and collected data for validation of GIS analysis and three dimensional visualisation of the reservoir.

Assessment of energy use and GHG emission associated with the fish processing sector

Kerala fish processing industry is an established setup catering to the export sector with a capacity to process 2781 tonnes of seafood per day. Global warming is a much debated environmental issue and emission of green house gases (GHG) from industrial activities contribute to it. For many food products, CO₂ equivalent per kg of the finished product is being provided by leading manufacturers to ensure green labelling and brand recognition. A sampling frame of 113 fish processing units was constructed along with their installed capacity to process. Using a PPS sampling design, 63 units were selected for a detailed study on the energy use during the various activities of processing right from the procurement of fish to packing the end product for export. Data was also collected on production during the year 2010. Diesel for transport, electricity of running the various machinery, equipments, diesel for processing, water usage, ice usage, chemicals etc. were identified as the main sources of energy used. It was observed that the fish processing plants were not producing to the full capacity due to various factors like non-availability of raw material and labour shortage. The actual production from the units varied from 33 to 50% of their installed capacity. For each of the identified source of energy, using the data, GHG emission associated were computed based on the emission figures provided by Carbon Trust (2007). The CO₂ equivalent per kg of the finished product was computed as 0.587 kg at 50% production capacity and 0.497 kg at 33% production capacity. Analysis of the data indicates that more than 40% of the computed CO₂ equivalent is due to transportation.

Two phase sampling design for the study on fuel efficiency of mechanized fishing system

To standardize a mechanized fishing system for fuel efficiency, a comprehensive assessment of the dimensions, hardware components and vessel operating behavior of the existing mechanized fishing fleet was planned through a sample survey. Due to the huge variability in the mechanized fishing fleet as regards to dimensions, installed power, fishing type (gear), propulsion and design, classification of the mechanized fishing fleet spread along the nine coastal districts, was attempted through a survey. A two phase sampling design was adopted. In the first phase, a large preliminary sample of 950 mechanized fishing vessels was covered for recording data on 12 parameters of importance. Deep stratification was employed for constructing 15 row x column strata based on the multiple criteria. The information collected was used to develop a profile of a typical mechanized fishing vessel falling into each stratum. The various stratum sizes were estimated and sub-samples drawn for detailed study.

Density dependent growth model for carps in reservoir system

The von Bertalanffy growth model was fitted to the growth data on carps stocked at Kanjirapuzha reservoir and annual growth rate of Catla and Mrigal obtained as 0.69 and 0.60. Virtual population analysis was done on the data on length-weight of Catla and Mrigal using Jones Length Cohort Analysis. Biomass available for exploitation in the reservoir for Catla was estimated as 33 tonnes and Mrigal was estimated as 209 tonnes.

A density-dependent growth model of the form $W_{\alpha\beta} = [W_{w\gamma}^{1/3} - C(\beta - \beta\gamma)]^3$ where, B is the actual population Biomass, $W_{w\gamma}$ is the asymptotic weight at reference Biomass B_r , and C is the competition coefficient developed by Lorenzen (1996), was employed to the data on stocking, catch, observed length and weight of Catla from Kanjirapuzha reservoir. The density dependent parameters were estimated as $W_{w\gamma} = 7450$ g, $c = 0.032$ g^{1/3} ha kg⁻¹ for a reference biomass of $B_r = 68$ kg ha⁻¹.

Assessment of sustainable livelihood interventions and entrepreneurial skills among coastal women self help groups using participatory methodologies

A study was conducted among the members of the women self help groups in

coastal villages in the selected districts of Kerala. The identified districts for the study are Kollam, Ernakulam, Thrissur and Kannur. The interview schedule for data collection was constructed and pretested in a non-sampling area. Based on pre-testing, the interview schedule was modified to remove ambiguous items, and the schedule was finalized for further data collection from sample respondents. Another schedule was constructed for collecting the data on general



Data collection from SHG members

profile of the study area. Data collection on the socio-economic profile of the coastal women SHG members were collected from four sample locations viz., Kannamali and Njarakkal villages in Ernakulam district, and Mayyanad and Thangasserry in Kollam district. Data from 120 women respondents representing six SHGs were collected during this period. The SHG units visited were producing goods using locally available raw materials for sale in local markets. These include dry fish, readymade garments, school notebooks, soaps, kites, traditional hand-made home-appliances (handicrafts), umbrellas and semi processed food such as jams, coconut creams, vegetable chips, pickles, ready-to-cook fish products, etc. Some of these products were also marketed outside the region. Data on the village resources and other basic details for the sampling locations were collected through PRA tools viz., Transect Walk, Resource Map of the selected villages and through Mobility Map of the selected sample respondents.

Feasibility of coconut wood canoes for small scale fisheries sector

The project was initiated and two sets of questionnaires have been designed for collection of primary information on the use of wood in the small scale fisheries sector in the south west coast of India and Lakshadweep. The survey work has been initiated in Kerala, Karnataka, Maharashtra and Goa.



Visakhapatnam Research Centre

Chief findings

- ❖ Designed and developed 26m multi seam (14 seam) demersal fish trawl and 28m eight seam fish trawl for exploitation of fishery resources.
- ❖ A new design of bag type stake net was fabricated with HDPE attached with 50mm square mesh window as BRD for elimination of juveniles.
- ❖ Biodiversity of trawl resources and bycatch was estimated off Visakhapatnam from commercial trawlers.
- ❖ The carbon foot print was estimated from Visakhapatnam (61563 tons/year), East Godavari (51622 tons/year), Krishna (9010 tons/year), Guntur (15949 tons/year) and Prakasham (4272 tons/year).
- ❖ Fishing gear survey was conducted at Visakhapatnam, Kakkinada, Bhimili, Uppada, Vasavanipalem, Odalarevu, Gologonda, Jogumpeta, Ammapeta and Pappusettypalem fishing villages of Andhra Pradesh. Three main types of trawls operated by commercial trawlers and three types of ring seines operated by motorized boats were surveyed and the results are published.
- ❖ Data collected during various deep sea fisheries expeditions of Fisheries and Oceanographic Research Vessel (FORV) Sagar Sampada was analyzed. A total of 155 species belonging to 88 families and 33 orders are identified from the depths ranging from 50 -1100m.
- ❖ Fermented fish procured from North-East India showed moisture content of 35.94% (range 31.14 to 41.98%), and fat 20.1% (range 13.01 to 29.54%).
- ❖ The biochemical, microbiological, textural and sensory analysis of Milkfish during iced-storage indicated that the quality loss was relatively faster in ice-stored gutted Milkfish compared to whole fish.
- ❖ Changes in the textural properties of *Penaeus monodon* and *Litopenaeus vannamei* during different processing methods and changes in textural properties of *L. vannamei* and *Metapenaeus monoceros* during soaking condition were studied.
- ❖ A new product Peeled Double Deveined (PDD) Vannamei was made by removing the ventral bluish structure of *L. vannamei* to improve appearance and quality.
- ❖ All the *Salmonella* (n=12) isolated from marine fish were found positive for the presence of the virulence genes namely *invA* and *stn* gene.
- ❖ A low percentage (3.9%) of *E. coli* isolated from fish showed resistance to antibiotic Meropenem but Meropenem resistant *E. coli* were found resistant to Norfloxacin, Ciprofloxacin, Gentamicin, Amoxicillin, Penicillin, Methicillin, Nalidixic acid and Tetracycline.
- ❖ *Vibrio* isolates (75%) showed chitinase activity from Day 2, on

Research projects handled

- ❑ Development of sustainable fishing technologies for exploitation of fishery resources in the east coast of India
- ❑ Development of appropriate fishing systems for rivers
- ❑ Assessment of Myctophid resources in the Arabian sea and development of harvest and post harvest technologies.
- ❑ Assessment of demersal fishery resources along the continental slope area of the Indian EEZ and the Central Indian Ocean
- ❑ Nutritional profiling and hazard assessment of fish and fishery products of marine and lacustrine environs of the east coast of India
- ❑ Diversity of seafood-borne pathogenic and commensal bacteria and bioscreening for novel genes and biocatalysts
- ❑ Bio-monitoring of bivalve molluscs and crustaceans from Indian waters as health promoters and indicators of environmental contaminants
- ❑ Zonal technology management and business planning and development unit
- ❑ Evaluation of technology transfer models in fisheries sector
- ❑ Management dimensions in fisheries sector - Issues, policies and implications

media with 3% and 6% NaCl, at pH 7 and 9 and at temperatures 22 °C and 37 °C.

- ❖ All O1 and O139 *V. cholerae* produced chitinase; but chitinase production was variable in non-O1/non-O139 *V. cholerae*.
- ❖ Survey conducted among fishermen engaged in gillnet fisheries using FRP crafts with out-board engines of 9-10 Hp



in Vasuvanipalem and Peddajalaripeta fishing villages of Visakhapatnam revealed that the mean average investment on the fishing system was ₹ 3.12 lakhs with an average number of fishing days of 289 per year. Investigations on fishermen awareness and adoption of various fishing related innovations and practices showed that majority of them belong to medium level of awareness and adoption.

- ❖ As a part of assessing the role, functioning and gendered impacts of stakeholder organization in fisheries, a study was conducted on fisherwomen Co-operative Societies of Visakhapatnam. During the survey it was found that membership in Co-operative Societies is imperative for fisherwomen to get access to many government schemes. The livelihood outcome of fisherwomen Co-operatives Society members showed an average income of ₹ 2727.30 per month from fish drying and curing activities.
- ❖ Study was conducted on the impact of introduction of Pacific white shrimp in Andhra Pradesh. Data was collected from aqua farmers, processors/exporters and administrators regarding perceived reason for wide spread adoption of Pacific white shrimp and its perceived socio-economic and environmental impacts.

Report of the work done

Quantitative and qualitative estimation of catch and bycatch of commercial trawls

Data for trawl fishery resources of commercial trawlers and departmental trawler of Visakhapatnam coast were collected for study. Data on quantity of targeted and non-targeted catch of fish and shrimp trawl was collected from multiday and single day trawlers. Total quantity of discarded catch was collected from the deckhands and skipper of the vessels by interview. Random sample weighed 1kg of bycatch was collected and fish were identified up to species level. The total number of vessels operated from the harbor was 579. The total catch of the fish landed by multi day fishing vessels along Visakhapatnam harbor was

an average 1025 tones with an average CPUE of 23kg/hr. The total quantity of fish landed by single day fishing trawlers along Visakhapatnam coast was 19.75 tons. About 90% of the vessels of 15m L_{OA} and above are

going for multi day fishing and 10% of the vessels less than 15 m L_{OA} are doing single day fishing. The experimental multi seam trawl yielded CPUE of 42kg/hr. The main catches landed by commercial trawlers of Visakhapatnam harbour was *Upeneus* spp. (20%), Mackerel (15%), Sciaenids (10%), *Paenus indicus* (10%), Prawns (10%), Ribbonfish (10%), Squid and Cuttlefish (10%), Pomfret (5%), Anchovies (5%) and Nemipterids, Lizard fish and Catfish (5%). The juvenile catch landed by commercial trawlers is recorded. The quantity of juvenile catches in multi-day fishing vessels and single day vessels were collected. The juveniles of major commercial species landed from commercial trawlers observed were Ribbonfish of 18.75cm to 37.6cm length and are predominant during monsoon and post monsoon period followed by *Upeneus* spp. (10.0-11.7cm), Nemipterids (7.3-10.2cm) and Silverbellies (3.1-7.8cm).

Design and development of multi seam fish trawls for sustainable exploitation of fishery resources

Designed and developed 26m multi seam (14 seam) demersal fish trawl and 28m eight seam fish trawl for exploitation of fishery resources. Field trials were conducted with experimental trawls and performance of multi seam demersal

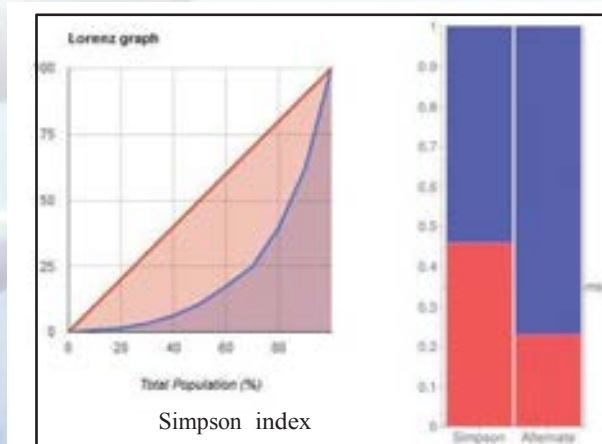


Field trials of multi seam trawl

fish trawl was compared with 26m two seam fish trawl. The multi seam trawl yielded CPUE of 42kg/hr and two seam trawl yielded 28kg/hr. The CPUE of 28m eight seam trawl was 34kg/hr.

Alpha biodiversity of trawl bycatch

Alpha biodiversity of trawl bycatch from Visakhapatnam was estimated as indices as follows: Simpson Index (0.5775), Simpson Index Approximation (0.2888), Dominance Index (0.4225), Dominance Index Approximation (0.7112), Reciprocal Simpson Index (1.732), Alternate Reciprocal Simpson Index (3.463), Shannon Index (2.276),

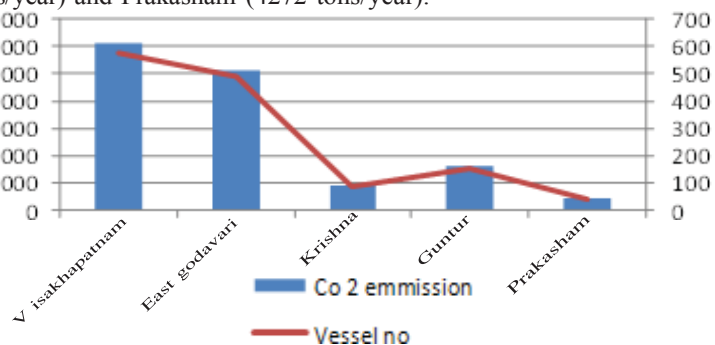


Alpha biodiversity of trawl catch

Berger-Parker Dominance Index (0.4839), Shannon Index (1.578), Inverted Berger-Parker Dominance Index (2.067), Shannon Index (-0.6851), Margalef Richness Index (0.6344), Menhinick Index (0.03213), Rényi Entropy/Hill Numbers ($r=0,1,2, \alpha$), 8, 4.852, 3.463, $=\alpha$, Buzas and Gibson's Index (0.6054), Gini Coefficient (2.427), Equitability Index (0.7586), $\ln()$ of Hill Numbers (0,1,2, α), 2.079, 1.579, 1.242, $=0.72$.

Estimation of carbon foot print from trawl fishing of Andhra Pradesh

Data are being collected for estimation of carbon footprint from trawl systems of selected districts in Andhra Pradesh. The carbon foot print estimated is as follows: Visakhapatnam (61563 tons/year), East Godavari (51622 tons/year), Krishna (9010 tons/year), Guntur (15949 tons/year) and Prakasham (4272 tons/year).



Carbon foot prints of trawl fishing of Andhra Pradesh

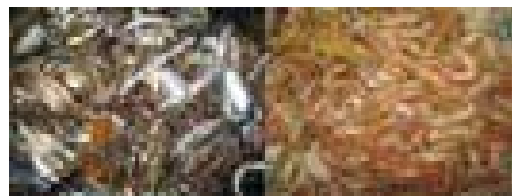
Design and development of bag type stake net with BRD

A new design stake net fabricated with HDPE twine attached with square mesh window for Hilsa fish juvenile conservation was operated at Odalarevu, East Godavary district of Andhra Pradesh. The first belly was fabricated with 2mm twine of single piece of 400 meshes circumference and four meshes of depth seamed in a tubular shape. The net is fabricated with seven bellies. The square mesh window of 1m x 0.5m of 50mm mesh size was tied on the top of the codend. The window was covered with a cover of 10mm mesh size. The net was tied to the stakes at 6.00 PM and was removed at 12.00 PM during low tied time. The catch recorded in codend was 5-15kg/



Stake net designed for conservation of Hilsa fish juveniles

per net in six hours and in cover 0.5-0.8kg. The catch recorded in codend was *Metapenaeus dobsoni* (40%), Silverbellies (15%), Ribbonfish (15%), *Stolephorus commersonii* (5%), Goatfish (5%), Squid (5%), Cuttlefish (5%), Crab (5%), Hilsa keele and *Sciaenid* spp. (5%). The catch escaped through square mesh window was M.



Catch of stake nets operated at Odalarevu

dobsoni (30%), *S. commersonii* (20%), Silverbellies (15%), Ribbonfish (15%), *Upeneus* (15%) and Cuttlefish (5%).

Nutritional profiling and iced-storage studies of Milkfish

Milkfish (*Chanos chanos*), a brackishwater fish is suitable as indigenous candidate aquaculture species in India that can meet the domestic market needs. Farmed Milkfish of length ranging between 52.5cm and 58.5cm and weight ranging between 0.985kg and 1.156kg were analyzed. The results revealed that Milkfish is nutritionally a good source of protein (20.3%), fat (3.84%) and beneficial minerals. The fatty acid profile of Milkfish constituted 40.17% of Saturated Fatty Acid (SFA), 34.47% Mono Unsaturated Fatty Acid (MUFA) and 16.27% of Poly Unsaturated Fatty Acid (PUFA). Aromatic amino acids constitute about 13.4%. The quality parameters viz., TVBN, TMAN, PV and FFA were within acceptable limit. Microbiological analysis revealed the absence of pathogens viz., *Salmonella*, *Vibrio cholerae*, coagulase positive *Staphylococci* and *Listeria*. Except cadmium, all other toxic metals were within acceptable limit in edible parts. Milkfish of about 1kg size was separated and one batch as whole fish and another batch as gutted (eviscerated and degutted etc.), were wrapped individually in polythene bags and kept in ice 1:1 (fish:ice) for 12 days and analyzed for various biochemical, microbiological, textural and organoleptic parameters. The results revealed that the decrease in moisture content was relatively lower in whole fish (72.62% to 69.66%) compared to gutted fish (71.05% to 70.38%) from first day of storage to 12th day of storage. TVBN, PV, APC values were relatively higher in gutted fish during the entire period of ice storage. Textural studies showed that the decrease in hardness, cohesiveness and chewiness was relatively slower in chill stored whole fish. The decrease in values of springiness and adhesiveness was similar in whole and gutted fish. The biochemical, microbiological, textural and sensory analysis indicated that the quality loss was relatively faster in ice stored

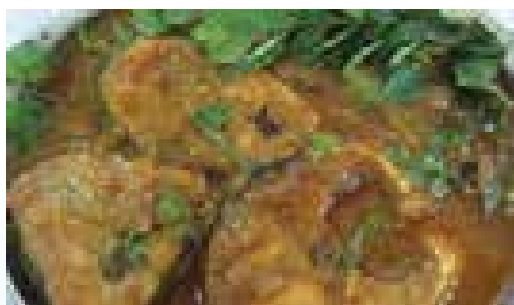
guttated Milkfish compared to whole fish. Presently idle brackishwater farming areas along the Indian coastline can be effectively utilized for low risk Milkfish farming. To realize this, there is a need to establish robust hatchery technology for continuous seed availability, create awareness among fish farmers by field demonstration and arrangements for continuous supply of big size Milkfish to the domestic markets to meet the consumer demands.



Farmed Milkfish of about 1kg size



Milkfish fillets



Milkfish curry

Nutritional profile of bio-processed fishery products

Nutritional composition of fermented freshwater fish (n=15) and dried fish (n=13) procured from markets in North-East India was analyzed. The mean moisture, fat and ash content of fermented fish were 35.94% (range 31.14 to 41.98%), 20.1% (range 13.01 to 29.54%) and 21.44% (14.51 to 27.88%). Fermented fish procured from Tripura markets had originated from three different sources viz., locally fermented in Tripura (n=8), fermented fish from Assam (n=1) and fermented fish from Bangladesh (n=6). The moisture, fat and ash

content of fermented fish from Tripura were 35.75% (range 31.14 to 41.98%), 20.94% (14.28 to 29.54%) and 23.05% (range 17.12 to 27.88%), respectively. The moisture, fat and ash content of fermented fish from Bangladesh were 35.64% (range 32.47 to 38.95%), 17.89% (range 13.01 to 19+.82%) and 19.76% (range 14.51 to 24.7%). The moisture, fat and ash content of fermented fish from Assam were 39.22%, 27.16% and 18.62% respectively. Dried fish were procured from Dimapur, Nagaland (n=11) and



Smoked products from NEH states



Fermented fish products from NEH states

Rudrasagar, Tripura (n=2) markets. The mean moisture, fat and ash content of dried fish were 11.23% (range 3.76 to 20.92%), 14.65% (range 8.89 to 21.06%) and 13.63% (range 7.95 to 19.77%), respectively.

Nutritional composition of different types of *L. vannamei* feeds

Starter, grower and finisher feeds used in White leg shrimp (*L. vannamei*) farming were analyzed for proximate composition, mineral content, fatty acid profile, amino acid profile and heavy metal content. Protein content of starter feed was higher (51.02%) than grower (45.32%) and finisher (41.67%) feeds whereas lipid content was higher in grower (7.192%) and finisher (7.03%) compared to starter (4.12%) feed. Carbohydrate content was higher in finisher (30.85%) than in grower feed (25.55%) and starter (19.57%) feed. Sodium (1111.5mg%) and phosphorus (1401.6mg%) content were relatively higher in grower feed. Calcium content was relatively lower in starter feed (120.3mg%). Iron content was lower in grower feed (548.8mg%) compared to finisher (1599.9ppm) and starter (2201ppm) feed. The content of amino acids namely Aspartic acid, Serine, Glutamic acid, Glycine, Alanine, Valine, Methionine, Isoleucine, Lysine and Phenyl alanine was higher in starter and grower feeds compared to finisher feed. Palmitic acid-C16 was the dominant SFA in starter, grower and finisher feeds. Oleic acid-C18:1 was the dominant MUFA in starter and grower feeds but palmitoleic acid-C16:1 was relatively higher in finisher feed. Eicosapentaenoic acid EPA-C20:5 and docosahexaenoic acid DHA-C22:6 content was almost double in grower (about 8%) compared to starter (about 4%) and finisher (about 4%) feeds.

Comparison between textural properties of Tiger shrimp and White leg shrimp during different processing methods

Texture Profile Analysis (TPA) of cultured Tiger shrimp (*Penaeus monodon*) and White leg shrimp (*Litopenaeus vannamei*) during different processing methods were measured at two different points (first abdominal segment and at the last abdominal segment). Different processing methods were fresh shrimp, freezing, cooking, blanching, microwave cooking, PD and PDTO. TPA was conducted using a Texture Analyser (TA Plus, Lloyd Instruments) at room temperature using a load cell of 50 N and cylindrical probe with a diameter of 6mm. The cross head was moved at a constant speed of 60mm/min. and shrimp sample were compressed to 60% of its original thickness. Five nos. of each sample were used for the analysis. From the resulting force-time curve, parameters such as hardness, cohesiveness, springiness, gumminess, chewiness and adhesiveness were determined. Significant differences for different samples were analyzed at $P < 0.05$ by one way analysis of variance (ANOVA) using software SPSS (Version 16.0). The instrumental texture parameters showed significant differences for hardness ($P < 0.003$), springiness ($P < 0.000$), gumminess ($P < 0.009$) and chewiness ($P < 0.000$) at the first abdominal segment and at the last abdominal segment in both *P. monodon* and *L. vannamei* but there was no significant difference in cohesiveness ($P < 0.008$) and adhesiveness ($p < 0.168$).

Changes in textural properties of *Litopenaeus vannamei* and *Metapenaeus monoceros* during soaking condition

The changes in textural properties of *L. vannamei* and *M. monoceros* during different soaking times was studied. Individual length and weight were taken for both the sample. The shrimps were divided into two batches viz., control lot and treated lot. The control lot comprised of Headon (HO) and Headless (HL) shrimp iced at 1:1 ratio. The treated batch comprised of HO and HL shrimp soaked in ice: water at 1:2 ratio. Samples were drawn at 0, 1, 2, 3, 4, 5, 6, 7 and 24h for Texture Profile Analysis (TPA). Five nos. of each sample were used for the analysis. Significant differences for different samples were analyzed at $P < 0.05$ by three way analysis of variance (ANOVA) using software SPSS (Version 16.0). There was a significant difference in the mean hardness value over different soaking times, both in *L. vannamei* and *M. monoceros*.

Colour analysis of Pangasius fillets

The colour of Pangasius (*Pangasiodon hypophthalmicus*) fish fillets procured from local market was measured using a Hunter's colorimeter (ColorFlex EZ, Hunter Lab), calibrated with a white tile having standard values of $X = 81.26$, $Y = 85.13$ and $Z = 88.57$ with corresponding L^* , a^* and b^* values of 93.94, -0.87 and 1.94 respectively as provided by the manufacturer. L^* is the luminance or lightness component, which ranges from 0 to 100, and parameters a^* (redness/greenness (+/-)) and b^* (yellowness/blueness (+/-)) are the two chromatic components,



Commonly observed Pangasius fillets (whitish, pink and yellow)

which range from -120 to +120. L^* , a^* and b^* values of Pangasius fillets procured from local markets were determined. Three types of fillets were commonly observed namely, white fillets, pink fillets and yellow fillets. Mean L^* , a^* and b^* values of whitish fillets was 60.07, 6.73 and 17.75 respectively. Pinkish fillets had mean L^* , a^* and b^* values of 40.49, 17.94 and 19.27, respectively. Yellow coloured Pangasius fillets had mean L^* , a^* and b^* values of 54.96, 12.34 and 27.78, respectively.

Iron content in Pangasius feeds

Commercial floating and sinking fish feeds were collected from a Pangasius fish farm at Bhimavaram and analyzed for the iron content. The average iron content was 1382.6 ppm and 1506.67 ppm in floating and sinking fish feeds, respectively. The other compositions are Moisture (%) - 8.72, Protein (%) - 36.82, Lipid (%) - 1.8, Total ash (%) - 8.1, TCHO (%) - 44.62, Sodium (mg%) - 1371.5, Potassium (mg%) - 2360.5, Calcium (mg%) - 581.72, Phosphorus (mg%) - 405.68 respectively in sinking feeds. Results revealed that composition-wise there was not much variation in floating and sinking feeds. In continuation to the study, Pangasius fish farms were visited and samples of water and sediments from nine different farms at Bhimavaram were collected to analyze the iron content in water and sediments as iron content may be a reason for the yellow colour of Pangasius fillets. The analysis is in progress.

Nutritional comparison between different types of *Litopenaeus vannamei* feeds

Starter, grower and finisher feeds used in *L. vannamei* farming were analyzed for proximate composition, mineral content, fatty acid profile, amino acid profile and heavy metal content. Protein content of starter feed (51.02%) was higher than grower (45.32%) and finisher (41.67) feeds whereas lipid content was higher in grower (7.192%) and finisher (7.03%) compared to starter (4.12%) feed. Carbohydrate content was higher in finisher (30.85%) than in grower feed (25.55%) and starter (19.57%) feed. Sodium (1111.5mg%) and phosphorus (1401.6mg%) content were relatively higher in grower feed. Calcium content was relatively lower in starter feed (120.3mg%). Iron content was lower in grower feed (548.8mg%) compared to finisher (1599.9ppm) and starter (2201ppm) feed. The amino acids namely Aspartic acid, Serine, Glutamic acid, Glycine, Alanine,

Valine, Methionine, Isoleucine, Lysine and Phenyl alanine was higher in starter and grower feeds compared to finisher feed. Histidine content was relatively higher in starter (7.7%) compared to finisher (1.2%) feed. Palmitic acid-C16 was the dominant SFA in starter, grower and finisher feeds. Oleic acid-C18:1 was the dominant MUFA in starter and grower feeds but Palmitoleic acid-C16:1 was relatively higher in finisher feed. Eicosapentaenoic acid EPA-C20:5 and Docosahexaenoic acid DHA-C22:6 content was almost double in grower (about 8%) compared to starter (about 4%) and finisher (about 4%) feeds.

Heavy metals and microbiological quality of *Penaeus monodon* and *Litopenaeus vannamei* shrimp feeds

Five shrimp feeds (three Vannamei feeds - starter, grower, finisher and two Black tiger feeds - grower, finisher) were analyzed. The Total Plate Count (TPC) of shrimp feeds ranged between 16 cfu/g and 450cfu/g. Total yeast mould count ranged between 0 to 20/g. Faecal indicator bacteria namely faecal Streptococci, faecal Coliforms and *E. coli* were not detected in shrimp feeds. Coagulase positive Staphylococci were not detected in shrimp feeds. Arsenic was detected in four shrimp feeds and the content ranged between 100 to 232 ppb. Selenium was present in all the shrimp feeds with levels ranging between 81 to 252 ppb. Copper content of shrimp feeds ranged between 5.9 and 32.65ppm.

Nutritional composition, chemical and microbial hazards in crabs

The body meat and claw meat of two species of locally available crabs viz., Mud crab (*Squilla serrata*) and Spotted crab (*Portunus pelagicus*) were analyzed for nutritional composition, heavy metals and microbiological parameters. The Mud crabs weighed 1.130kg while the Spotted crabs weighed between 92 to 124g. The fat content of crab claw meats (2.77 to 3.28%) was relatively higher than respective crab body meats (2.08 to 2.28%). Protein content of crab claw meats (12.25% to 15.06%) was lower than the respective body meats (13.12% to 18.31%). Potassium content was higher in Mud crab body and claw meat compared to spotted crab. There was no distinct difference in calcium content of the different crab meats. Arsenic was not detected in crabs. Selenium was relatively higher in crab body meats (82.16 to 85.18ppb) than claw meats

(57.71 to 60.63ppb). Copper content was higher in Mud crab (claw meat 5.69ppm and body meat 8.61ppm) than in Spotted crab (claw meat 1.99ppm and body meat 2.25ppm). The total plate count (TPC) of crab body meats (7.4×10^3 cfu/g to 2.63×10^4 cfu/g) was slightly higher than respective crab claw meats (3.5×10^3 cfu/g to 2.56×10^4 cfu/g). *E. coli* was detected only in the body meat of Mud crab (9.2 MPN/g) and Spotted crab (3.6 MPN/g) but not in claw meats. Coagulase positive Staphylococci were detected neither in crab body meat nor claw meat.

Heavy metals in cephalopods from Bay of Bengal

The cephalopod resource, mainly Cuttlefish and Squid is primarily constituted by *Uroteuthis (Photololigo) duvauceli*, *Sepia pharaonis*, *S. aculeata*, *S. brevimana*, *S. prashadi* and *Sepiella inermis*. Cephalopods were processed for various value added products like rings, fillets, skewer, fruity mix and exported to Italy, Spain and other EU and non-EU countries. Heavy metal accumulation in cephalopods has been one of the intricate issues in seafood export scenario in India. In recent years, many export consignments of cephalopods processed in India were rejected on account of high levels of heavy metals. Cuttlefish and Squid were dissected for eyes, skin, kidney/pancreas, meat, bone and tentacles and subjected to heavy metals like cadmium, selenium, lead and arsenic. Among all organs, 45.78 ppb selenium was found in squid tentacles and all other metals were below the detectable limit. In crab the highest content of selenium (148.58ppb) was found in claw meat and lowest in body meat (83.10ppb). Also the highest arsenic content was found in crab gut (187.66ppb) and lowest in body meat (61.49ppb).

Incidence of virulence genes in *Salmonella* using PCR

Salmonella (n=12) were isolated from marine fish (*Sardinella* spp.) and shrimp (*Metapenaeus* spp.) procured from retail fish market at Visakhapatnam. The *Salmonella* isolates were screened for the presence of the virulence genes, *invA* and *stn*. All *Salmonella* isolates from the marine fish and shrimp yielded the specific amplicon of 284bp and 260bp corresponding to the *invA* and *stn* gene, respectively in the specific PCR.



Salmonella isolates showing the amplification of *invA* gene (284bp amplicon) Lane 1 to 5 : *Salmonella* isolates from fish; Lane 6: Type culture; Lane 7: 100bp Marker



Trace metal concentration in different organs of farmed Milkfish

Skin, gills, liver, gut and meat of farmed Milkfish were analyzed for zinc, copper, cadmium, cobalt, mercury and lead. Cobalt and mercury were not detected. Copper (25.12ppm) and lead (0.31ppm) content was relatively higher in the liver. Zinc (10.97ppm) content was relatively higher in meat. Cadmium was detected in all the organs but maximum content of 0.907ppm was detected in the gut.

Incidence of toxigenic *V. cholerae* in *L. Vannamei*

Ten samples of *L. vannamei* comprising of three samples of raw head-on and seven samples of cooked PDTO were analyzed for the presence of *V. cholerae*. All the cooked samples were found negative for *V. cholerae* but one sample of raw *L. vannamei* was positive. The *V. cholerae* isolate was also positive (777bp amplicon) for the presence of *ctx* gene as evidenced by PCR targeting *ctxAB* operon. The isolate belonged to the O1 serogroup as evidenced by the positive result (192bp amplicon) in PCR targeting O1F2-1 and O1R2-2 primers (*V. cholerae* O1-rfb specific primers). All the *L. vannamei* samples were found negative for the presence of other human pathogens namely *Salmonella*, *Listeria* and *V. parahaemolyticus*.

Halophilic *Vibrios* in fish and fishery products

Eleven samples comprising of cultured (*Penaeus monodon* - n=2, *Litopenaeus vannamei* - n=5) and marine (*Metapenaeus* sp. - n=4) crustaceans were analyzed for the presence of *V. parahaemolyticus* using conventional enrichment method. All the culture shrimp samples were found negative for the presence of *V. parahaemolyticus* but one sample of marine shrimp (*Metapenaeus* sp.) was positive. The isolate also yielded the specific amplicon of 897bp in the PCR targeting the *flaE* sequence of *V. parahaemolyticus*.

Antibiotic resistance of *E. coli* (with special reference to Carbapenems)

The Carbapenems are β -lactam antimicrobial agents with an exceptionally broad spectrum of activity and are active against most Enterobacteriaceae including those that produce ampC β -lactamase. Carbapenems act by inhibiting cell wall synthesis by binding to and inactivating Penicillin-binding proteins (PCBs). Resistance to Carbapenems, especially Carbapenems-resistant- Enterobacteriaceae (CRE) is a serious issue world-wide as it is extremely difficult to combat bacteria resistant to Carbapenems. A total of 52 *E. coli* isolated from 12 marine fish (29 *E. coli* isolates) and 11 freshwater fish (23 *E. coli* isolates) were tested for their susceptibility to Carbapenems namely Meropenem (10 μ g), Imipenem (10 μ g), Ertapenem (10 μ g) and Feropenem (5 μ g). A low percentage (3.9%) of *E. coli* showed resistance to Meropenem. 11.5% and 17% of *E. coli* showed intermediate sensitivity to Meropenem and Ertapenem, respectively. However, 100% of *E. coli* were sensitive to Imipenem. Importantly, Meropenem resistant *E. coli* were also found to be resistant to commonly used antibiotics such as Norfloxacin, Ciprofloxacin, Gentamicin, Amoxicillin, Penicillin, Methicillin, Nalidixic acid and Tetracycline. The results indicate that Carbapenem resistance in *E. coli* fish is marginal but nevertheless needs continuous monitoring.

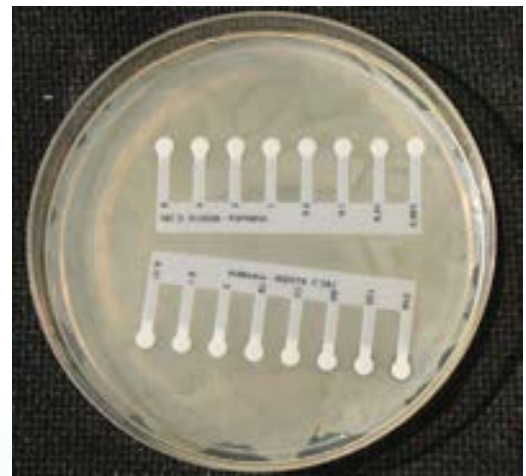
Studies on resistance of *Salmonella* to Carbapenems

Twelve isolates of *Salmonella* (*invA* and *stn* gene positive) isolated from marine fish and freshwater fish were tested for their susceptibility to Carbapenems namely Meropenem (10 μ g), Imipenem (10 μ g),

Ertapenem (10 μ g) and Feropenem (5 μ g). 8.3% of *Salmonella* isolates showed intermediate sensitivity to Meropenem and 25% of *Salmonella* isolates showed intermediate sensitivity to Ertapenem. However, 100% of *Salmonella* were sensitive to Imipenem

Chloramphenicol resistance of bacteria isolated from shrimp hatchery

In previous studies, the antibiotic Chloramphenicol was detected in two post larval feeds of *L. vannamei* at levels of 112.5ppb and 445ppb. In the present study, bacteria (n=32) isolated from water from post-larvae tank in *L. vannamei* shrimp hatchery were tested for their sensitivity to Chloramphenicol (30 μ g) by the disk diffusion test. 19% of the bacterial isolates showed resistance to Chloramphenicol and 13% isolates showed intermediate sensitivity. The minimum inhibitory concentration (MIC) of Chloramphenicol to inhibit the growth of resistant bacteria was high ranging between 120 μ g and 240 μ g.



Chloramphenicol resistance in bacteria isolated from shrimp hatchery

Screening of aquatic bacteria for production of chitinase

Sixteen isolates of chitinase producing bacteria were isolated from marine environment. All the bacteria were identified as *Vibrio* species based on biochemical tests. The chitinase activity was tested on 1.5% colloidal chitin supplemented agar having different salt concentrations viz., 0%, 1%, 3%, 6%, 9% and 12%. 75% of the *Vibrio* isolates showed chitinase activity from the second day on media with 3% salt and 6% salt. 25% of the *Vibrio* isolates showed activity only from the sixth day onwards. Maximum chitinase activity was observed in the *Vibrio* isolates on the sixth day





Chitinase production at 6% salt concentration



Chitinase production by ctx gene positive *V. cholerae* (centre well and wells 3, 4, 5) but no chitinase production in ctx gene negative *V. cholerae* (wells 1 and 2, clockwise)

on media having 1%, 3% and 6% salt. These bacteria showed growth at 9% and 12% but did not exhibit chitinase activity. Chitinase production in most of the strains (94%) was observed between 1% to 6% salt concentrations but only one isolate produced chitinase between 0% and 6% salt concentration. The chitinase activity was tested on 1.5% colloidal chitin supplemented agar having different pH viz., 4, 7, 9 and 11. The 16 *Vibrio* isolates exhibited chitinase activity only at pH 7 and 9.

All O1 (n=2) and O139 (n=1) *V. cholerae* produced chitinase but chitinase production was variable in non-O1/non-O139 *V. cholerae* isolated from fishery environment. Two isolates of non-O1/non-O139 *V. cholerae* were positive for chitinase production but six isolates of non-O1/non-O139 *V. cholerae* were negative for chitinase production.

Antimicrobial activity of shellfish extracts

The salt soluble extracts and methanol soluble extracts of body meat and tentacle meat of squid (*Loligo* sp.) and Cuttlefish (*Sepia* sp.) body meat and claw meat of Mud crab (*Sylla serrata*) and Spotted crab (*Portunus pelagicus*) were tested for antibacterial properties against *V. cholerae*, *V. parahaemolyticus*, *V. alginolyticus*, *Salmonella*, *Listeria* and *E. coli* but neither the salt nor the methanol extracts showed antibacterial property.

Antimicrobial activity of Squid ink and Cuttlefish ink

Eleven numbers of Squid with length ranging between 4.5cm and 11cm and weight ranging between 3g and 64g and 11 numbers of Cuttlefish with length ranging between 4.5cm and 13cm and weight ranging between 16g and 233g were procured from fishing harbor at Visakhapatnam. The ink glands were separated aseptically. The ink glands of squid weighed between 0.028g and 0.345g while the ink glands of Cuttlefish ranged between 0.048g and 2.186g. The ink from the glands was collected species-wise and freeze dried. Extracts were prepared from the freeze dried ink using water, hexane, methanol, petroleum ether, butanol, chloroform and ethyl acetate and tested for their antibacterial activity. Petroleum ether extract of Cuttlefish ink (*Salmonella*) and methanol extract of squid ink (*Shigella* and *V. parahaemolyticus*) showed antibacterial activity.

Value addition to improve appearance and quality of peeled *Litopenaeus vannamei*

Value can be added to the PD *L. vannamei* shrimp by removing the ventral bluish structure. The ventral bluish structure can be removed during processing by making a sharp cut with a stainless steel knife on the ventral side of the PD *Vannamei* extending from the anterior end to the posterior end on the ventral side and pulling out the bluish structure using fingers or knife. The resulting product with sharp cuts



Ventral view of *Litopenaeus vannamei*



L. vannamei with the dissected dorsal vein and ventral vein



Raw Peeled Double Deveined (PDD) dorsal view



Raw Peeled Double Deveined (PDD) ventral view



on both the dorsal side and ventral side and subsequent removal of both the gut and the bluish structure is christened Peeled Double Deveined (PDD) *L. vannamei*. A total of 32 numbers of *L. vannamei* were processed as head less (HL) at 4 °C. The total weight of HL *L. vannamei* was 556g with an average weight of 17.4g per shrimp. The dorsal and ventral veins of the shrimp were aseptically removed. The dorsal veins from 32 shrimps weighed 1.567g which was 0.28% of HL weight. The ventral veins from 32 shrimps weighed 0.934g which was 0.17% of the HL weight. The extra weight loss in making PDD product was only marginal. Processing one kg of HL *L. vannamei* from PD to PDD results in a marginal loss of 1.68g. However, extra labour and time is involved in processing PD to PDD. The microbial load of dorsal structure was relatively higher (14,80,000 cfu/g) compared to the ventral structure (13,000 cfu/g). Faecal Coliforms and *E. coli* were not detected either in the dorsal structure or in the ventral structure. Total *Vibrio* count was higher in the dorsal structure (1600 cfu/g) than in ventral structure (80 cfu/g). Similarly total Enterobacteriaceae count was higher in dorsal structure (1,100 cfu/g) compared to ventral structure (40 cfu/g).

Evaluation of technology transfer models in fisheries sector

As a part of assessing the identified technology transfer models using stakeholder analysis in small scale fisheries sector, survey was conducted among the fishermen of Vasuvanipalem and Peddajalaripeta villages of Visakhapatnam who are engaged in gillnet fisheries using motorized FRP crafts. Through structured questionnaires, data was collected from 30 fishermen on various aspects such as socio-economic and personal attributes, technology use details, social participation and awareness and adoption regarding various practices in fisheries. The results show that the average age of fishermen engaged in gillnet fisheries is 43.13. Sixty per cent of the respondents were illiterate and fishing is the only occupation in case of 87 per cent of the respondents. Major crafts used by the respondents were fibre boat fitted with out-board motors of 9-10 Hp. Based on target fish species, gillnets with different dimensions and mesh sizes are used by the fishermen. The average investment on a fishing system including craft, OBM and three to four different types of fishing gears was observed as `3.12 lakhs. Out of 365 days in a year, fishermen are engaged in fisheries for about 289 days. Social participation of the respondents is restricted to membership in Fishermen Co-operative Societies. Awareness and adoption of 10 practices in fishing and allied activities, viz; hygienic

fish handling on-board, use of ice to preserve fish, use of improved fishing boat/design, use of appropriate mesh size in fishing gear, use of responsible fishing method, conservation methods for sustainable fisheries, reducing post harvest losses, hygienic handling of fish in the landing centre before sale, fish processing methods for preservation of fish and improved fish packaging materials for transport/sale were measured using a three point scale. Results showed that majority of the fishermen belong to medium level of awareness and adoption category with respect to various fishing related innovations/practices.

Role and functioning of Fisherwomen Co-operative Societies in Visakhapatnam

Co-operative Societies are one of the major institutional mechanism through which the major welfare schemes and programmes are implemented among the fishermen and fisher women in Andhra Pradesh. Women engaged in fisheries activities in Visakhapatnam have formed different Co-operative Societies such as Co-operatives for women engaged in fresh fish marketing and fish drying activities. Women members registered in the Co-operative Societies are further divided into different Matsya Mitra Groups (MMGs) having 10-12 members each. Recurring funds are being given to the MMGs to promote income generating activities. Data was collected from 50 fisherwomen engaged in fish drying and activities in Visakhapatnam district. The socio-economic impact of the stakeholder organisation was assessed using Sustainable Livelihood Framework (SLF). Results of the study showed that average age of fisherwomen engaged in dry fish making and marketing is 45.8. Eighty per cent of the women are illiterate whereas 18 per cent can read and write and two per cent have education up to primary level. Average years of experience of the women engaged in fish drying activities were observed as 15.4. On an average they are engaged in 10.8 working hours per day and 263.4 working days in a year. Access to different assets showed that lack of proper fish drying platforms and lack of proper storage facility are some of the major constraints. Average income of the fisherwomen engaged in drying activities was found to be `2727.30 with an average family income of `9245.50. Out of the total household income eight per cent is spent for children's educational expenses and 5.5 per cent on medical expenditure. Most of the household and managerial decisions are taken by the



FRP boat used in the fishing villages



women themselves which indicates empowerment in decision making in case of Co-operative Society members.



Survey among women engaged in fish drying activities

Stakeholder analysis for impact assessment of introduction of Pacific white shrimp in Andhra Pradesh

Export oriented shrimp production has been showing an increasing trend in the last decade. In India the dominant Black tiger prawn, *Penaeus monodon* approached its peak production during the year 2006-2007 and at the same time other species, *Litopenaeus vannamei* has been introduced among the aqua farmers. Recent data shows a huge increase in

production of *L. vannamei* (80,717 MT from 7837 Ha in 2011-12) with a hallmark productivity of 10.30 MT/ha/year. A pilot study was undertaken in Andhra Pradesh which is the major producer of farmed prawn (*L. vannamei* - 75385 MT, *P. monodon* - 51081 MT in 2011-12) in India, to identify causes and implications of such a rapid replacement of Black tiger prawn by Pacific white shrimp. Information was collected from different stakeholders including aqua farmers, processors/exporters and administrators working in the field of seafood export promotion using a questionnaire survey. Results of the study showed that high yield and disease resistance are the major factors for increased adoption of *L. vannamei*. Structural changes are pre-requisite for the processing factories to accommodate the high production of *L. vannamei* and they have incorporated changes such as establishment of additional plants, increasing the capacity utilization of existing plants and installation of more efficient equipments. Out of the total shrimp processed in the processing industry 80 per cent is contributed by *L. vannamei* in 2012-13. The present study also showed an increase in the employment generation in 50 per cent firms mainly in processing and pre-processing activities. As the meat yield is comparatively high in case of *Vannamei*, the women engaged in pre-processing activities are getting a better remuneration which is fixed on per kilogram of the shrimp peeled. Increased production and processing of Pacific white shrimp (*L. vannamei*) is thus indirectly contributing towards a decline in gender gap in wages after the introduction of *L. vannamei*. Another important survey of stakeholder administrators indicated that the major positive impact of introduction of *L. vannamei* would be economic whereas the replacement of native species will be the major challenge in near future. Strict implementation of scientific farming techniques is vital for maintaining a sustainable production level in case of *L. vannamei*.



Veraval Research Centre

Chief findings

- ❖ Freshly caught Croaker (*Johnius* spp.) from single day trawler maintained the keeping quality up to 14 days in refrigerated storage condition (1-2 °C). *Pseudomonas* spp. and H₂S forming bacteria formed the major spoilage bacteria.
- ❖ Cryogenic freezing method like brine freezing reduced the freezing time and improved the quality of Tiger shrimps (*Peneaus monodon*) compared to air blast frozen samples. Freezing loss and thawing loss was higher for air blast frozen shrimps (2.24 and 0.86% respectively) compared to brine frozen samples (1.84 and 0.38% respectively). Salt uptake was higher for brine frozen samples.
- ❖ Quality changes of cultured Tiger prawn (*P. monodon*) and White shrimp (*L. vannamei*) processed by IQF, plate freezing and air blast freezing methods were studied. Textural changes, freezing loss, thawing loss and cooking loss was least for IQF processed samples followed by plate freezing and air blast freezing. Water holding capacity was highest for IQF followed by plate freezing and air blast freezing. Textural and biochemical quality of Tiger prawn was slightly better compared to White shrimp.
- ❖ Textural changes of raw and cooked commercially important fish (Shark, Rays, Goatfish, Pinkperch, Lizardfish, Cod, Ribbonfish, Bigeye, Seabream, Longtail tuna and Dhoma) and shellfishes (Tiger prawn, Vannamei, Karikkadi, Brown shrimp, Squid, Cuttlefish and Octopus) were evaluated. Hardness, chewiness and springiness of cooked samples were better compared to raw samples. Hardness of Tiger prawn and White shrimp increased 4.0 and 4.8 times with cooking whereas chewiness increased 9.7 and 14.2 times respectively.
- ❖ Quality of fish mince from the initial and final section of the refiner of Pinkperch (*Nemipterus japonicus*) surimi processing was evaluated. Protein content of mince ranged between 14-16% and fat content ranged 0.54-2.67%. Pathogens of human significance was absent in both the samples.
- ❖ The gel strength of surimi prepared from Threadfin bream was highest followed by Bigeye, mixed surimi from Croaker and Lizardfish, Ribbonfish and Goatfish. Mixing different varieties of fish improved the gel strength of surimi.
- ❖ Oil recovery from surimi waste was more in heat extraction method (50.62%) compared to solvent extraction (4%). Fat oxidation and hydrolysis reduced significantly for the surimi oil with natural antioxidant.
- ❖ Biochemical quality and microbial flora associated with Portunid crabs, Blue swimming crab (*Portunus pelagicus*) and Three spotted crab (*Portunus sanguinolentus*) were evaluated. Total volatile bases were observed higher for Three spotted crab

Research project handled

- ❑ Processing and quality improvement of seafoods in Gujarat

compared to Blue swimming crab. Among the microflora associated, *B. thermosphacta* dominated followed by *Pseudomonas* spp., H₂S forming bacteria, faecal Streptococci and *Lactobacillus* spp.

- ❖ Quality evaluation of air blast frozen male and female Blue swimming crab in different style (whole and cut crab) indicated that microbial load of cut crab was slightly higher compared to whole crab. Female crab had better microbial quality.
- ❖ The biochemical quality of Horse mackerel caught from gillnet and single day trawler was not significantly different.
- ❖ Blanching with 0.5 and 1.0% salt for 5 min. reduced the sun drying time by 15.5 and 17 hrs respectively for shrimp (*Parapeanopsis stylifera*) compared to samples dried without blanching. The yield was 6% less for the blanched samples compared to samples dried without blanching.
- ❖ Solar drying (58-60 °C) of shrimp reduced the drying time by 9 h compared to sun drying. Yield was 39.5 and 32.5% for sun and solar dried samples. Total volatile base nitrogen content was 15.53 mg N₂/100g for fresh shrimps which increased to 24.45 and 38.09 mg N₂/100g for solar and sun dried shrimps, respectively. Total mesophilic counts reduced from an initial 5.38 log cfu g⁻¹ to 2.0 and 2.39 log cfu g⁻¹ for solar and sun dried shrimps respectively.
- ❖ Dried air bladder of Ghol (*Protonibea diacanthus* Lacepede), Koth (*Otolithoides biauritus* Cantor), Threadfins (*Eleutheronema*



tetradactylum and *Polydactylus* spp.), Catfishes, Eel (*Muraenesox talabonoides*) etc. had very good export market. The protein content of dried air bladder of different fishes ranged between 90-95% and ash content was 3-4%.

- ❖ Collagen prepared from Threadfin bream scales had protein content of 92% and 6% ash. Total aerobic plate counts were 85 cfu/g and total Enterobacteriaceae, faecal Streptococci, *S. aureus* and *E. coli* were absent.
- ❖ Keeping quality of traditional Gujarati style shark curry under frozen storage was 10 months.
- ❖ Ginger essential oils were extracted using steam distillation by Clevenger's apparatus and antimicrobial properties at different concentration against *S. aureus* was evaluated.
- ❖ Barracuda (*Sphyrna jello*) steaks treated with 0.1, 0.2 and 0.3% ginger essential oil improved the flavor, odour and extended the shelf life under refrigerated storage condition.
- ❖ Biodegradable antimicrobial packaging film was prepared using chitosan incorporating ginger essential oil and its antimicrobial properties were evaluated against *S. aureus* and physical properties were studied.
- ❖ A total of 77 samples consisting of fresh, frozen and dried fish and shellfishes, ice and water were monitored for microbial quality like mesophilic bacterial counts, total Enterobacteriaceae, *E. coli*, *S. aureus*, faecal Streptococci, *Salmonella*, *V. cholera*, *V. parahaemolyticus* and *Listeria monocytogenes*.
- ❖ The *E. coli* isolates were confirmed by streaking on to EMB agar (small, dark with green metallic sheen colonies) and IMViC tests and *S. aureus* was on Mannitol Salt Agar (Oxoid) and Rabbit coagulase plasma (Difco) and faecal Streptococci by catalase test. The isolates were preserved in liquid paraffin for further PCR characterization.
- ❖ *S. aureus* occurrence was 43.52% in seafood of which 12.77% were coagulase positive strains.
- ❖ Nearly 86.6% of the coagulase positive *S. aureus* bacteria were positive for beta lactamase production.
- ❖ Seafood effluent discharge elevated the

levels of microbial pollution indicators in the bar mouth of Bhidia landing centre.

- ❖ Bromocresol purple gave better indication of freshness for shrimp and Cuttlefish compared to Bromothymol blue, Bromocresol green and mixed indicators.
- ❖ Long tail tuna packed under control air was in good condition up to 5-6 days when compared to 9-10 days for O₂ scavenger packs in refrigerated storage conditions.
- ❖ Histamine formation rate in Mackerel packed with oxygen absorber were compared to vacuum pack and control air packed samples in refrigerated conditions.
- ❖ The level of cadmium in Squid was high in ink sac followed by skin, tentacle and edible part.
- ❖ Surveyed the gill netters of Veraval and collected data regarding fuel consumption.
- ❖ Questionnaires were prepared to collect the information about economics of dry fish like Ribbonfish, Horse mackerel and Croakers by traditional sun drying method in Veraval.
- ❖ The mean benefit/cost (B/C) ratio observed during experimental fishing in the PFZ and NPFZ locations were 1.42±0.12 and 1.21±0.11 respectively.

Report of the work done

Shelf life studies of Croaker

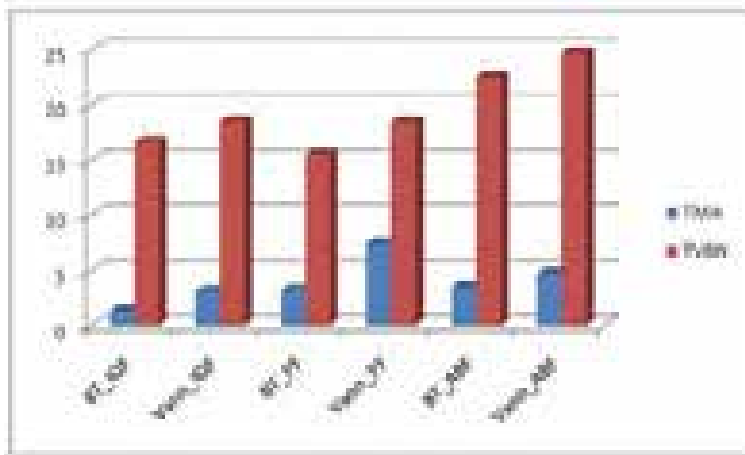
Quality and shelf life study of refrigerated Croaker (*Johnius* sp.) commonly known as Dhoma was undertaken. The fish is a good source of protein (20.83% crude protein) and is a medium fatty fish (2.56% crude fat). The fish was caught from single day trawler, dressed in headless gutted form packed in polyester polyethylene laminated pouch and was stored in refrigerated condition. Biochemical, microbiological, textural and sensory attributes were monitored at regular intervals. The fish used in the study was very fresh as evident from biochemical and microbial results. TMAN and TVBN content was 1.4 and 9.79 mg% respectively whereas TBA value was 0.12 mg malonaldehyde/kg fish. Both biochemical and microbial quality attributes increased with the storage period. Total mesophilic counts increased from an initial value of 3×10^2 cfu/g to 6.24×10^5 cfu/g at the end of 17th day of storage. The counts of *Pseudomonas* spp. and H₂S forming bacteria increased from an initial value of 1.5×10^1 and < 1.0 cfu/g to 1.48×10^5 and 3.6×10^4 cfu/g respectively at the end of 17th day. TBA value increased to 2.13 mg malonaldehyde/kg fish on 17th day from an initial value of 0.12 mg malonaldehyde/kg fish. Sensorily, fishes were acceptable up to 14 days. The results indicated that Dhoma can be stored in an acceptable condition for 14 days in refrigerated storage.



Johnius spp. in headless gutted form packed in polyester poly-ethylene laminated pouches

Quality studies of frozen prawn and shrimp

Biochemical and microbial quality of frozen Tiger prawn (*P. monodon*) and White shrimp (*L. vannamei*) frozen by individually quick freezing, plate freezing and air blast freezing was compared. Trimethyl amine nitrogen content and total volatile base nitrogen was least for IQF Tiger prawns compared to other samples. An inverse relation was observed between water holding capacity (WHC) and cooking loss with higher WHC for Tiger prawn compared to White shrimp. Among the two shrimp samples, biochemical and microbial quality attributes were slightly better for Tiger shrimp compared to Vannamei.



TMA and TVBN content in prawn and shrimp under different freezing treatments

Quality changes in Tiger shrimp

Quality changes of cultured Tiger shrimp (*Peneaus monodon*) frozen by cryogenic freezing method like brine freezing was compared with the conventional air blast freezing. The freezing time was only 35 min. for brine freezing compared to 7h for air blast freezing. Changes in biochemical, microbial, physical and sensory quality of Tiger shrimp frozen by both the methods were compared. Freezing loss and thawing loss was higher for air blast frozen shrimps (2.24 and 0.86% respectively) when compared to brine frozen samples (1.84 and 0.38% respectively). Water holding capacity was better for brine frozen shrimps compared to air blast frozen samples. Hardness, chewiness and springiness were higher for brine frozen samples compared to blast frozen samples. Peroxide value was observed higher for brine frozen samples whereas free fatty acids and TBA value was higher for blast frozen shrimps. Micro biological quality attributes were well within the limit for both the samples. Total mesophilic and total psychrotrophic counts of brine frozen shrimp were lower than air blast frozen shrimp.



Tiger shrimp frozen by brine freezing

Brine freezing lowered total Enterobacteriaceae, H₂S forming bacteria, *Pseudomonas* spp., whereas *Lactobacillus* spp. counts were significantly lower ($P < 0.01$) in air blast frozen shrimp. In none of the samples pathogens of human significance were detected. Salt content (NaCl) of brine frozen shrimp was 1.62% compared to 0.38% for air blast frozen shrimp.

Quality studies of shellfishes

Textural changes of raw and cooked commercially important shellfishes were assessed. For this four varieties of shrimps (Tiger prawn, Vannamei, Karikkadi and Brown shrimp) and three types of cephalopods (Squid, Cuttlefish and Octopus) were used. Hardness, chewiness and springiness of cooked samples were better compared to raw samples. Texture of commercially important fresh fishes landed in Gujarat was investigated. For this 12 fishes (Shark, Rays, Goatfish, Pinkperch, Lizardfish, Cod, Ribbonfish, Bigeye, Seabream, Longtail tuna and Dhoma) were used. Hardness and chewiness was observed highest for Ribbonfish followed by Rays, Breams, Pinkperch and shark whereas springiness was highest for shark followed by Pinkperch. For the same size grade, hardness, cohesiveness, springiness and chewiness was higher in Tiger prawn compared to White shrimp. Texture values increased with the cooking in boiling water for 5 min. Hardness of Tiger prawn and White shrimp increased 4.0 and 4.8 times with cooking whereas chewiness increased 9.7 and 14.2 times respectively.

Effect of blanching on quality of shrimps

Effect of blanching on the drying time and quality of shrimp was assessed. The air temperature and velocity of air during sun drying varied in the range of 33.7 - 33.82 °C and 13.2-14.4 km h⁻¹ respectively. Blanching with 0.5 and 1.0% salt for 5 min. reduced the drying time by 15.5 and 17 hrs respectively compared to samples dried without blanching. The yield was 6% less for the blanched samples compared to samples dried without blanching. A reduction of 1.63 and 1.83 log cfu g⁻¹ of total aerobic bacterial counts were observed for blanched samples compared to raw shrimp and *E. coli* and *S. aureus* were not observed in blanched samples. Moisture content of shrimp decreased from an initial level of 79.9-81.02% to 8.6-11.5% whereas crude protein content increased to 70.8-72.7% from an initial level of 16.2-18.8%.

Drying performance of solar and sun dried shrimps

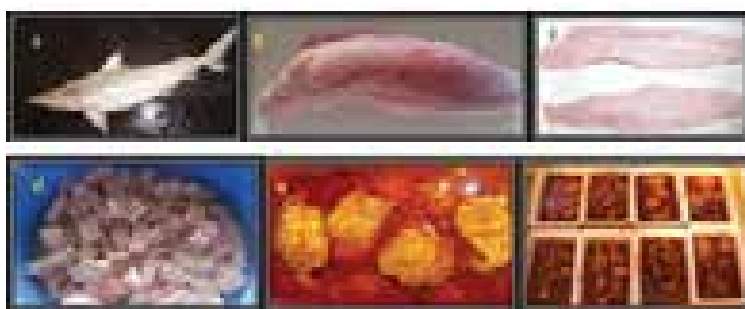
A comparative study on drying performance and quality characteristics of solar and sun dried shrimp (*Parapeaneopsis stylifera*) was undertaken. Shrimps of size grade 40-60 counts lb⁻¹ were used in the study. The shrimps in peeled and deveined form was mixed with rock salt (30%) and kept for overnight. The shrimps were dried in solar drier and compared with traditional open sun drying. The air temperature varied in the range of 30-33 °C whereas air velocity was in the range of 14.1- 6.8 km h⁻¹. The temperature of the solar drying chamber was maintained at 58-60 °C throughout the study. A yield of 44% was obtained for PUD shrimps whereas it was 39.5 and 32.5% for sun and solar dried shrimps. Drying time was 11 and 20h for solar and sun dried shrimps respectively. Moisture content of sun dried and solar dried shrimp decreased to 37.6 and 12.2% respectively from an initial 79.8%. Total volatile base nitrogen content was 15.53 mg N₂/100g for fresh shrimps which increased to 24.45 and 38.09 mg N₂ /100g for solar and sun dried shrimps, respectively. Total mesophilic counts reduced from an initial 5.38 log cfu g⁻¹ to 2.0 and 2.39 log cfu g⁻¹ for solar and sun dried shrimps respectively. Textural parameters like hardness increased from an initial value of 0.28 kgf to 0.61 and 1.99 kgf for sun and solar dried shrimps respectively whereas chewiness decreased from 1.74 to 0.5 and 1.26 kgf mm for sun and solar dried shrimps respectively. The cutting force (shear force) was higher for solar dried samples (8.33 kgf mm) followed by sun dried sample (5.72 kgf mm) and fresh shrimp (3.76 kgf mm).



Solar and sun dried shrimps

Quality studies of shark curry

Traditional Gujarati style shark curry was prepared using shark meat chunks and spices. Proximate composition of the shark and shark curry was compared. Moisture and protein contents were 74.64% and 23.65% in shark which decreased to 48.60% and 16.90% respectively in shark curry. Lipid content was 0.37% in shark and it increased to 28.28% after curry preparation. Total plate count of fresh shark was 1.34x10⁵ CFU/g which decreased to < 1 CFU/g in shark curry. Trimethyl amine and total volatile basic nitrogen contents were 5.49 and 34.34 mg% in shark which decreased to 2.06 and 19.22 mg% in shark curry. Shark curry was packed in HIPP trays and stored at -20 °C. Various biochemical, microbiological and sensory qualities were monitored during storage. There was an increase in pH, TMA, TVBN, PV, FFA, TBA and TPC during the storage time. A shelf life of 10 months was observed for shark curry in frozen storage condition.



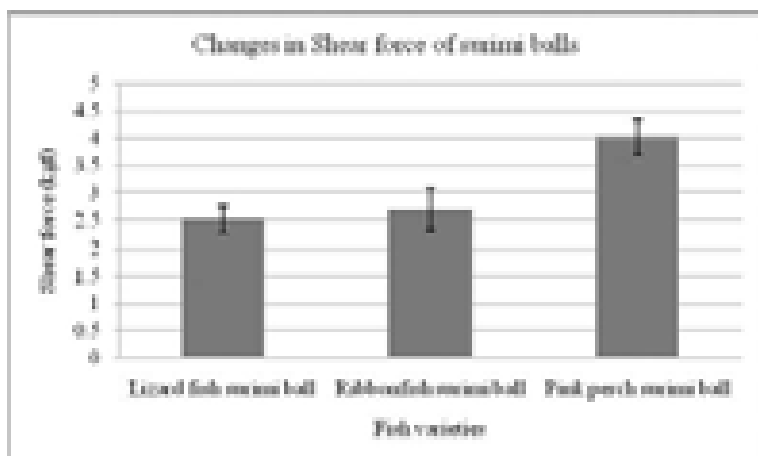
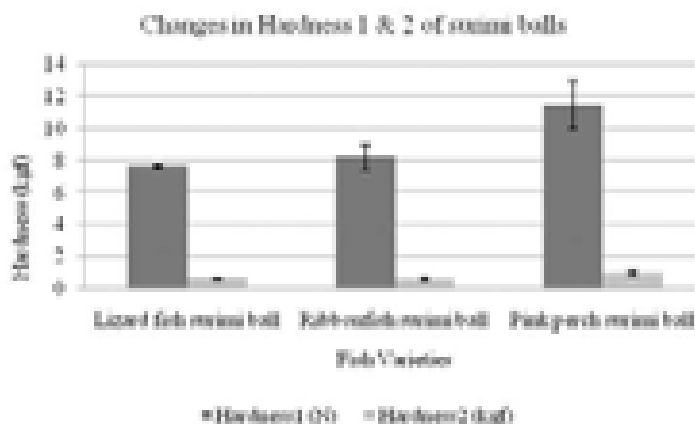
Gujarati style ready to eat shark curry preparation stages (a to f: fresh shark, dressed shark without skin, shark fillet, shark chunks, shark curry and packed curry in HIPP trays)

Studies on surimi fish balls

Fish balls are very delicacy items in many countries. Fish balls prepared from surimi is preferred over the traditional fish balls as it provides the desirable texture. In the present study quality attributes of surimi fish balls prepared from Threadfin bream (*Nemipterus japonicus*), Ribbonfish (*Trichiurus lepturus*) and Lizardfish (*Saurida* spp.) were assessed during chilled storage (1-2 °C). The gel strength and whiteness of the surimi used were 484, 205 and 90 g cm and 47.20, 42.23 and 41.63 for Threadfin bream, Ribbonfish and Lizard fish respectively. The ingredients used for the fish ball preparation was surimi (65%), potato (25%), corn starch (4.5%), spice mixture (4%), salt (1.5%) and water as required. The fish balls of 12 g each were prepared manually and cooked in boiling water (98-100 °C) for 15 min. and cooled and packed in high impact polypropylene (HIPP) trays and stored in chilled condition to assess the shelf



Surimi fish balls



life. Various biochemical, physical, microbiological and sensory quality attributes were monitored. A reduction of 1 to 2 log cfu/g was observed for total mesophilic counts for surimi fish balls compared to surimi. The hardness of Threadfin bream, Ribbonfish and Lizardfish surimi ball was 11.4, 8.2 and 7.6 N respectively where as shear force was 4.0, 2.7 and 2.5 kgf mm and elasticity was 7.4, 5.6 and 5.6 mm respectively.

Antimicrobial activity of essential oils

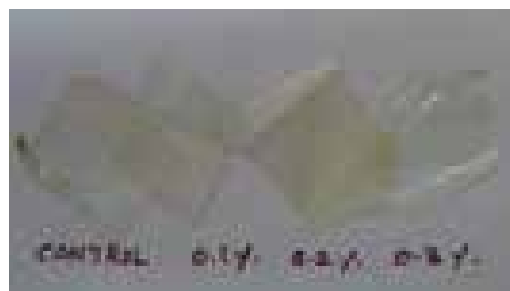
Essential oils are highly concentrated volatile aromatic compounds extracted from plant materials. Plant derived essential oils are well known natural antimicrobial agents and thus can be safely used in food to control food spoilage and food-borne pathogenic bacteria. Studies on antimicrobial properties of essential oil extracted from plant sources were undertaken. For this, ginger was selected for initial studies and steam distillation was carried out in a Clevenger apparatus. The peeled ginger to water ratio of 1:2 was maintained for the study and the mixture was boiled and essential oil obtained was collected upon condensing with water. Essential oil from ginger exhibited good antimicrobial properties against *S. aureus*.



Essential oil extracted from Ginger

Antimicrobial packaging film with essential oil

Antimicrobial packaging film was prepared incorporating ginger essential oil at different concentrations (0.1, 0.2, 0.3% v/v) with chitosan solution (1% w/v in acetic acid 1%). Mechanical properties like tensile strength and elongation at break were determined and compared with control chitosan films. The effect of different concentrations of essential oil on the equilibrium moisture content, swelling percentage and water solubility of the chitosan film was also evaluated. The physical properties of the chitosan film did not affect significantly with the addition of essential oil. Antibacterial effect of the film against *S. aureus* was assessed both qualitatively and quantitatively. The study indicated that the essential oil incorporated antimicrobial active packaging may be a potential alternative approach to inhibit the microbial growth and to extend the keeping quality of food products.



Ginger essential oil-incorporated chitosan films

Effect of essential oil on quality characteristics of Barracuda

Barracuda (*Sphyraena jello*) is a highly preferred semi fatty fish because of its unique



Barracuda whole, steaks and packed samples

taste. Steaks were prepared from Barracuda and treated with 0.1, 0.2 and 0.3% ginger essential oil for 15 min. before packing. The treated Barracuda steaks were stored in refrigerated condition and quality changes were monitored. One batch of packs which were not treated with essential oil was kept as control. Effect of essential oil on various biochemical, microbiological and sensory quality parameters were analyzed at regular intervals. Ginger essential oil treated samples had better biochemical and microbiological quality due to its antioxidant and antimicrobial properties. Also essential oil treated samples exhibited better sensory properties compared to the control. The improved flavor, odour, texture and appearance were added advantages of treating the samples with essential oil.

Shelf life assessment of Longtail tuna under various storage conditions

Shelf life assessment of Longtail tuna (*Thunnus tonggol*) chunks packed under air and O₂ absorber were studied during iced storage conditions. During the study period biochemical (pH, TVBN, TMAN, PV, FFA, TBA, conjugated dienes, browning index), textural parameters and microbiological quality parameters (total mesophilic, psychrotrophic counts, anaerobic counts, *Lactobacillus* spp., total Enterobacteriaceae, faecal Streptococci, *Pseudomonas* spp., H₂S producing bacteria and *Brochothrix thermosphacta*) were monitored. Moisture, ash, protein and fat content were 69.21, 1.19, 22.367 and 1.72% respectively.



Longtail tuna



Tuna chunks

TMA and TVBN content were 2.07 and 7.6 mg%. pH was 5.85. Total mesophilic counts (at 30 °C) and total psychrotrophic counts (at 7 °C) were 7.1 x10⁴ and 8.0 x10¹ cfu/g. Count of total Streptococci and Staphylococci were 9.0 x10² and 1.0 x10² cfu/g respectively. *E. coli* and total Enterobacteriaceae were absent in fresh samples. Initially, *Pseudomonas* spp., H₂S producing bacteria, *B. thermosphacta* and *Lactobacillus* spp. counts were 2.6, 2.3, 2.48 and 2.18 log cfu/g respectively which increased with the storage period. The counts of *Pseudomonas* spp. and H₂S producing bacteria was higher for air packed samples whereas the counts of *B. thermosphacta* and *Lactobacillus* spp. were higher for O₂ absorber packs during storage period. Sensorily, the eating quality of Longtail tuna packed under control air was in good condition up to 5-6 days compared to 9-10 days for O₂ scavenger packs which correlated well with the biochemical and total mesophilic counts.

Studies on temperature monitoring of crab sticks stored in dry ice (-78 °C) and in refrigerator (2-5 °C)

Transportation of fishery products to distant places is normally done using refrigerated system maintaining a cold chain throughout the transportation. In the present study, frozen crab sticks stored in dry ice (solid CO₂ -78 °C) at 1:1 ratio in polystyrene box was monitored for the temperature profile of the product and its surrounding. The inner dia. of thermocol box was 47.5cm x 31.5cm x 19cm (LxBxH). Frozen pasteurized crab stick packed in laminated pouches (450g each) was packed with dry ice and stored in refrigerated condition (2-4 °C). The temperature of product and the air surrounding the product was monitored continuously. The results indicated that the frozen product stored with dry ice in 1:1 ratio can maintain the internal product temperature of -20 °C up to 129 h. The study indicated that the dry ice can be used for transporting high value products to distant markets maintaining the desired product temperature.

Quality evaluation of surimi waste

An initial study was conducted from the surimi processing waste. The samples were collected from the surimi processing unit of Veraval. The samples were analyzed from whole fish, edible portion, waste and surimi fat collected from processing plant. The major species used in the processing plant is Threadfin bream. The proximate composition was analyzed for all the samples. The moisture content was high in edible portion (80.04%) followed by whole fish (72.9%), waste (72.2%) and surimi fat (36.6%). The crude fat was high in surimi fat (62.3%) followed by whole fish (2.7%), edible portion (1.5%) and waste (0.4%). The ash content was high in waste sample (6.5%) than all other samples. The quality parameters like TMA, TNBN, PV, FFA, TBARS, pH and microbial quality was also analyzed.

Extraction and quality evaluation of oil from surimi waste was conducted with traditional heat extraction method and solvent extraction method for high quality lipid from surimi fat. The study showed that heat extracted oil recovery was high (50.62%) when compared to the solvent extraction method (4%). The quality of oil was evaluated by storage study of both solvent extracted and heat extracted oil. The oil quality parameters like Peroxide Value (PV) and Free Fatty Acid (FFA) were analyzed for both the samples during storage studies. While comparing the FFA and PV, the addition of natural antioxidant ascorbic acid has showed more stability. The PV of oil

without antioxidant has gradually increased and it was high on tenth day of storage study (9.1 milieqO₂/kg fat). The oil added with antioxidant was high on 25th day (5.6 milieqO₂/kg fat). On 25th day of storage, the free fatty acid was 0.17 mg% oleic acid for oil without antioxidant and 0.09 mg% oleic acid for oil with antioxidant. The antioxidant added oil showed more stability when compared to that without antioxidant. The storage study of heat extraction is in progress.

Quality evaluation of Blue swimming crab

Initial biochemical and microbiological quality of male and female Blue swimming crab (*Portunus pelagicus*) was evaluated. Moisture content of crabs ranged between 80-82% and ash content was 1.2-1.3%. TMAN content was observed higher in female crabs (4.55 mg%) compared to male (2.34 mg%). pH of the meat content was around 8 for both the crabs. Microbiologically, female crab had lower total aerobic plate counts at 37 °C and 7 °C, total Enterobacteriaceae, faecal Streptococci, *Brochothrix thermospacta*, *Pseudomonas* spp., H₂S producing bacteria (1.65 x 10⁴, 2.5 x 10⁴, Nil, 3 x 10¹, 1.43 x 10³, 7 x 10¹, 10 cfu/g compared to 8.5 x 10⁴, 7.8 x 10⁴, 1.15 x 10², 8 x 10², 3.95 x 10³, 2.9 x 10², 3 x 10² cfu/g) whereas *Lactobacillus* spp. was observed higher in female crabs (3.5 x 10¹ cfu/g) compared to male crabs (2.5 x 10¹ cfu/g).

Quality evaluation of air blast frozen male and female Blue swimming crabs in different style (whole and cut crab) was also undertaken. Various biochemical and microbial quality was monitored during the study. The moisture content of the fresh and frozen crabs ranged between 79-82%. The quality of female crab mainly TMAN, TVBN and microbial load was lower compared to male crab. The microbial load of cut crab was slightly higher compared to whole crabs. Further storage studies are in progress.



Male and female Blue swimming crabs in whole and cut forms

Heavy metal content in different fish varieties

Studies on heavy metal content of fish muscle and egg of different fish varieties were undertaken. Catfish, Lizardfish and Pinkperch fish muscle and eggs were monitored for toxic heavy metals (Hg, Cd, As, Pb) and trace minerals (Fe, Cu, Zn, Mg, Mn, Co, Cr, Ni). Mercury content was not detected in any of the samples where as cadmium ranged between 0.019 to 0.197 ppm. Lead content ranged between

0.33 to 1.99 ppm. Cadmium and lead content was noticed higher in eggs compared to muscle. The levels of Zn, Fe, Mg and Cu were higher in eggs compared to muscle in all the fishes.

Proximate composition of trawl net and gillnet caught fish

Fish sample caught by trawl net and gillnet were collected from Sagar Kripa and Jaleswar landing centre respectively and quality parameters of the collected samples were analyzed. The different quality parameters like TMA, TVBN, PV, FFA, PH, TBA etc. of fish caught from both the nets were well within the acceptable limits. No significant quality difference was observed in fishes caught from different catching system. TMA, TVBN, PV, FFA, TBA of fish caught from trawl net were 1.1%mg N₂, 4.3%mg N₂, 4.5 miliequivalent of O₂/kg fat, 4.32% oleic acid, and 1.6 mg malonaldehyde/kg fat, respectively, whereas for the fish sample caught from gillnet the values were 1.12%mg N₂, 10.02%mg N₂, 4.13 miliequivalent of O₂/kg fat, 4.46% oleic acid, and 1.8 mg malonaldehyde/kg fat, respectively. pH of the samples collected from trawl net and gill net were 5.9 and 5.6 respectively.

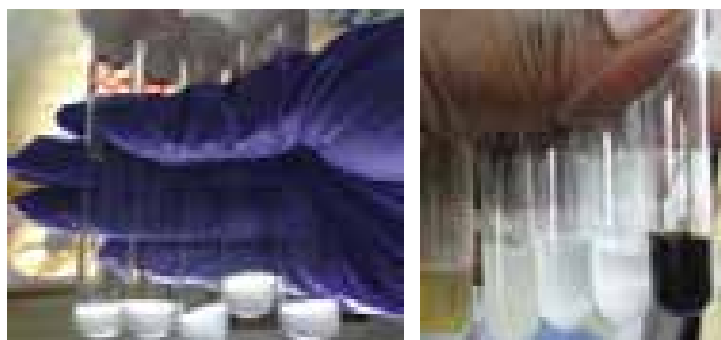
Comparison of surimi from different fishes

Studies on quality comparison of surimi prepared from different fishes like Japanese Threadfin bream (*Nemipterus japonicus*), Lizardfish (*Saurida* spp.), Goatfish (*Upeneus* spp.), Ribbonfish (*Trichiurus lepturus*), Bigeye (*Priacanthus* spp.) and surimi prepared from mixed varieties using Croaker and Lizardfish was undertaken. The gel strength was highest for Threadfin bream (480-850) followed by Bigeye (210-520), mixed surimi (110-260), Ribbonfish (115-205), Goatfish (80-150) and Lizardfish (90-120 g cm). Whiteness of Threadfin bream was in the range of 47-51 compared to 40-41 for Bigeye, 28-42 for Ribbonfish, 29-41 for Lizardfish, 31-39 for Goatfish and 29-30 for mixed surimi samples. The moisture content was in the range of 74-76% whereas pH varied between 6.8 to 7.3. The TMAN, TVBN and microbial quality attributes were well within the limit.

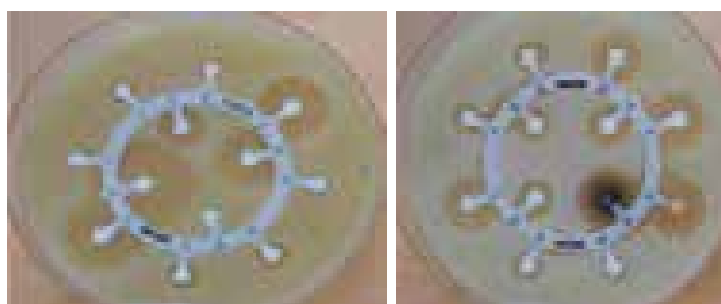
Detection of multidrug resistant coagulase positive β -Lactamase producing *Staphylococcus aureus* in seafood

A total of 235 isolates of *S. aureus* were isolated from 108 seafood samples and the count ranged between 2.0 x 10¹ and 7.8 x 10² cfu/g. Overall occurrence of *S. aureus* contamination

in seafood and its products was 43.52% (47 samples out of 108) and 12.77% of the isolates (Six samples out of 47 *S. aureus* stains) were coagulase positive. Almost all of the coagulase positive *S. aureus* (CPS) isolates (86.66%) was positive for the β lactamase (BL) production. These CPS isolates showed a variable range resistant pattern to the 24 antimicrobials tested. All the CPS BL producing isolates demonstrated resistance to Penicillin with at least three groups of antibiotics revealing the presence of multidrug resistance (MDR). The highest sensitivity towards Cefoxitin (100%), Piperacillin - Tazobactam (96.67%), Rifampicin (93.33%), Novobiocin (90%) and Teicoplanin (86.67%) was observed among these CPS strains. The antibiotic resistant pattern clearly indicated that the BL-CPS isolates were 96.67% resistant to Penicillin and Azithromycin, 86.67% to CIP, GAT, and PIT, 93.33% to RIF and LOM, 90.00% to NV, 86.76% to E, CLR, OF, NX and 83.33% to NIT antimicrobials. Also intermediate sensitivity of CPS isolates was highest (36.66%) in OF, LOM and NIT, 20.00% to GAT, 16.00% to CIP, 13.33% to LOM, RP and A/s, 10% to E, CD, MO, 6.67% to RIF and 3033% to AZM, and GEN. The present study revealed that seafood is frequently contaminated with multidrug resistant β lactamase producing coagulase positive *S. aureus* and could possibly be due to poor hygienic profile of the handlers, processing and unhygienic environment of the fish source.



Coagulation tube agglutination test and Iodometric tube method for β -Lactamase production



Antimicrobial profiles of CPS isolates

Impact of seafood processing effluent discharge on the microbial quality of bar mouth at Bhidia landing centre off-Veraval

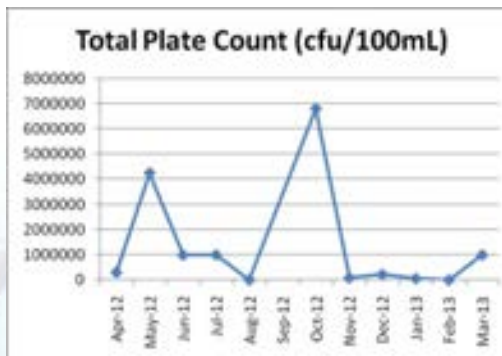
The impact of seafood effluent discharge on certain microbial quality indicators was assessed during April 2012 to March 2013 on a monthly basis. The microbial parameters like total viable bacterial count, total Enterobacteriaceae count (TEC), *E. coli*, *S. aureus* and faecal Streptococci were monitored. Total viable bacterial counts ranged 3.0×10^1 to 6.8×10^6 cfu 100mL⁻¹ whereas the counts of total TEC, *E. coli*, *S. aureus* and faecal Streptococci were in the range of 9.0×10^1 - 2.9×10^4 , Nil to 5.0×10^3 , Nil to 4.0×10^1 and 3 to 1.0×10^3 cfu 100mL⁻¹, respectively. All the microbial parameters showed a varying trend over the year. The highest counts of total viable bacteria were observed during the month of October whereas for total Enterobacteriaceae, *E. coli* and faecal Strep



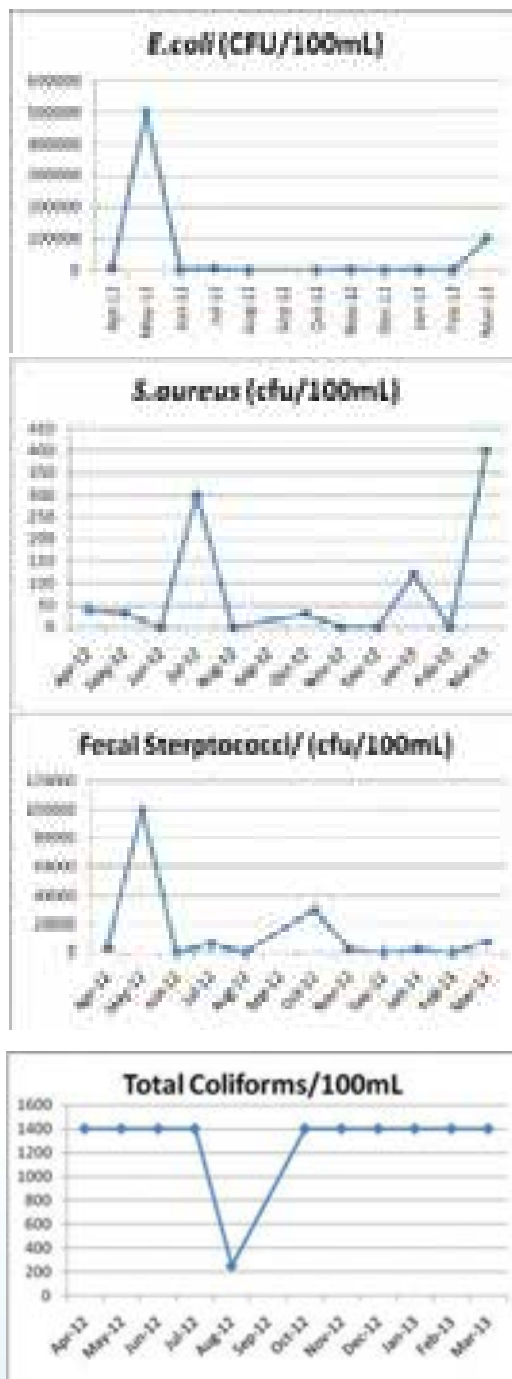
S. aureus on BP Agar plate



Coagulase positive and negative *S. aureus* on Manitol Salt Agar



total Enterobacteriaceae, *E. coli* and faecal Streptococci, it was in the month of May. *S. aureus* counts were highest in



the month of March. Total Coliforms and faecal Coliforms counts were found to be higher than $1400 + 100\text{mL}^{-1}$ MPN value throughout the study period except in the month of August for total Coliforms. Among the total isolates, 90.9 and 54.54% of isolates were confirmed as E. coli and S. aureus. The antibiogram of the pathogenic E. coli indicated that all the isolates were resistant to Cefazidime/Clavulanic acid (CAC), Amoxycyclav (AMC), Ciproflaxacin (CIF) and Ampicillin (AMP). Some of the E. coli isolates were intermediate to Amikacin (AK), Cefotaxime (CTX) and Cefoperazone (CPZ) and sensitive to Gentamicin (GEN), Imipenem (IPM), Cefoxitin (CX) and Ceftizoxime (CZX). The present study indicated that the seafood effluent discharge elevates the levels of microbial population which invariably affects the

odour, appearance and aesthetic properties of the water. It also poses a potential health hazard to different life forms associated with the water. A routine treatment of the effluent before discharge is highly recommended to minimize microbial population to safe levels.

Fish freshness indicators

Studies on freshness indicator development was continued for shrimps (*Parapenaeopsis stylifera*) and Cuttlefish. For this, indicators like Bromocresol purple (BCP), Bromocresol green (BCG), Bromothymol blue (BTB) and mixed indicators impregnated to sterile filter paper was used. Peeled and deveined shrimps packed in HIPP trays and stored in ice were in good acceptable condition up to seven days. Among the indicators, BCP gave better indication of freshness

compared to other indicators. Colour changes of BCP correlated well with the sensory quality, volatile bases and total mesophilic counts with storage days. Cleaned Cuttlefish was packed in HIPP trays and indicator was fixed in the lower side of the sealing film without touching the fish and the samples were stored in refrigerated condition. During the storage period various parameters like TVBN, TMA, pH, total mesophilic count and sensory quality was monitored at regular intervals. BCP and mixed indicator gave better indication of spoilage which was correlated well with the TVBN and sensory quality.

Studies on technology utilization in different sectors



Studies on fish freshness indicators using BCP, BCG and BTB

Field visits were made to the processing factory, fish landing centre and fish markets at Veraval. Discussions were held with motorized craft owners and collected information regarding technology utilization. The technology adopted include use of FRP crafts with out-board engines, improved gillnets in the study area. Field visits were also made to the processing factory, fish landing centre, ice factory and market intermediaries involved in the fish markets at Veraval. Discussions were made with them and information regarding handling of fish and preservation was collected.

Validation of PFZ along Gujarat coast

Nine validation experiments were carried out along the Veraval coast on-board the departmental fishing vessel and private trawlers. Seven fishing operations were carried out in the



PFZ locations and nine locations were outside the PFZ areas. The mean CPUE realized in the PFZ and NPFZ locations were 23.94 ± 3.62 and 18.15 ± 2.07 kg/h respectively. The total expenses incurred while fishing in the PFZ locations was 2142.8 ± 36.88 INR and the value for NPFZ was 1922.22 ± 87.84 INR. The mean revenue realized when experiments were conducted in the PFZ and NPFZ were 3028.79 ± 248.51 INR and 2330.56 ± 244.67 INR. The profit worked out when fishing was conducted in the PFZ locations was 885.93 ± 261.31 INR and the profit from the NPFZ locations was 408.33 ± 222.03 INR. The mean CPUE realized by fishing in the PFZ and NPFZ locations was 67.64 ± 11.56 and 51.22 ± 5.75

kg/h respectively. The mean B/C ratio for the PFZ and NPFZ locations were 1.42 ± 0.12 and 1.21 ± 0.11 respectively.

Awareness campaigns conducted on PFZ

During the period under report, five awareness campaigns were conducted at Veraval and Mangrol fishing harbours. On 28 July, 2012 an awareness campaign was conducted at Veraval for the benefit of 15 fishermen. Another mass awareness programme was conducted at Cochin on 31 July, 2012 for the benefit of purse seine and ring seine fishermen operating off Cochin waters. Interaction workshop was carried out during September and October 2012 for fishermen operating along Veraval coast. Another interaction workshop was conducted on 15 December, 2012 at Mangrol fishing harbour in association with NETFISH, MPEDA and more than 25 fishermen participated in the programme.



Mumbai Research Centre

Chief findings

- + Ready to eat product from Kardi (*Pa/aemon* sp.) remained tasty and crispy during storage even after one year in sealed glass container at ambient temperature.
- + Fish protein hydrolysate prepared from Bombay Duck (*Harpadon neherius*) meat utilizing the endogenous proteolytic enzymes exhibited good bioactive and functional properties.
- + Natural microbial culture media supplement from Rohu scales was prepared. Incorporation of peptide extract at 1% level in culture media supplemented the growth of *E.coli*.
- + Hydrolysate prepared from marine Catfish roe using alkalase enzyme indicated good metal chelating and metal reducing properties, but poor Di Phenyl Picryl Hydrazyl (DPPH) radical scavenging activity.
- + Chitin and chitosan hydrolysate was prepared from deproteinised Jawla shrimps. Chitosan hydrolysate solution at 20-50 mg/ml markedly inhibited the growth of most gram-negative and gram-positive bacteria tested.
- + Hydroxyapatite (HAP) prepared from Catla and Rohu scales were tested for their efficacy in removing the heavy metal content from aqueous solution of known concentration of heavy metals. The results indicated a significant reduction in the content of iron and toxic heavy metals.
- + A comparative evaluation was carried out on the quality characteristics of Pabda (*Ompok pabda*) fish processed by *sous vide* technique employing two different modes of heating *viz.* microwave oven heating and conventional heating. Both microwave heated and conventionally heated samples remained in acceptable condition for more than a month.
- + Gelation characteristics as well as microbial inoculation study of surimi from *Pangasius hypophthalmicus* as affected by microwave heating indicating significant reduction in microbial count and solubility values of heat induced gel subjected to 60 and 90 sec. durations, whereas the gel heated for 30 sec. showed values similar to unheated sol.

Research project handled

- ☐ Technologies for utilization of fishery resources at Maharashtra coast

- + An intermediate moisture containing product from Pangasi uscatfish fillet prepared by a combination of pH modification (potassium sorbate and citric acid), controlled microwave heating and drying technique, remained in acceptable condition for more than 45 days under chill storage.
- + Vacuum packaging studies of gutted Pabda fish under iced condition indicated a shelf life of 24 days for vacuum packed samples, whereas control samples packed in Poly Ester (PE) pouches were rejected after 18 days of storage.
- + Treatment with salt followed by vacuum packaging considerably improved the quality characteristics of laminated Bombay Duck during one year storage period.
- + Plant extract was prepared from orange peel and mint leaf powder and the mint extract has shown to exhibit higher antioxidant and antibacterial activities.
- + Microbiological analysis revealed that 20% of the fishes in the Vashi market were unfit for human consumption due to high level of *E. coli* contamination. Faecal Streptococci (FS) and Sulphite Reducing Clostridia (SRO) was found in very high level in the water used in the local fish market.
- + All Scombroid species of the local fish market of Vashi contained high level of histamine up to the level above 10 mg%.
- + 67.74% of sample of Vashi fish market contained > 0.2 ppm lead. But, in case of cadmium, only 6.45% of samples exceed 0.05 ppm.



Report of work done

Studies on antioxidant activity of plant extracts

Extracts were prepared from dried orange peel and mint leaf powder using ethanol as solvent. Yield of extract in mint leaf and orange peel was found to be 12-15% and 17-20% respectively. Total phenolic content of the extract was determined and the antioxidant activity was evaluated by FRAP assay, DPPH assay, metal reducing power and metal chelating activity. Total phenolic content in mint leaf extract (105.46 mg GA Eqwt/g of sample) was found to be five times higher than that of orange peel extract (21.97 mg GA Eqwt/g of sample). IC₅₀ values of DPPH radical scavenging assay of mint and orange peel extract was comparable (20 mg/ml of the sample). Reducing power of the mint leaf extract was 10 times higher than that of orange peel extract. Moreover, mint extract recorded higher activity for FRAP assay (1914.28 μM Fe(II)/mg extract) than orange peel (200 μM Fe(II)/mg extract). Whereas, orange peel extract showed higher metal chelating activity than mint extract. The results of the study indicated that mint leaf extract have higher antioxidant activity than orange peel extract.

Development of health product from Bombay Duck

Fish protein hydrolysate was prepared from Bombay Duck (*Harpodon neherius*) meat utilizing the endogenous proteolytic enzymes present in the meat by a serial extraction process for different time-temperature combinations. The progress of hydrolysis process was monitored by estimating the total protein, alpha-amino nitrogen, non-protein nitrogen content and the absorbance values at 280nm. A higher yield of 30% was obtained when Bombay Duck meat was hydrolyzed at 60 °C for 6 hrs. The hydrolysate was screened for molecular weight profiling of peptides by SDS-PAGE analysis. The PAGE pattern indicated intensification of peptides mainly in the molecular weight range of 6.5-14 KD and 1-3.5 KD, which is an indication of hydrolysis of fish meat. The solubility of hydrolysate powder in distilled water was found to be above 90% at room temperature. Further, the microbial analysis of the hydrolysate during the various stages of extraction was carried out. The results indicated a gradual build up in microbial load during the successive stages of preparations. This was further controlled by adding potassium sorbate in the extraction buffer and boiling the hydrolysate before drying. Further, the results of *in vitro* analysis of antioxidant properties of the hydrolysate using standard activity assays indicated good DPPH radical scavenging, metal reducing and metal chelating properties. The hydrolysate exhibited poor foaming properties, but, showed good emulsifying and fat binding properties. The hydrolysate powder was mixed with calculated



Protein hydrolysate from Bombay Duck

quantities of minerals and artificial flavouring compounds.

Characterization of chitosan hydrolysate from Jawla shrimp

Chitin and chitosan hydrolysate was prepared from deproteinised Jawla shrimp (*Acetes* sp.). The shell sediment after deproteinisation was autoclaved for 15 min. Further, hydrolysis was performed by a combination of chemical (H₂O₂ and ferric chloride) and serial enzymatic degradation process using protease, papain and chitosanase enzyme. The solubility of hydrolysate powder in distilled water was found to be about 95% at room temperature. The hydrolysate was further screened for their antimicrobial properties. The results shows that chitosan hydrolysate solution at 20.50 mg/ml markedly inhibited the growth of most gram-negative and gram-positive bacteria tested.



Jawla shrimp

Characterization of protein hydrolysate from fish roe

Protein hydrolysate was prepared from marine Catfish (*Pangasius* sp.) egg using alkalase enzyme. The proximate composition of raw Catfish egg indicated a moisture, protein content and fat content of 77, 19.6 and 9.7%, respectively; whereas, the egg hydrolysate powder indicated moisture content of 1.8%, fat content of 11.5% and protein content of 85%. The solubility of hydrolysate powder in distilled water was found to be about 91% at room temperature. The hydrolysate was further screened for its antioxidant properties based on standard





activity assays. The results indicated good metal chelating and metal reducing properties, but poor DPPH radical scavenging activity.



Hydrolysate from marine Catfish roe

Natural supplement peptides from fish scale for microbial culture

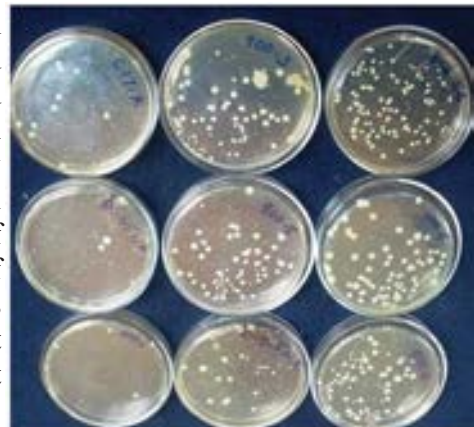
Collagen peptide was prepared from Rohu (*Labeo rohita*) scales using the enzyme alkalase and the peptide fractions were characterized based on molecular and bioactive properties. SDS-PAGE analysis of peptide extract indicated narrow range of molecular weight distribution. Further, the peptide extract was screened for growth inhibiting effect on selected bacterial cultures. Incorporation of peptide extract at 1% level in culture media supplemented the growth of *E. coli*. The results were compared against the media from standard Himedia. The results suggested that a good quality protein discarded in seafood processing industry can be ideally exploited as a source of natural supplement for the preparation of culture media.



Collagen peptide supplement for microbial culture

Characterization of hydroxyapatite from fish scale

Hydroxyapatite (HAP) prepared from Catla (*Catla catla*) and Rohu scales were tested for their efficacy in removing the heavy metal content from aqueous solution of known concentration of heavy metals. The results indicated a significant reduction in the content of iron and toxic heavy



metals *viz.* cadmium and lead. However, samples heated at different time-temperature combinations exhibited varying capacities for heavy metal removal. HAP was further tested for antimicrobial efficiency on selected cultures. Fish scales heated at 600 °C for 3 h. exhibited maximum inhibitory action on microbial cultures tested, compared to that prepared by severe heat treatment.

Sous vide processing of Pabda catfish fillets by microwave heating

A comparative evaluation was carried out on the quality characteristics of Pabda catfish (*Ompok pabda*) processed by *sous vide* technique employing two different modes of heating *viz.* microwave oven heating and conventional heating. The core temperature of the samples were allowed to reach 70 °C and maintained at different temperatures. The time-temperature combinations were selected based on a separate preliminary experiment. The fish samples were vacuum packed before heating and separate control was maintained for comparison. Further, after heating, the samples were quick chilled using crushed ice and were further stored at 5 °C. The microbiological parameters were analyzed at regular intervals for total mesophilic, psychrophilic and thermophilic count,

Enterobacteriaceae in addition to common pathogenic/spoilage organisms like *E. coli*, *Streptococcus*, *Vibrio parahaemolyticus*, *Salmonella*, *Listeria* and *Staphylococcus*. The biochemical parameters analyzed included IVBN, NPN, alpha amino Nitrogen, FFA, PV, TBA,

Histamine, Drip loss, pH and haeme iron content. Results indicated that



vacuum packed Pabda catfish



both microwave heated and conventionally heated samples remained in acceptable condition for more than a month. However, conventionally heated samples excelled in quality during the initial 15 days of storage and thereafter showed similar trend for both the samples. On the other hand, control vacuum packed samples were to be rejected after 20 days of storage under chilled condition.

Microwave blanching of freshwater Catfish surimi

Gelation characteristics of surimi from Catfish (*Pangasius hypophthalmicus*) as affected by microwave heating were evaluated. Gels were prepared by heating at 2450 Hz for 30, 60 and 90 sec. The nature of the gel network formed during heating was evaluated based on solubility profile of the heat induced gel in distilled water, high ionic strength buffer, TCA and SDS buffer. The results indicated significant reduction in solubility values of heat induced gel subjected to 60 and 90 sec. durations, whereas the gel heated for 30 sec. showed higher solubility values similar to unheated sol.

Quality characteristics of intermediate moisture products from Sutchi catfish fillets

An intermediate moisture containing product from *Pangasius* catfish fillet was prepared by a combination of pH modification (potassium sorbate and citric acid) and controlled microwave heating and drying technique. Moisture content in the range of 40-50% was achieved by varying the treatment durations. The product was further tray packed under vacuum and stored at two different conditions, viz. room temperature and chill storage at 5 °C. The microbiological parameters were analyzed at regular intervals for total mesophilic and psychrotrophic bacteria, Enterobacteriaceae, total anaerobic sulphite reducing Clostridia, *Pseudomonas* spp., and total lactics in addition to common pathogen spoilage organisms like *E. coli*, *Streptococcus*, *Vibrio parahaemolyticus*, *Salmonella*, *Listeria* and *Staphylococcus*. The biochemical parameters analyzed included pH, protein solubility, IVBN, NPN, alpha amino Nitrogen, FFA, PV, TBA and haeme iron content. The results indicated that the chill stored samples remained in acceptable condition for more than 45 days, whereas the samples stored at room temperature showed a shelf life of 12-15 days.

Shelflife characteristics of vacuum packed Pabda catfish fillets under chilled storage

Vacuum packaging studies of gutted Pabda fish under iced condition was carried out. Separate samples packed in PE pouches were maintained as control. Samples were drawn at regular intervals for biochemical, microbial and sensory



analysis. Results indicated that samples remained in acceptable condition till 24 days of storage in ice, whereas control samples packed in PE pouches gave less satisfactory results and were to be rejected after 18 days of storage in ice.

Quality evaluation of laminated Bombay Duck

Effect of salt and vacuum packaging on the quality characteristics of laminated Bombay Duck samples over a period of one year storage was evaluated. Dried and laminated Bombay Duck was prepared after dipping in a solution containing 2% salt (w/v) and 0.2% (w/v) potassium sorbate for one hour (2 S). Another set of sample was prepared after dipping in 4% brine (w/v) containing 0.2% (w/v) potassium sorbate for one hour (4 S). A set of sample was also prepared without salt treatment. Both the salt treated and salt control samples were packed under vacuum. Another set of sample was prepared without salt and potassium sorbate and packed in polythene pouch (control). All the four samples were analyzed at 1-2 month interval for a period of one year to evaluate the quality changes. The TVBN content of the samples increased from an initial value of 12.8 mg% to a final value of 149, 126, 117 and 112 mg% in control, salt control, 2 S and 4 S samples respectively at the end of first year, whereas the TMA content increased from an initial value of 3.2 mg% to 49, 42, 30 and 26 mg% in control, salt control, 2 S and 4 S samples respectively. Lipid oxidation was found to be higher in the control sample followed by salt control. All the samples were in acceptable condition even after one year of storage. However, salt treatment and vacuum packaging significantly enhanced the quality of dried Bombay Duck. Sensorial attributes like colour and appearance of 2 S samples was better compared to other samples. Halophiles were absent in all the samples through out the storage period. Among all samples, the control sample has shown

nigher Total Plate Count (TPC) followed by salt control samples. 4 S samples showed lower values for TPC compared to 2 S samples.

Microbial contamination profile of fish and water

Sixty (n = 60) fish and shellfish samples were collected from the various fish markets of Vashi Maharashtra coastal region for the assessment of microbial quality. Twelve number of sample (20%) were found unfit for human consumption due to the presence of *E.coli* of more than the recommended level. Likewise four samples (6.67%) were rejected due to high level of *Staphylococcus aureus*.

Thirty two (n = 32) fish samples were tested for the presence of faecal indicators. Among the 32 samples, 29 (93.75%) were found positive for the faecal Streptococci and two samples contained more than 100du/g. Twenty two (68.75%) samples possessed the Sulphite reducing Clostridia of more than one number (MPN technique).

Water used in the fish market for cleaning was tested for microbiological evaluation. Eight (n = 8) water samples

were collected which revealed very high number of Aerobic Plate Count (APC), Faecal Streptococci (FS) and Sulphite Reducing Clostridia (SRQ). The mean APC was 10 times higher than the recommended level. FS count for 2 sample was 3000 and 4000 per ml. The mean value of the SRC was 6.17/mL.

Bombay Duck intestine microflora

Fourteen numbers of gram positive and 20 numbers of gram negative bacteria were isolated from the intestine of the Bombay Duck for the identification of microbial diversity. Among the 20 gram negative samples, six samples were identified up to species level using API test strip. The isolates are *Proteus penneri*, *P. vulgaris*, *P. mirabilis*, *Grimontia hollisae* and *Chryseobacterium indologenes*. Antibiogram was carried out for two gram negative bacteria against 20 antibiotics. Both were resistant to Gatifloxacin, Cloistin and Imipenem.

Monitoring of histamine content and toxic metal from fish and shellfishery products

Sixty two fish samples including 20 Scombroid species were tested for the level of histamine. All the scombroid species (100%) contained histamine of more than the recommended level i.e., 10mg%. But, in case of all other fishes, the level of histamine was below the limit.

Sixty two samples (n = 62) were tested for the presence of heavy metals such as lead and cadmium. Out of this 42 samples (67.74%) contained lead more than 0.2ppm. The investigation revealed that the region is heavily polluted with lead. But, in case of cadmium, only four number of samples (6.45%) exceeded 0.05 ppm.







Ad hoc Projects Under Operation

1. Zonal Technology Management-Business Planning and Development
2. Intellectual property management and technology transfer/commercialization
3. Nutrient profiling and evaluation of fish as a dietary component
4. Green fishing systems for tropical seas
5. Development of multiplex micro array for detection of food-borne and shrimp pathogens
6. Responsible harvesting and utilization of selected small pelagics and freshwater fishes
7. Bioprospecting of genes and allele mining for abiotic stress tolerance
8. Oceanic tuna fisheries of Lakshadweep seas - A value chain approach
9. Studies on high pressure processing (HPP) of high value perishable commodities
10. Mobilizing mass media support for sharing agro information
11. Utilization strategy for oceanic squids (cephalopods) in Arabian sea - A value chain approach
12. Resource assessment of deep sea fishes along the continental slope of India EEZ and the central Indian Ocean
13. Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies
14. Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications
15. Characterization of harmful algal bloom along Indian coast
16. Isolation and characterization of collagen and gelatin from aquatic sources and development of pharmaceutical and food grade products of commercial importance
17. Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala
18. Food safety interventions for women in fishery based microenterprises in coastal Kerala
19. Techno-economic feasibility of coconut wood canoes for the small-scale fisheries sector in the south west coast of India and Lakshadweep
20. Retrieval of phytoplankton and associated optical constituents based on long term bio-optical studies
21. Validation of PFZ along Gujarat coast



Zonal Technology Management-Business Planning and Development

Funding Agency: Indian Council of Agricultural Research (ICAR)

Principal Investigators

Dr. Leela Edwin/Dr. C.N. Ravishankar

Co-Investigators Dr.

George Ninan Dr.

A.A. Zynudheen

Dr. B. Madhusudana Rao

Project Staff

Shri Nitin Singh

Dr. Elizabeth Carolin Shri

Rakesh Thomas Kurian Shri

P. Vineeth Kumar

Inauguration of ZTM-BPD Business Incubation Centre

The Business Incubation Centre established at CIFT, Cochin under the project ZTM-BPD Unit was inaugurated by Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR on 5 April, 2012. In the meeting Presidential Address was delivered by Dr. T.K. Srinivasa Gopal, Director, CIFT. Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR and Dr. Bangali Baboo, National Director, NAIP, ICAR were the Guests of Honour. Felicitations were offered by Dr. G. Syda Rao, Director,



Dr. S. Ayyappan inaugurating the Business Incubation Centre



Ceremonial breaking of coconut by DG, ICAR prior to inauguration of BIC

CMFRI, Cochin, Dr. S. Mauria, Assistant Director General (IP&TM), ICAR, New Delhi, Dr. K. Gopakumar, former Deputy Director General (Fisheries), ICAR and Shri Anwar Hashim, Vice President, MPEDA, Cochin. Dr. Leela Edwin, Principal Scientist & PI, ZTM, CIFT welcomed the participants. Dr. C.N. Ravishankar, Principal Scientist & PI, BPD, CIFT proposed the vote of thanks.

Establishment of Pilot Plant Facility

A Pilot Plant complex was set up with state-of-the-art generic semi-commercial production facility for fish and meat-based products. Various production lines are equipped 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. Various lines available with Business Incubation Centre (BIC) for entrepreneurs are as follows: Fish pre-processing line, Retort pouch processing unit, Fish canning line, Fish sausage production line, Fish extruded product line, Fish curing and drying line, Fish battering and breading line, Fish product packaging system line and Chitin and chitosan production line.

Enrolment of Entrepreneurs as Incubatees

During the year 2012-13, a total of 15 entrepreneurs have enrolled at ZTM-BPD BIC for direct and virtual incubation at CIFT. The incubatees under the unit are given access to the following:

- ◆ Human resources (personnel, technical capability, knowledge of the sector)
- ◆ Social resources (access to national and international networks)
- ◆ Financial resources (public and private funding agencies)
- ◆ Physical resources (office space, laboratory, pilot plant, library)
- ◆ Technology resources (access to technological know-how,



patents, licenses, on-site technical guidance from R&D personnel)

◆ Organizational resources (consultants/mentors)

Product formulation, standardization and packaging are the areas which are mainly looked by incubatees and BIC is providing full fledged support to them. Product analysis/testing of products is also being done for incubatees.

Development of the Business Ideas of Entrepreneurs

Entrepreneurs with a good business idea or promising technology are encouraged to approach the CIFT BIC. The feasibility analysis of such business ideas is conducted in the initial phase and R&D inputs for modification/refinement of technologies involved are made available on need basis. BIC provides incubatees access to these facilities along with support of manpower, and assists the entrepreneurs in production and testing of new product formulations. For the tenants, the pilot plant is an ideal testing arena to determine the commercial viability of new products. The products developed by ZTM-BPD Unit in association with the incubating entrepreneurs are given below:



Product brand 'Fish Bite' developed by CIFT Incubatee

- ◆ Vitagreen - Organic fertilizers and nutrient extracts
- ◆ Prawnoes - Extruded fish product with prawn flavour
- ◆ Fish Queb - Value added fish product
- ◆ Fish Bite - Value added fish product

Technology Commercialization

CIFT signed a Memorandum of Agreement with Meat Products of India (MPI) Ltd., Ernakulam, Kerala for the production of ready-to-serve food products in retortable pouches and implementation of HACCP system. MPI is a Public Sector Undertaking of Government of Kerala, engaged in production and marketing of various meat and meat products derived from pork, beef, chicken, mutton, rabbit and quails. MPI products are available with all leading supermarkets and cold storages throughout Kerala and other states. The technical advice and assistance to MPI will be provided by the Quality Assurance and Management Division and Fish Processing Division of CIFT, Cochin.

ZTM-BPD took another major step towards strengthening the public private partnerships in ICAR, by signing an agreement with M/s Jai Gayatri Exports, Veraval for establishing a fish processing unit exclusively for value added products like



Dr. S. Ayyappan, Secretary, DARE and DG, ICAR handing over the copy of agreement to M/s Jai Gayatri Exports, Veraval

ready-to-serve products in retortable pouches and coated products. The establishment would be the first of its kind in Gujarat.

Branding and Test Marketing of Products Developed by ZTM-BPD Incubatees

The state-of-the-art generic semi-commercial production facility at CIFT is utilized by the incubatees for the trial production of various fish based products. The stages span from raw material processing to packaging. The ZTM-BPD Unit provides assistance in developing product brands, labels, promotional materials etc. and facilitates test marketing of the same.

Brands developed for ZTM-BPD Incubatees

Post Graduation Mentoring for Incubatees

The ZTM-BPD Unit continues to offer business support services to incubatees even after



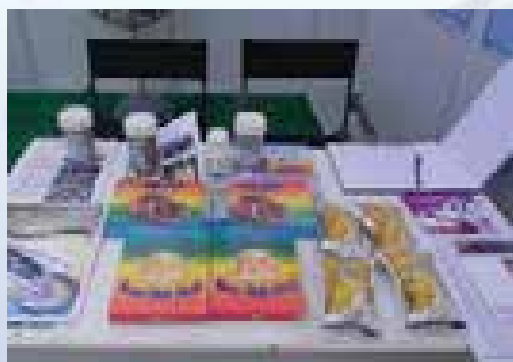
their graduation from the Business Incubation Centre. Currently assistance is provided to Shri Sultan Singh - who has received the NIABI Award for 'Best Incubatee' for his enterprise excellence and innovative technology ventures developed through the BIC - in increasing the market presence for the product 'Fish Bite' and to establish a distribution chain for his products throughout South India. The Unit has facilitated agreement with CIFA, Bhubaneswar for a collaborative project, and is also exploring new funding opportunities for Shri Sultan Singh's Food Court through DBT-BIPP programme.

Technology Promotion Activities

The ZTM-BPD Unit, since its establishment at CIFT, has been responsive to the rapid transformation of innovation processes and business needs, and has been continuously trying to enhance the visibility of ICAR technologies through Business/Industry Meets, Exhibitions, Industry Interface Programmes etc. This has helped in strengthening the public private partnerships and to bring together innovators involved in research and development, and entrepreneurs from the field of fisheries on to the same platform. The Unit regularly participates in technology exhibitions for showcasing the entrepreneur-ready innovations and technologies developed by the ICAR Institutes to the Industry. The technology promotion events participated by ZTM-BPD Unit during the year 2012-13 are as follows:

ICAR-CII Industry Regional Meets

The ICAR organized four Regional Industry Meets in association with Confederation of Indian Industries (CII) with the objective of promoting ICAR-Industry alliances as well as accelerating the commercialization activities. The four thematic areas identified were i) Crops



Product display at ZTM-BPD exhibition stall at ICAR-CII Industry Meet

and Horticulture, ii) Dairy and Veterinary Sciences, iii) Farm Implements and Machinery, and iv) Fisheries. The ZTM-BPD Unit was directed to coordinate among the ICAR Fisheries Research Institutes namely CIFT, Cochin, CIBA, Chennai, CIFA, Bhubaneswar, CMFRI, Cochin, CIFRI, Barrackpore, CIFE, Mumbai, NBFGR, Lucknow and DCFR, Bhimtal and represent the Fisheries Division of ICAR. ICAR organized these Meets in association with AAU, Ahmedabad, TNAU, Coimbatore, CAU, Agartala, and CCSHAU, Hisar during the months of April to September 2012. The ZTM-BPD Unit participated in all the four Meets and showcased the most potential technologies developed by the Fisheries Research Institutes.

AgriTech India at Bangalore

The ZTM-BPD Unit participated in AgriTech India 2012, one of South India's Largest

Exhibition on Agriculture, Farm Machinery, Dairy, Poultry, Livestock Equipment and Agri Processing Technology organized during 27-29 August, 2012 at Bangalore. Leading Companies including growers, wholesalers, importers, exporters



and all other stakeholders of every segment of agriculture and farm machinery, equipment and allied sectors from 24 countries besides India participated in the event. The ZTM-BPD Unit participated in the event representing ICAR and raised awareness about the business incubation drive, its services and facilities offered at CIFT to the industry representatives and entrepreneurs.

Global Symposium on Ready-To-Eat Foods

A two-day interactive Global Symposium on Ready-To-Eat Foods was organized during 24-25 September, 2012 by Assocom India in association with the International Crops Research Institute for the Semi Arid Tropics (ICRISAT) at Cochin to address the challenges and issues faced by the RTE industry with specific focus on addressing the challenges in the value chain. The objective of the Symposium was to identify the gaps in value chain and the key interventions and strategies that need to be adopted to promote RTE foods to a wider market through involvement of all key stakeholders. The ZTM-BPD Unit participated in the event and showcased the ready-to-eat fish products developed by CIFT, Cochin.

MSME National Level Vendor Development Programme cum Industrial Exhibition and Business 2 Business Meet

ZTM-BPD Unit, CIFT participated in two National Level Vendor Development Programme-cum-Industrial Exhibition and B2B Meet organized by Micro Small and Medium Enterprises-Development Institute (MSME-DI) at Thrissur and Kannur during 14-16 December, 2012 and 23-24 January, 2013 respectively. The events were aimed at disseminating technologies, interacting with entrepreneurs to understand



their technological needs, identifying potential new vendors for MSMEs and building confidence on research institutions among MSMEs. ZTM-BPD Unit exhibited the technologies and products developed by CIFT to the industry participants. Shri Nitin Singh, Business Manager, ZTM-BPD Unit delivered a lecture on 'Research organization's supportive role for the development of MSMEs' during both the programmes.

Workshop on Intellectual Property Rights for Seafood Industry

An Awareness Workshop on 'Intellectual Property Rights for Seafood Industry' was organized by Micro Small and Medium Enterprises - Development Institute (MSME-DI), Thrissur in association with the ZTM-BPD Unit, CIFT and Industrial Fisheries Alumni Association (IFAA) on 30 July, 2012 at Cochin. The Workshop was aimed at assisting entrepreneurs in the fisheries sector in increasing awareness regarding the use of the IP system (Detailed report appears elsewhere in the Section "Special Days and Events").

Workshop on Networking Opportunities for Entrepreneurs

A Workshop on 'Networking Opportunities for Entrepreneurs' was conducted on 14 August, 2012 at CIFT, Cochin. The Workshop was meant for building relationship of the incubatees and entrepreneurs with the public sector, funding bodies and policy makers. It was also aimed at increasing awareness and improving the understanding of the role of Government in promoting business in food processing and fisheries sector. Eminent speakers, Smt. K.M. Veena, Joint Director (Development), MPEDA, Cochin, Dr. C.K. Murthy, Executive Director (Technical), NFDB, Hyderabad, Shri Abdul Jaleel, Food Safety Officer, FSSAI, Ernakulam, Shri Martin P. Chacko, Assistant Director (Food), MSME-DI, Thrissur, Shri Shivdas B. Menon, Managing Director, Sterling Group of Companies, Shri R. Shivakumar, Co-ordinator, Food Processing Division, KINFRA, Cochin and Ms. Ashley Susane, Assistant Manager, State Bank of India, Agri-Commercial Branch, Ernakulam addressed the incubates on promotional schemes available from their respective organizations. Twenty two incubates/prospective entrepreneurs participated in the Workshop.

Young Entrepreneur Development Programme for Students

A Young Entrepreneur Development Programme was organized on 15 October, 2012 for students of MBA, as part of initiating a Young Entrepreneur Campaign by ZTM-BPD Unit. About 75 students from Mar Athenasius College, Thiruvalla participated in the Workshop and interacted with the ZTM-BPD team and scientific staff of CIFT. The Workshop provided an overview of the role of Business Incubators in business development, initiatives of ICAR and the facilities and services offered by CIFT BIC for assisting entrepreneurs in building their competence in the areas of business practices, technology up-scaling, networking and finance management.

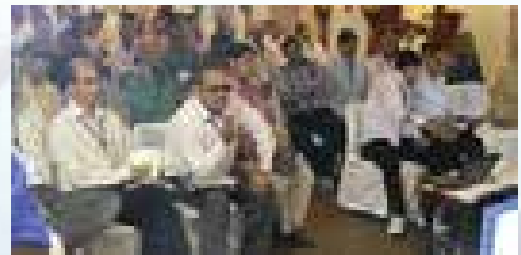
National Workshop on Business Opportunities in Freshwater Fisheries at Patna, Bihar

A National Workshop on 'Business Opportunities in Freshwater Fisheries' was organized at Patna, by the ZTM-BPD Unit, CIFT along with Directorate of Fisheries, Govt. of Bihar on 23 March, 2013. The objective of the Workshop was to popularize the path breaking technologies developed by CIFT, as well as to scientifically and

commercially address the issues faced by the freshwater fisheries sector. The Workshop was inaugurated by Shri Giriraj Singh, Hon'ble Minister for Animal Husbandry and Fisheries Resources Department, Govt. of Bihar. Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi and Dr. Mangala Rai, Agriculture Advisor to Hon'ble Chief Minister, Bihar were the Guests of Honour for the event. The Workshop witnessed participation of 170 members including Officials of State Fisheries Departments and Entrepreneurs/ Industry representatives from seven states viz. Odisha, West Bengal, Jharkhand, Uttar Pradesh, Madhya Pradesh, Chatisgarh and Bihar. The Workshop consisted of an exclusive technical conference that featured technical presentations and panel sessions for providing a topical arena for the industry professionals to enhance their technical knowledge, share ideas with scientific community and formulate new business plans. The session was followed by the demonstration of preparation of various value added products from freshwater fish to the participants.



Shri Giriraj Singh, Hon'ble Minister, Govt. of Bihar inaugurating the Workshop



Participants of the Workshop

Workshop on Technology Management for Researchers

The National Academy of Agricultural Research Management (NAARM), Hyderabad and ZTM-BPD Unit, CIFT jointly organized a Workshop on Technology Management for Researchers during 28 February to 6 March, 2013 at Hyderabad. The objective of the



Workshop was to provide an overview of the key concepts and legal framework of technology management, to develop a practical understanding of technology management principles such as technology marketing, techno-entrepreneurship, new product development, technology product life cycle, and to lay the groundwork for further study in the nuances / intricacies of intellectual property and patents. The programme was planned for the members of 22 ITMUs of South Zone. Members of ITMUs including Officers-in-Charge and Research Associates attended the Workshop.

The Technical Sessions were organized as six modules under the themes (i) Structuring knowledge transfer and intellectual property regime, (ii) Technology translation, (iii) Technology parks and incubation centres, (iv) Markets, (v) Technology commercialization, and (vi) Successful models and the way forward. The programme consisted of a blend of presentations, lectures, self-exploration instruments, case analysis, experimental learning and group discussions.



Participants of Workshop

National Seminar on Traditional Knowledge and Management Systems in Fisheries

A National Seminar on 'Traditional Knowledge and Management Systems in Fisheries' (FISHFOLK 2012) was organized jointly by ZTM-BPD Unit, CIFT and SOFTI, Cochin during 30-31 October, 2012 (Detailed report appears elsewhere in the section "Special Days and Events").

National Seminar on Application of Emerging Technologies in Fish Processing

A National Seminar on 'Application of Emerging Technologies in Fish Processing' (PROTECH) was organised by ZTM-BPD Unit, CIFT and SOFTI, Cochin on 8 January, 2013 at CIFT (Detailed report appears elsewhere in the section "Special Days and Events").

ZTM-BPD Annual Meeting (South Zone) 2012-13

The ZTM-BPD Annual Meeting (South Zone) 2012-13 was organized at Directorate of Oilseeds Research (DOR), Hyderabad on 7 March, 2013. The Officers-in-Charge and Research Associates of Institute Technology Management Units (ITMUs) from 22 ICAR Research Institutes of South Zone participated in the event. The Meeting provided an opportunity for the Institutes to deliberate on the issues faced by them in IP management and technology commercialization.

During the Technical Session, Dr. C.N. Ravishankar, PI, ZTM-BPD gave a presentation on the role of ZTM-BPD Unit, South Zone in Technology Management and Entrepreneurship Development. He also presented the activities and achievements of the ZTM-BPD Unit during the year 2012-13. In the following session, presentations were made by all ITMU Officers-in-Charge.



Dr. C.N. Ravishankar delivering the talk

Facilitating the activities of Member Institutes under South Zone

The ZTM-BPD Unit provided assistance to 21 member institutes under the South Zone on a case to case basis in commercializing and protecting the intellectual assets, formulating model licensing contracts/MoUs, business proposals, technology promotional materials, effective IP management, technology transfer/commercialization, and database management of the intellectual assets. The ZTM-BPD Unit has successfully facilitated the following activities during the year 2012-13.

1. Facilitated the transfer of Shrimp Feed Technology developed by Central Institute for Brackishwater Aquaculture (CIBA), Chennai to M/s Kairali Feeds
2. Provided assistance in drafting MoU for National Bureau of Agriculturally Important Insects (NBAIL), Bangalore for taking up R&D, through a project 'Baseline susceptibility of multiple populations of *Chilo partellus*, *Sesamia inferens* and *Helicoverpa armigera* for two Bt insecticidal proteins (Cry1Ab and Cry1F)' in partnership mode with M/s DuPont India Pvt. Ltd., Gurgaon
3. Provided assistance in drafting Agreement/MoU for Licensing of Know-How/Product of High temperature tolerant strain of *Trichogramma chilonis* developed by NBAIL, Bangalore to M/s Sun Agro Biotech Research Centre (SABRC), Chennai
4. Provided guidance for joint patent filing for Central Plantation Crops Research Institute (CPCRI), Kasaragod and Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore
5. Preparation of question paper in Agribusiness Management for recruitment of staff at CPCRI, Kasaragod
6. Examination of MoU prepared by CPCRI, Kasaragod for transfer of 'Technical knowhow of production of virgin coconut oil by hot process' to M/s Malabar Ayurveda Ashram



7. Provided guidance and assistance to Indian Institute of Spices Research (IISR), Kozhikode, Central Plantation Crops Research Institute (CPCRI), Kasaragod, Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar, National Academy of Agricultural Research Management (NAARM), Hyderabad and National Bureau of Agriculturally Important Insects (NBAIL), Bangalore for preparing proposals for establishing Business Incubation Centres at their campus
8. Provided financial support to Indian Institute of Horticulture Research (IIHR), Bangalore in organizing Horticulture Industry Meet 2013 at Bangalore
9. Examination of MoU prepared by CPCRI, Kasaragod for transfer of technology of coconut chips
10. Provided guidance in copyright protection for the software NADRES, a web based software epidemiology and EpiTrak, an offline version developed by Project Directorate of Animal Disease Monitoring and Surveillance (PDADMAS), Bangalore
11. Provided assistance in registering Trademark for NBAIL, Bangalore
12. Facilitated technology transfer of biopesticidal formulations and two processes for machinery for the isolation of biopesticide and for biofumigant developed by Central Tuber Crops Research Institute, Thiruvananthapuram to M/s Huntin Organics, Faridabad
13. Provided guidance to NBAIL, Bangalore regarding the revenue generation sources which come under IP revenue and items that come under the institute revenue
14. Provided guidance to Directorate of Rice Research (DRR), Hyderabad for sharing the revenue generated through technology transfer/commercialization and consultancy

The zonal status of technology commercialization and IPR protection by all 21 Institutes are as follows: Technologies commercialized - 123 Nos, Patent applications filed - 128 Nos, Patents granted - 12 Nos, Trademark applications filed - 11 Nos, Trade mark granted - 5 Nos, Copyrights - 22 Nos, Registered plant varieties/hybrids etc. - 94 Nos, Registered germplasm etc. - 106 Nos, Registered animal breeds/germplasm - 6 Nos, Registered insects/fungi and other strains - 6 Nos, and Industrial designs - 5 Nos.

Development of Organic Liquid Fertilizer for M/s Green Allies Organics Pvt. Ltd.

M/s Green Allies Organics Pvt. Ltd. is a registered incubatee at Business Incubation Centre (BIC) at CIFT, Cochin. The company joined hands with ZTM-BPD Unit, with the objective of developing effective and reliable nature/farmer-friendly agricultural technologies for the benefit of the society. A range of organic fertilizer products are being developed under the trade mark of Vitagreen™. The first product under this brand is released under the name Vitagreen Plant Health Booster, which is a liquid fertilizer containing Poly-(D) glucosamine, known for its beneficial effects on growth, yield and resistance enhancement in flowers, vegetables and a number of cash crops. The product is derived from de-proteinised, de-mineralised and de-acetylated Poly-(D) glucosamine prepared from natural shrimp shells from Indian waters.

BIC provided technical guidance and assistance to M/s. Green Allies Organics Pvt. Ltd. for standardizing the process for the production of Poly-(D) glucosamine by retaining the organic nature of the product for ensuring maximized plant protection. Vitagreen™ Plant Health Booster was introduced into the market during January 2013. The product is now the only organic liquid fertilizer currently available in the market, containing pure Poly-(D) glucosamine. The organic certification of the product is in process with INDOCERT, which would qualify Vitagreen™ as the only organic certified liquid fertilizer containing Poly-(D) glucosamine.



Vitagreen Plant Health Booster, Organic Liquid Fertilizer

International Associations

As part of the initiatives to address the food security challenges in Africa, MANAGE, Hyderabad was assigned the responsibility of organizing the United States-India-Africa Triangular International Training Programme on New Dimensions in Agricultural Extension Management for Extension Functionaries from Liberia, Kenya and Malawi during 6 January - 6 March, 2013. As part of the programme, about 30 International Delegates visited the Business Incubation Centre (BIC), CIFT on 28 January, 2013, to share the initiatives of research and development, and the technology transfer process carried out by the ZTM-BPD Unit. Dr. C.N. Ravishankar, Principal Investigator, ZTM-BPD Unit addressed the delegates and gave a presentation on the Prospects of Indian fisheries sector and the role played by BIC in entrepreneurship development.

Awards/ Recognitions

The ZTM-BPD Unit at CIFT, Cochin was awarded a Certificate of Appreciation for the outstanding work on Establishment of Business Incubation Centre and Commercialization of Technology in Fish Processing, from NAIP, (ICAR) (Details are given elsewhere in the Section 'Awards and Recognitions').



Intellectual property management and technology transfer/commercialization

Funding Agency: Indian Council of Agricultural Research (ICAR)

Principal Investigators

Dr. T.V.Sankar/Dr. C.N. Ravishankar

Project Staff Shri

M. Kiran Das Smt.

K.A. Anju

The Institute Technology Management Unit (ITMU) is pursuing all IP protection, maintenance and transfer/commercialization related matters at the Institute level as per ICAR guidelines and any other administrative or policy decisions taken in the ICAR from time to time. The ITMU seeks any specific, case-to-case basis advice/assistance from the Zonal Agro-Technology Management Centre (ZTMCs) at the zonal level or the Agro-Technology Management Centre (ATMC) at the ICAR Headquarters.

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,	:	Chairman
Director		
Dr. S. Balasubramaniam, Head,	:	Member
EIS Division		
Dr. T.V. Sankar, Head,	:	Member
QAM Division		
Dr. P. Pravin,	:	Member
Principal Scientist		
Dr. K. Ashok Kumar,	:	Member
Principal Scientist		
Dr. Suseela Mathew,	:	Member
Principal Scientist		
Dr. T.E. Sheeja, OIC, ITMU,	:	Member
IISR, Kozhikode		
Dr. C.N. Ravishankar, Head,	:	Member
FP Division		Secretary

Patents obtained

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

Patent applications filed

3. 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)
4. Process for the production of high density bulk chitosan – K.G. Ramachandran Nair, George Ninan and P.T. Mathew (No. 2582/DEL/2004)
5. Fishing canoes from treated rubber wood – Leela Edwin, Saly N. Thomas and B. Meenakumari (No. 2583/DEL/2004)
6. 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)
7. 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 of 23-12-2005)
8. 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)
9. Mesh gauge – A device for easy measurement of fishing net mesh size – U. Sreedhar (No. 42/DEL/2006)
10. 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)
11. 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)
12. 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)
13. 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)
14. Ready to serve Manipuri 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)
 15. Ready to serve Mughalai 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)
 16. 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)
 17. 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)
 18. Collapsible lobster trap – P. Pravin and B. Meenakumari (No. 173/CHE/2010)
 19. Collapsible fish trap – M.P. Remesan, P. Pravin, P. George Mathai and B. Meenakumari (No. 174/CHE/2010)
 20. Method of extracting *Eichornia crassipes* root extract exhibiting analgesic, anti pyretic, anti ulcer, ant-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)
 21. 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)
 22. 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)
 23. A low cost easy method for extraction of caroteno protein from tropical shrimp waste – R. Chakrabarti (No. 4273/CHE/2011)
 24. 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)
 25. 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)
 26. Smoked masmin flakes and a process for preparing the same – T.K. Srinivasa Gopal, R. Yathavamoorthy, V.R. Mumtaz, J. Bindu and Suseela Mathew (No. 4276/CHE/2011)
 27. 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)
 28. 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)
 29. Insulated fish bags for preserving quality of iced-fish – D. Imam Khasim, B. Madhusudana Rao and A.K. Chattopadhyay (No. 4345/CHE/2011)
 30. Rapid test kit for identification of white spot disease and stress in shrimps and method thereof - Suseela Mathew, K. Ashok Kumar, R. Anandan, K. Devadasan and P.G. Viswanathan Nair (No. 4344/CHE/2011)
 31. Fish enriched noodles and a process for preparing the same – A.K. Chattopadhyay, B. Madhusudana Rao and D. Imam Khasim (No.4322/CHE/2011)
 32. 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)
 33. Fibre glass sheathed rubber wood canoe – Leela Edwin and B. Meenakumari (No. 2826/CHE/2012)
 34. Seafood self heating pack – T.K. Srinivasa Gopal, R. Yathavamoorthi and C.N. Ravishankar (No. 2827/CHE/2012)
 35. Taurine extraction from fish head – T.V. Sankar, S. Abhilash, Suseela Mathew, R. Anandan, K.K. Asha and P.T. Lakshmanan (No. 2825/CHE/ 2012)
 36. Instant fish gravy powder – A.A. Zynudheen, George Ninan and C.N. Ravishankar (No. 2828/CHE/2012)
 37. Fish decaling machine – A.A. Zynudheen, C.R. Gokulan, George Ninan and C.N. Ravishankar (No. 2829/CHE/2012)
 38. A novel cost effective environmental friendly depuration system for bivalves – Femeena Hassan and T.V. Sankar (No. 2831/CHE/2012)
 39. A process for the development of fish gel from mince of Threadfin Bream (*Nemipterus japonicus*) in synthetic casings employing high pressure – J. Bindu, C.K. Kamlakanth, Ginson Joseph, C.G. Joshy and T.K. Srinivasa Gopal (No. 2830/CHE/2012)

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.



Nutrient profiling and evaluation of fish as a dietary component

Funding Agency: Indian Council of Agricultural Research (ICAR)

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The Project on, 'Nutrient Profiling and Evaluation of Fish as a Dietary Component' was started on network mode involving all the eight fisheries institutes with mandated activities. The Project started in 2007 during the 11th Plan period and was operated from the Biochemistry & Nutrition Division of the Institute. The fish species identified for CIFT included Indian Mackerel (*Rastrelliger kanagurta*), Japanese Threadfin Bream (*Nemipterus japonicus*), Commerson's anchovy (*Stolephorus commersonii*), Batavian anchovy (*Stolephorus waitei*), Yellowfin tuna (*Thunnus albacares*), Kawakawa (*Euthynnus affinis*) and Giant Snakehead (*Channa striatus*). The samples were collected from west coast (Veraval and Cochin) as well as east coast (Visakhapatnam and Chennai). More than 130 samples collected from the locations habitat-wise, species-wise and size-wise were analyzed for proximate composition namely protein, fat, minerals as well as fatty acids, amino acids, vitamins and trace elements.

A survey also formed part of the study to identify the fish consumption pattern among the population of Kerala state and to identify its nutritional significance attenuating nutritional deficiency disorders. In Kerala, a total of 2700 households (900 from each district) were surveyed from Kollam, Thrissur and Kozhikode districts representing Southern, Central and Northern Kerala respectively. From Kollam district, 900 households were surveyed, 300 respondents each from Thangassery panchayath

(coastal area), Kadavoor panchayath (adjacent to brackishwater lake) and Kottarakkara panchayath (interior area). In Thrissur district, the areas covered were Nattika panchayath (coastal area), Adat panchayath (adjacent to Thrissur city) and Panancheri panchayath (interior area), while from Kozhikode district Chorodu panchayath (coastal area), Maniyoor panchayath (interior area) and Kozhikode Corporation (urban area) were identified for the survey.

The biochemical composition showed that fish are rich sources of nutrients particularly omega-3 fatty acids, essential amino acids and trace elements required to support health of consumers. They are also good sources of fat soluble vitamins required for the maintenance of vital organs. It is observed that consumption of these common food fishes can effectively ameliorate the malnutrition disorders in young children and protein deficiency during adult pregnancy. The objective of the Project was to promote fish as a health food. From the outcome of the Project a 'Manual on Nutrient Profiling of Fish' was published.

Further, a research paper entitled " ω - 3 polyunsaturated fatty acid profile of four Indian food fishes of Arabian sea" was presented at the UGC sponsored International Conference on Nutritional Medicine, Health and Wellness during 7-8 June, 2012 at St. Teresa's College, Ernakulam, Kerala. The Conference was organized in collaboration with Dr. Rath Research Institute, USA. The following two research papers were also published:

1. Aneesh, P.A., Jones Varkey, Anandan, R., Suseela Mathew, Asha, K.K., Lakshmanan, P.T. and Sankar, T.V. (2012) - Proximate composition, amino acid and fatty acid profiles of Commerson's Anchovy (*Stolephorus commersonii*) and Indian Mackerel (*Rastrelliger kanagurta*), *Biochemical and Cellular Archives*, 12(2): 371.
2. Sankar, T.V., Anandan, R., Suseela Mathew, Asha, K.K., Lakshmanan, P.T., Jones Varkey, Aneesh, P.A. and Mohanty, B.P. (2013) - Chemical composition and nutritional value of Anchovy (*Stolephorus commersonii*) caught from Kerala coast, India, *European J. Expt. Biol.* 3(1): 85-89.



Green fishing systems for tropical seas

Funding Agency: National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA)

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The Project on 'Green Fishing Systems for Tropical Seas' is jointly carried out by the Central Institute of Fisheries Technology (ICAR) Cochin, Goa Shipyard Ltd. (Ministry of Defence) Goa, M/s Garware Wall Ropes Ltd., Pune and M/s DSM India Ltd., Mumbai at a cost of ₹ 1224.54 Lakhs. The Project was launched on 16 February, 2013 at CIFT by Shri K. Babu, Hon'ble Minister for Fisheries, Ports and Excise, Govt. of Kerala (Details given elsewhere in the section 'Special Days and Events').

At present there is no standard design of a combination fishing vessel incorporating fuel efficiency features to reduce carbon footprint for small-scale mechanized sector. Absence of low drag trawl systems, seines with high sinking speed and operational efficiency and resource specific static gears has resulted in excessive use of energy in the fishing sector. It is inferred that a standard green combination fishing vessel with energy saving selective fishing gears made out of new generation materials will reduce the carbon footprint in fishing operations and enhance sustainable production.

Bench marking and development of database of existing fishing vessel designs and energy efficiency

The principal dimensions like length, breadth, depth and draft of

the vessel were collected to group the vessels into different size ranges. The details of the engine power, fish hold capacity, number of crew on-board, type of fishing done from the boat, average fuel consumed during the trip were also collected. The details regarding deck equipment installed for fishing purpose of the vessel and structural details of the vessel showing the scantlings of different parts were collected. From the data collected, some vessels were identified based on the type of fishing, number of units operating and region of operation. The most popular fishing vessels selected from different states were identified. This will serve as parent design of vessel for developing the new design envisaged in the project.

A National Stakeholders' Workshop on 'Energy Saving in Fishing Vessels' was held on 18 January, 2013 at CIFT to get inputs for a model vessel for operation in near shore and



deep sea waters (Details given elsewhere). A technology forecasting analysis was done to assess the energy consumption scenario in fisheries by taking opinion of 50 stakeholders.

Development of data base of existing fishing gear designs

As part of the study for developing energy saving selective fishing gear systems through material substitution and design optimization, preliminary data were collected for the existing fishing gear materials and designs. Data on gear designs and construction, operation and economic details were collected and digitized.

Small scale traditional fishing systems and large scale industrial mechanized fishing systems exist in the west and east coast. Synthetic fibers like Polyamide, Polyethylene, Polypropylene etc. are normally used for netting. The structural, operational and design differences in the common gear systems of different coastal states were documented.



Data collection in progress

Different type of gears operated from mechanized/motorized craft

1. Trawl nets (Pelagic and Demersal)
2. Gillnets (Drift gillnet, Set gillnet, Trammel nets and Surrounding gillnets)
3. Surrounding nets (Purse seines and Ring seines)
4. Hooks and Lines (Hand lines, Long lines and Troll lines)

The details regarding the dimensions, materials, accessories like floats, sinkers;

operational parameters and specific details of the trawl net were studied. The majority of the designs were two seam type and the deployment of a particular net is based on the predominance of the targeted catch in the fishing ground. The analysis revealed an upward trend in the size of the net used, with the length of the head rope significantly higher compared to other reports available from the region. The most common material used for fabrication was High Density Polyethylene (HDPE) with different twine sizes used according to the local preference and species distribution. Mesh sizes used vary from 5000 mm to 10 mm in fish trawls, 400 mm to 16 mm in shrimp trawls, 1200 mm to 18 mm in cephalopod trawls and 80 mm to 20 mm in gastropod trawls. Another important feature observed was indigenous methods of drag reduction like increasing the size of the meshes in the front parts of the net, and substitution with materials like PA for targeting fast moving pelagic fishes. The most widely used otter board was flat rectangular otter board, which was followed by V form type.

Purse seines and ring seines are the surrounding gears operated commonly along west coast. Ring seines are operated from both mechanized and motorized vessels of west coast with various modifications of the fishing gear and methods of operation. The total length of the ring seine nets usually range from 250 to 600m with 8-12mm mesh size and it is used for capturing white baits and sardines and 600-1300m with 18-22mm mesh size is used for catching mackerel, sardine and carangids. Long line fishing is an important commercial fishing method in mechanized and motorized sector. Two types of hook and line fishing methods viz., hand lining and long lining are prevalent in the region and trolling lines are also documented. Traditional fishermen use catamarans and small scale motorized canoes for operating hand lines. The length of the main line ranged from 1000-5000m and the main line is usually made of Polyamide monofilament. Recently fly-boards are used in troll lines for catching Tuna.

Design of seines with high sinking speed and operational efficiency

The catch effectiveness of purse seine depends on its length, depth, sinking speed, net type, hanging ratio, and the skill in operation, among which the sinking speed is one of the most important component influencing the catch efficiency. Webbing weight, mesh size, mesh geometry, material used, twine size, and the hanging coefficients are the principal factors that influence the sinking speed. The sinking speed of ring seine has not been calculated as yet. A new method was arrived at based on Dickson (1980), Prado (1990) and Misund, (1992) which was found suitable for the ring seine which differ from purse seine in structure and mode of operation.

Material testing and evaluation for gillnet and lines

The materials tested for the analysis are Nylon monofilament of (0.16 to 0.6 mm dia). Nylon multifilament of (210x1x2 to 210x24x3) and HDPE twine of (0.5 to 2.5 mm dia). commonly used for gillnets and lines. The tests conducted were linear density, twists per meter, runnage, break load (wet and dry), knot break load (wet and dry) and corresponding elongation at break. Studies on the comparative efficiency of different synthetic materials have been carried out.

Development of multiplex micro array for detection of food-borne and shrimp pathogens

Funding Agency: National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA)

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Project Staff
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Validation and standardization of primers for detection of shrimp pathogens by multiplex PCR

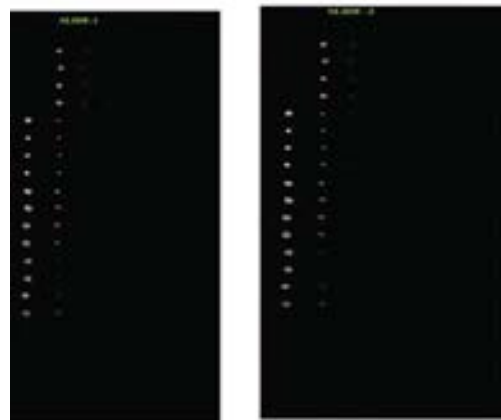
Sixteen *P. monodon* and 14 *L. vannamei* post larval samples collected from different hatcheries of Kerala and Andhra Pradesh were screened for the presence of viral shrimp pathogens - WSSV, MBV, IHHNV and HPV by *oi* protocol. 17% of the samples were positive for IHHNV, 7% for MBV, 13% for WSSV and 3% was found to have multiple infections with MBV and IHHNV. None of the samples were positive for HPV. For standardization of a PCR protocol prior to hybridization in microarray, the shrimp samples that were positive for virus by *oi* primers were subjected to PCR by four sets of primers for each virus. The isolated viral DNA was found to be unstable for long term storage even at -80 °C and hence PCR amplified DNA fragments were cloned into a T/A cloning vector for use as template for standardization of multiple PCR prior to microarray hybridization. The plasmids with corresponding inserts were then confirmed by sequencing.

Preparation of indigenous epoxide slide for microarray

Low cost epoxide slides for microarray were prepared using an in-house developed modified microarray epoxide slide preparation protocol. In-house prepared Silane glass slides were used for preparation of epoxide glasses. The amine-modified capture DNAs were covalently immobilized on the activated glass. The slides prepared were then subjected to further quality checks for ensuring spotting consistency, efficiency and optimum probe concentration determination.

Immobilization efficiency of epoxide slide

To investigate the effect of concentration of probe DNA on efficient immobilization, a 40 T-mer probe labelled with Cy3 on the 3' end were immobilized on the activated glass at concentrations ranging from 0.01uM-30uM. Whattmann Micro-caster micro arrayer was used to spot the probes onto the slides. The probes were then immobilized by an overnight incubation in a humidity chamber at 70% humidity. The slides were subjected to stringent washing steps and the probe immobilized. Slides were then scanned using a commercial microarray scanner.



Scanned images of slides spotted with varying concentrations of probe

The probes formed a stable covalent bond on the slide which is evident from the high fluorescent intensities. The immobilization capacity on the glass slide increased as the concentration of applied oligonucleotide probe increased and reached a plateau at about 20uM. Further increase in concentration over 20uM did not cause improvement in the immobilization capacity. The optimum concentration of probes to be spotted was found to be 20uM. Considering all these experimental evidences and the low cost of the indigenous slides (1/100th of market price) it was decided to use the developed slides for further studies.

Responsible harvesting and utilization of selected small pelagics and freshwater fishes

Funding Agency: National Agriculture Innovation Project (NAIP)

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The project, "Responsible harvesting and utilization of selected small pelagics and freshwater fishes" (RHSSP) has been extended up to 30 June, 2014 with the main focus on creation of a value chain for the selected low value small pelagic fishes and freshwater fishes. The major achievements under the project are given below.

Commercial launching of FISHMAID products

Commercial launching of the FISHMAID products developed under the project was done at a formal function organized by the Kerala State Coastal Area Development Corporation (KSCADC) at Thiruvananthapuram. Honourable Chief Minister of Kerala, Shri Oommen Chandy launched the product logo and the Hon. Speaker of Kerala Legislative Assembly, Shri G.



Product launch of FISHMAID by Chief Minister of Kerala

Karthikeyan launched the products in the presence of an august audience including more than 20 MLAs, Director of Fisheries and many other dignitaries. A display of 25 fish products developed under the project was arranged and the products were served to the dignitaries and other participants who attended the function.

MoA signed between NAIP-RHSSP Project and Kerala State Coastal Area Development Corporation

A Memorandum of Agreement (MoA) was signed between NAIP-RHSSP Project and Kerala State Coastal Area Development Corporation to transfer the technologies developed under the Project to KSCADC. The agreement was signed between the Director of CIFT, Dr. T.K. Srinivasa Gopal and Project Leader Dr. K.V. Lalitha with the MD of KSCADC, Dr. K. Ampady, IIS. As per the agreement, the project will provide technology support to KSCADC for establishing production units of 25 fish-based "Innovative value added products" like Fish burger, Fish noodles, Fish lollipop under the brand name "FISHMAID". This includes designing of units and training of women from coastal villages on production technology and packing. Apart from this, design of three types of kiosks and marketing model provided by the Project will enable KSCADC for selling the product in urban markets through 100 signature



Dr. T.K. Srinivasa Gopal handing over the MoA to Dr. K. Ampady



kiosks. The MoA also equips KSCADC to establish coastal women units to produce hygienically cleaned and packed fresh fish and dried fish under the brand names "SEAFRESH" and "DRISH" respectively and market them through innovative means. The consultancy comprise of a team of six Scientists under the leadership of Shri M. Nasser, Principal Scientist. This project leads to the beginning of a business model that can bring about an overall change in the fisheries sector. The Department of Fisheries expects that the venture will create employment opportunities for more than 1000 individuals belonging to the fisheries community, especially women and encourages budding entrepreneurs to invest in fisheries sector. The technical experts and employees of this sector expect that the collective efforts of CIFT and KSCADC would be able to provide unadulterated high quality fish and its products to the market.

FISHMAID kiosks developed

'Infosys' - the leading software organization has come forward and provided space in their Food Court in Thiruvananthapuram Campus to start FISHMAID outlet for their employees. The kiosk design is ready under the project and is about to be installed.

It was decided to open a FISHMAID signature kiosk in the MLA hostel at Thiruvananthapuram for public to encourage the production groups comprising coastal women trained under the project. Kiosk is under construction.

Business model implementation in Poompuhar

A plan has been drawn in association with M.S. Swaminathan Research Foundation's "FISH FOR ALL" facility (Poompuhar, Tamil Nadu) to empower 300 selected fisherwomen from 12 coastal villages of Poompuhar with production technologies and marketing strategies developed under the project for continuous employment, reduction of drudgery, elevation of social status and income augmentation. A rural appraisal and benchmark assessment has been conducted for need assessment and planning appropriate technology intervention. The fisherwomen beneficiaries were identified and detailed interactions was done. Two workshops were conducted for the women involved in dry fish trade and fresh fish vending on the new business model on both sectors in February 2013.



Fishmagic outlet

FISH MAID products outlet was established by a women group at Kollam beach.

Fuel efficient propeller designs released

Supply of fuel efficient propellers for engines upto 200 Hp on commercial mode has been demonstrated through M/s Sree Muruga Propeller Works, Kozhikode, Kerala. The business model equips the manufacturer as well as the boat owner to decide suitable propeller based on identified design groups without any extensive pre-vessel testing. The commercial trial made on 12 vessels using seven commercially released designs proved that the method can reduce fuel



Propeller demonstration at Kozhikode

consumption of around 21%. Speed was improved by 10-15% on an average. Average earning per vessel was clocked at around ₹ 52,000/- per month. Cost involved in propeller change is found to be recoverable within 2-3 months of vessel operation. M/s Sree Muruga Propeller Works is planning to switch over to the fuel efficient propellers, once commercial release of designs for all major design groups is available.

Fuel efficient propeller designs for six ring-seine design groups for engines 225-475 Hp have been developed. Field trials of these designs are being planned. M/s Mahindra & Mahindra Ltd., Powerol Division has come forward to try the modified versions of these designs on trawlers at Bhatkal, Karnataka.

New FRP vessel designed and developed

An innovative design of 9.1m FRP seagoing fishing vessel was developed for the use of marginal fishermen engaged in pelagic fishing using out-board motors. Operational and maintenance cost of the existing vessels using out-board motors is high and in-board powering of these vessels are impractical. The new design will feature in-board powering and a unique propeller design for beach landing. More than 1,50,000 boats in this sector are in operation in the country. The design awaits prototype construction and field trials.

Fatty acid ethyl esters from sardine oil

A simple cost effective and reliable method was developed and standardized for the preparation of fatty acid ethyl esters from sardine oil. Fatty acid ethyl esters obtained were analyzed for the fatty acid composition using Gas Chromatography-Mass Spectrometer. This process may be effectively translated for the preparation of fatty acid ethyl esters especially n-3 Poly Unsaturated Fatty Acids (PUFA) required for incorporation in animal feed, anti-inflammatory ointments and nutritional supplements.



PUFA enriched poultry feed

A method has been standardized for the preparation and incorporation of fatty acid ethyl esters enriched in n-3 PUFA from sardine oil in poultry feed formulation. A feeding protocol of PUFA enriched feed for poultry has been successfully established and PUFA enriched eggs and chicken meat were commercially produced on a trial basis in collaboration with M/s Pankajam Poultry Farm, Kayamkulam, Kerala



Onfarm trial of PUFA enriched poultry feed

Value added product development for business model

Value added fish products namely Prawn Macroni Layers and Fish Pie were developed which are undergoing shelf life and storage studies.

Field trials on women-friendly hygienic fresh fish vending units

Field trials of fresh fish vending units run by "Samrudhi" (an SHG) at Kollam proved



Pre-processing unit for Seafresh

successful and are now commercially functioning under the brand name "Seafresh".

Pilot level commercialization of organic manure from fish waste

"Jaivasree" unit initiated under the project at Munambam, Ernakulam for demonstrating production of organic manure from fish waste,

under the brand name "FERTIFISH" has proved successful.

Business model for production of omega-3 enriched meat and eggs

The model is suitable for implementing in coastal villages through backyard poultry farming. The same is included in the Agri-sustainable village programme being implemented at Chellanam, Kumbalam and Kumbalangi panchayaths of Ernakulam. The proposal comprising an initial unit of 500 birds got approval for implementation by the Kerala Government.



Jaivasree organic manure unit

Other activities

The Project in association with Matsyafed organized a one day workshop for ring seine fishermen on 'Fuel efficient fishing' at Nattika Co-operative Bank Auditorium at Thriprayar, Thrissur on 6 January, 2013.



Workshop on Fuel efficiency at Nattika

A one day workshop was organized in association with M.S. Swaminathan Research Foundation for the coastal women in nearby five villages of Poompuhar on "Hygienic handling and fresh fish trading for coastal women" on 26 February, 2013. Another workshop was conducted at 'Fish for All Facility' of M.S.S.R.F. at Poompuhar on "Hygienic production and marketing of dry fish for coastal women on 27 February, 2013.



Workshop at Poompuhar

A one day training programme on 'Fuel efficiency in ring seine sector' was conducted for fishermen at Njarakkal. The programme was organized in collaboration



Training programme on Fuel efficiency at Njarakkal



with the Fishermen Co-operative Society, Njarakkal. Shri M. Nasser and Shri Ankur Nagori, Scientists of Engineering Division, CIFT, Cochin were the technical experts for taking class and the programme was co-ordinated by Dr. S. Ashaletha. The technical problems in the sector were discussed at length and follow up actions were planned systematically.

The Project and M/s Mahindra Ltd. jointly organized a one day workshop on 'Fuel efficient fishing' on 3 April, 2013 at Nagapatnam, Tamil Nadu. Shri M. Dileep Kumar, Area Manager, Mahindra Ltd. inaugurated the Workshop. Project Co PI, Dr. S. Ashaletha made an introductory speech about the importance of saving fuel and the magnitude of the issue of fuel inefficiency in fishing sector and its consequences. Project Co-PI and Principle Scientist, Shri M. Nasser 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, methods to achieve fuel efficiency etc.



Workshop on Fuel efficient fishing at Nagapatnam

During the field visit and survey fishermen clarified their technical problems and doubts about the ring seine fishing operations.

A review meeting of the Project was organized at the Kayamkulam and Kollam Field Centres during the visit of Dr. M. Kochu Babu, Principal Scientist, ICAR, New Delhi who is in charge of Monitoring and Evaluation of NAIP Projects (Comp-II).



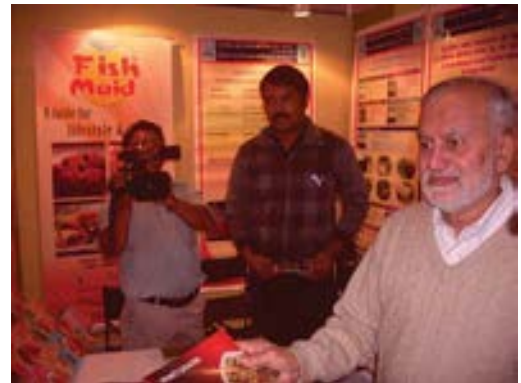
Review meeting at Kollam

As per ICAR directives, the Project participated in the 100th Indian Science Congress held at Kolkata during January, 2013 and exhibited products and technologies developed under the Project. During the event, ICAR Pavillion won the first prize in the exhibition (Detailed report appears elsewhere).



Fuel efficient boat, propeller and Fish Maid products in the ICAR Pavillion at Kolkata

India International Trade Fair (IITF) held at Pragati Maidan, New Delhi during 14-27 November, 2012 and the information on the omega-3 fatty acid enriched products, fuel efficient propellers and boats, the commercial and nutritional significance of all the 25 value added fish products etc. were displayed.



Dr. S. Ayyappan, DG, ICAR visiting the stall at Pragati Maidan, New Delhi

The Project participated in the "Kerala Agri Food Pro Meet 2013" and displayed the new value chain business models in the fisheries sector developed under the Project. The Project also participated in "Krishi Darpan 2013". Fish Maid products, organic fertilizer developed from fish waste - "Fertifish", models of fuel efficient



Vice Chancellor, GADVASU University, Ludhiana visiting RHSSP technologies displayed

propeller and boat were exhibited generating much interest among the visitors.

Media coverage and documentation of success stories

Under the Project, two Video films entitled, "Meat bone separator for Ludhiana freshwater fishery" and "SEAFRESH - A new fresh fish vending model" were made. A total of 22 news reports were published in different media and four success stories were documented.



Bioprospecting of genes and allele mining for abiotic stress tolerance

Funding Agency: National Agriculture Innovation Project (NAIP)

Principal Investigator
Dr. Toms C. Joseph

Co-Investigator
Dr. K.V. Lalitha

Project Staff
Kum. Anju Baby
Kum. Aswathy Mary Varghese

Molecular mechanisms involved in bacterial anoxia tolerance

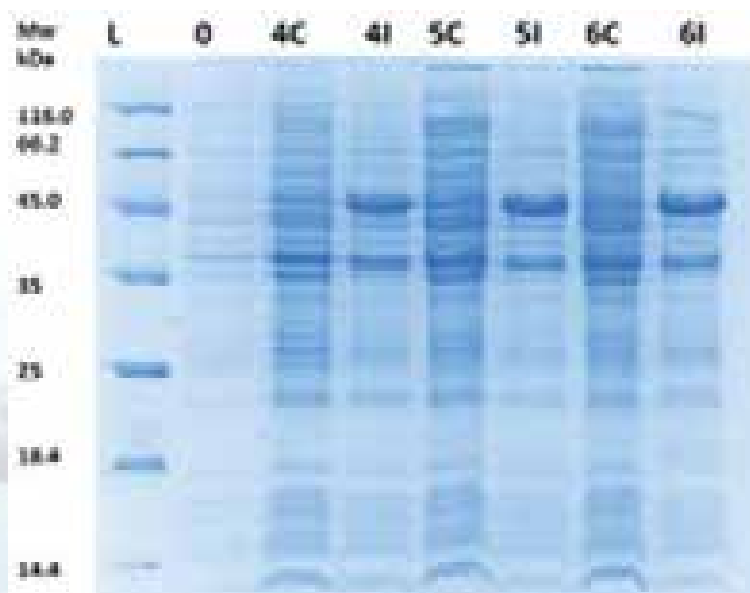
Differential gene expression of *Mangroveibacter* spp. under anoxia stressed and unstressed conditions was studied using whole transcriptome sequencing to understand the molecular mechanism involved in anoxia tolerance. Aerobic culture of *Mangroveibacter* spp. grown in a bio-reactor was adapted to anaerobic conditions, at constant temperature and pH. cDNA samples were synthesized from the transcriptome at three stages of growth viz. the log phase of aerobic growth, the lag phase of the anaerobic growth and the log phase of the anaerobic growth. The *de novo* transcriptome deep sequencing revealed 2.5 million reads with a coverage of 250 megabase.

Characterization of Fructose 1, 6 bisphosphate Aldolase from *Bacillus pumilus*

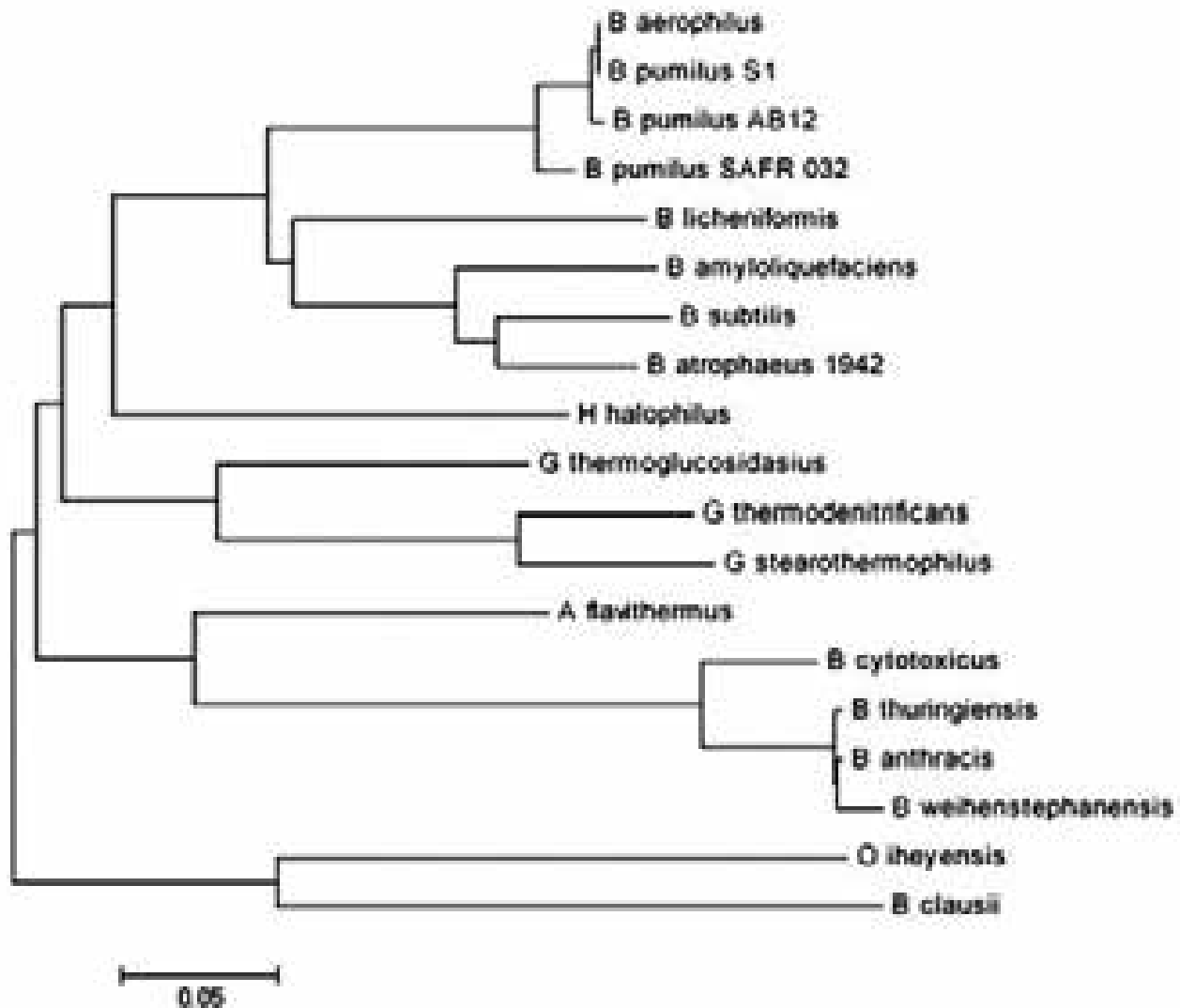
B. pumilus, which survives in absolute anaerobiosis was selected for isolating aldolase gene for characterization. Fructose 1, 6 bisphosphate Aldolase, a key intermediate of glycolysis, splits fructose 1, 6 bisphosphate to two 3 carbon molecules viz. glyceraldehyde 3 phosphate and its isomer dihydroxyacetone phosphate which is again converted to glyceraldehyde 3 phosphate. The fructose 1, 6 bisphosphate Aldolase gene from *B. pumilus* was cloned in pET-SUMO expression vector and expressed in *E. coli* BL21 (DE3) cells. The aldolase activity of the recombinant clone was assayed at 240 nm for formation of hydrazone with glyceraldehydes 3 phosphate. The crude enzyme showed a specific Aldolase activity of 9.95 U/mg and was stable for 10 min. at 50 and 60 °C.

Cloning, expression and characterization of L-Lactate Dehydrogenase gene of *Bacillus pumilus*

Fermentation of sugars plays a crucial role in plant survival under anoxia. Therefore Lactate dehydrogenase is a candidate gene for genetic engineering for anoxia tolerance. *Bacillus pumilus* strain AB 12, a facultative anaerobe isolated in the study, tolerated absolute anaerobiosis. Lactate dehydrogenase which catalyzes the inter-conversion of pyruvate and lactate with concomitant inter-conversion of NADH and NAD⁺, converts pyruvate, the final product of glycolysis, to lactate when oxygen is absent or in short supply. Lactate dehydrogenase gene of *B. pumilus* AB12 was cloned, expressed and characterized.



SDS-PAGE analysis of L-LDH expression in *E. coli*. Crude enzyme preparations extracted after 4 hours, 5 hours and 6 hours of induction with 0.8mM IPTG; from pET-SUMO vector carrying L-LDH gene of *Bacillus pumilus* expressed in *E. coli* BL21(DE3) cells are compared with their respective control experiments (4c, 5c and 6c respectively). The fusion protein LDH-SUMO is observed as a prominent 45kDa band in the crude enzyme extracts 4i, 5i and 6i



The phylogenetic tree analysis of Lactate dehydrogenase protein sequences using MEGA programme

The enzyme activity assay of recombinant fusion LDH by determining NADH depletion at 340nm revealed an activity of 20.062U/mg which is 692-fold increase in comparison with control. The molecular weight of LDH enzyme produced as SUMO fusion protein was confirmed by SDS-PAGE analysis and compared with the calculated molecular weight. The nucleotide and deduced amino acid sequences of LDH gene was analyzed with its genetic neighbours to identify conserved residues and to understand the phylogenetic relationship between them.

Deduced amino acid sequence revealed that the LDH gene encoded protein with 315 amino acids and it belongs to NADB Rosmann superfamily. The LDH protein has a calculated PI value of 4.95 and a molecular weight of 34.9 kDa. The calculated molecular weight was in agreement with the SDS-PAGE analysis; and with the previous reports on characterization of bacterial Lactate dehydrogenase genes. The nucleotide sequence of *B. pumilus* AB12 has 98% similarity with

reported sequences of *B. pumilus* S1 and *B. aerophilus*. Lactate dehydrogenase enzyme sequence of *B. pumilus* showed high sequence homology with the amino acid sequence of *B. aerophilus* and this gene is conserved among genus *Bacillus*. The sequence of LDH gene reported in the study have several base substitutions with that of reported sequences in GenBank, resulting in altered amino acid sequence of the translated proteins.

Submission to databases

16S rRNA gene sequences of 19 anoxia tolerant bacteria were submitted to the GenBank and were assigned the accession numbers viz. JQ993877- JQ993883 and JX188065- JX188076.

Oceanic tuna fisheries of Lakshadweep seas - A value chain approach

Funding Agency: National Agriculture Innovation Project (NAIP)

Principal Investigator
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Co-Investigators
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Dr. Suseela Mathew
Dr. J. Bindu
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Project Staff
Shri K.V. Aneesh Kumar
Shri P.S. Khanolkar
Shri T.R. Ananthanarayanan
Shri C.T. Nithin

Large scale production of "Silo Feed"

Large scale production of Silo feed based on the waste of oceanic tuna has been completed and 100 kg of feed was supplied to the Directorate of Coldwater Fisheries Research Field Centre at Champawat. Feeding trials on Rainbow trout is being conducted and the



'Silo feed' feeding trials

production of the feed was demonstrated to 40 participants during the training programme on 'Development of value added products' conducted by CIFT, Cochin in association with DCFR Field Centre, Champawat. According to them, results of the trial for first six months has shown higher growth prospects and good feed conversion ratio.

Effect of pulse light treatment on Yellowfin tuna steaks

Pulsed light treatment for Yellowfin tuna (*Thunnus albacres*) with different packing materials was undertaken and it was found that bacterial reduction was maximum in steaks packed in cast polypropylene pouches. Studies were also conducted by varying the time in sec. and a pulse treatment for 6 sec. with an energy output of 11.5 J/cm² was found to be acceptable with regard to microbiological and sensory attributes.

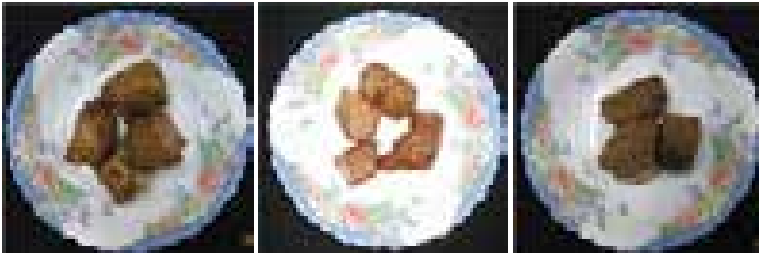
Effect of hurdle technology combined with pulsed light treatment on Yellowfin tuna steaks

Yellowfin tuna steaks were given dip treatments with sodium acetate and potassium sorbate and then packed in 300 gauge cast polypropylene pouches. The packed samples were pulsed for 6 sec. which gave an energy output of 11.5 J/cm². The effect of pulsed light treatment alone and the combined effect of chemical with pulsed light treatment had an additional shelf life extension of 13 days when compared to the control sample which was rejected after 13 days. The colour of the pulsed treated samples was retained throughout the storage period.

Characteristics of hot smoked, cold smoked and liquid smoked Yellowfin tuna chunks during chilled storage

Liquid smoked chunks showed slightly higher moisture content than hot smoked and cold smoked steaks. Salt content was estimated to be 2.10%. Liquid smoked Tuna showed higher peroxide value compared to Tuna treated by the other two methods. Due to the possible leaching out during the soaking process in liquid smoke, chunks treated with liquid smoke showed lower TBA value. The L* colour values in

cold smoked Tuna decreased during storage, an increasing trend was observed in the case of hot and liquid smoked Tuna. Slight increase in a^* value of cold smoked and liquid smoked Tuna was observed; in hot smoked Tuna a decreasing trend was seen. b^* value decreased in cold and liquid smoked Tuna while opposite trend was observed in hot smoked Tuna. The hot smoked Tuna had higher hardness compared to others. Overall acceptability was higher for hot smoked Tuna followed by cold and liquid smoked Tuna.



Hot smoked Tuna Cold smoked Tuna Liquid smoked Tuna

Spray application of liquid smoke on physico-chemical and microbiological changes of Catla fillets

The effect of spray application of commercial liquid smoke on the microbial, textural, biochemical and sensory properties of Catla

(*Catla catla*) fillets was evaluated. Catla fillets were soaked in 5% brine solution for 30 min. and then divided into three lots. One set was packed in pouches of size 15 x 22 cm made of 12 m polyester laminated with 300 gauge low-density polyethylene and kept as control and the remaining fillets were sprayed with diluted commercial liquid smoke (Red Arrow International) for 2 h in a smoker (Kerres CS700EL) with a flow rate of 1.5 l/h. The fillets were then surface dried. One set of the fillets were vacuum packed and rest were air sealed. All the three lots were stored at 2 ± 1 °C. Results showed that the application of liquid smoke resulted in lowering the total microbial count and improved the textural properties. Biochemical parameters such as total volatile base-nitrogen (TVBN) and Thiobarbituric acid (TBA) value were found to be lower in liquid smoke treated fillets during the storage period. Liquid smoke treated fillets showed superior shelf life than control.

Studies on high pressure processing (HPP) of high value perishable commodities

Funding Agency: National Agriculture Innovation Project (NAIP)

Principal Investigator
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Co-Investigators
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Project Staff
Shri Ginson Joseph
Shri C.K. Kamalakanth

Standardization of process parameters for Yellowfin tuna steaks using response surface methodology



High pressure treated Tuna chunks and control

Optimization of high pressure processing parameters like pressure and holding time at fixed ramp rate 600 MPa for Yellowfin tuna (*Thunnus albacares*) steaks was done using response surface methodology (RSM). Pressurization of Tuna chunks was done at 129, 150, 200, 250 and 270 MPa and hold time (1, 3, 6, 9 and 10 min.) at fixed ramp rate of 600 MPa. Tuna steaks vacuum packed in EVOH multilayer film and a combination of pressure (129, 150, 200, 250 and 270 MPa) and holding time (1, 3, 6, 9 and 10 min.) at fixed ramp rate 600 MPa were given. The effect of different levels of process parameters on the dependent

variables like total plate count (TPC), deoxymyoglobin, oxymyoglobin, metmyoglobin, colour (L^* , a^* and b^*) and hardness in Tuna steaks were studied. Among the treatments 200 MPa with a holding time of 5 min. was optimum.

Shelf life evaluation of high pressure processed Yellowfin tuna chunks during chill storage

Fresh Tuna chunks were vacuum packed in EVOH pouches and subjected to high pressure treatment of 200 MPa with a holding time of 5 min. and immediately stored in iced condition for shelf life evaluation and control was kept without any pressure treatment. Physico-chemical parameters like pH, thiobarbituric acid (TBA), free fatty acid (FFA), colour (L^* , a^* and b^* values), texture, myoglobin, metmyoglobin content, and microbiological parameters including total plate count, psychrophilic count, H_2S forming bacteria and proteolytic count were studied at regular intervals. pH, FFA, hardness and percentage of metmyoglobin had increased after HP treatment whereas TBA and all microbiological counts were reduced after HP treatment. L^* and b^* values were higher for pressure treated samples whereas a^* value was less compared to control. Control was to be rejected on 20th day of storage and treated sample was found to have a shelf life of 28 days.

Shelf life evaluation of ready to cook condiment-incorporated products from prawns

Peeled and undeveined prawns were mixed with 2% chilli powder, 1.5% salt and 0.1% turmeric and packed in EVOH pouches and subjected to pressure levels of 200, 250 and 300 MPa. The products were stored at 2 ± 1 °C for shelf life studies. The samples were periodically analyzed for pH, TBA, TVBN, FFA, TPC and organoleptic qualities. 250 MPa showed better acceptability and had a shelf life of 35 days.



Control and HPP treated condiment-incorporated prawn

Storage study of high pressure processed shucked oyster

Live oyster was shucked and packed in EVOH multilayer film and subjected to pressure levels of 300 MPa with a holding time of 5 min. at 25 °C. The treated samples were stored at 2 ± 1 °C. The samples were evaluated for pH, TBA, FFA, TMA, TVBN and TPC. Results indicated that pH of control and treated sample increased. TBA value was high for treated sample. FFA values increased for control and for pressure treated samples. TMA values were higher for 300 MPa pressure treated sample. TVBN values were lower for pressure treated sample and showed an increasing trend during the storage period. TPC was reduced after HP treatment. Microbiologically control was rejected on 15th day of storage and 300 MPa treated sample was rejected at 28th day of storage.



Pressure treated oyster meat

Effect of high pressure treatment on prawn curry

Prawn curry was prepared as per the standard recipe and 100 g curry packed in EVOH pouches. It was then subjected to 100, 250 and 400 MPa pressure treatments with a holding time of 5 min. A control was also kept without pressure treatment. Samples were stored at 2 ± 1 °C and analyzed for microbiological and organoleptic characteristics. Control had an initial bacterial load of 2.2 Log_{10} cfu/g and for 100, 250 and 400 MPa it was 1.8, 1.33 and 0.8 Log_{10} cfu/g respectively. Organoleptically there was no significant difference in the high pressure treated prawn curry at lower pressures. However the texture of the 400 MPa treated prawn was slightly harder.

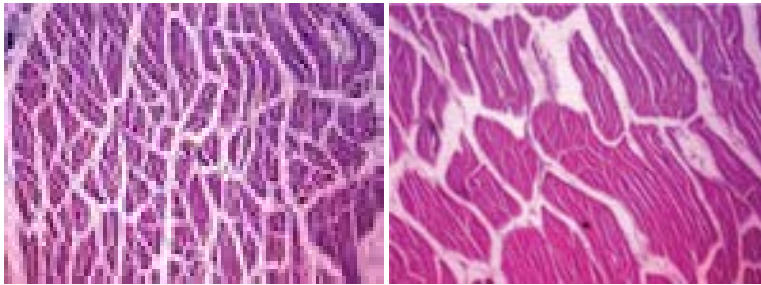


Prawn curry - Control and pressure treated

at 2 ± 1 °C and analyzed for microbiological and organoleptic characteristics. Control had an initial bacterial load of 2.2 Log_{10} cfu/g and for 100, 250 and 400 MPa it was 1.8, 1.33 and 0.8 Log_{10} cfu/g respectively. Organoleptically there was no significant difference in the high pressure treated prawn curry at lower pressures. However the texture of the 400 MPa treated prawn was slightly harder.

Effect of HP treatment on microstructure of Indian white prawn

Raw and high pressure processed shrimp (*Fenneropenaeus indicus*) samples were subjected to Scanning Electron Microscopy (SEM) analysis to determine the changes in their microstructure induced by HPP. Micrographs of the pressure treated samples showed shrinkage of muscle fibres and the boundary of muscle fibres was not clear. The possible reason for this is that during high pressure processing there is excessive strain in the membranes leading to loss of tissue integrity. No cracks in the tissues appear during storage and muscle remained more compact than for the control sample. The 250 MPa treated muscle showed a firmer texture than untreated sample. In HP treated sample fibres look tightened and round. This observation is attributed to the fact that the extracellular space decreases when pressure increases, in relation to the compaction of muscle and the possible protein gel network formation which leads to a higher hardness value.



Microstructure of control prawn and 250 MPa treated prawn

Optimization of process parameters for high pressure treatment of Giant freshwater prawn

The effect of high pressure processing parameters like pressure and holding time on physico-chemical and microbiological variables

of Macrobrachium rosenbergii was optimized using response surface methodology. HL prawns were vacuum packed in EVOH multilayer film for pressure treatment. The effect of treatment combination of 200, 400 and 600 MPa pressure and 2, 5, and 8 min. holding time at fixed ramp rate 400 MPa on trimethyl amine, total volatile nitrogen, free fatty acid, hardness, colour values and total plate count were studied. M. rosenbergii treated at 350 MPa pressure and 5 min. holding time was found to be of good quality with respect to the physico-chemical and microbiological response variables. Thus, the optimum combination of process parameters was 350 MPa pressure and 6 min. holding time.

Mobilizing mass media support for sharing agro information

Funding Agency: National Agriculture Innovation Project (NAIP)

Principal Investigator
Dr. S. Ashaletha

Project Staff
Shri Aswin Antony

The main focus of the Project is to strengthen the liaison with the media for disseminating the research findings to the grass root level. During the period under report 28 news reports were published in different newspapers like Malyala Manorama, Mathrubhumi, Madyamam, Desabhimani, The Hindu, Times of



News report in print media

India, Deccan Chronicle etc.

All India Radio supports the Project by giving scientist's interviews, informations for farmers, farm related news etc. During the year interview of three scientists were broadcast through AIR.

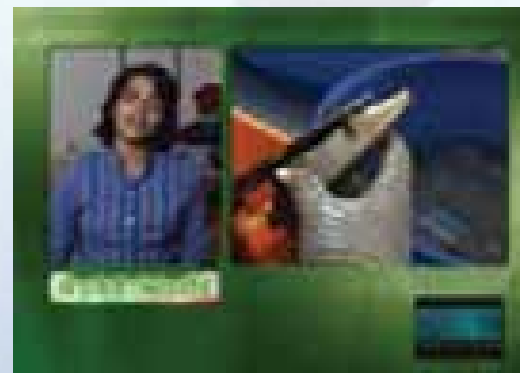
Nine posters for disseminating the CIFT

technologies were prepared for distribution.

During the year four video films were produced on topics such as 'Women empowerment', 'Fresh fish vending' and 'PUFA enriched chicken', which are successful technologies of another NAIP funded project and on 'Maize de-husking technology' by DWRA, Bhubaneswar. Another video of 20 minutes duration on Business model of seafresh vending units was telecasted 12 times through the Green Reporter programme of India Vision Channel.



Posters designed



Green Reporter programme

'Krishi Darpan -2013'

The Project organized a Technology Expo cum Farmers' Mela "Krishi Darpan -2013" on 27 March, 2013 at Municipal Town Hall, Ernakulam. During the inaugural session, the guests were welcomed by Dr. S. Ashaletha, Senior Scientist & Project Leader, who explained the purpose of conducting the programme and importance of media support for technology dissemination. Adv. V.D. Satheesan, MLA inaugurated the programme. Shri Salim Kumar, Malayalam Cine Artist was the Chief Guest who also released a music CD on Women Empowerment on the occasion. Smt. Valsala Prasanna kumar, Chair person of Paravur Municipality presided over the function. Dr. T.K. Srinivasa Gopal, Director, CIFT, Smt. C. R. Sathya



Music Video CD

vathy, Joint Director of Fisheries, Govt. of Kerala and Shri K.A. Vaidyanandan, Councillor, Paravur

Municipality offered felicitations. Dr. S. Balsubramaniam, Head, EIS Division, CIFT proposed vote of thanks.

During the programme, exhibition pavilions involving the Research Institutes under ICAR, Commodity Boards, NGOs and Self-Help Groups who offer technology support for the farming community participated and displayed their technologies and programmes. The scientist-farmer interaction 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 first hand information on problems of farmers.



Inauguration of Krishi Darpan-2013



Release of Music Video

Utilization strategy for oceanic squids (cephalopods) in Arabian sea - A value chain approach

Funding Agency: National Agriculture Innovation Project (NAIP)

Principal Investigator

Dr. K.S. Mohamed (CMFRI, Cochin)

Co-Investigators

Dr. K.K. Asha

Shri M.V. Baiju

Project Staff

Kum. K.R. Remyakumari



Freeze dried Oceanic squid ink powder



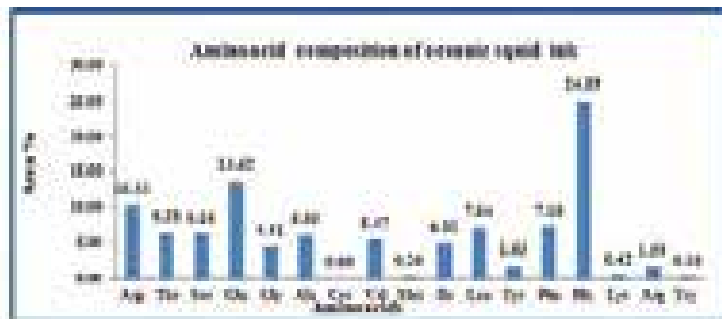
Oceanic squid ink

Biochemical evaluation of Oceanic squid ink

Proximate composition of Oceanic squid ink samples (g%) revealed a moisture content of 75.39%, ash - 5.24%, protein - 16.16% and fat - 1.01%.

Amino acid content of Oceanic squid ink

Amino acid content of the Oceanic squid ink was analyzed using the method described by Ishida et al. (1981). Histidine and some hydrophobic amino acids like Leucine, Valines etc. are associated with antioxidant potency and these are found to be high in Oceanic squid ink which indicates its importance as a medicine.



Amino acid profile of Oceanic squid ink

Mineral content of Oceanic squid ink

Mineral profile revealed potassium as the highest one (581.20 mg/100g ink) followed by sodium and calcium.



Minerals profile of Oceanic squid ink (mg/100g)

Fatty acid profile of the Oceanic squid ink

Important fatty acids like EPA and Oleic acid are found to be in

high amount in Oceanic squid ink. As the commercial world is increasingly becoming aware of significance of marine bioresources and associated traditional knowledge to find out drugs for the still incurable diseases, there is a gold rush for utilization of marine bioresources. The results of the study show that Oceanic squid ink contains significant levels of essential amino acids and fatty acids like poly unsaturated fatty acids particularly EPA in balanced proportions. It also contains macro elements in significant proportions which are all essential for human well-being.

Fatty acid profile of the Oceanic squid ink

Fatty acid	Total fatty acids (%)
Myristic acid	2.02
Palmitic acid	13.03
Palmitoleic acid	1.20
Heptadecenoic Acid	5.22
Stearic acid	1.66
Oleic acid	29.86
Arachidonic acid	13.42
Eicosapentaenoic acid	20.59
Docosahexaenoic acid	1.73
Others	9.27

Resource assessment of deep sea fishes along the continental slope of Indian EEZ and the central Indian Ocean

Funding Agency: Centre for Marine Living Resources & Ecology (CMLRE)

Principal Investigator
Dr. U. Sreedhar

Co-Investigators Dr.
Suseela Mathew Dr.
G. Rajeswari
Dr. R. Raghu Prakash

Deep sea resources from various zones

Data collected during various deep sea fisheries expeditions of Fisheries and Oceanographic Research Vessel (FORV) Sagar Sampada was analyzed. Random sampling method was used for surveying the deep sea resources in the present investigation. Deep sea demersal trawling was conducted in more than 100 stations in depths ranging from 50m to 1100m along the Indian EEZ.

Teleosts were represented by 121 species belonging to 65 families and 21 orders. The Elasmobranchs were few in number; they consisted

of 17 species belonging to 11 families and six orders. Crustaceans consisted of 10 species belonging to seven families and one order. Cephalopods were represented by seven species belonging to six families and five orders. The catch per unit effort (CPUE) was 103.78kg/h. South west coast dominated the catches with about 59% of the total catch. Second dominant zone is the east coast contributing 37% of the

total catch. The catch from Andaman coast was very low representing only 4% of the total catch.

Resources from various depth zones

Analyzing the results with regard to various depth zones, it is observed that the CPUE obtained from shallow waters was superior when compared to the deeper regions. A greater CPUE of 455.54kg/h was observed from 50-99m depth zone followed by 324.73kg/h from 100-199m depth zone. The other notable CPUE obtained was from 200-299m (160.83 kg/h) and 700-799m (87.45kg/h) depth zones. A reasonable CPUE is recorded from 800-899m (37.18kg/h), 400-499m (37.49 kg/h), 300-399m (43.25kg/h), 500-599m (61.88kg/h) and 600-699m (74.13kg/h) depth zones. A very low CPUE of 14.80kg/h and 1.06kg/h was recorded from 1000-1099m and 900-999m depth zones respectively.

Bathymetric analysis was conducted on 107 species out of the total 155 species caught. COG and HW values are used in establishing the bathymetric distributions. In the present study the COG values of some species (*O. ruber*, *P. niger*, *U. vittatus*, *S. tumbil*, *D. russelli* and *N. japonicus*) were restricted to ≤ 200 m of depth. In most of the species the COG values were observed above 200m of depth. Among all the species *E. radcliffei* has shown a widest HW value ranging from 50m to 950m depth. The other species with wide distribution of HW values are deep sea species like *Coraphenoides* sp., *G. taeniola*, *S. oualniensis*, *N. pinnata*, *A. alckoci*, *A. bicolor* and *E. pusillus*. The highest actual sampling depth in the study is 1070m, but HW values of some deep sea species like *E. pusillus*, *B. melanobranchus*, *Normichthys* sp. and *Narcetes* sp. are observed to be distributed beyond the maximum sampling depth.

Deep sea diversity parameters of these values pertaining to different depth zones and latitudes were estimated. An analysis of the numerical abundance at 50-99m depth zone revealed that the index values from the east coast had slightly increased from lat. 19°N-20°N to 20°N-21°N. Two latitudes i.e., 13°N to 14°N of south west and lat. 20°N to 21°N of east coast were compared at 100-199m depth zone. It is observed that the diversity and evenness were less in south west, whereas species richness was lower in east coast. The latitudes from 9°N to 14°N of south west coast were compared with lat. 18°N to 19°N of east coast at 200-299m depth zone. Similarly the diversity parameters are computed using the biomass (kg/h) data. In

the depth zone of 100-199m, the values of species diversity in lat. 20°N to 21°N of east coast are higher than values in lat. 13°N to 14°N of south west coast, whereas species richness is very high in lat. 13°N to 14°N of south west coast than in lat. 20°N to 21°N of east coast.

Feeding intensity studies

Feeding intensities were estimated for different species. *P. cyanea* (23.26) has shown the maximum feeding intensity followed by *P. hamrur* (17.74) and *A. lesueruii* (15.85). Feeding intensities are observed to be very low in other deep sea fishes. Among the species with low intensities, *C. invetogatoris* exhibited the lowest (1.80).

Sex ratio of deep sea fishes

Sex ratios were computed for the various deep sea species. The ratio between males and females are differing from species to species. Dominance of females is observed in *A. lesueruii*, *C. invetogatoris* and *G. teniola*. Males dominated in *A. bicolor*, *B. caudimaculata*, *E. radcliffei* and *L. exutus*. Male and female almost equally represented in *C. macrolophus*, *P. hamrur* and *P. cyanea*. Data on length frequency distribution the maximum and minimum lengths and weights of 30 deep sea species were also calculated. The exponential (b) values analyzed for these species varied from minimum of 2.316 (*G. teniola*) to maximum of 3.510 (*L. exutus*). In the present study, deep sea eels like *G. teniola* (b=2.316) and *X. trucidance* (b=2.772) exhibited acute negative allometric growth, whereas stout fishes like *L. exutus* (b=3.510) exhibited acute positive allometric growth.

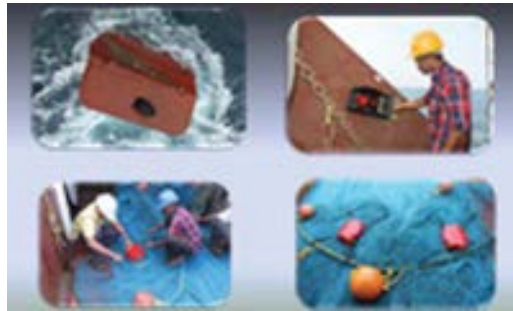


Deep sea catch from central Indian Ocean

In Cruise No. 291, it was observed that Cephalopods (Cuttlefish, Squid and Octopods) which are exclusively marine species were distributed in various depths of the oceans. Seven species of (Squids - 5 sp. and Octopods - 2 sp.) were recorded during the survey. The identified squids are *Ancistrocheirus lerueuri*, *Ommastrephes* sp., *Vampyroteuthis* sp. and octopods were *Cistopus indicus*. The remaining was unidentified.



Gear parameter studies were conducted in Cruise No. 291 of FORV Sagar Sampada using the Simrad III system available on-board. Two brackets were installed on the existing otter boards which lodged the



Gear parameters studies

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 floats were attached to counter the 6kg weight of the sensors. The study indicated that vertical opening of the net is greatly affected at deeper waters (Beyond 700m) with the same parameters which were used for trawling 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. There is a need for further studies to address this issue.

Studies on bioactive compounds

Presence of ether lipids (1-O-hexadecyl glycerol) was noted in the liver oils of the long-nosed Ratfish *Neoharriotta raleighana* (30% of the unsaponifiable matter of the oil). Ether lipids are important anti-tumour and anti-inflammatory agents. Presence of unusually high amounts of vitamin E was found in the liver tissues of the same Ratfish (4% of the tissue) which is very high when compared to their presence in natural food sources like nuts, green leafy vegetables etc. The role of vitamin E as an anti-oxidant and anti-ageing agent needs no mention. Presence of considerable amounts of long chain n-3 poly unsaturated

fatty acids (LC-PUFAs - EPA and DHA) in the liver oils of the Ratfish were also observed. Substantial amounts of squalene were quantified in the liver oils of the Dogfishes (*Centrophorus scalpratus* and *Centroscyminus crepidater*) as 68 - 76 % of the unsaponifiable matter. Squalene acts as a precursor for the synthesis of various steroids within the body that could possibly reduce an inflammation. Moreover, the role of squalene as a quencher of free radicals and reactive oxygen species (ROS) cannot be ignored.

Occurrence of Vampire squid in Bay of Bengal

A giant Vampire squid (*Vampyroteuthis infernalis*) weighing about 6 kgs was found at the depth of 786m in lat 18 °50'N, 85 °23'E . The Vampire squid is actually a detritus gobbler, skimming the oceans for any kind of remnants from crustacean eyes and legs to larvae poop. The Vampire squid is the single living representative of the cephalopod group known as the Vampyromorpha. It is a small (mantle length of 13 cm), gelatinous species that occurs in mesopelagic to bathypelagic depths (typically between 600 and 1200 m) in temperate and tropical waters of the Pacific, Atlantic, and Indian Oceans. At these depths, sunlight is limited or entirely absent, oxygen content is low, and temperatures range from about 2° to 6 °C.

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

Funding Agency: Centre for Marine Living Resources & Ecology (CMLRE)

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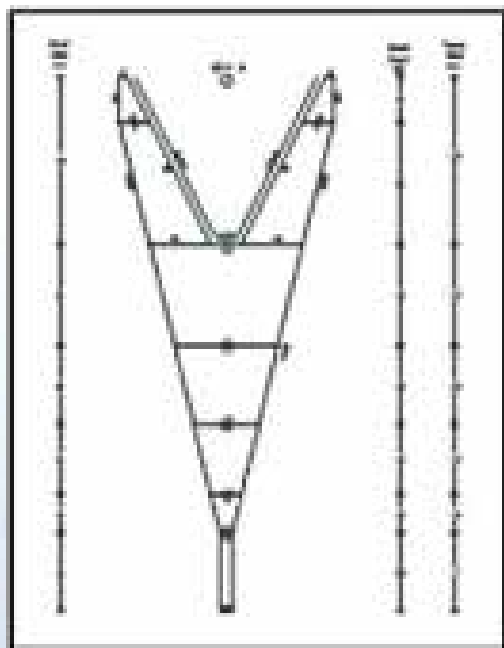


Shri R. Navaneethan Shri
M.M. Lijin Nambiar Shri
Rahul Ravindran

The Project became operational in October, 2012. During the period under report, manpower allocated for the Project was recruited and stores procurement initiated. Performance evaluation of 45m myctophid trawl was carried out on-board FORV Sagar Sampada and a new for equal panel 28.4 m myctophid trawl was designed for commercial operation from the deep sea shrimp trawlers from Mangalore and Kollam.

Myctophid trawl for commercial deep sea operation

A new 28.4m four equal panel myctophid trawl was designed by scaling down the CIFT designed 45m myctophid trawl, considering the biological characteristics and behaviour of myctophids, fishing conditions and available towing force of typical commercial deep sea trawler as well as CIFT Research Vessel Matsyakumari II. Procurement of the netting and fabrication of the net will be completed soon. Performance evaluation of the newly fabricated nets will be conducted along the south west coast of India.



28.4m four equal panel myctophid trawl

Performance evaluation of 45 m myctophid trawl on-board FORV Sagar Sampada

Performance evaluation of the newly fabricated four equal panel 45 m myctophid

trawl was done from FORV Sagar Sampada during the period 12 February -2 March, 2013 (Cruise No. 313) along 18°-20° N latitude and 65°-68° E longitude at a depth range of 2395 - 3185 m. Dr. K.K. Prajith, Scientist and Shri Sukumaran, Tech. Officer (T-5) were the scientific complements from CIFT along with other Scientists from CMLRE, CMFRI and CUSAT. Acoustic surveys of nine stations were performed using SIMRAD EK60 and EA60 with transducers 38 KHz and 120 KHz.



Benthosema fibulatum



Diaphus thiollieri



Bolinichthys sp.

Major myctophid species landed during trial fishing

Preliminary observations showed that four species of myctophids viz., Benthosema pterortum, B. fibulatum, Diaphus thiollieri and Bolinichthys sps. were the major species comprised in the catch. B. fibulatum was observed in four stations among the nine stations surveyed and D. thiollieri was observed in three stations. D. thiollieri was contributed significantly in large quantity than other myctophid species to the total catch from all stations. More trials are required on-board Sagar Sampada after the repair of the vessel and all the deck machineries are made operational.

Biochemical analysis of myctophids

Proximate composition of two species of myctophids viz., D. thiollieri and B. fibulatum, collected during February 2012 from the catch of FORV Sagar Sampada cruise, were analyzed using standard methods. The results revealed that D. thiollieri and B. fibulatum showed a substantial amount of protein viz; 15.04% and 14.22% respectively. The fat content was high in D. thiollieri (7.20%) compared to B. fibulatum (6.21%). Moisture content and ash content was found as 76.9% and 2.51% in B. fibulatum while in D. thiollieri it as 76.78% and 1.68%, respectively.

Fatty acid profile of Diaphus thiollieri

Fatty acid profile of D. thiollieri showed that the species have a higher Poly unsaturated fatty acid (PUFA) content. The fatty acid composition of D. thiollieri consists of Saturated fatty acid (SFA) - 31.54%, Mono unsaturated fatty acid (MUFA) 21.18% and Poly unsaturated fatty acids (PUFA) - 46.35%. Among the saturated fatty acids, palmitic acid was present in higher level (19%). In the mono unsaturated fatty acids, oleic acid was the prominent one (11.05). Within PUFA, Docosahexanoic acid (DHA) was present in a higher amount (32.5%) followed by Eicosapentanoic acid (EPA) - 6.73%.



Comparison of fatty acid components of oil extracted from *Diaphus watasei* and *Sardinella longiceps*

The fatty acid components viz; SFA, MUFA and PUFA of oil extracted from the myctophid species (*Diaphus watasei*) collected from the bycatch of deep sea shrimp trawlers operating off Kollam and Cochin coast were compared with that of Indian oil sardine (*Sardinella longiceps*). The total oil content was found to be more in *S. longiceps* (172.93 g kg⁻¹ on wet weight basis) than *D. watasei* (152 g kg⁻¹). SFA and PUFA were found in comparatively higher amount in sardine oil than the oil extracted from *D. watasei*, but MUFA content were found higher in the later. The fatty acid composition of *D. watasei* oil consists of SFA-37.49%, MUFA- 42.49% and PUFA-14.07% where as in sardine oil; the SFA, MUFA and PUFA were found as 42.17%, 23.61% and 30% respectively.

Comparison of SFA, MUFA and PUFA contents in *Diaphus* and Sardine oil

Saturated fatty acids like palmitic acid and stearic acid were found in comparable quantity in both the species and stearic acid was present in significantly higher level in *D. watasei*. Among the PUFA, DHA (Docosahexaenoic acid) which play a major role in counteracting various disorders and diseases related to ageing, was found in significantly higher amount in *Diaphus* oil than sardine oil. Presence of significantly higher level of DHA, *D. watasei* may be considered as a viable source for the extraction and purification of DHA, which is essentially required for the development of fetus brain and retina during pregnancy.

Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications

Funding Agency: Centre for Marine Living Resources & Ecology (CMLRE)

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Co-Investigators Dr.
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R. Anandan
Dr. K.K. Asha
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Project Staff Shri
B.P. Bijulal Shri
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Kum. N.B. Jayasree

Four Junior Research Fellows sanctioned under the Project have been recruited by conducting a Walk-in-interview and the selected JRFs joined for duty on 18 February, 2013. The Project work has been initiated, by imparting training to the newly joined Research Fellows on various aspects of analytical methodology on extraction, purification of marine samples for marine biomolecules etc. The bioactivities of the marine biomolecules are being studied. Upon isolation of the bioactive compounds, they will be incorporated in some nutraceutical products which is presumed to be developed from marine resources.

The Research Fellows presented a seminar talk on the topic of

their choice relevant to the Project. As the release of funds is still awaited, work could not be reached in full swing. However, the work has been started by drawing samples, particularly marine algae, sponges, chanks, coral fishes and other deep sea fishes, from Cochin fisheries harbor and from Mandapam, Tamil Nadu. The samples are being analyzed for various aspects, including their characterization.





Characterization of harmful algal blooms along Indian coast

Funding Agency: Centre for Marine Living Resources & Ecology (CMLRE)

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Co-Investigators
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"Characterization of harmful algal blooms along Indian coast" is a research project implemented as part of the Monitoring and Modeling of Marine Ecosystem (MMME) under the Marine Living Resources Programme (MLRP) during the 12th Plan Period. The five year project aims at the collection of harmful algal bloom (HAB) species for toxin characterization along the coastal waters of India.

HABs are considered as an environmental hazard because these events can make people sick when contaminated shellfish are eaten, resulting in the closure of shellfish beds, massive fish kills, death of marine mammals and seabirds, and alteration of marine habitats. Toxins associated with HABs are Saxitoxin, Brevetoxin, Domoic acid, Okadaic acid and Ciguatoxins. These are neurotoxins responsible for Paralytic Shellfish Poisoning, Neurotoxic

Shellfish Poisoning, Amnesic Shellfish Poisoning, Diarrhetic Shellfish Poisoning and Ciguatera Fish Poisoning, respectively. Hence HAB events adversely affect commercial and recreational fishing, tourism, and valued habitats, creating a significant impact on local economies and the livelihood of coastal residents.

Our approach to research on HABs and biotoxins recognizes three broad categories of research. It includes:

1. Extraction, purification, screening and characterization of HAB toxin from marine resources
2. Elucidating the HAB toxin data in Indian Ocean as well as to evaluate the shellfish contamination situation in this area and to give scientific advice for local sea food safety.
3. Developing sensitive and specific detection methods and toxin standards

Since HABs and marine toxin outbreaks are largely unpredictable with our current state of knowledge, our research places a strong emphasis on developing fundamental understandings of the mechanisms of toxin production and distribution into our coastal living marine resources.

Isolation and characterization of collagen and gelatin from aquatic sources and development of pharmaceutical and food grade products of commercial importance

Funding Agency: Department of Biotechnology (DBT)

Principal Investigator
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Co-Investigator
Dr. George Ninan



Project Staff
Kum. K. Shiny
Kum. G.S. Hema

Collagen extraction from air bladder, skin and waste of *Johnius amblycephalus* fish

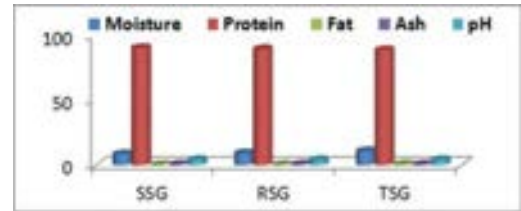
Acid Soluble Collagen (ASC) and Pepsin Digestible Collagen (PDC) were extracted from air bladder, skin and waste of *Johnius amblycephalus*. On wet weight basis the yield of ASC and PDC from skin are 8.96% and 7.68% respectively.



Extracted Collagen

Collagen yield from different fish skin

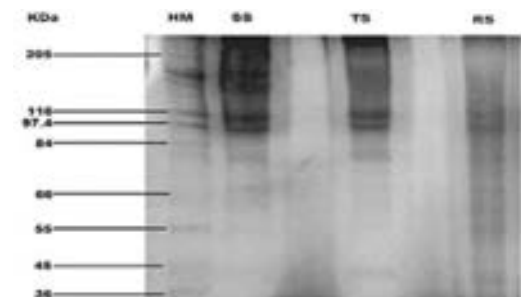
Collagen type	Yield (%) on wet weight basis
Air bladder ASC	17.45
Air bladder PDC	1.20
Skin ASC	7.82
Skin PDC	3.92
Waste ASC	2.71
Waste PDC	0.88



Proximate composition



Gel strength (Bloom)



Molecular weight distribution

Characterization of gelatin extracted from skin of Skipjack tuna (*Katsuwonu spelamis*), Dog shark (*Scoliodon sorrakowah*) and Rohu (*Labeo rohita*)

Protein was observed as the major component in all gelatin samples. Gel strength was highest in shark skin gelatin which is 206.67. According

to electrophoretic data $\alpha 1$ and $\alpha 2$ chains were observed as the major components for all samples with a molecular weight distribution of 97-116KDa. In the intestinal gelatin from Grouper and Queenfish there was no observable bands and that may be probably due to the microbial and intestinal enzymatic hydrolysis prior to the extraction. Since Queenfish skin gelatin showed good yield and functional properties among all samples, it was used for edible gelatin film preparation.



Extracted gelatin Jellied form Liquid form
Film prepared from Queenfish gelatin

Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala

Funding Agency: Department of Science and Technology (DST)

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Co-Investigators
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Dr. J. Charles Jeeva

Project Staff Kum.
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The three proposed interventions - culture of edible oysters, preparation of value added seafood products and net mending - were fulfilled in three identified women SHG groups at Moothakunnam in Ernakulam district and four women groups at Azheekkal in Kollam district.

The third phase of oyster culture was also completed in both sites. At both sites the harvest of oysters was done marking the end of the years edible oyster culture. Exquisite seafood delicacies prepared by women drew the attraction of public at the Seafood Fest organized at Kollam.

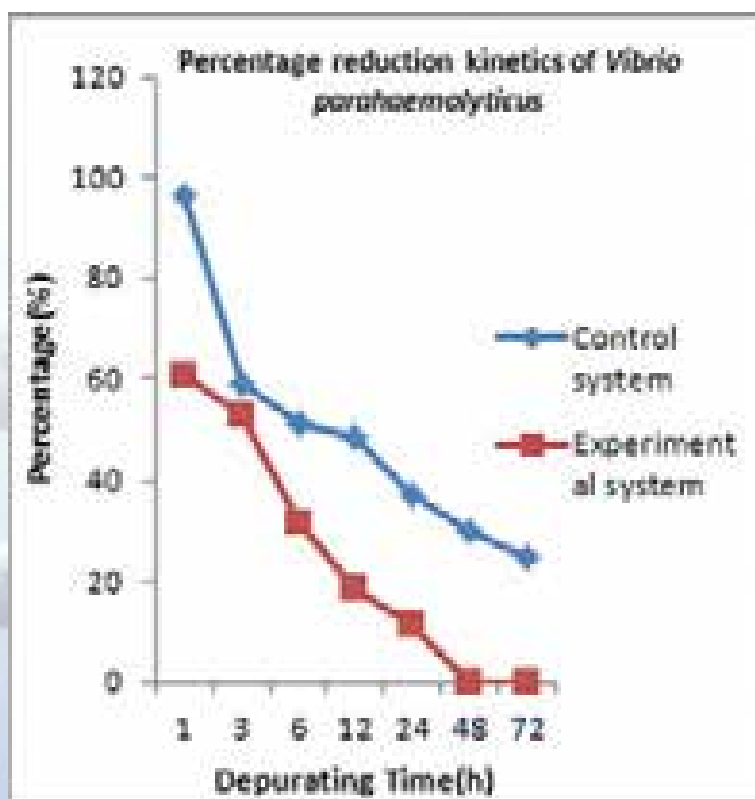
A field level demonstration and validation of depuration system for oysters was conducted at Moothakunnam. After demonstration women groups were allowed to depurate their farmed produce. A brief introduction on bio accumulation of bacteria of public health significance and consequent health problems associated with the consumption of oysters and need for depuration were imparted to the stakeholders. The newly designed system is

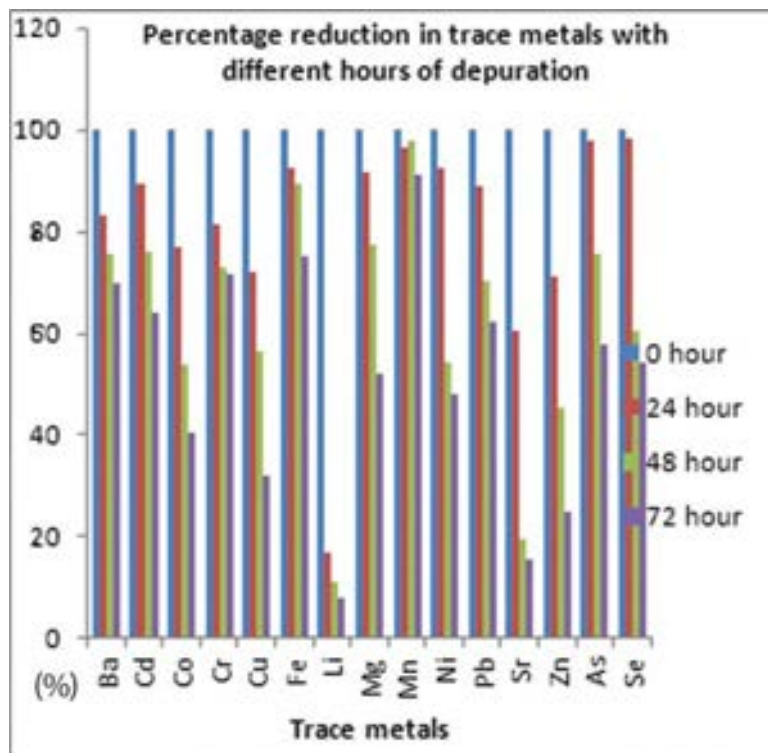
dominant over the existing depuration systems with a simple, cost effective and easy to handle design.

Under the Project, shelf life studies of some of the products were carried out. The quality evaluation and shelf life studies were conducted for a novel battered and breaded snack product named as 'Oyster Pablano Pepper Fitter' prepared from edible oyster (*Crassostrea madrasensis*) under chilled storage. The organoleptic, chemical and microbiological quality attributes were evaluated for the product both in Ready to Fry (RTF) and Ready to Eat (RTE) form under chilled storage. There was significant decrease in moisture and organoleptic scores on storage. The levels of other bio-markers like TMAN, TBAN, pH, TBA value, FFA value and PV showed significant increasing trend on storage



Project staff operating the depurating system





for both the RTF and RTE products. Sensory quality attributes of products decreased on storage and under chilled storage RTC samples got spoiled on 10th day and RTE products on 14th day as indicated by sensory scores.

Efficiency of depuration system was established by studying pathogen reduction kinetics bivalves. The bivalves are known for bio-accumulation of chemical contamination and they clearly indicate the pollution of the environment in which they habitat. The edible oyster, can be effectively used as a bio-monitoring organism for water quality evaluation. The efficacy of depuration system on the purging out of 16 trace metals viz. Barium, Cadmium, Cobalt, Chromium, Copper, Iron, Lithium, Magnesium, Manganese, Nickel, Lead, Strontium, Zinc, Arsenic, Silver and Selenium, from the body of cultured edible oyster, was evaluated by comparing the initial concentration with concentration of these trace metals after different intervals of depuration. The study showed a decrease in metal concentration in the edible portion of

oyster with duration of depuration. The study revealed that there was no significant reduction of trace metals ($P > 0.05$) after six hours of depuration. However after 72 hours of depuration there was significant reduction ($P < 0.05$) in all trace metals under study based on one way analysis of variance, though the percentage of reduction varies with metals. The same study also revealed that the mortality rate of oyster in depurated one is 13% less than the undepurated one kept under the same condition.

An awareness campaign was organized for the Self Help Groups (SHGs) at Moothakunnam, Ernakulam on 20 July, 2012. An informative talk on the topic "Food safety issues in bivalves" was delivered emphasizing the importance of food safety issues to maintain the quality of bivalve shellfish during consumption. The campaign's aim was to help the SHGs to upgrade their knowledge on food safety and also to make them aware about the problems that can be associated with the consumption of bivalve shellfish. During the campaign a booklet on "Oyster delight" was distributed to the stake holders. The booklet, is an attempt to increase consumer awareness and to popularize oyster products. With a view to create awareness among public on the importance of seafood safety and quality, a series of ten informative pamphlets were produced. The pamphlets are concise and it is believed that it would be much beneficial for the public and seafood entrepreneurs to unveil the facts behind seafood safety and quality and also to have an inquisitiveness on safe seafood handling practices.

Food safety interventions for women in fishery based microenterprises in coastal Kerala

Funding Agency: Department of Science and Technology (DST)

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Food safety is an upcoming issue and is very important to prevent food borne-illness from mis-handled food. Food is an important thing that determines health of a society or a nation and it is a tool to meet public health



Stake holders meet at Valiyaparamba



PI interacting with stakeholders in the field

goal. Safe food is produced by adhering to good hygienic practice, good manufacturing and good agricultural practice etc. Fish and shellfish are more likely to produce food borne-illness than any other category of food item. Fish products are perishable by nature and refrigeration alone cannot ensure the safety and quality of the product. Assuring safety of the consumer is possible only by practicing safety tools and guidelines.

Fishery provides a large food source as well as employment to the whole world. Both men and women are working in different fields of fishery (harvest and post harvest). There are many fishery-based microenterprises and self help groups all over in India and they are supplying fish both to domestic and international markets. Self help groups are small groups who provides employment and financial support to the workers without much capital investments. Many women are employed either as part time or full time worker and SHGs also uplifts the social living status of fisherwomen. But as far as they are concerned it is found that their knowledge about food safety is very poor. Awakening them with the importance and need of food safety is also very important. The Project envisages at improving the safety aspects in value added fish products.

The Project started on 8 November, 2012. The Project is to be implemented in three coastal districts of Kerala viz., Alappuzha, Ernakulam and Kasaragod. As part of the Project field visits were conducted for the selection of Self Help Groups at Kasaragod and Alappuzha. A stake holder meet was also conducted at Valiyaparamba in Kasaragod district.

Techno-economic feasibility of coconut wood canoes for the small-scale fisheries sector in the south west coast of India and Lakshadweep

Funding Agency: Coconut Development Board (CDB)

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Sruthi
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As a part of conducting a background study about techno-economic feasibility of introduction of coconut wood canoes in the small scale fisheries sector, two questionnaires were designed and baseline survey was

conducted in south west coast of India. The questionnaires were designed to collect data on demographic characteristics of small scale fisheries sector and operational details. The survey covered the economic aspects of wooden canoes, information on the small scale fisheries sector, dimensions of different types of craft, ownership pattern

of crafts used, types of wood used, preservatives used, operational details including duration of fishing, fishing area, number of days of fishing, average income from fishing etc. A separate questionnaire was designed to collect information on construction costs of wooden canoes, availability of wood, labour requirement, types of crafts constructed, number of man days required, and number of craft constructed per year, etc. The baseline survey was conducted in the south west coast of



Survey at canoe construction site



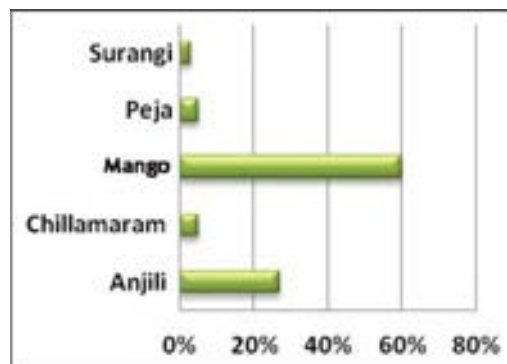
Pilot level wood preservation facility

India covering the states Kerala, Karnataka and Goa. All the coastal districts of Kerala, Karnataka and Goa were covered in the survey. Anjili (*Artocarpus hirsutus*), Peja (*Artocarpus heterophyllus*), Surangi (*Mammea suriga*), and Chillamaram (*Albizia sp.*) are the common wood species used in small wooden canoe construction.

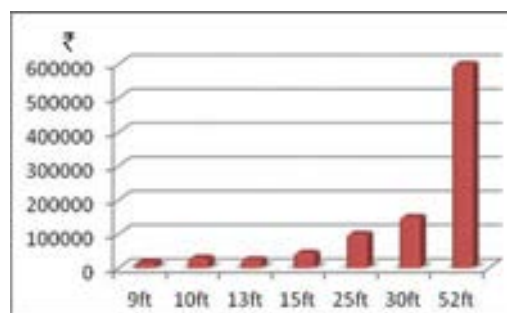
Coconut wood samples were procured from trees above 60 year for experimental purpose. Coconut wood was treated with different wood preservatives like Cashewnut shell oil (CNSL), Chromated Copper Arsenate (CCA) and Chromated Copper Borate (CCB) for retention studies. The different concentration of CCB was also used for getting higher retention. To increase the level of retention and penetration to the wood panels, vacuum pressure impregnation method was adopted and treatment conducted in the newly installed pilot level wood preservation facility available in the Fishing Technology Division. This method gives a uniform and higher retention of wood preservatives. The standardization of the treatment parameters are being done to achieve the specific retention.

According to the survey details Mango tree (*Mangifera indica*) is the most commonly used wood species for the construction of canoes.

Coconut wood samples were procured from trees above 60 year for experimental purpose. Coconut wood was treated with different wood preservatives



Species of wood used for canoe construction



Variation in the cost of wooden crafts

It is mostly preferred in the states of Karnataka and Goa. The second most popular species is Anjili (*Artocarpus hirsutus*) and is the commonly used wood species in Kerala for construction of canoes. Other species like Peja (*Artocarpus heterophyllus*), Surangi (*Mammea suriga*), and Chillamaram (*Albizia sp.*) are also used in different areas, but are not much popular among fishermen. The average cost of the wooden canoes varied from rupees one lakh for a 25 feet canoe to six lakhs for a bigger canoe with a length of 52 feet.

Gillnet was the most commonly used gear variety among wooden canoe users in the south west coast. 72% of the small scale fishermen surveyed use gillnet for fishing. A majority of the fishermen using wooden canoes covers an area of 2km to 3km for fishing operations.

Retrieval of phytoplankton and associated optical constituents based on long term bio-optical studies

Funding Agency: Indian National Centre for Ocean Information (INCOIS)

Principal Investigator
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Project Staff
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Kum. U. Smitha

Ocean colour data measured from satellites are nowadays used to assess the ability of phytoplankton size and functional type for ecosystem based management of oceans. The methods used for the assessment needs to be validated because it changes with regional coastal dynamics.

Objectives of the project which was initiated in February, 2013 is:

1. To establish a database on bio-optical parameters for the ocean colour application and ecosystem modeling based on phytoplankton size distribution,
2. To prepare a comprehensive library of phytoplankton species, functional type and biomass for ocean colour remote sensing applications.
3. To validate in situ information of bio-optical characteristics of different phytoplankton size groups, their absorption, CDOM and detritus absorption characteristics to retrieve satellite data for primary production estimation.
4. To prepare improved regional specific algorithm for coastal waters and to retrieve new bio-optical information from spectrally high resolved satellite data for complimenting potential fishing zone advisories.

Validation of PFZ along Gujarat coast

Funding Agency: Indian National Centre for Ocean Information (INCOIS)

Principal Investigator
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The project was intended to validate the potential fishing zone advisories being disseminated by INCOIS for the coastal districts of India. The sea surface temperature, concentration of chlorophyll and the wind data were used as proxies to identify the areas of probable fish aggregation. The three main objectives of the project were:

1. To collect feedback data from the commercial fishermen operating along the Gujarat coast
2. To conduct real time experimental fishing in and outside the identified locations and carry out biological studies on the fish caught in the regions.
3. To popularize the use of PFZ advisories along the Gujarat coast by conducting awareness programmes and interaction workshops with stakeholders.

Validation using feedback data

Data regarding the operational details of fishing vessels were collected from three fishing

harbours along the Saurashtra coast of Gujarat viz., Veraval, Vanakbara and Mangrol. The details regarding the total number of fishing vessels and other operational parameters of the fishing vessels were collected from the State Fisheries Department. Small groups of fishermen were invited to the Veraval Research Centre of CIFT and were introduced to the theory of PFZ generation and the utility of satellite derived images for effective fishing. The progressive fishermen from these groups, willing to participate in the validations were supplied with the PFZ advisories, either as FAX or by email. Survey forms were prepared to collect information regarding the operational details of the fishing vessels and were tested prior to using them for experiments and the final survey forms were prepared after modifications to include all the information needed for validation experiments using commercial fishing vessels. The data regarding the catches and the operational details were collected by visiting the fishing harbour when the vessel comes back after the operation.

Validation by experimental fishing operations

The experimental validation of the PFZ were carried out by actual fishing in and outside the advisories on-board the Departmental Fishing Vessel MFV Sagar Kripa and other hired private fishing vessels. The catches from both the locations were quantified and length frequency analysis, gut content analysis etc. were carried out. The physico-chemical



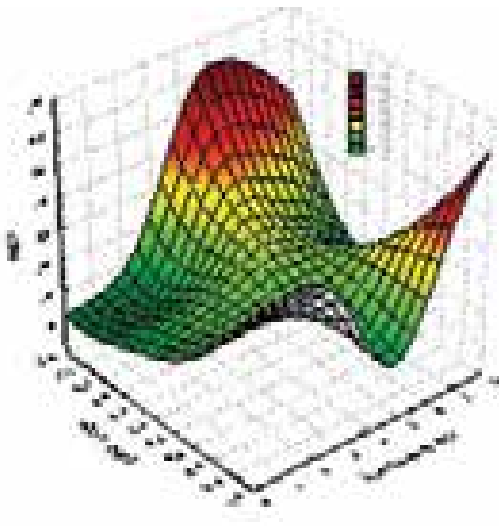
parameters from the locations were also collected and analyzed.

Popularization of PFZ advisories

The popularization of the INCOIS advisories were carried out by mass awareness programmes and conducting stakeholder meetings at different landing centres of Gujarat. The theory and the utility of using the advisories were explained during the meetings.

Validation using feedback data

During the plan period catch and operational parameters details were collected from a total of 257 commercial fishing vessels operating from Veraval, Vanakbara and Mangrol fishing harbours. Benefit cost (B/C) analysis of fishing operations were carried out and this indicated that the mean B/C ratio for vessels fishing with PFZ advisories were 1.84 ± 0.14 (SE) and for fishing without PFZ the ratio observed was 1.26 ± 0.14 (SE). The differences were found to be significant at $P < 0.01$. The mean CPUE observed when fishing was done with help of PFZ was 36.94 ± 2.29 and without PFZ the mean was noticed as 30.84 ± 2.45 . The mean expenditure for a trip which included the observations from all the vessels clubbed together was ₹60,244±2695 for vessels using PFZ and for the other vessels this was noticed as ₹67,735±2872. An increase of 19.7% was noticed in the mean CPUE, when vessels used PFZ when compared to trawlers not using PFZ for fishing. There is a reduction of about 12.43% in the total expenses when using PFZ in case of multi-day fishing trawlers and since 60% of the total expense is fuel, this helps in greatly reducing the amount of diesel consumed for the fishing operations. Month-wise variation in the B/C ratio was also analyzed and this showed that the month of February showed the least ratio (0.89 ± 0.24) and the B/C ratio was significantly different from all other months ($P < 0.01$). The highest B/C ratio was observed in the month of August (4.21 ± 0.90) followed by May (3.24 ± 1.27) and November (2.36 ± 0.34) respectively.



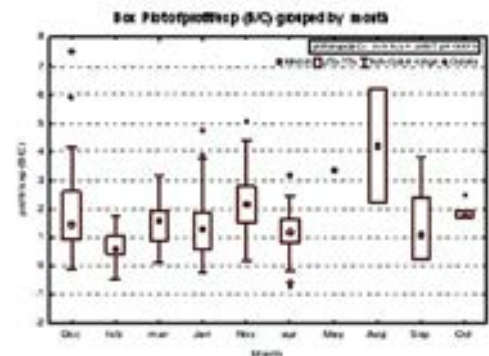
3D surface plot of CPUE

Validation by experimental fishing operations

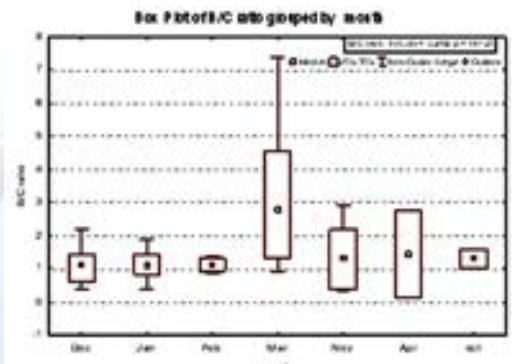
A total of 49 validation experiments were carried out along the Veraval coast with the help of similar class of trawlers (110 Hp, 15.5m L_{OA}). The departmental fishing vessel MFV Sagar Kripa was also used for the experimental validations. Benefit-cost analysis of the experimental fishing operations were carried out and this indicated a

significant difference between the catches fishing in the PFZ and areas outside the PFZ advisories location. The monthly differences in the B/C ratio was also found to be significantly different ($P < 0.05$), with highest B/C ratio observed when fishing was carried out during the month of March. The lowest B/C ratio was observed during the months of December (1.11 ± 0.39) and January (1.09 ± 0.34) and the B/C of these months were significantly different from the month of March. The B/C ratio of other months did not vary significantly when compared to B/C of other months.

The revenue generated and the B/C ratio were significantly different ($P < 0.05$), when vessels fished in the PFZ locations. The mean B/C ratio observed at the PFZ locations was 2.09 ± 0.31 and vessels fishing in the area outside of PFZ realized a B/C ratio of 1.22 ± 0.26 respectively.



Variation in the monthly B/C ratio observed from feedback data analysis



Variation in the monthly B/C ratio observed by experimental fishing operations

Analysis of physico-chemical parameters

The analysis of different physico-chemical parameters in the PFZ and grounds outside the PFZ revealed that the concentration of chlorophyll was significantly different between the locations ($P < 0.05$). The other parameters that were analyzed like temperature,

transparency, total suspended solids and total dissolved solids did not show any significant change, ($P > 0.05$). The mean values noticed in the PFZ locations for the chlorophyll, temperature, transparency, TSS, TDS, nitrate and phosphate were 0.76 ± 0.07 , 25.37 ± 0.44 , 4.28 ± 0.34 , 0.57 ± 0.17 , 1.43 ± 0.33 , 3.82 ± 0.23 and 0.46 ± 0.09 respectively.

The values noticed for the areas outside the PFZ for the above parameters were 0.52 ± 0.07 , 25.18 ± 0.37 , 4.16 ± 0.29 , 0.54 ± 0.14 , 1.78 ± 0.28 , 3.36 ± 0.19 and 0.44 ± 0.08 respectively.

Awareness programme conducted

A total of 16 interaction workshops and three mass awareness programmes (two at Vanakbara and one at Cochin) were conducted on the utility of PFZ advisories.





CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY



General Information

(1 April, 2012 to 31 March, 2013)

Training Programmes Conducted

Sl. No.	Subject	No. of beneficiaries	Venue and date
1.	Value addition and hygienic handling of dry fish	40	Repelli, Guntur, A.P. 1-2 April 2012
2.	Phytochemical screening and immune-modulatory activity of <i>Ventilago madraspatana</i>	1	Cochin 2 March – 2 April 2012
3.	Laboratory methods for microbiological examination of seafood	8	Visakhapatnam 28 March – 4 April 2012
4.	Antimicrobial effect of chitooligosaccharides produced by bacterial degradation of chitin	1	Cochin 6 March – 9 April 2012
5.	Decomposition of shrimp shell waste by microbial deproteination and decalcification	1	Cochin 27 March – 10 April 2012
6.	Antibiotic resistance profile of <i>Staphylococcus aureus</i>	1	Cochin 27 March – 10 April 2012
7.	Isolation and molecular characterization of <i>Shigella</i> spp. from seafood	1	Cochin 6 March – 12 April 2012
8.	Antimicrobial effect of chitooligosaccharides produced by bacterial degradation of chitin	1	Cochin 6 April-10 May 2012
9.	Power block aided purse seining	9 fishennen from Goa	Cochin 10-13 April 2012
10.	Fish processing technology- Value addition and product development techniques	4	Cochin 16 April-15 May 2012
11.	Fish processing technology- Value addition and product development techniques	9	Cochin 23 April – 22 May 2012
12.	Post harvest processing and value addition in fish	6	Cochin 1-3 May 2012



SJ. No.	Subject	No.of beneficiaries	Venue and date
13.	SuiVivalcharacteristics of <i>Vibrio alginolyticus</i> in seafoods	1	Cochin 1 May-30 July 2012
14.	Prevalence of <i>Vibrio alginolyticus</i> in various markets of Cochin	1	Cochin 1 May-30 July 2012
15.	Fishermen training programme organized by DFFTA	1000	Digha Mohana, West Bengal 2 May 2012
16.	Advanced methods in food processing	3	Cochin 7-11 May 2012
17.	Isolation, identification and molecular characterization of <i>Vibrio parahaemolyticus</i> from seafood	1 7	Cochin May – 6 June 2012
18.	Characterization of thermostable alkaline protease from marine bacteria	1	Cochin 7 May-6 June 2012
19.	Isolation, identification and molecular characterization of <i>Vibrio parahaemolyticus</i> from seafood	3	Cochin 7 May- 6 July 2012
20.	Molecular characterization of <i>Staphylococcus</i> spp.	1	Cochin 9-23 May 2012
21.	Decomposition of shrimp shell waste by microbial deproteinization and decalcification	1	Cochin 9 May-6 June 2012
22.	Preparation and quality evaluation of value added products from fish and shellfish	1	Cochin 10 May- 10 June 2012
23.	HACCP concepts	30	Cochin 14-18 May 2012
24.	Antibiotic resistance profiles of <i>Staphylococcus aureus</i> isolated from seafood	1	Cochin 17 May – 6 June 2012
25.	Fish processing technology	1	Cochin 22 May- 4 June 2012
26.	Modern analytical techniques in biochemistry	14	Cochin 4-16 June 2012
27.	Standardization, quality and pilot scale production of value added fishery products	3	Cochin 4 June - 7 July 2012
28.	Advanced analytical methods in chromatography	4	Cochin 11-16 June 2012
29.	Production of value added products	1	Cochin 25-27 June 2012
30.	Microbiological quality of seafood	22 quality managers/ technologists	Veraval 25-29 June 2012
31.	High performance liquid chromatographic methods of amino acid analysis	1	Cochin 25 June-9 July 2012
32.	Microbiological quality control parameters of food	10	Mumbai 2-7 July 2012



Sl. No.	Subject	No.of beneficiaries	Venue and date
33.	Production and quality evaluation of chitin and chitosan from prawn shell waste	1	Cochin 4-10July2012
34.	Fish value addition	3	Visakhapatnam 5 july 2012
35.	Housekeeping sterilization and sample preparation	1	Cochin 9-11 July 2012
36.	Microbiological analysis of seafood	1	Cochin 9-13 July 2012
37.	Estimation of heavy metals	1	Cochin 9-13 July 2012
38.	HACCP concepts	36	Cochin 9-13July2012
39.	Biochemical parameters of food quality	6	Mumbai 9-14 July 2012
40.	Production of dry fish	1	Cochin 11-13 july 2012
41.	Detection of WSSV, MBV, IHNV and HPV in shrimp by PCR	2	Cochin 16-21 july 2012
42.	Fish processing technology- Value addition and product development techniques	6	Cochin 16 July- 16 August 2012
43.	Food safety issues in bivalves	36	Moothakunnam, Emakulam 20July 2012
44.	Fish processing and value addition	2	Cochin 23-28 july 2012
45.	Isolation and identification of bacteria of public health significance	13	Cochin 23-28 july 2012
46.	Responsible line fishing	60 fishermen	Cochin 31 July 2012
47.	Food safety standards of sampling of fish, fishery products and food contact surface, water and ice	2	Cochin 1 August 2012
48.	Microbiological quality of seafood	12	Cochin 21-25 August 2012
49.	Microbiological quality of seafood	17 quality managers/ technologists	Veraval 21-25 August 2012
50.	Laboratory techniques for microbiological examination of seafoods	18	Visakhapatnam 21 August-1 September 2012
51.	Hygienic preparation of dry fish	2	Visakhapatnam 22-23 August 2012



HACCP concepts (Cochin) Microbiological



Laboratory methods for microbiological examination of seafood (Visakhapatnam)



quality of seafood (Veraval) Value addition



Microbial quality of seafood - Participants and faculty (Veraval)



of trout (Champawat)



Laboratory techniques for microbiological examination of seafood (Visakhapatnam)



Modern analytical techniques in biochemistry (Cochin)



Hygienic handling of fish (Visakhapatnam)

Sl. No.	Subject	No.of beneficiaries	Venue and date
52.	Hygienic handling of fish	40 members of SHG's	Tallaveru, East Godavary 31 August- 2 September 2012
53.	Post harvest utilization and value addition of trout and carp	50	DCFR FC, Champawat 9-10 September 2012
54.	Microbiological and molecular methods for the examination of seafoods for commensal and pathogenic bacteria	1	Cochin 10 September- 9 October 2012
55.	Harvest and post harvest fisheries technologies	Tribal fishermen	Jeypore, Odisha 13-15 September 2012
56.	Modern analytical techniques in biochemistry	8	Cochin 17-29 September 2012
57.	Fabrication of improved gillnets and eco-friendly fishing gears	40 fishermen	Shillongani, Assam 23-25 September 2012
58.	GC analysis of fatty acids	2	Cochin 24-29 September 2012
59.	Technologies in harvest and post harvest fisheries sectors	20 fishermen	Visakhapatnam 26 September 2012
60.	Hygienic fish handling and processing techniques	45	Barpetta, Assam 27-29 September 2012
61.	Technical skill upgradation under Integrated Coastal Zone Management Project	24 women SHG members from Ganjam, Odisha	Visakhapatnam 9-11 October 2012
62.	Technologies in harvest and post harvest fisheries sectors	20 traditional fishermen youth	Visakhapatnam 10 October 2012
63.	Microbiological and chemical analysis of water	1	Cochin 15-20 October 2012
64.	Laboratory techniques for microbiological examination of seafoods	1	Cochin 15-22 October 2012
65.	HACCP concepts	13	Cochin 16-20 October 2012
66.	Processing and packaging of condiment-incorporated dry fish	1	Cochin 23 October 2012
67.	Quality evaluation of fish meal and oil	3	Cochin 30 October – 2 November 2012
68.	Technologies in harvest and post harvest fisheries sectors	20 traditional fishermen youth	Visakhapatnam 31 October 2012
69.	Value added products	50 fish farmers	KVK, Roing, Arunachal Pradesh 1-3 November 2012



Sl. No.	Subject	No.of beneficiaries	Venue and date
70.	Gear fabrication,hygienic handling and preparation of value added products	30	Visakhapatnam 3 November 2012
71.	Ecofriendly fishing gear	40 fishermen	Ziro, ArunachalPradesh 3-5 November 2012
72.	Fish canning	30	Yazali, ArunachalPradesh 5-7 November 2012
73.	Interventions of CIFT technologies for the benefit of scheduled tribe fisherfolk	30	VaniVilasa Sagar, Karnataka 16-18 November 2012
74.	Harvest and post harvest technology for exploitation of reservoir fish and preparation of value added fish products	36	Doyang, Nagaland 20-24 November 2012
75.	HaJVest technology for exploitation of reservoir fisheries	50 fishermen	Dumbur,Tripura 24-25 November 2012
76.	Harvest and post harvest technology for exploitation of reservoir fish and preparation of value added fish products	45	Rudrasagar,Tripura 26-28 November 2012
77.	Value added fishery products	5	Cochin 1 December – 2 March 2013
78.	Hygienic handling and preparation of value added products from fish	30	Amalapuram,A.P. 5 December 2012
79.	Nutritionalprofiling of tuna waste	4	Cochin 10 December 2012 – 15 January 2013
80.	Development and standardization of an extruded snack from prawn	4	Cochin 10 December 2012 – 15 January 2013
81.	Fish processing extension methods	13 officials from State Departments	Cochin 12-19 December 2012
82.	Use of INCOIS PFZ	25 fishermen	Mangrol,Gujarat 15 December 2012
83.	Value added products from freshwater fish for employment and income generation	46	Ranchi,Jharkhand 16-19 December 2012
84.	Laboratory techniques for microbiological examination of seafoods	2	Cochin 17-29 December 2012
85.	Characterization of plastic degrading bacteria from aquatic and terrestrial environment	1	Cochin 17 December 2012 – 16 March 2013



Sl. No.	Subject	No.of beneficiaries	Venue and date
86.	Modern analytical techniques in biochemistry	3	Cochin 19 December 2012 – 18 January 2013
87.	Hygienic handling and minimization of post haJVest losses	60	SIFT, Kakkinada 20 December 2012
88.	Biochemical evaluation of fish and fishery products and microbiological examination of seafoods	5	Cochin 26 December 2012 – 2 January 2013
89.	Quality changes of <i>sous vide</i> processed fish balls from Red snapper under chilled storage (24 °C)	1	Cochin 1 January-28 February 2013
90.	Quality changes of vacuum packed fish fingers prepared from Red snapper under chilled storage (24 °C)	1	Cochin 1 January-28 February 2013
91.	Proximate composition, mineral content, fatty acid and amino acid profiling of three marine species, <i>Chanos chanos</i> (Milkfish), <i>Laetarius /actarius</i> (White fish) and <i>Loligo duvacei</i> (Indian squid)	4	Cochin 7 January- 6 February 2013
92.	Isolation and partial characterization of glucosaminoglycans (GAG) from Cuttlefish ink	2	Cochin 7 January- 6 February 2013
93.	Studies on biochemical profiles of <i>Platycephalus indicus</i> for the preparation of fish cutlet: Determination of nutrient composition and microbial characteristics of the fish cutlet formulated	1	Cochin 7 January- 28 February 2013
94.	Evaluation of nutrient profiling of <i>Anadostama chacunda</i> for the preparation of essential amino acid enriched soup powder by incorporating defatted fish protein powder	1	Cochin 7 January- 28 February 2013
95.	FTIR spectra of selected <i>Vibrio</i> spp.	1	Cochin 7 January-6 April 2013
96.	Seafood quality assurance	2 from Sri Lanka (Under the TCS of Colombo Plan)	Cochin 14-25 January 2013
97.	Post haJVest processing and value addition of fish and shellfish	11	Cochin 15-16 January 2013
98.	Sample preparation for heavy metal analysis by AAS	1	Cochin 16 January 2013
99.	Microbiological quality of seafood	18 quality managers! technologists	Veraval 17-23 January 2013





Biochemical parameters of food quality (Mumbai)



Fabrication of improved gillnets (Shillongani)



Fabrication of multi mesh gillnets (V.V Sagar)



Preparation of value added products (V.V. Sagar)



Value added products from freshwater fish (RanchO)



Preparation of value added fish products (Doyang)



Hygienic handling of fish (Kakkanada)



Fish processing and extension methods (Cochin)

Sl. No.	Subject	No.of beneficiaries	Venue and date
100	Fish processing technology	12	Cochin 28 January – 8 February 2013
101	Preparation of value added products from fish	40	Palluruthy, Cochin 13 February, 2013
102	HACCP concepts	25	Cochin 18-25 February 2013
103	Fabrication of square mesh net	43	Vanakbara, Gujarat 22 February, 2013
104	Microbiological quality control parameters of food	7	Mumbai 25 February-3
105	Hygienic handling and fresh fish trading for coastal women and hygienic production and marketing of dry fish for coastal women	50	M.S.S.R.F., Poompuhar, Tamil Nadu 26-27 February, 2013
106	Hygienic production of smoke cured fish using Community Fish Smoking Kiln	40	KVK, Ranipol, Sikkim 4 March, 2013
107	Hygienic production of smoke cured fish using Community Fish Smoking Kiln	40	KVK, Roing, Arunachal Pradesh 8 March, 2013
108	Fabrication of square mesh net	30	Veraval 11 March 2013
109	Hygienic production of smoke cured fish using Community Fish Smoking Kiln	40	Dimapur, Nagaland 11 March, 2013
110	Production of fish pickle and its related quality aspects	2	Cochin 11-12 March 2013
111	Laboratory techniques for microbiological examination of seafoods	18	Visakhapatnam 11-22 March 2013
112	Modern analytical techniques in biochemistry	10	Cochin 11-23 March 2013
113	Sensory evaluation of seafoods	5	Mumbai 14-16 March 2013
114	Hygienic production of smoke cured fish using Community Fish Smoking Kiln	30	ICAR RC for NEH Region, Meghalaya 15 March, 2013
115	Hygienic production of smoke cured fish using Community Fish Smoking Kiln	35	Nangthymain, Meghalaya 16 March, 2013
116	Harvest and post harvest technologies	40	Roing, Arunachal Pradesh 17-19 March, 2013





**Harvest and post harvest technology -
Faculty and trainees (Doyang)**



**Microbiological quality of seafood -
Faculty and trainees (Yerava)**



Fabrication of square mesh net (Vanakbara)



Fabrication of square mesh net (Yerava)



**Laboratory techniques for micorbiological
examination of seafoods (Visakhapatnam)**



**Microbiological quality control of seafood
(Mumbai)**



Interventions of CIFT technology Oangareddygudem)



**Harvest and post harvest technologies -
Faculty and trainees (Lengsuai)**

Sl. No.	Subject	No.of beneficiaries	Venue and date
117.	Hygienic production of smoke cured fish using Community Fish Smoking Kiln	36	KVK, Lengpui, Mizoram 18 March, 2013
118.	Computational Fluid Dynamics (CFD)	5	Cochin 19 March 2013
119.	Hygienic production of smoke cured fish using Community Fish Smoking Kiln	32	ICARRC, Lembucherra, Tripura 20.23 March, 2013
120.	Fabrication of square mesh net	30	Veraval 22 March 2013
121.	Fabrication and operation of improved gill nets	80 fishermen	Kabini reseivoir, Kamataka 25 March, 2013
122.	HaiVest and post haiVest technologies	42	KVK, Lengpui, Mizoram 26-28 March 2013
123.	HaiVest and post harvest technologies	40	Jangareddygudem, West Godavari, A.P. 26-28 March 2013

Indicates Outstation Training Programmes

Technologies Assessed and Transferred

- + Designs of wooden fishing vessels in the size range of 7.6 m – 15.2m
- + Designs of steel fishing vessels of size 15.5 M L.0.v 20M L.a, and fuel efficient vessel of 18M 'o,.
- + 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, gillnets, 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 back-up
 - + Designs of deep fat fryer and cutlet moulding machine
 - + Fuel efficient propeller for fishing vessels and other fuel saving devices such as propeller nozzle
 - + Stainless steel tilting kettle for processing plants
 - + Oil fryer for battered and breaded products
 - + Meat bone separator for removal of bones including pin bones from Rohu
 - + Electronic instruments for application in fishing technology, fish processing technology, aquaculture, marine environmental monitoring, agricultural investigation 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 2012 to March 2013) 33 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:

- + 'Sagar Khedu' exhibition organized by Gujarat state Govt. at Ahmedabad on 13 August, 2012.
- + Exhibition organized on the occasion of National seminar on Official language at CIFT, Cochin during 17-18 August, 2012.
- + Seminar cum exhibition on Environmental awareness, Dr. V.S. Krishna College, Visakhapatnam during 17-18 August, 2012.
- + Exhibition held in connection with National consultation meet at Karwar, Karnataka during 31 August-2 September, 2012.
- + Exhibition held on the occasion of National convention – The next frontier of agri business and technology at Gandhinagar, Gujarat during 3-6 September, 2012.
- + 16th National exhibition organized by Central Calcutta Science and Culture Organization for Youth at Kolkata during 7-11 September, 2012.
- + Exhibition held in connection with the Seminar on Mountain fisheries: Challenges and opportunities, DCFR, Bhimtal during 5-7 November, 2012.
- + Exhibition organized by Press Information Bureau at Piravom Panchayath during 5-7 November, 2012.
- + 'Swasraya Bhjarat' – 2012' at Cochin during 30 November to 5 December, 2012.
- + Exhibition held in connection with Global symposium on Aquatic resources for eradicating hunger and malnutrition: Opportunities and challenges at Mangalore during 4-6 December, 2012.
- + 'Fish and Food Fest 2012' held at Pathanamthitta during 1-2 December, 2012.
- + 'Karshika Mela 2012' held at Thodupuzha during 26 December, 2012 to 5 January, 2013.
- + Exhibition (ICAR Pavilion) held in connection with 100th Indian Science Congress, Kolkata during 3-7 January, 2013.
- + Global Konkani Festival, Mumbai during 7 January, 2013.
- + Exhibition held in connection with International symposium on Genomics in aquaculture, CIFA, Bhubaneswar during 22-23 January, 2013.
- + Exhibition held in connection with 25th Kerala Science Congress, Thiruvananthapuram during 28 January to 3 February, 2013.
- + 'Kisan Mela', Regional Research Station (Acharya N.G. Ranga Agricultural University), Anakapalli during 5-6 February, 2013.
- + Exhibition held in connection with XIth Agricultural Science Congress, QUAT, Bhubaneswar during 7-9 February, 2013.
- + Exhibition held in connection with PAF Congress on Public-private partnership in aquaculture, CIFRI, Barrackpore during 9-11 February, 2013.
- + 'Kisan Mela' organized by Central Horticultural Experimental Station at Vejalur, Godhra on 16 February, 2013.
- + Kerala Agri Food Pro Meet, Cochin during 18-19 February, 2013.
- + 'Krishi Darpan- 2013', North Parur, Emakulam on 27 March, 2013.

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 fisherfolk 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.





Cochin



Kolkata



Pathanamthitta



Dr. N.K. Krishnakumar, DDG (Hort.), ICAR visiting CIFT stall at Vejalpur



Dr. B. Meenakumari, DDG (Fy.), ICAR in CIFT stall at Bhubaneswar



Dr. B. Meenakumari and Shri Giriraj Singh, Fisheries Minister, Bihar visiting CIFT stall at Barrackpore



Global Konkani Festival, Mumbai



Prof. Laxmi Orban (Temasek Life Sciences Lab., Singapore) and Dr. A.S. Ninawe (Advisor, DDT) at CIFT stall at Bhubaneswar



Radio Talks

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

- + Dr. M.M. Prasad, SIC, Visakhapatnam - Role of marine protected areas in conservation of marine fishery resources (In Telugu), AIR, Visakhapatnam (20 February, 2013)
- + Dr. Suseela Mathew, Principal Scientist - Fish as health food (In Malayalam), AIR, Kochi (27 November, 2012)
- + Dr. G. Rajeswari, Principal Scientist - Fish aggregating devices for resource conservation and enhancement (In Telugu), AIR, Visakhapatnam (30 October, 2012)
- + Dr. G. Rajeswari, Principal Scientist - Role of bycatch reduction devices in fish conservation (In Telugu), AIR, Visakhapatnam (22 March, 2013)
- + Dr. R. Anandan, Senior Scientist - Biomedical applications of marine natural products (In Malayalam), AIR, Kochi

(20 November, 2012)

- + Dr. K.K. Prajith, Scientist Engineering and technological aspects of pond construction and pre-stocking procedure for aquaculture (In Malayalam), AIR, Kochi (17 December, 2012)
- + Dr. M.S. Kumar, Tech. Officer (T7) - Importance of marine biodiversity and marine fishery resources (In Telugu), AIR, Visakhapatnam (27 September, 2012)
- + Dr. M.S. Kumar, Tech. Officer (T7) - Treated catamarans for the benefit of poor traditional fishermen (In Telugu), AIR, Visakhapatnam (29 January, 2013)

Agricultural Technology Information Centre

At Agricultural Technology Information Centre (ATIC), at the Head Quarters arrangements were made for the visitors such as fisherpersons, students, technologists and officials. Analytical samples were received at ATIC and test reports were sent after analysis. Various priced publications and value added fishery products were sold through ATIC. Technical queries received regarding training and other extension activities were replied. About 800 fishermen from different coastal districts of Tamil Nadu, sponsored under the National Agricultural Development Programme (NADP), Dept. of Fisheries, Govt. of Tamil Nadu visited the Institute during the period 15 April to 24 July 2012. They were briefed about the research and extension activities of the Institute, and had exposure to study the craft/gear, fishing methods and post harvest technologies.



Fishermen from Tamil Nadu being briefed about the activities of the Institute

Awards and Recognitions

*Certificate of Appreciation for ZTM-BPDU

The Zonal Technology Management- Business Planning and Development (ZTM-BPD) Unit at CIFT, Cochin was awarded a Certificate of Appreciation for the outstanding work on Establishment of Business Incubation Centre and Commercialization of Technology in Fish Processing, from National Agricultural Innovation Project

(NAIP), Indian Council of Agricultural Research (ICAR), New Delhi.

Dr. C.N. Ravishankar, Principal Investigator, ZTM-BPD Unit, CIFT received the Award from Dr. S. Ayyappan, Director General, ICAR and Secretary,



DARE, Govt. of India during the Regional Committee Meeting Of ICAR held at Central Arid Zone Research Institute (CAZRI), Jodhpur during 16-17 November, 2012. Dr. Ayyappan congratulated the ZTM-BPD Unit for nurturing the growth of technology based enterprises and for creating successful business ventures in the field of fisheries.



Dr.C.N.Ravishankar receiving the award from Dr.Ayyappan

Official Language Implementation Prize

The Visakhapatnam Research Centre of CIFT was adjudged first in promoting the use of Official Language Hindi during the year 2011-2012 among government offices in and around Visakhapatnam. The prize was given during the meeting held on 4 May, 2012 at DRM office in Visakhapatnam. Dr. M.M. Prasad, SIC & Principal Scientist, received the prize and Dr. Santosh Alex, Technical Officer (TS) received the commendation certificate.



Dr.M.M. Prasad receives the prize from Shri Kashinath, Chairman, TOLIC

Jawaharlal Nehru Award

Dr. Rakesh Kumar, Senior Scientist, Microbiology, Fermentation and Biotechnology Division, CIFT, Cochin received the 'Jawaharlal Nehru Award – 2011 for P.G. Outstanding Doctoral Thesis Research in Agriculture and Allied Sciences (Fisheries)' instituted by ICAR, New Delhi for his Ph. D. thesis entitled, "Biochemical and molecular investigations on *Salmonella* serovars from seafood" under the guidance of Dr. P.K.Surendran, former Head, MFB, CIFT, Cochin. The award was received from Shri Sharad Pawar, Honourable Union Minister for Agriculture, Food and Public Distribution on 16 July, 2012.



Dr.Rakesh Kumar receiving the award from Shri Sharad Pawar

Peter Howgate Award

Dr. A.Jeyakumari, Scientist, Fish Processing, CIFT, Cochin was deputed to Thailand to undergo a training programme on "Encapsulation of fish oil" at Kasetsart University, Thailand during 17-21 December, 2012. Dr. Jeyakumari was selected for the 'Peter Howgate Award for Young Fish Technologists 2012' based on merit and her Ph.D. programme. The aim of the award was to support students, technologists and young scientists, to advance their international experience, with a view to developing their career, skills and knowledge in the field of fish technology. The training programme was carried out under the guidance of Dr. Utai Klinkesorn, Assistant Professor, Department of Food Science and Technology, Faculty of Agro-Industry, Kasetsart University, Chatuchak, Bangkok, Thailand.

Best Paper Award

Dr. Femeena Hassan, Senior Scientist, Quality Assurance and Management Division, CIFT, Cochin received the 'Dr. Ravindran Endowment Award' for best paper presented in the technical session 'Ocean technology and fisheries sciences' at the 22nd Swadeshi Science Congress held at CPCRI, Kasaragod during 6-8 November, 2012. Dr. Femeena Hassan presented the award winning paper entitled, 'Isolation of squid chromatophores and its commercial application as a natural



Dr. Femeena Hassan receives the award from Dr. Madhusudana Kurup



pigment in lipsticks* by Femeena Hassan, P. Muhamed Ashraf, V. Geethalakshmi and T.V. Sankar. The award was instituted by Swadeshi Science Movement, Kerala in the name of Late Dr. K. Ravindran, former President, Swadeshi Science Movement, former Director, CIFT, Cochin and an eminent ocean technology scientist. Prof. B. Madhusudana Kurup, Vice Chancellor, Kerala University of

Fisheries and Ocean Studies (KUFOS), Cochin gave away the award to Dr. Femeena Hassan during the valedictory session of the Science Congress.

Analytical Services

The Headquarters and Research Centres of the Institute undertook testing 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 workers' hands, chemicals, salt, water, ice, packaging material etc. Type testing of marine diesel engines was also carried out and performance certificates were issued to the concerned

manufacturers in addition to calibration of mercury, alcohol and digital thermometers received from different fish processing plants and industry. About 1288 samples {NABL:180; Non-NABL:1108} were tested in the different laboratories at Headquarters of CIFT and the test reports {597 reports; NABL:87; Non-NABL:510} were sent to the concerned.

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
- + Kerala University of Fisheries and Ocean Studies, Cochin

National Institutes and Agricultural Universities

- + Agricultural Universities
- + Ministry of Agriculture
- + Ministry of Food Processing Industries
- + Ministry of Defence
- + Department of Ocean Development

- + Department of Biotechnology
- + Department of Science and Technology
- + Department of Electronics
- + Indian Institute of Technology, Chennai/Kharapur
- + 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
 - + Central Inland Fisheries Research Institute, Barrackpore
 - + National Institute of Cholera and Enteric Diseases (NICED), Kolkata
 - + Marine Biotechnology MIRCEN (UNESCO), Department of Fishery Microbiology, College of Fisheries, Mangalore
- Private Sector**
- + M/s GaJ Ware Wall Ropes Ltd., Pune
 - + M/s DSM Indian Ltd., Mumbai
- International Institutions**
- + Food and Agriculture Organization (FAO), Rome
 - + Bay of Bengal Programme (BOBP)
 - + Asia Pacific Fisheries Commission (APFO)
 - + 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, Emakulam
 - + Kerala State Women's Development Corporation Ltd., Thiruvananthapuram
 - + Chellanam Panchayat SGST Co-operative Society Ltd., Cochin
 - + Development Action through Self Help Network (DARSHN)
 - + Agency for Development of Aquaculture in Kerala (ADAK)
 - + Kudumbasree Community Development Society, Pallipuram
 - + 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., Jafarabad, Gujarat
 - + Gandhi Smaraka Seva Kendram, Alappuzha
 - + Kottappuram Integrated Development Society (KIDS), Kodungalloor
 - + MSSwaminathan 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:

1. Establishment of HACCP system for a pig slaughter house cum pork processing plant- NRC on Pig, Rani, Guwahati
2. Setting up of quality control labs at Bhubaneswar, Nellore, Bhimavaram and Chennai – Marine Products Export Development Authority (MPEDA), Cochin
3. Production of ready to serve food products in retortable pouches and implementation of HACCP system - Meat products of India Ltd., Koothattukulam, Ernakulam
4. Consultancy on construction of Effluent Treatment Plant for Cochin Fisheries Harbour - Cochin Port Trust, Cochin

5. Consultancy on construction of Effluent Treatment Plant for chitosan and fish processing plant - M/s Uniloyds, Bhimavaram
6. Consultancy on ETP commissioned at Cochin Fisheries Harbour with CIFr Consultancy construction of Effluent Treatment Plant for fish processing unit - M/s Bluewater Foods, Mangalore
7. Consultancy on NABL accreditation for SLMAP-Kerala State



- livestock Development Board, Thiruvananthapuram
8. Consultancy on construction of domestic fish market at Anchal - Matsyafed, Thiruvananthapuram
9. Consultancy on HACCP implementation for Semen plant - KLDB, Kulathupuzha
10. Transfer of technology package for establishing business models developed under NAIP-RHSSP project - KSCADC, Thiruvananthapuram

Committees

Grievance Cell

Chairman: The Director, CIFT

Members

1. Dr. T.V. Sankar, HOD, QAM
2. Senior Administrative Officer
3. Finance and Accounts Officer
4. Dr. T.K. Thankappan, Principal Scientist
5. Shri P.T. Viswambharan, T-11-3
6. Shri P. Mani, UDC
7. Shri M.T. Mani, Cook
8. Shri V. Deepak Vin, SSS

Nominated Member Secretary

Asst. Admn. Officer, CIFT

Research Advisory Committee

Chairman

Dr. K. Devadasan, former Director, CIFT, Flat No. 7, Kalika Apartments, Cheruparampathu 2M Cross Road, Kadavanthra, Cochin -682020

Members

1. Dr. A.K. Upadhyay, Prof. & Head, Fish Processing Technology Department, College of Fisheries, G.B. Pant University of Agriculture and Technology, Pant Nagar, Dist. Udham Singh Nagar, Uttarakhand-263145
2. Dr. C. Hridayanathan, former Director, School of Industrial Fisheries, CUSAT, Cochin, Suhas, 29/1069, Janatha Road, Vyttila, Cochin-682019
3. Dr. V. Venugopal, former Scientific Officer, BARC, Mumbai, 8602, Skyline Villa, Opposite IIT Main Gate, Navabharath

Compound, Powai, Mumbai - 400 076

4. Dr. Indrani Karunasagar, College of Fisheries, Kankanady P.O., Mangalore-575002
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-110012
7. Dr. T.K. Srinivasa Gopal, Director, CIFT

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

Management Committee

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

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. Dr. Mohanakumaran Nair, Dean, Faculty of Fisheries, Kerala University of Fisheries and Ocean Studies, Panangad P.O., Cochin 82506



4. Smt.ChayaD.jadhav, AtPostlanja, Dist. Ratnagiri, Maharashtra
5. Shri P. Gopinath, N.C.P. Dist. Committee Office, M.G. Road, Thrissur, Kerala
6. Dr. B.C.Jha, Principal Scientist, CIFRI, Barrackpore, West Bengal -700120
7. Dr.C.S.Purushothaman, Principal Scientist, CIFE, Mumbai
8. Dr. P.K. Mukhopadhyay, Principal Scientist, Regional Centre, CIFA, Rahara, West Bengal-700118
9. Dr.C.N.Ravishankar, Principal Scientist, CIFT, Cochin
10. Assistant Director General (M. Fy.), ICAR, Krishi Anusandhan Bhavan II, Pusa, NewDelhi-110012
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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1. Dr.S.Balasubramaniam, HOD, EIS
2. Shri P.K. Vijayan, Principal Scientist
3. Dr.Saly N.Thomas, Principal Scientist
4. Dr.K.Ashok Kumar, Principal Scientist
5. Asst. Finance & Accounts Officer

Secretary(Official Side)

Sr.Administrative Officer

Members(Staff Side)

1. Shri V.T.Sadanandan, Tech.Asst.
2. Shri K.Das, Asst.
3. Shri K.B.Subukuttan, Asst.
4. Shri C.D.Pameswaran, 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 Participants(&)	Training attended	Venue and Date
1.	Dr. G. Rajeswari Dr. R. Raghu Prakash (As resource persons)	Fishermen training programme	Digha Mohana, West Bengal 2 May 2012
2.	Dr. P.K. Binsi	HACCP concepts	CIFT, Cochin 14-18 May 2012
3.	Shri M.V.Baiju	Refresher course on Agricultural research management for newly recruited Senior/Principal Scientists of non-ARS stream of ICAR	NMRM, Hyderabad 5-18 June 2012
4.	Dr. G. Rajeswari (As resource person)	Refresher course in Life Sciences	Andhra University, Visakhapatnam 16 June 2012
5.	Shri Charles Ekka	Special programme on Pension and other retirement benefits	ISTM, New Delhi 18-22 June 2012
6.	Dr. G.K. Sivaraman	Summer school on Opportunities in value addition and challenges in quality control of meat products including slaughterhouse byproducts	VC&RI, Namakkal 4-24 July 2012
7.	Dr. Elizabeth Carolin Shri P. Vineeth Kumar Shri K.K.Santhosh	Training programme on ISO 22000: 2005 Food Safety Management Systems	IICPT, Thanjavur 16-18 July 2012
8.	Kum.Jesmi Debbarma	Training programme on Sensory and instrumental methods in texture analysis of processed foods	CFrRI, Mysore 1-3 August 2012

Sl. No	Name(s) of Participants(s)	Training attended	Venue and Date
9.	Shri A.K. Jha Shri V. Chandrasekar (As resource persons)	Training programme on Conversion of diamond mesh to square mesh	Fisheries College, Veraval 6 August 2012
10.	Shri T. jjoy Shri K.C. Anish Kumar Shri G. Vinod	Training programme on Advances in HPLC in food sciences and technologies	CFTRI, Mysore 6-17 August 2012
11.	Dr.M.M. Prasad	Advanced techno management programme for F&G Level Scientists	ASCI, Hyderabad 17 September – 19 October 2012
12.	Shri V.Chandrasekar	Short course on World Trade Agreements and Indian fisheries: A policy outlook	CMFRI, Cochin 17-26 September 2012
13.	Shri Nitin Singh Dr. Elizabeth Carolin Shri Rakesh T. Kurien	Regional training programme for Business Incubator Managers and Staff organized by ISBA jointly with NAIP and APIN	Technopark, Thiruvananthapuram 1 21 September 2012
14.	Dr. Nikita Gopal (As resource person)	Short course on World Trade Agreements and Indian fisheries: A policy outlook	CMFRI, Cochin 24 September 2012
15.	Dr.A.R.S.Menon	Training workshop on Scientific report writing and presentation	NAARM, Hyderabad 25-28 September 2012
16.	Dr.S.K. Panda	Technical workshop on Risk based approaches for food safety management	New Delhi 26-27 September 2012
17.	Dr.G. Rajeswari	Awareness training programme on Fishing technology	CIFNET, Visakhapatnam 13 October 2012
18.	Dr.S.K. Panda	Training programme on Use of modules in ICAR web portal	ICAR, New Delhi 15 October 2012
19.	Shri T.B. Thampi Pillai Shri Sajith K. jose Shri P.V. Sajeevan	Training programme on CAD CAM (2D and 3D mechanical modeling with AutoCAD Inventor 2012}	Bangalore 29 October-9 November 2012
20.	Dr.P.T. Lakshmanan	Short course on Microwave assisted organic synthesis and new methodologies for the synthesis of novel multifunctional and bioactive molecules	liT, Mumbai 31 October 2012
21.	Dr.M.M. Prasad Dr. U. Sreedhar (As resource persons)	Awareness training programme on Fishing technology	CIFNET, Visakhapatnam 3 November 2012
22.	Shri A.K. jha	Training on Research strategies for mitigation and impact of climate change on fisheries	CIFE, Mumbai 15 November – 5 December 2012



Sl. No	Name(s) of Participants(s)	Training attended	Venue and Date
23.	ShriC.K. Suresh	Training on The maintenance and care of Isostatic Press System	M/s Stanstead Fluid Power Ltd., U.K. 19-23 November 2012
24.	Dr.George Ninan (As resource person)	Technology meet on food processing	DIC,Alappuzha 20 November 2012
25.	Smt.Arathy Ashok ShriV.Chandrasekar Dr.K.K. Prajith ShriP.H.Dhiju Das ShriP.S.Khanolkar	Winter schoolon Fish harvesting systems for resource conservation	CIFT,Cochin 20 November- 10 December 2012
26.	Dr.S.K.Panda	E-Leaming course on Food safety and traceability	APO,New Delhi 11-13 December 2012
27.	Dr.George Ninan (As resource person)	Technology clinic for entrepreneurs in food processing industry	DIC,Cochin 27 December 2012
28.	Dr.A.Jeyakumari	Training on Encapsulation of fish oil	Kasetsart University, Thailand 17-21 December 2012
29.	Kum.Anu Mary Jose	Training programme on Overview of operational, preventive and corrective measures of HPLC and GC	CFTRI,Mysore 17-21 December 2012
30.	Smt. V.Renuka Dr.A.Jeyakumari	Training programme on Responsible harvest and quality standards for seafood export	CIFE,Mumbai 9-29 January 2013
31.	ShriC.G.Joshy	Lead auditor training on Quality management systems	NDRI,Bangalore 21-25 January 2013
32.	Dr.T.K. Srinivasa Gopal	Training programme on Financial rules for Heads of Departments	ISTM,New Delhi 6-8 February 2013
33.	Dr.Toms C. Joseph ShriV.N.Sreejith	Realtime PCR training	M/s Invitrogen Bioservices India Pvt.Ltd.,Bangalore 13-15 February 2013
34.	ShriA.K.Jha (As resource person)	Training on Fabrication of square mesh net	Vanakbara 22 February 2013
35.	Dr.Suseela Mathew (As resource person)	UGC-SAP DRS 1 Programme	CUSAT,Cochin 25 February 2013
36.	ShriV.Chandrasekar	Training workshop on Scientific report writing and presentation	NMRM,Hyderabad 4-7 March 2013
37.	Dr.G.Rajeswari (As resource person)	Training programme on Recent trends in aquaculture	SV University, Kakinada 6March 2013



Sl. No	Name(s) of Participants(s)	Training attended	Venue and Date
38.	Shri A.K. Jha (As resource person)	Training on Fabrication of square mesh net	Veraval 11 March 2013
39.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Shri P.K. Vijayan Dr. Suseela Mathew Dr. A.A. Zynudheen Dr. George Ninan Dr. j. Bindu Dr. Sanjoy Das Dr. S.K. Panda Dr. K.K. Asha Shri C.G. Joshy Dr. V. Murugadas Dr. A. Jeyakumari Smt. S.j. Laly Dr. Niladri Sekhar Chatterjee	Training on Application of high pressure for food processing	CIFT, Cochin 12 March 2013
40.	Dr. G.K. Sivaraman Dr. C.O. Mohan (As resource persons)	Training programme on Food safety and certification	EIA, Veraval 19 March 2013
41.	Shri A.K. Jha (As resource person)	Training on Fabrication of square mesh net	Veraval 22 March 2013
42.	Dr. S. Vishnuvinayagam	Training on HI 9828 Multiparameter	Navi Mumbai 29 March 2013

Visits Abroad

Dr. R. Raghu Prakash, Senior Scientist, Fishing Technology, Visakhapatnam Research Centre of CIFT was deputed to attend the International Fisheries Symposium held at Can Tho, Vietnam during 6-8 December, 2012. Dr. Raghu Prakash also presented a paper entitled, "Role of fishing technology in responsible fishing for sustainable fisheries development and conservation of resources" by R. Raghu Prakash, G. Rajeswari and U. Sreedhar in the Symposium.

Dr. Toms C. Joseph, Senior Scientist, Microbiology, Fermentation and Biotechnology Division, CIFT, Cochin was deputed to Thailand to attend the Workshop on Regional proficiency testing programme for aquatic animal disease in Asia-Pacific at Network at Aquaculture Centre for Asia Pacific (NACA), Bangkok during 25-26 July, 2012.

Dr. A. Jeyakumari Scientist, Fish Processing, CIFT, Cochin was deputed to Thailand to undergo a training programme on "Encapsulation of fish oil" at Kasetsart University, Thailand during 17-21 December, 2012. Dr. Jeyakumari was selected for the 'Peter Howgate Award for Young Fish Technologists-2012' based on merit and her Ph. D. programme. The aim of the award was to support



Dr. Raghu Prakash making the presentation



Dr. Jeyakumari at Kasetsart University



students, technologists and young scientists, to advance their international experience, with a view to developing their career, skills and knowledge in the field of fish technology. The training programme was carried out under the guidance of Dr. Utai Klinkesom, Assistant Professor, Department of Food Science and Technology, Faculty of Agro-Industry, Kasetsart University, Chatuchak, Bangkok, Thailand.

Shri C.K. Suresh, Junior Technical Assistant (T3), Fish Processing Division, CIFT, Cochin was deputed to attend training in the maintenance and care of Isostatic Press System at Ws Stanstead Fluid Power Ltd., Harlow, U.K. during 19-23 November, 2012.



Shri C.K. Suresh undergoing training

Participation in Symposia/Seminars/ Workshops etc.

Sl. No	Name(s) of Participants(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
1.	Dr. j. Bindu	International conference on Polymers for packaging applications	IMSC, Kottayam 31 March – 2 April 2012
2.	Shri P.K. Vijayan	State level guidance council meeting of Matsya Samrithi Project, Govt. of Kerala	Thiruvananthapuram 3 April 2012
3.	Dr. Nikita Gopal Dr. Femeena Hassan Dr. S.K. Panda Smt. P. Jeyanthi Smt. Arathy Ashok	National brainstorming Workshop on Gender in fisheries: A future roadmap	CIFT, Cochin 4 April 2012
4.	Dr. R. Anandan	National conference on Molecular and cellular mechanisms of diseases: Intervention with natural products	Annamalai Univ., Annamalanagar 7-8 April 2012
5.	Dr. M.R. Boopendranath	XV meeting of Governing Body of State Fisheries Resource Management Society (FIRMA)	Cochin 9 April 2012
6.	Shri Nitin Singh	ICAR-CII Industry Regional Meet	Ahmedabad 15 April, 2012
7.	Dr. Sanjoy Das	12 th Indian Veterinary Congress and National symposium on Changing scenario in veterinary vaccinology and diagnostics in India with reference to national standards	College of Vet. Sci., Mhow 20-21 April 2012
8.	Shri Nitin Singh	ICAR-CII Industry Regional Meet	Coimbatore 25 April 2012

Sl. No	Name(s)of Participant(s)	Symposia/Seminars/Workshops etc.attended	Venue and Date
9.	Dr. M.M.Prasad Dr. G. Rajeswari Dr. U.Sreedhar Smt. Arathy Ashok Kum. jesmi Debbarma Dr. M.S.Kumar Shri K.V.S.S.S.K. Harnath Shri B.K. Panda Shri A.K. Panigrahi Shri D. Rout Shri P. Radhakrishna Shri M. Prasanna Kumar	Interface meeting on Expert consultation on academic partnership for excellence and networks	Visakhapatnam 29 April 2012
10.	Dr. T.K.Srinivasa Gopal Smt. P.Jeyanthi	Meeting on XII Plan	ICAR, New Delhi 30 April 2012
11.	Dr. M.M.Prasad Dr. G. Rajeswari Dr. R. Raghu Prakash Smt. Arathy Ashok Kum.Jesmi Debbarama	Consultation cum stakeholders workshop for Identification and prioritization of research gaps in coastal and marine biodiversity conservation in east Godavari estuarine ecosystems	Kakinada 8 May 2012
12.	Dr. K. Ashok Kumar Dr. P. Pravin	Technical workshop for Technical/Nodal Officers of Kerala on National Knowledge Network (NKN)	NIIST, Thiruvananthapuram 9-10 May 2012
13.	Dr. R. Badonia	Krishi Mahotsav	Chorwar 16May 2012
14.	Dr. G.K.Sivaraman	Mega harvest of open sea cage lobster farm and Samudriya Krishi Vigyan Mela	Veraval 16May 2012
15.	Dr. R. Badonia	Krishi Mahotsav	Ahmedabad 25 May 2012
16.	Dr. T.V.Sankar	Brainstorming meeting on Setting up of National referral contaminants in raw and processed food commodities	ICAR, New Delhi 28 May 2012
17.	Dr. R. Badonia	Krishi Mahotsav	Porbandar 28 May 2012
18.	Dr. S.Sanjeev Dr. K.Ashok Kumar Dr. Femeena Hassan Dr. S.K. Panda	National seminar on Food safety- Role of standards	Cochin 28 May 2012
19.	Dr. Suseela Mathew (As resource person) Dr. A. A. Zynudheen Dr. R.Anandan Dr. K.K. Asha Dr. A.Jeyakumari Smt. V. Renuka Shri P.A.Aneesh Shri P.K.Mahato	International conference on Nutritional medicine, health and wellness	St. Teresa's College, Cochin 7 June 2012



Sl. No	Name(s)of Participant(s)	Symposia/Seminars/Workshops etc.attended	Venue and Date
20.	Dr.T.K.Srinivasa Gopal	Workshop on Disposal of appeal under RTI	ISTM, New Delhi 8June 2012
21.	Dr. K.K. Prajith	World Ocean Day celebrations	CUSAT, Cochin 8june 2013
22.	Dr. K.V. lalitha Dr. Toms C. Joseph	Meeting convened by DOG (Fy.) on participation in NACA initiative on regional proficiency testing programme for aquatic disease laboratories in Asia-Pacific and network on aquatic animal health	ICAR, New Delhi 11 June 2012
23.	Shri A.K. Jha	Workshop on Ecology	Ahmedabad 12 June 2012
24.	Dr. T.K.Srinivasa Gopal Dr. A.R.S. Menon	XXIII Meeting of the ICAR Regional Committee No. VIII	TNAU, Coimbatore 15-16June 2012
25.	Shri Nitin Singh	Seminar on Food Safety and Standards Act 2006 and its impact on food industry	16June2012
26.	Dr. T.K.Srinivasa Gopal Dr. P.T.lakshmanan Dr. Leela Edwin Dr. T.V.Sankar Dr. S. Balasubramaniam Dr. C.N. Ravishankar Dr. M.R. Boopendranath Shri P.K. Vijayan Dr. P. Pravin Dr. K. Ashok Kumar Dr. Suseela Mathew Dr. M.P. Remesan Dr. V. Geethalakshmi Dr. R. Anandan Dr. Nikita Gopal Dr. Femeena Hassan Dr. A.A. Zynudheen Dr. Toms C. Joseph Shri V. Radhakrishnan Nair Dr. V.R. Madhu Shri V. Chandrasekar Dr. V. Murugadas Shri C.G. joshi Dr. A. Jeyakumari Dr. K.K. Prajith	National brain storming workshop on Harvest and post harvest losses in fisheries sector	CIFT, Cochin 22 June 2012
27.	Dr. R. Badonia Dr. G.K. Sivaraman Dr. C.O. Mohan Shri A.K. Jha	Regional workshop and exhibition on Marine fisheries resources of Gujarat and diversified fishing methods	Veraval 26June 2012
28.	Shri Nitin Singh Shri P. Vineeth Kumar	ICAR III Industry Regional Meet	Aprtala 3-4 July 2012
29.	Shri P.K. Vijayan	Governing body meeting of NIFAM, Govt. of Kerala	Thiruvananthapuram 11 July 2012

Sl. No	Name(s)of Participant(s)	Symposia/Seminars/Workshops etc.attended	Venue and Date
30.	Dr.Toms C.Joseph	Meeting of the Animal Safety Committee	College of Veterinary Sciences, Mannuthy 11 July 2012
31.	Dr. M.M.Prasad	Meeting on the problems of fishermen community in Visakhapatnam	Visakhapatnam 13 July 2012
32.	Dr. Leela Edwin Shri S. Abhilash Smt. A. Razia Mohamed Shri P. Vineeth Kumar	International Conference on Technology management 2012:Driving the economy through innovation and entrepreneurship	liSe., Bangalore 18-20 July 2012
33.	Dr. M.M.Prasad	XXI Meeting of ICAR Regional Committee No.II	NMRM, Hyderabad 19-20 July 2012
34.	Dr. S. Sanjeev	Meeting to finalize the plan of action for testing water, ice, fish and fishery products from various markets, hotels etc. for hazards	Thiruvananthapuram 21 July 2012
35.	Dr. Toms C. Joseph	Workshop on regional proficiency testing programme for aquatic animal diseases in Asia-Pacific	NACA, Bangkok 25-26 July 2012
36.	Dr. LN. Murthy	Review meeting on Fisheries by the District Collector, Visakhapatnam	DRDA, Visakhapatnam 28 July 2012
37.	Dr. Leela Edwin Dr. T. V. Sankar Dr. Nikita Gopal Dr. A.R.S. Menon Shri S. Abhilash Shri M. Kiran Das Smt. A. Razia Mohamed Smt. K.A. Anju	Awareness programme on Intellectual property rights for seafood industry	Cochin 30 July 2012
38.	Dr. T. V. Sankar Dr. C.N. Ravishankar	Brainstorming session to develop a perspective plan and strategies for the development of fisheries and aquaculture in the country	New Delhi 3 August 2012
39.	Dr. Santhosh Alex	National seminar on 'Rajbhasha Hindi ki Bahuyami Prasangikata'	Andhra University, Visakhapatnam 4-5 August 2012
40.	Shri M.V. Baiju	Seminar cum brainstorming session on Call from deep sea	Thuthoor, T.N. 6-8 August 2012
41.	Dr. T.K.Srinivasa Gopal	Assessment committee meeting	CFTRI, Mysore 7 August 2012
42.	Dr. K.V. Lalitha	Meeting on Platforms and diagnostics	CIBA, Chennai 7 August 2012
43.	Dr. K.V. Lalitha Dr. T.V. Sankar	Consultative meeting and concept finalization on Platform and network on fish health	CIBA, Chennai 7 August 2012
44.	Dr. George Ninan	Meeting for finalizing the Platform project on Secondary agriculture	New Delhi 9 August 2012



Sl. No	Name(s)of Participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
45.	Shri V.Chandrasekar Shri A.K.Jha	Workshop on NETFISH	Mangrol 14 August 2012
46.	Dr.T.K.Srinivasa Gopal Dr. P.T.Lakshmanan Dr. Leela Edwin Dr. K.V. Lalitha Dr.T.V.Sankar Dr. S. Balasubramaniam Dr. C.N. Ravishankar Dr. M.R. Boopendranath Dr. S. Sanjeev Dr. Saly N. Thomas Dr. P. Pravin Dr. K.Ashok Kumar Dr. Suseela Mathew Dr. M.P. Remesan Dr. R. Anandan Dr. Nikita Gopal Dr. George Ninan Dr. A.A. Zynudheen Dr. Femeena Hassan Dr. Sanjoy Das Shri M.V. Baiju Dr. Toms C. Joseph Dr. S.K. Panda Dr. J. Charles Jeeva Dr. K.K. Asha Shri V. Radhakrishnan Nair Dr. C.O. Mohan Shri Ankur Nagori Shri C.G. joshi Dr. V.R. Madhu Smt. P. Jeyanthi Smt. Arathy Ashok Dr. P.K. Binsi Dr. K.K. Prajith Dr. Niladri Sekhar Chatterjee Dr. B. Ganesan Smt. K.G. Sasikala Dr. M. Baiju	National Official Language Seminar on Technological advances in fisheries	CIFT, Cochin 17-18 August 2012
47.	Dr. M.M. Prasad Dr. G. Rajeswari Dr. U. Sreedhar Dr. LN. Murthy Kum. Jesmi Debbanna (As resource persons)	National workshop on Improving post harvest practices and sustainable market development for long line fisheries for tuna and other pelagic fish species in the Indian ocean region	Visakhapatnam 18 & 21 August 2012
48.	Dr. T.K.Srinivasa Gopal	Knowledge Meet- Meeting of Agricultural University Vice Chancellors and ICAR Directors	New Delhi 21 August 2012

Sl. No	Name(s)of Participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
49.	Dr. Suseela Mathew	Meeting to discuss strengthening of research and education in aquaculture and marine biotechnology	DBT, New Delhi 24 August 2012
50.	Dr. Nikita Gopal	Meeting of the RFD Nodal Officers	CIBA, Chennai 24-25 August 2012
51.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar	Brainstorming meeting on Global system on aquatic resources for eradicating hunger and malnutrition – Opportunities and challenges	Mangalore 25 August 2012
52.	Dr. T. V. Sankar Dr. C.N. Ravishankar Shri Nitin Singh	4th Agri-Tech exhibition	Bangalore 27-29 August 2012
53.	Dr. M.S. Kumar	Farm and home unit rural programme Sub committee meeting	AIR, Visakhapatnam 28 August 2012
54.	Dr. M.M. Prasad	Expert consultation meeting to conduct awareness programme for fishermen youth to pursue fishing related livelihood opportunities using the technological advancements in the sector	CIFNET, Visakhapatnam 30 August 2012
55.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Dr. P. Pravin Dr. C.O. Mohan	National consultation on Integrated development of Uttara Kannada	Karwar 1 September 2012
56.	Shri Nitin Singh	ICAR III Industry Regional Meet	Hissar 3 September 2012
57.	Dr. Leela Edwin	Conclave on Aquaculture development for stakeholders of North Eastern region	Shillong 11 September 2012
58.	Dr. Saly N. Thomas Dr. P. Pravin	Expert consultation on mainstreaming research for ocean and resource management	FSI, Cochin 12-14 September 2012
59.	Dr. Nikita Gopal	Seminar on WTO and its impact on Kerala's economy	IMG, Thiruvananthapuram 17-18 September 2012
60.	Dr. C.N. Ravishankar Dr. J. Bindu Shri Nitin Singh	Global symposium on RTE foods: Addressing challenges in the value chain in the food processing industry	Cochin 24-25 September 2012
61.	Dr. S. Vishnuvinayagam Dr. P.K. Binsi	4th National workshop on Research and development in food processing sector	Mumbai 27 September 2012
62.	Dr. Sanjoy Das	National conference on Current scenario in biotechnology	KSR College of Tech., Thiruchengode 27-29 September 2012
63.	Dr. V.R. Madhu	Public consultation workshop on State action plan on climate change	KFRI, Peechi 28 September 2012
64.	Dr. K. Ashok Kumar	National conference on Identification of areas for skill upgradation in fishery sector and development of model curriculum	NFDB, Hyderabad 1 October 2012



Sl. No	Name(s)of Participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
65.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Dr. A.A. Zynudheen (As resource persons)	National conference on Research, production and marketing of value added fish products: Present status and future directions	CFTRI, Mysore 4-5 October 2012
66.	Dr. U. Sreedhar Dr. B. Madhusudana Rao	Meeting with the Committee on the welfare of fishermen and allied workers of Kerala legislative Assembly	Visakhapatnam 5 October 2012
67.	Dr. T.K. Srinivasa Gopal	Meeting to discuss skills and technologies for promotion of scientific and profitable fish production	ICAR, New Delhi 8 October 2012
68.	Dr. Nikita Gopal	20annual conference of the Agricultural Economics Research Association (India) on Agricultural inputs and services delivery system for accelerating growth and improving fann income	IARI, New Delhi 11 October 2012
69.	Dr. S. Vismuvinayagam	Expert consultation on Managing transboundary diseases of agricultural importance in Asia Pacific	New Delhi 1 12 October 2012
70.	Shri P.K. Vijayan	Governing body meeting of NIFAM	Thiruvananthapuram 16 October 2012
71.	Dr. C.N. Ravishankar	ASEAN-ICAR-CII industry Meet	New Delhi 16-17 October 2012
72.	Shri M.V. Baiju	Tender scrutinizing committee meeting for purchase of 40 feet fiberglass reinforced plastic (FRP) boats	FliT, Chennai 22 October 2012
73.	Dr. T.K. Srinivasa Gopal Dr. Leela Edwin Dr. K.V. Lalitha Dr. C.N. Ravishankar Dr. M.M. Prasad Dr. T.K. Thankappan Dr. S. Sanjeev Shri M. Nasser Dr. Saly N. Thomas Dr. P. Pravin Dr. K. Ashok Kumar Dr. Suseela Mathew Dr. M.P. Remesan Dr. V. Geethalakshmi Dr. Nikita Gopal Dr. S. Ashaletha Dr. j. Bindu Dr. A.A. Zynudheen Dr. Femeena Hassan Dr. George Ninan Dr. R. Anandan Shri M.V. Baiju Dr. S.K. Panda Dr. J. Charles Jeeva Dr. Rakesh Kumar Dr. K.K. Asha Shri V. Radhakrishnan Nair	National seminar on Traditional knowledge and management systems in fisheries	CIFT, Cochin 3 31 October 2012

Sl. No	Name(s) of Participant(s)	Symposia/Seminars/Workshops etc.attended	Venue and Date
	Dr. V.R. Madhu Dr. C.O. Mohan Shri A.K.Jha Dr. V.Murugadas Shri Ankur Nagori Shri CG.joshy Dr. Niladri Sekhar Chatterjee Dr. K.K. Prajith Dr. A.R.S. Menon Shri C.R.Gokulan Smt. K.B. Beena Dr. M. Baiju Smt. P.K. Shyma Dr. G. Usha Rani Dr. B.Ganesan Shri P.S. Babu Smt. K.K. Kala Smt. K.G.Sasikala Smt. G. Remani Smt. N. Lekha Dr. K.A. Martin Xavier Smt. G. Archana Shri S. Abhilash Smt. A. Razia Mohamed Smt. K.A. Anju Shri M. Kiran Das Shri Renju Ravi Shri P.J. Antony Sijo Kum. K.R. Remya Kumari		
74.	Dr. M.M. Prasad Dr. B. Madhusudana Rao Dr. LN. Murthy	National seminar on Microbial approaches towards sustainable development	Dr.V.S. Krishna Govt. College, Visakhapatnam 1-2 November 2012
75.	Dr. R. Badonia Dr. C.O. Mohan	Meeting with State Fisheries Officials to discuss the five year project plan of the Fisheries Department, Gujarat	Veraval 2 November 2012
76.	Dr. T.K. Srinivasa Gopal Dr. S. Vishnuvinayagam	2nd National conference on Fisheries biotechnology	CIFE, Mumbai 2-3 November 2012
77.	Shri M.V. Baiju	Meeting to discuss the recommendations of the committee constituted by Govt. of Kerala for formulating regulations of registration of boat building yard and restriction of engine power of fishing boats	Cochin 5 November 2012
78.	Dr. T.K. Thankappan Dr. j. Bindu Dr. George Ninan Dr. G.K. Sivaraman	National seminar on Mountain fisheries: Challenges and opportunities	DCFR, Bhimtal 5-6 November 2012



Sl. No	Name(s)of Participants(s)	Symposia/Seminars/Workshops etc.attended	Venue and Date
79.	Dr. P. Muhamed Ashraf Dr. V.R. Madhu Dr. K.K. Prajith Shri P.H. Dhiju Das Shri S.S. Shaju Kum. P.Minu Shri K.V. Aneesh Kumar	International conference on Ocean remote sensing for well being of all	Cochin 5-9 November 2012
80.	Dr. Femeena Hassan	22"d Swadeshi Science Congress	CPCRI, Kasaragod 6-8 November 2012
81.	Dr. S. Sanjeev	Project monitoring committee meeting for monitoring the shellfish growing water of ?adana, Kasaragod	MPEDA, Cochin 8 November 2012
82.	Dr. R.Chakraborti	ICAR Regional Committee Meeting	Goa 11 November 2012
83.	Dr. P.T.Lakshmanan	Consultation meeting of Quinquennial Review Team	NMRM, Hyderabad 15-16 November 2012
84.	Dr. C.N. Ravishankar Dr. R. Badonia	ICAR Regional Committee meeting	CAZRI, jodhpur 16-17 November 2012
85.	Dr. M.S. Kumar	Farm and home rural unit programme sub committee meeting	AIR, Visakhapatnam 20 November 2012
86.	Dr. C.N. Ravishankar (As resource person)	National conference of Krishi Vigyan Kendra's on Integrating technologies and best practices	PAU, Ludhiana 2 22 November 2012
87.	Shri K.K. Santhosh	Cold Chain Exhibition	Hyderabad 21 November 2012
88.	Shri Ginson joseph Shtri C.K. Kamalakanth Shri T.R. Anantha narayanan Shri C.T. Nithin	International conference and exhibition on Food processing and technology	Hyderabad 22-24 November 2012
89.	Dr. S. Ashaletha	Seminar on Entrepreneurship development	DIC, Ernakulam 23 November 2012
90	Shri V. Radhakrishnan Nair	Meeting of Kerala State Debt Relief Commission	Thiruvananthapuram 23 November 2012
91.	Dr. S. Ashaletha	Project review meeting of NAIP on Mobilizing mass media support for sharing agro information	Anand 28-29 November 2012
92.	Dr. K.K. Asha Dr. Niladri S. Chatterjee Kum. R. Remya Kumari	International conference on Environment and human health	New Delhi 28-29 November 2012
93.	Dr. Toms C. Joseph	15" Workshop on Biomedical informatics	MG Institute of Medical Sciences, Wardha 2 December 2012

Sl. No	Name(s) of Participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
94.	Dr.Suseela Mathew	Annualreview meeting	DBT,New Delhi 4 December 2012
95.	Dr.Nikita Gopal	Meeting ofthe NodalOfficers of RFD	New Delhi 4-5 December 2012
96.	Dr.C.N.Ravishankar Dr.K.Ashok Kumar Dr.G.K.Sivaraman Dr.S.K. Panda Dr.LN.Murthy Dr.K.K.Asha Dr.C.O.Mohan Dr.S.Vishnuvinayagam ShriA.K.Jha Dr.P.K.Binsi Smt. V.Renuka Dr.A. Jeyakumari ShriC.K.Kamalakanth ShriT.R.Anantha narayanan ShriC.T.Nithin ShriGinson Joseph	Global symposium on Aquatic resources for eradicating hunger and malnutrition:Opportunities and challenges	Mangalore 4-6 December 2012
97.	Dr.R.Raghu Prakash	InternationalFisheries symposium 2012	Can Tho,Vietnam 6-8 December 2012
98.	Dr.P.K.Binsi	Expertcommittee meetingof MOFPIand DST	New Delhi 7 December 2012
99.	Dr.S.Vishnuvinayagam	18 th Internationalcongress on Ruralhealth and medicine	Goa 10-12 December 2012
100.	Dr.T.V.Sankar	National seminar on Food safety – Role of standards	BIS,New Delhi 12 December 2012
101.	Dr.P.Pravin	Trawlban committee meeting	Dept. of Fisheries, Thiruvananthapuram 14 December 2012
102.	ShriNitin Singh (As resource person) ShriRakesh T.Kurien	National levelVendor Development Programme cum IndustrialExhibition & Business 2 Business Meet	MSME,Thrissur 14-16 December 2012
103.	Dr.T.V.Sankar	First meeting of the Committee constituted by Department of Animal Husbandry,Dairying and Fisheries to examine the SPS notification issued by various trading partners to WTIpertainingto fish and fisheries products	New Delhi 17 December 2012
104.	Dr.U.Sreedhar Dr.V.R.Madhu	Review meeting for the sanction of projects for 12o. plan under PFZ Mission	INCOIS,Hyderabad 17 December 2012
105.	Dr.S.Ashaletha	Meeting on Scaling up of pelagic value chain business model	KSCADC, Thiruvananthapuram 19 December 2012



Sl. No	Name(s)of Participant(s)	Symposia/Seminars/Workshops etc.attended	Venue and Date
106.	Dr. Toms C. Joseph (As resource person)	Seminar on DNA, protein and modern perspectives	SN College, Nattika 20 December 2012
107.	Shri V. Chandrasekar	4 th International workshop on Quantitative finance	liT, Kanpur 22-25 December 2012
108.	Dr. C.N. Ravishankar	NIABI Mentor Programme	ICRISAT, Patancheru 24 December 2012
109.	Dr. P. Pravin	Trawl ban committee meeting	Dept. of Fisheries, Thiruvananthapuram 27 December 2012
110.	Dr. T.V. Sankar Dr. K. Ashok Kumar	Meeting of the Expert committee on National referral laboratory for fisheries	NRC Grapes, Pune 29 December 2012
111.	Dr. Sanjoy Das	3 rd International conference on Food technology	IICPT, Thanjavur 4-5 January 2013
112.	Dr. S. Vishnuvinayagam Dr. P.K. Binsi Smt. P. Viji	Workshop held in connection with Global Konkani Festival 2013	Mumbai 4-7 January 2013
113.	Dr. R. Anandan	Symposium on Environment and health management for sustainable animal and fish production	Kolkata 5-8 January 2013
114.	Dr. T.K. Srinivasa Gopal Dr. P.T. Lakshmanan Dr. K.V. Lalitha Dr. T.V. Sankar Dr. S. Balasubramaniam Dr. C.N. Ravishankar Shri P.K. Vijayan Dr. S. Sanjeev Shri M. Nasser Dr. Saly N. Thomas Dr. K. Ashok Kumar Dr. Suseela Mathew Dr. Nikita Gopal Dr. Femeena Hassan Dr. V. Geethalakshmi Dr. S. Ashaletha Dr. A.A. Zynudheen Dr. j. Bindu Dr. George Ninan Dr. J. Charles jeeva Dr. Rakesh Kumar Dr. K.K. Asha Shri C.G. Joshy Dr. A. Jeyakumari Dr. V. Murugadas Dr. P.K. Binsi Kum. Jesmi Debbarna Smt. S.J. Laly Dr. Niladri Sekhar Chatterjee	National seminar on Application of emerging technologies in fish processing	CIFT, Cochin 8 January 2013

Sl. No	Name(s) of Participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
	Dr. A.R.S. Menon Shri C.R. Gokulan Smt. P.K. Shyma Shri T.V. Bhaskaran Dr. G. Usha Rani Shri P.S. Babu Smt. K.K. Kala Dr. M. Baiju Shri Nitin Singh Dr. Elizabeth Carolin Shri Rakesh Thomas Kurian Smt. K.A. Anju Shri K.K. Santhosh Shri C.T. Nithin Shri T.R. Anantha narayanan Kum. G.S. Hema Kum. K. Shyni		
115.	Dr. Femeena Hassan	International conference on Increasing agricultural productivity and sustainability in India: The future we want	NIAS, Bangalore 8-9 January 2013
116.	Dr. T.K. Srinivasa Gopal Dr. Nikita Gopal	Result Framework Document (RFD) meeting	ICAR, New Delhi 9 January 2013
117.	Dr. Sanjoy Das	International conference on Food processing, value chain management and food safety	NIFTEM, Kundli 11 January 2013
118.	Shri M.V. Baiju	National strategic workshop on Small scale fisheries	BOBP, Chennai 11 January 2013
119.	Shri K.S. Sreekumaran Shri P.P. Anil Kumar	Zonal Workshop for Financial Officers of South Zone	NAINP, Bangalore 11 January 2013
120.	Dr. A.R.S. Menon	Brainstorming session on Business opportunities in Life Sciences	KCCI, Cochin 14 January 2013
121.	Dr. P. Muhamed Ashraf Dr. Niladri Sekhar Chatterjee	Chemist Conclave – Brain Storming Session of Chemists	IARI, New Delhi 14-15 January 2013
122.	Dr. P. Pravin	Meeting of Trawl ban committee	CMFRI, Cochin 15 January 2013
123.	Dr. Toms C. Joseph (As resource person)	National seminar on Health and environment	CUSAT, Cochin 15 January 2013
124.	Dr. Saly N. Thomas	17 th meeting of Textile Division Council, TXDC	BIS, New Delhi 16 January 2013
125.	Dr. leela Edwin Dr. Saly N. Thomas Dr. P. Pravin Dr. M.P. Remesan Shri M.V. Baiju Dr. V.R. Madhu	National stakeholder's workshop on Energy saving in fishing vessels	CIFT, Cochin 18 January 2013



Sl. No	Name(s) of Participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
	Dr.K.K.Prajith Dr.M.Baiju		
126	Dr.K.Ashok Kumar	Draft committee meeting on formulation of ISO standard on traceability for fanned crustacean, captured crustacean, farmed mollusk and captured mollusk	NIPHATT, Cochin 18 January 2013
127	Dr.Toms C.Joseph	National seminar on Health and environment	Cochin 18 January 2013
128	Dr.S.Vishnuvinayagam Dr.P.K.Binsi Smt. P.Viji	First annual convention on Sustainable agriculture and food security: Challenges and opportunities in agriculture, animal husbandry and fisheries	CIFE, Mumbai 18-19 January 2013
129	Dr.P.Pravin	2nd Public meeting on trawl ban as expert committee member on scientific study of fish wealth	Thiruvananthapuram 21 January 2013
130	Dr.C.N.Ravishankar Dr.C.O.Mohan	Technical scrutiny committee meeting of Ministry of Food Processing Project on Laboratory upgradation for Veraval Research Centre of CIFT	New Delhi 22 January 2013
131	Dr.Toms C.Joseph Dr.B.Madhusudana Rao	International symposium on Genomics in aquaculture	CIFA, Bhubaneswar 22-23 January 2013
132	Dr.T.K.Srinivasa Gopal	Institute Management Committee Meeting	NRC Meat, Hyderabad 23 January 2013
133	Shri Nitin Singh (As resource person) Shri P.Vineeth Kumar	National Level Vendor Development Programme cum Industrial Exhibition & Business 2 Business Meet	MSME, Kannur 23-24 January 2012
134	Dr.Santhosh Alex	International Hindi seminar on 'Tulanatmak Sahitya Mein Samajik Nyay'	Andhra University, Visakhapatnam 29-31 January 2013
135	Dr.P.Muhamed Ashraf	India- Israel meeting on materials and nano sciences	MG University, Kottayam 31 January- 1 February 2013
136	Dr.Saly N.Thomas	Third Public sitting of expert committee on Scientific study of fishery wealth	Kozhikode 5 February 2013
137	Dr.M.M.Prasad Dr.R.Raghu Prakash Shri K.V.S.S.S.K. Harnath	Agricultural Science Congress	OUAT, Bhubaneswar February 2013
138	Dr.V.R.Madhu	Meeting of the expert committee for finalizing the technical bid for purchase of VHF and Echo sounder for mechanized fishing boats for KSCADC	Cochin 6 February 2013
139	Shri Ankur Nagori Shri C.R.Gokulan Smt. P.K.Shyma	Business meet on Solar PV	Cochin 7 February 2013
140	Dr.R.Anandan	National conference on Advances in the management and prevention of clinical disorders due to malnutrition	Rajah Serofji Govt. College, Thanjavur 7 February 2013

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141.	Shri Nitin Singh (As resource person)	ISBA Annual Conference	KiIT, Bhubaneswar 7-9 February 2013
142.	Dr. George Ninan Dr. V. Geethalakshmi	PAF Congress on Public-private partnership in aquaculture and culture based fisheries	CIFRI, Barrackpore 11 February 2013
143.	Dr. R. Anandan Dr. A. A. Zynudheen Dr. S. K. Panda	International conference on Indo European Food for health- 2013	IIT Madras, Chennai 10-12 February 2013
144.	Shri Nitin Singh	Workshop on Technology transfer and management for biotech sector	12-13 February 2013
145.	Dr. R. Badonia	Scientific advisory committee meeting of KVK, Ambuja Cement Foundation	Ambujanagar 13 February 2013
146.	Dr. R. Badonia Dr. C. O. Mohan Shri S. B. Purohit	Town Official language Implementation Committee meeting	Verval 20 February 2013
147.	Dr. M. S. Kumar	Farm and home rural unit programme sub committee meeting	AIR, Visakhapatnam 20 February 2013
148.	Shri V. Radhakrishnan Nair	Workshop on GIS application on natural resource management	NMRM, Hyderabad 20-23 February 2013
149.	Dr. R. Badonia	Scientific advisory committee meeting of KVK, Ambuja Cement Foundation	Ambujanagar 22 February 2013
150.	Dr. Suseela Mathew	Committee for fixation of specifications for equipments and for tender opening in chemical and microbiology laboratories	EIA, Cochin 25 February 2013
151.	Dr. Suseela Mathew	Subsidy committee meeting of pre-processing centre	MPEDA, Cochin 27 February 2013
152.	Dr. C. N. Ravishankar (As resource person) Dr. B. Madhusudana Rao Shri Nitin Singh Shri P. Vineeth Kumar Smt. A. Razia Mohamed Smt. K. A. Anju Shri M. Kiran Das	Workshop on Technology management for researchers	NMRM, Hyderabad 28 February – 6 March 2013
153.	Dr. A. R. S. Menon	Inter Media Publicity Coordination Committee Meeting	Doordarshan Kendra, Thiruvananthapuram 1 March 2013
154.	Dr. C. O. Mohan	National workshop on Foresight and future pathways of agricultural research through involvement of youth in India	ICAR, New Delhi 1-2 March 2013
155.	Dr. Santhosh Alex	Official language seminar	HPCL, Visakhapatnam 3 March 2013
156.	Dr. Leela Edwin	National seminar on Law and policy on fisheries conservation management: Issues and challenges	NUALS, Cochin 5 March 2013



Sl. No	Name(s) of Participant(s)	Symposia/Seminars/Workshops etc. attended	Venue and Date
157.	Dr. C.N. Ravishankar Dr. B. Madhusudana Rao Shri Nitin Singh	ZTM-BPD South Zone Annual Meeting - 2012-13	DOR, Hyderabad 7 March 2013
158.	Dr. U. Sreedhar	INCOIS Third user interaction workshop	Hyderabad 8 March 2013
159.	Dr. R. Anandan	National seminar on Biochemistry in health and environment	St Joseph's College of Arts & Science, Cuddalore 9 March 2013
160.	Dr. K.V. Lalitha	5th Annual workshop-2013 of NAIP Component II	New Delhi 11-12 March 2013
161.	Dr. K.V. Lalitha	Meeting of the Committee for Formulation of guidelines for testing materials	ICAR, New Delhi 12 March 2013
162.	Dr. P. Muhamed Ashraf	Indo-UK Workshop on Marine primary production	KUFOS, Cochin 12-15 March 2013
163.	Dr. T.K. Srinivasa Gopal Dr. P.T. Lakshmanan Dr. Leela Edwin Dr. K.V. Lalitha Dr. T.V. Sankar Dr. S. Balasubramaniam Dr. C.N. Ravishankar Dr. M.M. Prasad Dr. R. Badonia	Meeting of HOD's and SIC's of ICAR Institutes	ICAR, New Delhi 15 March 2013
164.	Dr. T.K. Srinivasa Gopal	Meeting of the Directors of ICAR Institutes	ICAR, New Delhi 19-20 March 2013
165.	Dr. P.T. Lakshmanan	National seminar on Aquatic Chemistry	CUSAT, Cochin 21 March 2013
166.	Dr. C.N. Ravishankar	First meeting of consortia partners for development of digital knowledge management platform for fisheries	ICAR, New Delhi 21 March 2013
167.	Dr. Sanjoy Das Dr. j. Bindu Dr. K.K. Asha	Workshop on High pressure processing of high value perishable commodities	IIT, Kharagpur 22 March 2013
168.	Dr. B. Madhusudana Rao	Annual review workshop of Component-I of NAIP	NAARM, Hyderabad 22-23 March 2013
169.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Dr. George Ninan Dr. A.A. Zynudheen Dr. S.K. Panda Shri Nitin Singh Shri P. Vineeth K	National workshop on Business opportunities in freshwater fish	Patna 23 March 2013

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170.	Dr.J. Bindu	National workshop on the NAIP Component- 4	ICAR, New Delhi 25-26 March 2013
171.	Dr. P.T.Lakshmanan	Meeting of Council for Food Research and Development, Konni	Cochin 26 March 2013
172.	Shri M.V.Baiju	Meeting of the Expert committee constituted for installing insulated fish hold on-board fishing vessels	MPEDA, Cochin 26 March 2013

Special Days and Events

Workshops and seminars

National Brainstorming Workshop on Gender in Fisheries: A National Brainstorming Workshop on •Gender in fisheries: A future roadmap* was held at CIFT, Cochin on 4 April, 2012. The Workshop was chaired by Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi and Co-chaired by Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin. Dr. Nikita Gopal, Senior Scientist, CIFT and Convener of the Workshop presented the workshop themes. The themes identified for the Workshop were; (i) Assessment of gender roles and analysis of gender issues; (ii) Opportunities and constraints in performing gender roles; (iii) Power and decision making (iv) Capabilities and vulnerabilities with respect to shocks; and (v) Future strategies for mainstreaming gender towards equity and empowerment. She also presented the Workshop scheme. This was followed by a Working Group discussion in the forenoon session on the themes (i) to (iv) with the theme (v) being common to all groups. The Working Groups made their presentations in the afternoon session. The groups discussed the issues with respect to the various sectors like **marine, inland, aquaculture, coldwater, processing, marketing, education and professionals.** A Video Conferencing was also organized with experts of the Food and Agricultural Organization (FAO) of UN, Rome. Three experts, Dr. Nandini Gunewardena, Gender,



Dr. B. Meenakumari offering her introductory remarks. Also seen is Dr. T. K. Srinivasa Gopal



Group discussion in progress

Equity and Rural Employment Division, and Dr. Helga Josupeit and Dr. Daniela Kalikoski of FAO Fisheries Department participated. They interacted with the Workshop participants and discussed the themes. They also highlighted the various initiatives being taken globally in agriculture and fisheries in gender mainstreaming like the USAID and the Iceland initiative in Africa. The participants got an overview of the work by FAO in the area of gender.

National Brainstorming Workshop on Harvest and Post Harvest Losses in Fisheries: National Brainstorming Workshop on "Harvest and post harvest losses in fisheries* was held at CIFT, Cochin on 22 June, 2012. Participants from ICAR fisheries Institutes, MPEDA, SAUs, and NGOs attended the Workshop. The Workshop was chaired by Dr. B. Meenakumari, DOG (Fy.), ICAR, New Delhi and Co-chaired by Dr. T. K. Srinivasa Gopal, Director, CIFT, Cochin. Dr. K. K. Singh, ADG (Engg.), ICAR attended as a special invitee.

The Workshop began with introductory remarks by Dr. B. Meenakumari. Dr. P. Pravin, Principal Scientist, CIFT, Cochin made a presentation on the themes of the Workshop which was followed by a brief presentation by Dr. V. Geethalakshmi, Senior Scientist, CIFT, Cochin on the Institute Project on harvest and post harvest losses. There was an extended



session of discussion on the presentation with participants expressing their views regarding the sampling as well as methodology in relation to fisheries. This was followed by group discussions by the participants. The group leaders presented the salient points that emerged out of the group discussions.



Dr. B. Maanukumari offering her introductory remarks



Group discussion in progress

Awareness Workshop on Intellectual Property Rights: An Awareness Workshop on "Intellectual Property Rights for Seafood Industry" was organized by Micro, Small and Medium Enterprises – Development Institute (MSME-DI), Thiruvananthapuram in association with the Zonal Technology Management Centre, CIFT, Cochin and Industrial Fisheries Alumni Association (IFAA) on 30 July, 2012 at Cochin. The Workshop was aimed at assisting entrepreneurs in the fisheries sector in increasing awareness regarding the use of the intellectual property system. The programme organized for the benefit of about 100 participants from the seafood industry was inaugurated by Shri Dominic Presentation, MLA, Cochin. Shri Savyasachi Panikkassery, Director, MSME-DI presided over the inaugural meeting. Dr. T.K. Srinivasa Gopal,

Director, CIFT, Cochin, delivered the Keynote address. Felicitations were offered by Shri Edwin Joseph, President, IFAA, and Shri T.H. Badarudeen, President, KSSIA, Cochin. Smt. Kathreenamma Sebastian, Asst. Director (EI), MSME-DI welcomed the gathering. Dr. leela Edwin, Principal Investigator, Zonal Technology Management Unit and Head, FT Division, CIFT proposed a vote of thanks. The first technical session was on 'An overview of intellectual property rights' by Shri V.P. Balagangadharan, Brahmaprakash Scientist, VSSC, Thiruvananthapuram while the second on 'Patent registration with relevance to seafood industry' was handled by Shri S. Safikh, Project Scientist, Patent Information Centre, KSCSTE, Thiruvananthapuram. The technical sessions were followed by panel discussion and interactive sessions.



Shri Dominic Presentation delivering the inaugural address

Workshop on Networking Opportunities for Entrepreneurs: The Business Incubation Centre (BIQ) of CIFT, Cochin conducted a one day Workshop on 'Networking Opportunities for Entrepreneurs', on 14 August, 2012 (Detailed report appears elsewhere in the Section 'ZTM & BPD Unit').

National Seminar on Traditional Knowledge: A National Seminar on 'Traditional Knowledge and Management Systems in Fisheries' (FISHFOLK 2012) was organized at CIFT, Cochin during 30-31 October, 2012. The Seminar was jointly organized by SOFT(I), Cochin, CIFT, Cochin, ZTMC, Cochin and BOBP-IGO, Chennai. The two day National Seminar featured invited talks from leading researchers and master fishermen in the field, and a poster session which showcased 25 posters in the areas of Fish Harvesting, Fish Post Harvesting, Aquaculture, Fisheries Management and related sectors. Professor Anil K. Gupta, Indian Institute of Management, Ahmedabad and Executive Vice Chair of National Innovation Foundation was the Chief Guest of the inaugural function. The inaugural session was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT and President, SOFT(I). Shri P. Mohanasundaram, Director, MPEDA, Cochin offered felicitations. Dr. leela Edwin, Convener, FISHFOLK 2012 and Dr. T.V. Sankar, Secretary, SOFT(I) also spoke on the occasion.

The second day of the Seminar opened with the Lead talk by Dr. Y.S. Yadava, Director, BOBP-IGO, Chennai on 'Mainstreaming traditional knowledge into marine fisheries management'. Shri Julian Teeler, Chief Executive, SIFFS, Thiruvananthapuram spoke on the co-management experience of SIFFS. Dr. K.T. Thomson, Professor,





Prof. Anil K. Gupta inaugurating the Seminar



A view of the poster presentations

research. An account of indigenous technical knowledge in aquaculture was detailed by Dr. Ganagadhar Barlaya from CIFA, Bhubaneswar.

Pre-Conference Tutorials of PORSEC: In connection with the International Pan Ocean Remote Sensing Conference (PORSEO 2012), a pre-conference tutorial was organized jointly by PORSEC, INCOIS and CIFT during 30 October to 3 November, 2012 at CIFT, Cochin. The pre-conference tutorial was inaugurated by Dr. T.K.



Inauguration of the pre-conference tutorials

one focusing on ocean colour remote sensing and the other on active microwave remote sensing. Thirty one candidates comprising of students, research scholars and scientists from eight countries participated in the five day training. Out of this, 16 candidates attended tutorials on active microwave remote sensing and the other 15 on ocean colour remote sensing. On 3rd November a valedictory function was organized and the Chief Guest of the function was Shri S. Ananthanarayanan, Director, Naval Physical Oceanography Laboratories (DRDO), Cochin. The felicitation

CUSAT, Cochin spoke on the relevance of traditional institutional management systems and the debate on the relevance in the modernized and globalized scenario. Shri Vincent Jain, Chief Executive, Association of Deep Sea Artisanal Fishermen, Thoothoor, spoke on 'Sharing of artisanal deep sea fishing knowledge' and explained the methods of fishing of the artisanal deep sea fishers. Dr. j.B. Rajan, Professor, KILA, Thrissur spoke on the factors that prevent utilization of traditional knowledge in modern

address were delivered by Dr. P.T. Lakshmanan, Director In Charge, CIFT and Dr. S.C. Shenoy, Director, INCOIS. Feedback was given by the professors and students and they have appreciated the course content and facilities extended by CIFT. The meeting ended by a vote of thanks by Dr. P. Muhamed Ashraf, Senior Scientist, CIFT and Co-Chair of PCT.

Seminar on Emerging Technologies in Fish Processing: CIFT, Cochin has organized a National seminar on "Application of emerging technologies in fish processing" (PROTECH-2013) on 8 January, 2013. The Seminar organized jointly by Society of Fisheries Technologists (India), Zonal Technology Management-Business Planning & Development Unit and Industrial Fisheries Alumni Association, Cochin University of Science and Technology, Cochin. Dr. T.K. Srinivasa Gopal, Director, CIFT delivered the introductory remarks and also Chaired the Technical Sessions that followed. Dr. T.V. Sankar, Secretary, SOFT(I) was the Co-Chair. Dr. C.N. Ravishankar, HOD, FP and PI, ZTM-BPD was the Convener of the Seminar and the Co-conveners were Dr. j. Bindu, Senior Scientist, CIFT and Shri Edwin Joseph, President, Industrial Fisheries Alumni Association, CUSAT. The Seminar addressed specific consumer



Dr. H.S. Ramaswami delivering lecture Dr. T.K. Srinivasa Gopal delivering lecture



Visit to fish processing facilities at CIFT



needs towards safe, healthy and minimally processed seafood. The Seminar which was attended by about 75 participants was aimed at introducing the emerging technologies to the seafood industry, entrepreneurs, researchers, academicians and students.

Workshop on Energy Saving in Fishing Vessels: A National Stakeholders' Workshop on 'Energy saving in fishing vessels' was organized under the project 'Green fishing systems for tropical seas' on 18 January, 2013 at CIFT, Cochin. The programme began with a welcome speech of Dr. leela Edwin, HOD and PI of the Project. A brief introduction about the Project and Workshop was given by the PI. The function was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT. Dr. K. Gopakumar, former DOG (Fisheries), ICAR gave the introductory remarks. There were a total of 76 participants consisting of boat builders, boatyard owners, auxiliary equipment manufacturers, naval architects, users of alternate energy in fishing boats, manufacturers of alternate energy-powered boats, fishermen, researchers, academicians, scientists and students. The presentations ended by a self explanatory video prepared by Shri Mohanlal, Entrepreneur from Alappuzha, which featured the experiences of fishermen who were using inboard 10 Hp diesel engine. Shri M.V. Baiju, Convener of the workshop presented the specifications of 19.8m vessel which is to be built as a part of the Project by Goa Shipyard Limited, Co-partner of the Project. Suggestions were received regarding the need for increasing the capacity of fuel tank,



Dr.K. Gopakumar giving the introductory remarks

number of crew on the vessel and the comments were recorded. The formal vote of thanks was proposed by Shri M.V. Baiju, Senior Scientist.

Technical Workshop on Green Fishing Systems: The first technical workshop of the project 'Green fishing systems for the tropical seas' was organized at CIFT, Cochin on 16 February, 2013. The Principal Investigators of the lead and the cooperating agencies presented the progress of the respective work components. Dr. K. Gopakumar, former DOG (Fisheries), ICAR and Dr. A. Bandyopadhyay, National Coordinator, NAIP chaired the sessions. From CIFT, Cochin Dr. leela Edwin, HOD, FT, Dr. Saly N. Thomas, Dr. P. Pravin, Dr. M.P. Remesan, Principal Scientists, Shri M.V. Baiju, Senior Scientist and Dr. V.R. Madhu, Scientist attended the Workshop.

National Workshop on Business Opportunities in Freshwater Fisheries: A National Workshop on 'Business opportunities in freshwater fisheries' was organized by the ZTM-BPD Unit, CIFT, Cochin along with Directorate of Fisheries, Govt. of Bihar on 23 March, 2013 at Patna (Detailed report appears elsewhere in the Section •Ad hoc projects under operation").

Workshop on Technology Management for Researchers: NMRM, Hyderabad and ZTM-BPDU (South Zone), CIFT jointly organized a Workshop on 'Technology Management for Researchers' during 28 February to 6 March, 2013 at Hyderabad (Detailed report appears elsewhere in the Section *Ad hoc projects under operation").

Workshop on Fuel Efficient Fishing: The NAIP Sub project on 'Responsible harvesting and utilization of selected small pelagics and freshwater fishes' under operation at CIFT, Cochin in association with Matsyafed organized a one day Workshop on 'Fuel efficient fishing' at Nattika Co-operative Bank Auditorium in Thriprayar, Thrissur on 6 January, 2013. Shri C.K. Majeed, Vice President, Block Panchayath, Kodungallur inaugurated the Workshop. Shri M. Nasser, Principal Scientist, CIFT and Project Co-PI conducted a class on fuel efficient fishing in which he discussed in detail about the problems faced by the ring seiners with respect to fuel expenses, maintenance of propellers etc. A total of 65 fishermen from 36 ring seine boats attended the Workshop. Preliminary data was collected from all the participants. All the 36 boats were registered in the fuel efficiency improvement programme package" under the project.

Trainings and Awareness Programmes

Training on Power Block Aided Purse Seining: A training programme on "Power block aided purse seining" was held at CIFT, Cochin during 10-13 April, 2012. Nine fishermen trainees sponsored by the Directorate of Fisheries, Goa under the 'Rajiv Gandhi Rashtriya Krishi Vikas Yojana' participated in the training programme. Dr. T.K. Srinivasa Gopal, Director, CIFT inaugurated the training. Dr. P. Pravin, Principal Scientist briefed about the training programme. Dr. leela Edwin, Head, FT Division proposed the vote of thanks. Theory classes were held on different aspects of purse seining with special emphasis on large mesh purse seining. The fishermen trainees were





On-board training on power block aided purse seiner

board Fishermen Co-operative Society purse seiner 'Bharat Darshan' on 12 April, 2012. Dr. Srinivasa Gopal gave away the certificates to the trainees on 13 April, 2012 after successful completion of the training.

Awareness Campaign on Food Safety Issues in Bivalves: The Institute conducted an awareness campaign for Self Help Groups (SHGs) at Moothakunnam, Emakulam district on 20 July, 2012 (Details given in the Section 'Ad hoc projects under operation').

Training on Value Addition of Trout and Carp: A two day's training programme was organized jointly by the ZTMC-BPD unit of CIFT, Cochin and Directorate of Coldwater Fisheries Research on "Post harvest utilization and value addition of trout and carp" at DCFR Field Centre, Champawat during 9-10 September, 2012. The programme was inaugurated by Shri S.C. Negi, Second in Command, Sashastra Seema Bal, Champawat Range. About 70 persons including rural women, self-help group members and unemployed youth participated in the training. Dr. George Ninan, Senior Scientist, CIFT and Coordinator of the programme demonstrated the hygienic post harvest handling and processing practices of carps. The team from CIFT demonstrated the preparation of value added products viz., fish



Dr. Georp Ninan, Co-ordinator of the programme speaking at the inaugural function

pickle, fish cutlet, fish ball, fish fillet and fish roll from carps. A special session was devoted to hygienic handling, processing and value addition of rainbow trout. Extension officers of State Fisheries Department, Govt. of Uttarakhand, representatives of Krishi Vigyan Kendra, Lohaghat, State District administration, Food Processing Department, local people and media personnel were present during the training programme.

Training cum Demonstration Programme on Harvest and Post Harvest Fisheries Technologies: A training cum Demonstration Programme on 'Harvest and post harvest fisheries technologies' was conducted by the Visakhapatnam Research Centre of CIFT for the

also taken around the Institute and were briefed about various technologies developed by the Institute. Field visits to Cochin Fishing Harbour, fish markets and fish landing centers were also arranged for the fishermen trainees. A demonstration fishing trip was carried out on-

tribal fishermen and fisherwomen in Upper Kolab reservoir, Jeypore, Koraput district, Odisha during 13-15 September, 2012. About 50 scheduled tribe beneficiaries from Meenakshi Primary Fishermen Co-operative Society, Upper Kolab Reservoir attended the programme. Shri Madhavachandra Khosla, Vice Chairman, Jilla Parishad, Koraput, Odisha inaugurated the programme. On the occasion, foldable shrimp traps, gill nets, ice boxes, sealer machines, meat mincer and fish bags were handed over to the fishermen of Meenakshi Primary Fishermen Co-operative Society. In the subsequent days the technical talks were delivered by scientists of the Institute.



Resource personnel with the tribal fisherfolk

Training on Interventions of CIFT Technologies: A training programme on "Interventions of CIFT Technologies for the benefit of Scheduled Tribe fisherfolk" was conducted by the Visakhapatnam RC of CIFT under the tribal plan component at Vani Vilasa Sagar, Hiriyur taluk, Chitradurga District, Karnataka state during 1 & 18 November, 2012. Fifty tribal fishers participated in the programme. The programme was inaugurated by Shri Safiulla, President, Gram Panchayat, W Pura. Dr. U. Sreedhar, Dr. B. Madhusudana Rao, Senior Scientists, Dr. LN. Murthy, Scientist, Shri Srinivas, Asst. Director, Karnataka Fisheries Department, Shri Suresh, President, Fishermen Co-Operative Society, W Pura, Shri Kariyappa, Vice President, W Pura, Shri Sridhar and Shri Shanta Kumar, Gram Panchayat members, W Pura, addressed the gathering during the inaugural session.



Participants and co-ordinator of the programme

Training was imparted on the various harvesting methods that could be employed in harvesting resources from the reservoir. Training was also imparted on use of troll lines and hook and line for freshwater fishes. Detailed information was disseminated to the tribal folk on various types of baits for use in reservoirs. The training session on 'Value added products' comprised of lectures on different methods of fish processing, different types of value added fish products, hygienic handling of fish and importance of packaging. Practical training was imparted to the tribal fisherfolk on preparation of fish pickle using freshwater fish, preparation of prawn pickle, preparation of fish mince employing a meat mincer, preparation of fish pakoda and fish wafers.

In both the programmes inputs such as ice boxes, insulated fish bags, heat sealing machines, a meat mincer, and sundup pouches were distributed to the trainees.

Winter School on Fish Harvesting Systems: A 21 days Winter School on 'Fish harvesting systems for resource conservation', organized by the Fishing Technology Division of CIFT, Cochin during 20 November to 10 December, 2012 was inaugurated by Dr. E.G. Silas, former Vice Chancellor, Kerala Agricultural University, Thrissur and former Director, CMFRI, Cochin on 20 November, 2012. The inaugural session was presided over by Dr. T.K. Srinivasa

Gopal, Director, CIFT. Dr. O.K. Gulati, Zonal Director, Fishery Survey of India offered felicitations. Dr. Gulati also released the Winter School Manual by handing over a copy to Dr. Silas. Earlier Dr. Leela Edwin, Head, FT, CIFT welcomed the gathering while Dr. Saly N. Thomas, Director of the Winter School gave a brief introduction about the Winter School. Dr. P. Pravin, Principal Scientist proposed the vote of thanks.

The programme covered all relevant aspects on fish harvesting systems with emphasis on conservation aspects. **Important topics** included the latest developments in harvest technology, like resource conservation strategies, advancement in craft and gear materials, capacity reduction strategies and design and operation based conservation strategies for major fish harvesting systems, Fish Aggregating Devices, GIS and remote sensing applications, climate change, eco labelling and fishery certification.

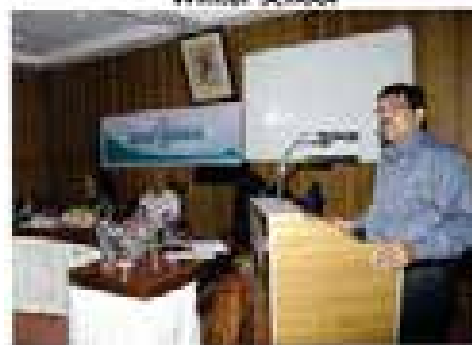
The Winter School concluded on 10

December, 2012 with a valedictory function. Dr. A. Ramachandran, Registrar, CUSAT, Cochin and Director, School of Industrial Fisheries delivered the valedictory address and gave away the certificates to the participants. Dr. T.K. Srinivasa Gopal, Director, CIFT presided over the function. Dr. Leela Edwin, Head, FT welcomed the gathering. Dr. Saly N. Thomas presented a report on the Winter School. The function came to a close with vote of thanks by Dr. P. Pravin, Principal Scientist, CIFT.

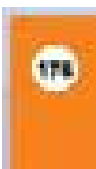
Training on Fish Processing and Extension Methods: A training course on 'Fish processing innovations and extension methods' was organized at CIFT, Cochin during 12-19 December, 2012. The programme was sponsored by Directorate of Extension, Ministry of Agriculture, Govt. of India, New Delhi. Thirteen fisheries officials from the State Fisheries Departments of Assam, Punjab, Manipur, West Bengal, Rajasthan, Odisha and Union Territory of Puducherry participated in the training. The training schedule consisted of both theoretical and practical aspects of various subjects/innovations. The subject areas such as post harvest handling and chilled storage of fish, freezing and frozen storage of fish products, canning, preservation of



Dr. E.G. Silas inaugurating the Winter School



Dr. A. Ramachandran delivering the valedictory address





Participants and faculty of the training programme

adoption of innovations, technology transfer in fisheries, harvest and post harvest losses in fisheries, and coastal zone management and evaluation methods etc. were included in the training schedule. Lecture, group discussion, demonstration, case study analysis, and field visits were the training methods used. Training course manuals and course certificates were distributed to the trainees.

Training on High Pressure Food Processing: CIFT, Cochin organized a National training on "Application of high pressure for food processing" on 12 March, 2013. The training was organized to disseminate the knowledge and achievements gained under the NAIP Sub project "Studies on high pressure processing (HPP) of high value perishable commodities". The training was intended to equip scientists, teachers, students, technologists and entrepreneurs involved in food industry with the recent advancements in the novel processing techniques so as to benefit the food processing sector. In the introductory remarks, Dr. T.K. Srinivasa Gopal, Director, CIFT emphasized on the importance of high pressure processing in today's



Practical demonstration in progress

emerging world of food processing. Dr. K. Devadasan, former Director, CIFT and Chairman, RAC, CIFT released the manual brought out on the occasion. Five lectures were delivered in the technical session which followed. The afternoon session was devoted to practical classes. Dr. J. Bindu, Senior Scientist, Fish Processing was the Convener of the programme.

Training programme on Interventions of CIFT Technologies: A training cum demonstration programme on Interventions of CIFT technologies was conducted for the benefit of tribal fisherfolks of Kotaramachandrapuram of Jangareddygudem, West Godavari, Andhra Pradesh by Visakhapatnam Research Centre of CIFT during 2&-28 March, 2013. Fifty fishermen belonging to ST groups from two villages viz. Reddygudem and Lakshmiapuram engaged in fishing activities in Kowada Canal Reservoir of Jangareddygudem were benefitted from the training programme. The Inaugural function of the programme was presided by Dr. M.M. Prasad, SIC of the Centre. The programme was inaugurated by Shri Surya Narayana, Project Officer, Integrated Tribal Development Authority, K.R. Puram. Felicitation

fish and shellfish, curing of fish, value added fish products, fishery by-products, retort pouch processing and packaging materials, extension methods, extension programme development and

was offered by Dr. V.V. Krishna Murthy, Deputy Director of Fisheries, West Godavari District. In the programme, different technical sessions on recent trends in fishing technologies for inland sectors and income generation through preparation of value added products were dealt with. Practical demonstration sessions were held on Hygienic handling of fish, Preparation of value added products viz., fish pickles, fish cutlet, fish pakoda and fish wafers, and Employing gillnets and foldable fish traps in reservoir fisheries. The foldable fish traps developed by CIFT were tested in field conditions in Kowada Reservoir. The trainees were also distributed with gillnets, foldable fish traps, fish meat



Distribution of insulated fish bag

mincers, hand-held sealing machines, and insulated fish bags.

Training cum Demonstration Programme on Value Added Products: A training on Value added products from freshwater fish for employment and income generation was conducted at Ranchi, Jharkhand in collaboration with Department of Fisheries, Ranchi, Jharkhand during 16-19 December, 2012.



Dr. L.N. Murthy, Scientist imparting training

Training Workshops on Hygienic Handling of Fish: Two training cum workshop programmes on •Hygienic



handling and fresh fish trading for coastal women" and "Hygienic production and marketing of dry fish for coastal women" were conducted in collaboration with "Fish for All" Facility, M.S. Swaminathan Research Foundation (MSSRF), Poompuhar, Tamil Nadu during 26-27 February, 2013. As part of the programmes, PRA workshops were also conducted in two coastal villages, landing centres and markets in Poompuhar on 28 February, 2013.

About 300 fisherwomen from the villages of Puthukkuppam, Nagarkuppam, Vanagiri, Chinnakudi and Poompuhar participated in the Workshop. The Workshop was followed by a discussion with a group of interested business entrepreneurs including M/s. Green Diamond International and market supervisors from selected supermarkets in the nearby township.



Discussion with fishery entrepreneurs

International Training on Fishery Byproducts: Ms. Dongdavanh Sibounthong, Head of Fisheries, Fisheries Resources and Wetland Management Session, Department of Livestock and Fisheries, Ministry of Agriculture and Forestry, Vientiane Capital, Lao PDR sponsored by TCS of Colombo Plan Programme of the Ministry of External



Ms. Dongdavanh being trained

Affairs has undergone training in "Fishery byproducts, prawn shell powder, chitin, chitosan and glucosamine hydrochloride" at CIFT, Cochin during 3-29 December, 2012.

International Trainees on Seafood Quality Assurance: An International training programme on "Seafood quality assurance" under Colombo Plan Programme was conducted at CIFT, Cochin during 14-26 January, 2013. Mrs. Harini Suravandita and Mrs. Pavithra Hasangi Gingaddarange from Department of Fisheries, Sri Lanka attended the training.

Technology Transfer Programmes at NEH Region

At Shillongani, Assam: A training programme on 'Fabrication of improved gillnets and eco-friendly fishing gears' was organized at Shillongani, Nagoan District, Assam on 24 and 25 September, 2012 under the NEH programme. The programme for the benefit of 60 fishermen was jointly organized by CIFT and Department of Fisheries, Govt. of Assam. The resource persons from CIFT, Dr. P. Pravin and Dr. M.P. Remesan, Principal Scientists delivered lectures and conducted practical demonstrations.



Participants and faculty of the training

At Howly, Assam: Another training programme on 'Hygienic fish handling and processing techniques' was conducted at Howly, Barpeta District, Assam during 27 to 29 September, 2012. The programme was jointly organized by CIFT and Department of Fisheries, Govt. of Assam. The resource person from CIFT, Dr. A.A. Zynudheen, Senior Scientist delivered lectures and conducted practical demonstrations.

At Hapoli, Arunachal Pradesh: A training programme on 'Fabrication of improved gillnets and eco-friendly fishing gear' was conducted at Hapoli, Ziro in Lower Subansiri District of Arunachal Pradesh during 3-5 November, 2012. The programme was organized by CIFT, Cochin in association with the Department of Fisheries, Government of Arunachal Pradesh. About 30 fishermen and fish farmers and 15 fishery extension officials from the Department of Fisheries participated in the programme. The inaugural session was presided over by Shri Pani Taram, District Fisheries Development Officer, Lower Subansiri District. Dr. Leela Edwin, HOD, FT, CIFT, Cochin



Frontline demonstration of eco-friendly cillnet fishing

inaugurated the programme. Dr.J. Charles jeeva, Senior Scientist, gave a brief introduction about the technology transfer programmes being organized in NEH states. Smt. Pani Odyssey, Farm Manager, Regional High Altitude Fish Seed Fann, Tarin-Ziro and Shri Mudang Ranka, Asst. Fishery Officer offered felicitations on the occasion. Shri N.K. Purkayastha, Fishery Officer proposed a vote of thanks. In the technical session which followed, Dr. leela Edwin delivered lectures on responsible fisheries, inland fishing methods, craft and gear for inland fishing in India, the ill-effects of destructive fishing methods and the principles of gillnetting.

At Doyang Reservoir, Nagaland: Training cum demonstration programme on 'Harvest and post harvest technology for exploitation of reservoir fish' and 'Preparation of value added fish products' was conducted at Doyang reservoir area, Wokha district, Nagaland during

20-24 November, 2012. More than 50 fishermen and fisherwomen have been benefited from the programme. On the occasion fishing traps, stick held drag net, gillnets, iceboxes, sealing machines, insulated fish bags and meat mincer were handed over to the beneficiaries. During the programme technical talks on importance of fish as health food, hygienic handling of fish and importance of value added products for sustainable income were given by Dr. M.M. Prasad, SIC, Visakhapatnam. Demonstration sessions on fabrication and operation of fishing gears and traps and preparation of value added products namely fish pickle, fish cutlet, fish ball and fish pakoda were also held. Field visit to the reservoir was also made for resource estimation and exploitation.



Practical session in progress

preparation of value added products namely fish pickle, fish cutlet, fish ball and fish pakoda were also held. Field visit to the reservoir was also made for resource estimation and exploitation.

At Dumbur Reservoir, Tripura: The training programme on 'Improved gillnets and eco-friendly fishing gear' for reservoir fisheries was held at Gandacherra, Tripura (near Dumbur Reservoir) on 24 & 25 November, 2012. Shri Nikhil Majumdar, Principal Officer (Fisheries), Tripura Tribal Area Autonomous Development Council presided over the training sessions. Dr. M.S. Kumar, Tech. Officer (T 7-8) conducted the training on fabrication of collapsible fish or prawn traps and on the fabrication of improved gillnets. Dr. S. Balsubramaniam, HOD, EIS, CIFT, Cochin



Participants of the training

conducted two sessions on the extension methodologies and management issues in the adoption of responsible fishing techniques. Shri K.H. Tripura, Superintendent of Fisheries, Gandacherra assisted the training team. There were 54 participants (fishermen habituated around the Dumbur Reservoir area and officials) for the training.

At Rudrasagar Reservoir, Tripura:

Training cum demonstration programme on Hygienic handling of fish and preparation of value added products for the benefit of fisherwomen at Rudrasagar Reservoir area, Melaghar, Tripura was conducted during 26-28 November, 2012. Fifty fisherwomen members of Rudrasagar Fisheries Co-operative Society were benefited from the programme. Shri Bijay Ghosh, Fisheries Officer, FFDA, Agartala and Shri Kamal Hassan, Fisheries Officer, Rudrasagar co-ordinated the training programme. Certificates were distributed to all the beneficiaries at the end of the training programme.



Women trainees at Rudrasagar

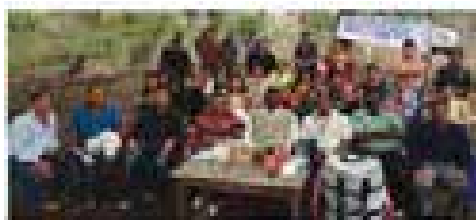
At Ranipol, Silldm: The newly designed Community Fish Smoking Kiln (COFISKI) was installed at Krishi Vigyan Kendra, Ranipol in Sikkim on 3 March, 2013 and a training cum demonstration programme on Hygienic production of smoke cured fish using COFISKI was conducted by Dr. M.M. Prasad, SIC, VRC of CIFT, Visakhapatnam during 3-4 March, 2013.

At Iduli and Jia villages, Arunachal Pradesh: A Training cum Demonstration on 'Interventions of CIFT technologies' for the benefit of fisherfolk, progressive farmers and women self help group' was



conducted by the Visakhapatnam RC of CIFT under the NEH plan at Iduli and Jia villages of Roing, Lower Dibang Valley District, Arunachal Pradesh during 17-19 March, 2013. Fifty trainees which included tribalfishers, progressive farmers and different women self help group members participated in the programme. The training session was imparted on various harvesting methods that could be employed in harvesting resources from the fast flowing rivers, small reservoirs and different farm levels. Training was given in fabricating simple multifilament gillnets set either at bottom, mid-water or surface. Inputs such as simple multifilament gillnets, multifilament multimesh gillnets, plastic coated iron meshed foldable traps, troll lines, hooks and artificial baits were distributed to the trainees.

The training session on 'Value added products' comprised of lectures on different methods of fish processing, different types of value added fish products, hygienic handling of fish and importance of packaging. Practical training was imparted to the tribal fisherfolk and other self help group members on preparation of fish pickle using freshwater fish, preparation of fish mince employing a meat mincer, preparation of fish pakoda, breaded and battered products and preparation of fish cutlets. Demonstration of fish wafers was also performed. Inputs such as, insulated



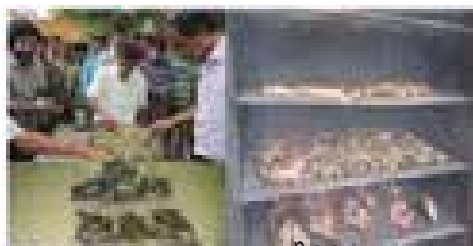
Participants and resource persons of the training

fish bags, heat sealing machines, meat mincers, standup pouches, masks and mouth guards were distributed for the benefit of the trainees.

At Lembucherra, Tripura A training-cum-demonstration programme on 'Hygienic production of smoke-cured fish using

Community Fish Smoking Kiln' was conducted at ICAR Research Complex, Lembucherra, Tripura and KVK, South Tripura during 20-23 March, 2013. Major objectives of the programmes were:

- i). To install two **Community Fish Smoking Kiln (COFISKI)** units, and
- ii). To conduct training-cum-demonstration for hygienic production of smoke-cured fish using **Community Fish Smoking Kiln**. The training session comprised of lectures on different methods of fish preservation, health benefits of fish consumption, importance of smoking fish using COFISKI and practical training on hygienic production of smoke-cured fish using COFISKI. The programmes were inaugurated by Dr. M. Dutta, Joint Director, ICAR Complex, Lembucherra, Tripura and Dr. A.K. Singh, Programme Co-ordinator, KVK, South Tripura. Two COFISKI Units were installed at ICAR complex, Lembucherra, Tripura and KVK, South Tripura. About 100 fishermen and fisherwomen were benefited from both the programmes.



Demonstration on hygienic production of smoke cured fish using COFISKI

At Lengpui Mizoram: A training-cum-demonstration programme on 'Harvest and post harvest technologies' was conducted by the Visakhapatnam Research Centre of CIFT at Krishi Vigyan Kendra (KVK), Lengpui, Mamit District, Mizoram during 26-28 March, 2013. Fifty participants from Dinthar, Venglai, Kanan Veng, Model Veng, Vengthar, Venghlui and Lengpui villages attended the programme. The training session on 'Harvest technologies' included lectures on various harvesting methods that could be employed in Mizoram for harvesting resources from various water bodies. Training was also imparted on use of troll lines and hook and line for freshwater predatory fishes.

The training session on 'Post harvest technologies' comprised of lectures on different methods of fish processing, different types of value added fish products, hygienic handling of fish and importance of



Demonstration session in progress

packaging. Practical training was imparted on the preparation of fish pickle using freshwater fish, preparation of fish mince employing meat mincer, preparation of fish balls and fish cutlets and preparation of smoked fish.

Tribal Sub Plan Programmes

Distribution of FRP Aluminium Boat and Gillnets at Wayanad, Kerala: Under the Tribal Sub Plan, a programme for distribution of

aluminium boat and gillnets to tribal fishermen was organized by CIFT, Cochin in association with Nellarachal ST Fisheries Co-operatives Society at Karapuzha, Ambalavayal in Wayanad District of Kerala on 27 February, 2013. Dr. Leela Edwin, HOD, Fishing Technology welcomed the gathering and gave an introduction about the TSP of CIFT. Dr. T.K. Srinivasa Gopal, Director, CIFT gave the Key Note address and he also explained briefly about the activities of CIFT. Shri M.V. George, Grama Panchayath President, Ambalavayal presided over the meeting. Smt. A.S. Vijaya, Block Panchayath President, Batheri was the Chief Guest and she inaugurated the programme by lighting the lamp. She also handed over the aluminium canoe fabricated by CIFT and improved gillnets to the Fisheries Society. Shri P. Gopinath, IMC Member, CIFT, Dr. A. Radhama



The team after the function



Aluminium boat after the distribution ceremony

Distribution of FRP Coracles and Gillnets at Kabini, Karnataka:

Under the Tribal Sub Plan, a programme for distribution of FRP coracles and gillnets to tribal fishermen was organized by CIFT, Cochin in association with Kamataka State Co-operative Fisheries Federation (KSCFF) at Krishna Raja Sagar, Mysore district, Karnataka on 3 March 2013. The programme was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT. Shri H.S. Veerappa Gowda, Director of Fisheries, Govt. of Karnataka participated as Chief Guest. During the



Inaugural session in progress



FRP coracle after the distribution ceremony

Pillai, Programme Coordinator, KVK, Ambalavayal, Smt. Subaida Gafoor, Ward Member, Nellarachal and Shri A. Sukumaran, Promoter, Tribal Society and Dr. S. BaJa subramaniam, Head, EIS Division, and Coordinator, TSP programmes offered felicitations. Dr. M.P. Remesan, Principal Scientist, CIFT proposed vote of thanks. About 80 fishermen participated in the programme.

programme, 20 improved FRP coracles and improved gillnets developed by CIFT were distributed to the tribal fishermen belonging to the Girijanara Meenugarara Sahakara Sangha affiliated to KSCFF. About 80 fishermen participated in the programme. Shri N. Nanje Gowda, Ex-Chairman and Director, KSCFF and Shri Siddaiah, Project Manager, KSCFF participated as special invitees.

Celebrations

Foundation Day and Agricultural Education Day:

The 55th Foundation Day of CIFT, Cochin was celebrated on 28 April, 2012. Shri R.C. Sinha, Director, CIFNET, Cochin inaugurated the function. Four senior-most retired persons from different categories were honoured at the function. Ms. Parvathy Soman of 'Munch Star Singer fame' was the Guest of Honour who also mesmerized the audience with her voice. There were cultural programmes by the staff and children of staff. The meeting was presided over by Dr. T. K. Srinivasa Gopal, Director, CIFT. Dr. P. T. lakshmanan, Head, B&N Division welcomed the audience and Dr. T.V. Sankar, Head, QAM Division offered vote of thanks.

As part of the Agricultural Education Day celebrations, the research



Shri R.C. Sinha delivering the inaugural address of Foundation Day celebrations



Students being explained on Agricultural Education Day





laboratories of the Institute were kept open to the public in the forenoon of 28 April and large number of students from Kendriya Vidyalaya visited the Institute and had first-hand information on the research activities.

Anti Terrorism Day: The Institute observed Anti Terrorism Day on 21 May, 2012. The staff of the Institute assembled together and took Anti Terrorism Day Pledge.

World Environment Day: The Visakhapatnam Research Centre of CIFT in collaboration with the CMFRI Regional Centre observed World Environment Day on 8 June, 2012. Saplings were planted in the CMFRI IFT Residential Complex on the day in order to create awareness about protecting environment.

Sadbhavana Day: "National Sadbhavana Diwas" was observed by the Institute on 21 August, 2012 in connection with the observance of Communal Harmony Fortnight. The staff of the Institute assembled together and took Sadbhavana Day Pledge.

Meetings

Research Advisory Committee Meeting: The Research Advisory Committee (RAQ) under the Chairmanship of Dr. K. Devadasan, former Director, CIFT met during the period 9-10 April, 2012 to discuss about the research activities of the Institute.



RAC meeting in progress

Institute Staff Research Council Meeting: The Institute Research Council (IRC) under the Chairmanship of Dr. T.K. Srinivasa Gopal, Director, CIFT met during the 19-21 April, 2012 to discuss the progress in the ongoing research programmes as well as to

finalize the research projects for the next year. Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi presided over the meeting on the last day and took part in the deliberations. The house discussed in detail the 17 ongoing research projects, seven new project proposals and the various ad hoc research projects. Presentations were also made on the visits of Scientists abroad to attend training programmes, symposia etc.



IRC meeting in progress

ZTM-BPD Meeting: The ZFM-BPDU (South Zone) organized the Annual Meeting 2012-13 on 7 March, 2013 at DOR, Hyderabad (Detailed report appears elsewhere in the Section "Ad hoc projects under operation").

Consultancy. Agreements

CIFT, Cochin signed a series of consultancy agreements with various firms during the year under report. The most significant ones are reported below:

With FIT&T, Chennai: On 2 August, 2012 an MoU was signed between CIFT, Cochin and Fisheries Institute of Technology and Training, Chennai for technical assistance for fabrication of a 40 feet long Fiberglass Reinforced Plastic (FRP) boat for an amount of ₹ 50,000/-.

With M/s Blue Water Foods & Exports (P) Ltd., New Mangalore: On 23 August, 2012 an MoU was signed with M/s Blue Water Foods & Exports (P) Ltd., New Mangalore for technical guidance and assistance relating to the setting up of an Effluent Treatment Plant (ETP) for an amount of ₹ 4,76,2000/-.

With M/s Mangala Marine Exim Pvt. Ltd., Cochin: On 10 September, 2012 an MoU was signed with M/s Mangala Marine Exim Pvt. Ltd., Cochin for technical guidance and assistance relating to the setting up of an Effluent Treatment Plant (ETP) for an amount of ₹ 2,00,000/-.



Handing over MoU to M/s Mangala

With MPEDA, Cochin: An MoU was signed with Marine Products Export Development Authority (MPEDA) (Ministry of Commerce & Industry, Govt. of India), Cochin on 27 September, 2012 for setting up of Quality Control Labs at Bhubaneswar, Nellore, Bhimavaram and Chennai. Under the agreement CIFT shall provide the services such as



design of the laboratory (both chemical and microbiology), list of equipment, specification of the equipment, supervision visit etc. The consultancy charges for the scheme realized is ₹ 87,500/-.

With MPI, Koothattukulam: A MoU was signed with Meat Products of India Ltd., Edayar, Koothattukulam, Ernakulam District (A Government of Kerala undertaking firm) for assistance for the production of ready to serve food products in retortable pouches and implementation of HACCP system. Under the agreement CIFT shall provide technical and other information for the production of ready to serve food products in retortable pouches and also technical consultancy for implementation of HACCP which includes



Handing over MoU to MPI

preparation of HACCP manual, HACCP plan, SSO? and GMP for the desired products, providing layout, training to staff on HACCP implementation and auditing as also providing HACCP certification which is valid for a period of two years with scope for

surprise audit at least three times during the validity period. The consultancy charges for the scheme realized is ₹ 4,50,000/-.

With NRCP, Guwahati: CIFT, Cochin signed an MoU with National Research Centre on Pig, Rani, Guwahati to maintain close liaison and co-operation for providing technical advice and assistance relating to establishment of HACCP system for pig slaughter house cum pork processing plant at NRC on Pig. CIFT will be charging an amount of ₹ 1,00,000/- for the consultancy services. Under the agreement CIFT will validate the quality system operating in the pig slaughter houses and pork processing plant and will certify the unit after fulfilling the requirements laid down for the purpose.

With CPT, Cochin: CIFT, Cochin signed a consultancy agreement with Cochin Port Trust for providing technical guidance for the setting up of an Effluent Treatment Plant (ETP) at Cochin Fisheries Harbour in connection with the up-gradation of infrastructure. Under the agreement CIFT will be providing engineering drawing with specification, membrane filter and undertake supervision of construction of the ETP at different stages.

With KSCDAC, Thiruvananthapuram: The NAIP-RHSSP project under operation at CIFT, Cochin signed an MOU with Kerala State Coastal Area Development Corporation to transfer the technology package for establishing business models developed (Details given elsewhere under the section 'Ad hoc projects under operation').

Other Important Activities

Inauguration of Business Incubation Centre: The Business

Incubation Centre established at CIFT, Cochin under the project ZTM-BPD Unit was inaugurated by Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR on 5 April, 2012. (Detailed report appears elsewhere in the Section 'Ad hoc projects under operation').

DG, ICAR and Secretary, DARE Visits MV Bharat Darshan:

Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE visited the Manasseri Fishermen Development Co-operative Society, Cochin owned boat 'Bharat Darshan' at Cochin Fisheries Harbour to inspect the power block installed on-board the vessel by CIFT under the Institute project 'Resource specific large mesh purse seine for tuna and large pelagics in the Indian EEZ'. With the installation of the power block, the fishermen are able to haul up the net faster and are able to carry out more sets of operations on the same day which also has resulted in heavy catches. Dr. Ayyappan also visited another vessel belonging to the same Society at Cochin Fishing Harbour, 'Bharat Sagar' where the Institute has installed a hydraulic tuna long liner winch and setter under the new Institute project on 'Responsible line fishing'. He was impressed with the concept of carrying out research on a participatory approach.



DG, ICAR inspecting tuna long line branch Jines on-board Bharat Sagar

DG, ICAR and Secretary, DARE Visits ETP Designed by CIA':

Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE visited M/s Mangala Seafoods, Aroor to inspect the performance of the Energy Efficient Treatment Plant (ETP) designed,



developed and installed at the factory. The plant functions as common ETP for three export oriented units, viz., M/s Mangala Sea Products, M/s Bhatsons Aquatic Products and M/s Roshan Foods located at the Industrial Development Area, Aroor, and has a capacity to treat 3 lakh litres of effluent per day. The treated effluent conform to the norms prescribed by Central Pollution Control Board and State Pollution Control Board. The main advantage of the unit is that, it is highly energy efficient. It needs only two numbers of 1 Hp motors for its operation. The processors expressed their satisfaction about the performance of the ETP to Dr. Ayyappan.

The ETP installed in the plant of M/s Bhatsons Aquatic Products has been awarded SECOND POSITION by Kerala State Pollution Control Board for the year 2011. The award was conferred to the firm after a detailed visit by a panel of experts appointed by KSPCB. The award was presented to the firm by Chief Minister of Kerala, Shri Oommen Chandy, at a function held at Thiruvananthapuram on 5 June, 2012 in connection with World Environment Day celebrations.



Dr. S. Ayyappan visiting ETP

Launching of 'FishMaid' Products: Under the project, 'Responsible harvesting and utilization of selected small pelagics and freshwater fishes' an array of life style snack products have been developed from small pelagic fishes like oil sardine, mackerel, anchovies and freshwater fishes. The formal product launch of 25 products branded 'Fish Maid' was arranged on 17 July, 2012 at Thiruvananthapuram. Shri Oommen Chandy, Honorable Chief Minister of

Kerala, launched 'Fish Maid' products by handing over a complementary packet to Shri G. Karthikeyan, Speaker, Kerala Legislative Assembly (Detailed report appears elsewhere under the Section 'Ad hoc projects under operation').

Launching of Project on Green Fishing Systems for Tropical Seas: 'Green fishing systems for tropical seas', a research project funded by National Fund for Basic, Strategic and Frontier Application Research in Agriculture

(NFBSFARA), ICAR, New Delhi, was formally launched by Shri K. Babu, Hon'ble Minister for Fisheries, Ports and Excise, Govt. of Kerala on 16 February, 2013 at CIFT, Cochin. The project with an outlay of ₹12.25 crores envisages optimized energy saving fishing vessels and resource specific fishing gears and better



Launching of the project (L to R: Dr. K. Gopakumar, Dr. T. K. Srinivasa Gopal, Shri K. Babu, Dr. Mohan Joseph Modayil and others)

operational methods to save energy. Goa Shipyard Limited, Goa, M/s. Garware-Wall Ropes Ltd., Pune and M/s. DSM India Pvt. Ltd., Mumbai are partnering CIFT in the attempt. This is the first ever basic and strategic research project to be undertaken under Public Private Partnership Mode in fisheries. Three new publications of Fishing Technology Division, 'Trawl Designs Developed at CIFT for Small, Medium and Large Trawlers' and 'Bycatch Reduction Devices for Responsible Shrimp Trawling' (English and Hindi versions) were also released by the Hon'ble Minister.

CIFT Designed Solar Fish Dryer at Yanam, Puducherry: As a part of the project of

Department of Fisheries and Fishermen Welfare, Puducherry, a wholesale hygienic fish market and solar fish dryer constructed by Yanam Municipality at Savithri Nagar, Yanam was inaugurated by Hon'ble Chief



Minister of Puducherry fish market and solar fish dryer at Yanam Shri N. Rangasamy on 6 January, 2013. Solar drier designed under the technical guidance of CIFT has a capacity to process 1000 kg fresh fish. The project was funded by National Fisheries Development Board. Honorable Chief Minister of Puducherry has given special appreciation to CIFT's contribution in installing the solar drier.

Technical Discussions with Foreign Nationals: The scientists of the Veraval Research Centre of CIFT participated in technical discussions with M/s. Intertek Moody Marine, Canada and M/s Hindustan Unilever Limited, Gujarat on the 'Sustainability and MSC certification to threadfin breams (*Nemipterus japonicus*)' on 4 February, 2013. The scientists of the Centre also participated in another technical discussion on 'Sustainable harvesting and fishery certification of Cephalopods Of Gujarat'. Mr. Francesco Palau, Appetais Italia SpA, Italy, Mr. Egidio Machhi, Chief Executive, M&G Trading, Italy and exporters of Gujarat attended the session on 26 February, 2013.

CIFT Participates in 1st Indian Expedition to Southern Ocean: An expedition was conducted to Indian sector of Southern Ocean by National Centre for Antarctic and Ocean Research (NCAOR), Goa on-board FORV Sagar Nidhi to work on the inherent properties of the optically active substances with special reference to phytoplankton size spectra in Southern Ocean. Kum. P. Minu, Research Scholar, INCOIS Project participated in the expedition which started from

Chennai on 11 January, 2013. The objective was to study the phytoplankton absorption based on size fraction and effect of optically active substances on it. Phytoplankton size spectral algorithm validation for the determination of phytoplankton species in Southern Ocean waters, Improvement of phytoplankton size spectral algorithms suitable for Southern Ocean waters and to make an *in situ* bio-optical data base for ocean colour applications in Southern Ocean. The expedition was for 46 days and covered 20 sampling stations from 40 °S and 56 °E. Water samples were collected from the surface and analysis for various parameters were done. The expedition ended on 28 February, 2013 at Mauritius.

Administration

Cases considered by the Departmental Promotion Committee

Category	Promotion	Declaration of probation & confirmation	Granting MACP
Scientific	10	01	-
Technical	38	-	-
Administrative	10	09	03
Supporting	-	01	04
Auxiliary	-	-	-

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 Committees met for purposes as follows: Departmental Promotion Committee (4 times), Departmental Selection Committee (Once), Assessment Committee (7 times), Career Advancement Committee (Once), MACP Committee (3 times) and Selection test (Once).

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.

Publication of the 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 seven times for screening 28 papers.

Institute Research Council

The Institute Research Council meeting was convened during 19-21



April, 2012 to review the progress achieved in the ongoing research projects of the Institute during 2011-12 and to discuss the research project proposals for the year 2012-13. The Institute Research Project Document for the year 2012-13 was compiled and brought out for discussion at the Meeting. The House discussed in detail the 17 ongoing research projects, besides six concluded projects and 10 new projects apart from the various ad hoc projects.

PERMISnet, IRS and PIMS-ICAR

The Technical Section helps in maintaining the Personal Management Information System network (PERMISnet-II) of ICAR up-to-date. Further, the Section also furnishes quarterly inputs to the Intelligent Reporting System (IRS-II) being maintained by ICAR. Through this a set of 40 reports (Both administrative and financial) are being furnished regularly online. 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 were published during the period. Besides, the Institute Annual

Report 2011-12 (bilingual) and Research Highlights 2011-12 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 17 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 seven times to discuss 125 cases. As recommended by the HR Committee the scientists and officers of the Institute participated in 42 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 In-charge 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 book collection on all aspects of harvest and post harvest technology of fish. A good collection of digital resources are available to CIFT community through the library portal <http://library.cift.res.in>.

The library acquired 192 books during the period. Forty four foreign and 19 Indian scientific periodicals have been subscribed. Online databases viz., ASFA (Aquatic Science and Fisheries Abstracts), FSTA (Food Science and Technology

Abstracts), Indiastat.com and Indian Standards on DVD 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 2002 scientific papers of CIFT are available in the digital form. Library has supplied copies of 778 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.



Official Language Implementation

Hindi Workshop

During the year two Hindi Workshops were conducted for technical staff of the Institute. The first workshop meant for Technician I to T-4 was held on 30 April, 2012. A total of 24 technicians attended the programme. The second workshop was conducted for Technical Officers (T6 to T9) of the Institute on 1 May, 2012 for the benefit of 24 Technical



Dr. Radhika Devi conducting classes

Officers. Dr. Radhika Devi, Assistant Director, Hindi Training Sub-Institute, Hindi Teaching Scheme, Kakkanad was the faculty for both the programmes.

Official Language Workshop for the Administrative

Assistants and Upper Division Clerks was conducted on 7 November, 2012 by Dr. Ramesh Prabhu, Chief Official Language Officer, Hindustan Petroleum Corporation Ltd., Cochin.

'Chetana Mass 2012' Celebrations

Chethana Mass 2012 was celebrated at CIFT, Cochin during 13



Chief Guest Dr. Mohanakumaran Nair along with Dr. T.K. Srinivasa Gopal, Dr. P.T. Lakshmanan and Dr. C. Jessy Joseph

August to 14 September, 2012. During the celebrations various competitions in Hindi were conducted for the staff members of the Institute, namely:

Division-wise terminology, Still photography, Advertisement for print media, Street play on social issues, 'Matsya Darshan', Identify the instruments and give brief details and Administrative terminology quiz. Concluding function of the Chethana Mass was held on 14 September, 2012.



Nimita Devi Nritya Ashram artists performing Manipuri classical dance

Chief Guest of the function was Dr. C. Mohana Kumaran Nair, Pro-Vice Chancellor, KUFOS, Cochin. The function was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT. Welcome address was

delivered by Dr. P.T. Lakshmanan, HOD, B&N and vote of thanks by Dr. C. Jessy Joseph, DD(OL). Chief guest distributed cash prizes to the winners of the competitions.

This was followed by a very colourful cultural programme presented by the artists of the "Nimita Devi Nritya Ashram", Imphal, Manipur and Dr. K.K. Prajith, Scientist, CIFT, Cochin.

'Hindi Divas' was celebrated at Mumbai Research Centre of CIFT on 15 September, 2012. Several competitions in Hindi were conducted and prizes distributed to the winners. Smt. Sushmita Bhattacharya, Asst. Director of Hindi Implementation was the Chief Guest of the function. The Veraval Research Centre of CIFT also celebrated 'Hindi Divas' on 14 September, 2012 by conducting various competitions. Hindi week was observed at CIFT Visakhapatnam Research Centre during 1-6 October, 2012. Various competitions were held for the staff members of the Centre. Shri B.S. Murthy, Branch Manager, Central Bank of India, Visakhapatnam was the Chief Guest during the valedictory function of the Hindi week celebrations.

Official Language National Seminar

An Official Language National seminar on "Technological advancements in fisheries" was held at CIFT, Cochin during 17-18 August, 2012. The inaugural session on 17 August started with a welcome by Dr. P.T. Lakshmanan, HOD, B&N Division, CIFT. The session was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT. Shri P.A. Sheik Pareeth, IAS, District Collector, Ernakulam inaugurated the Seminar while Dr. K.D. Kokate, Deputy Director General (Extension), ICAR, New Delhi delivered the Keynote address. Dr. G. Syda Rao, Director, CMFRI, Cochin offered felicitations. Dr. C. Jessy Joseph, DD (OL), CIFT proposed vote of thanks.

The technical sessions that followed were on Trends in aquaculture, Harvest and post harvest technologies and Resource management. Dr. Leela Edwin, HOD, FT, Dr. C.N. Ravishankar, HOD, FP and Dr. M.R. Boopendranath, Principal Scientist were the Session Chairs, respectively. Altogether 16

papers were presented in the sessions. In the poster session of the Seminar six posters were presented.

The valedictory session of the Seminar was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT who also gave away the best poster cash prizes to Dr. Sanjoy Das and Dr.



Shri Harikrishnan delivering the talk

P.K. Binsi of CIFT.

Publications brought out in Official Language

The following two books were published in the year 2012 which were released by Shri K. Babu, Hon'ble Minister for Fisheries and Excise, Govt. of Kerala during the launching of the project on 'Green fishing systems for tropical seas' at CIFT, Cochin on 16 January, 2013:

1. CIFT semi pelagic trawl systems by Dr. M.R. Boopendranath, Dr. M.P. Remesan and Dr. V.R. Madhu.
2. Bycatch reduction device for responsible shrimp trawling by Dr. M.R. Boopendranath, Dr. P. Pravin, Dr.T.R. Gibinkumar and Dr. S. Sabu

Invited Technical Talk

Shri S. Harikrishnan, Sub-Divisional Engineer, BSNL, Kochi Circle delivered a Technical Talk in Official Language on 'Latest trends in telecommunication' on 11 June, 2012 for the benefit of Institute staff members.

Priority Setting, Monitoring and Evaluation Cell

Priority setting, Monitoring and Evaluation (PME) Cell serves as a node for information flow and action and has the following Terms of Reference:

- ◆ Sensitization of policy makers, 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), activities related to EFC Memo, publication of annual reports etc.

- ◆ Facilitating monitoring and evaluation of research programmes including the newly introduced Web-based Half Yearly Progress Monitoring (HYPM) of scientists.
- ◆ Impact analysis of research and extension activities.

The PME Cell functions at the Institute with the following composition:

Dr. S. Balasubramaniam,	: Scientist Incharge
Principal Scientist & Head, EIS	
Dr. Nikita Gopal, Senior Scientist	: Member
Shri C.G. Joshy, Scientist	: Member
Dr. A.R.S. Menon, Technical Officer (T9)	: Member
Smt. P.K. Shyma, Technical Officer (T6)	: Member
Smt. N.C. Shyla, Sr. Tech. Asst. (T4)	: Member

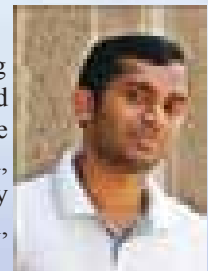
Post Graduate Studies

Shri Niladri Sekhar Chatterjee, Scientist, Biochemistry and Nutrition Division, CIFT, Cochin was awarded Ph. D. degree of Indian Agricultural Research Institute, New Delhi (Deemed University) for his thesis entitled, "Fate of metal flumizone in cabbage, soil and water". He



worked under the guidance of Dr. Suman Gupta, Senior Scientist, IARI, New Delhi.

Shri K.K. Prajith, Scientist, Fishing Technology Division, CIFT, Cochin was awarded Ph. D. degree of Cochin University of Science and Technology, Cochin for his thesis entitled, "Application of biofloc technology in the nursery rearing and farming of giant freshwater prawn, *Macrobrachium rosenbergii*". He worked under





the guidance of Dr. B. Madhusudana Kurup, Vice Chancellor, Kerala University of Fisheries and Ocean Studies, Cochin.

Smt. A. Jeyakumari, Scientist, Fish Processing Division, CIFT, Cochin was awarded Ph. D. degree of Central Institute of Fisheries Education (CIFE), Mumbai (Deemed University) for her thesis entitled, "Studies on delivery of omega-3 fatty acids through emulsification and encapsulation". She worked under the guidance of Dr. G. Venkateshwarlu, Principal Scientist, CIFE, Mumbai.



Shri M.S. Kumar, Tech. Officer (T7-8), Visakhapatnam Research Centre of CIFT was awarded Ph. D. degree of Andhra University,



Visakhapatnam for his thesis entitled, "Studies on biology, biochemistry and trawl codend selectivity of Karut Croaker *Johnius carutta*, Bloch, 1793 off Visakhapatnam coast". He worked under the guidance of Dr. G. Rajeswari, Principal Scientist, CIFT, Visakhapatnam, Prof. K. Sreeramulu and Prof. B. Kishore, Department of Zoology, Andhra University, Visakhapatnam.

Invited Talks

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

1. Dr. S. Audilakshmi, Principal Scientist, DSR, Hyderabad - How to encourage women? (15 May, 2012)
2. Shri K.S. Harikrishnan, Sub-Divisional Engineer, BSNL, Thodupuzha - Latest trends in telecommunication (11 June, 2012)
3. Dr. Raxit J. Jariwalla, Dr. Rath University, California - Nutritional medicine and infectious diseases (12 June, 2012)
4. Dr. O.N. Tiwari, Scientist, Indian Institute of Bio-resources and

Sustainable Development, Imphal - Biodiversity analysis of cyanobacteria and microalgae from North East region of India falling under Indo-Burma biodiversity hotspots and possible commercial exploitations (28 December, 2012)

5. Dr. R. Jayakumar, Professor, Amritha Centre for Nano Sciences and Molecular Medicines, Cochin - Advances in chitosan based nano materials (29 January, 2013)



Dr. S. Audilakshmi delivering her talk. Also seen are Dr. S. Ashaletha, Senior Scientist and Dr. P.T. Lakshmanan, Director I/c, CIFT



Dr. Rixit J. Jariwalla



Dr. O.N. Tiwari delivering the talk

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
- ◆ Collaborative project by MPEDA, CIFT and IFP on up-gradation of seafood packaging
- ◆ Assessment committee for Scientists, CFTRI, Mysore and University of Kerala
- ◆ Board of Studies in Food Science and Technology, University of

Mysore

- ◆ Examiner for Ph.D. and M.F.Sc. in University of Mysore, CUSAT, Cochin, College of Fisheries, Mangalore, KUFOS, Cochin and College of Fisheries, Tuticorin
 - ◆ Institute Management Committee, NRC Meat, Hyderabad
- Dr. P.T. Lakshmanan**, Head, Biochemistry & Nutrition Division

As Member

- ◆ Examiner, M.Sc. Environmental



Technology, CUSAT, Cochin

- ◆ Task force committee on fisheries, Govt. of Kerala

Dr. Leela Edwin, Head, Fishing Technology Division

As Member

- ◆ Institute Management Committee, CIFRI, Barrackpore
- ◆ Sub committee for framing Ph.D. regulation, KUFOS, Cochin
- ◆ Sub committee for framing guidelines for granting recognition to the Institution, KUFOS, Cochin
- ◆ Academic Council, KUFOS, Cochin
- ◆ Task force for Gap analysis of ILO Convention No. 188, Ministry of Labour and Employment, Govt. of India
- ◆ Institute Technology Management Committee, NRC for Banana, Thiruchirappalli and IISR, Kozhikode
- ◆ Working group on Fisheries, Department of Fisheries, Govt. of Kerala
- ◆ Expert committee, Coastal Area Development Agency for Liberation, Alappuzha

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

As Member

- ◆ Assessment committee for promotion of Scientists and Technical personnel, CMFRI, Cochin
- ◆ 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 and 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

- ◆ Expert committee, Regional expert group on Transboundary aquatic animal health issues in the Bay of Bengal, 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 and KUFOS, Cochin

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
- ◆ Editorial Board, Journal of Food Science and Technology, Association of Food Scientists and Technologists, CFTRI, Mysore
- ◆ Technical committee, Establishment of Incubation Centres, NFDB, Hyderabad
- ◆ Expert committee, Sacred Heart College (MG University), Cochin
- ◆ Committee for evaluating BPD proposals, NAIP, ICAR, New Delhi
- ◆ Committee for drafting curriculum and syllabi, KUFOS, Cochin
- ◆ Review committee of DBT, New Delhi for reviewing projects in post harvest technology of fish
- ◆ Technical committee, Lakshadweep Development Corporation Ltd., Cochin for setting up of Tuna canning factory at Minicoy island

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

As Member

- ◆ Assessment panel of experts visits in support of seafood industries located in Andhra Pradesh, Odisha and West Bengal
- ◆ External examiner, M.Sc. students of two colleges affiliated to Osmania University, Hyderabad

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
- ◆ Scientific advisory committee, KVK, Ambuja Cement Foundation, Kodinar

Dr. S. Visnuvinayagam, Scientist Incharge, Mumbai Research Centre



As Member

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

Dr. S. Sanjeev, Principal Scientist

As Chairman

- ◆ National Mirror Committee of ISO/TC 34/SC9 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 constituted by EIC, Govt. of India on Export of live bivalve molluscs
- ◆ 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 Tarangambadi, Tamil Nadu
- ◆ Inter Department Panel of experts for approval of fish processing plants for export to EU
- ◆ DPC, Coir Board, Cochin and MPEDA, Cochin
- ◆ Committee for Technology up-gradation scheme for marine products, MPEDA, Cochin
- ◆ Interest subsidy committee for seafood processing units, MPEDA, Cochin
- ◆ Expert committee for Canning plant construction, Lakshadweep Administration

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, Bureau of Indian Standards, New Delhi

Dr. Saly N. Thomas, Principal Scientist

As Chairperson

- ◆ 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.

Dr. P. Pravin, Principal Scientist

As Member

- ◆ Expert committee on NFDB, Hyderabad funding in Lakshadweep islands on various fisheries related projects
- ◆ Expert team to Lakshadweep islands for survey work of NFDB, CMFRI, CICEF, Sate Fisheries Department and UT of Lakshadweep

Dr. K. Ashok Kumar, Principal Scientist

As Member

- ◆ Inter Departmental Panel of experts for approval of seafood processing plants for EU
- ◆ Assessment Board for the approval of technologists for seafood processing plants constituted by EIC, Govt. of India
- ◆ 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 committee for the construction of modern hygienic fish markets in all states, NFDB, Hyderabad
- ◆ Expert group of Ministry of Agriculture for review of standard conditions for sanitary import of various fish/fishery products

Dr. Suseela Mathew, Principal 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. M.P. Remesan, Principal Scientist

As Member

- ◆ Committee for the selection of Group C (Jr. Clerks) and Field Supervisor, MPEDA, Cochin

Dr. G. Rajeswari, Principal Scientist

As Member

- ◆ External examiner for M.Sc. students, Department of Marine Living Resources, Andhra University, Visakhapatnam
- ◆ Resource person for the Interdisciplinary Refresher Course in Life Sciences in Andhra University
- ◆ Committee for up-gradation of fellowship



from JRF to SRF, Andhra University, Visakhapatnam

- ◆ Interview panel for selection of Deckhands, CIFNET, Visakhapatnam

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. V. Geethalakshmi, Senior Scientist

As Member

- ◆ Examiner for Ph.D. course thesis evaluation in Biostatistics of NIMHANS, Bangalore

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 for value added products of MPEDA, Cochin
- ◆ Working group on ILO Convention 188
- ◆ Executive committee, Agricultural Economics Research Association
- ◆ Paper setter for the course on managerial Economics for PG students, CUSAT, Cochin
- ◆ Paper setter for the course on Diploma in Fish Products Technology, IGNOU, New Delhi
- ◆ Examiner, B.F.Sc. course, KUFOS, Cochin

Dr. G.K. Sivaraman, Senior Scientist

As Member

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

Dr. A.A. Zynudheen, 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
- ◆ Technical committee of Matsyafed for setting up of fish meal plant and glucosamine plant
- ◆ Editor, Fishery Technology

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
- ◆ Question paper setter, CIFE, Mumbai

Dr. U. Sreedhar, Senior Scientist

As Member

- ◆ Examiner for the subject, 'Practical navigation, fishing gear technology and onboard navigation aspects in fisheries' at CIFNET, Visakhapatnam

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. Ashaleta, Senior Scientist

As Member

- ◆ Examiner for PG courses of 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 Member

- ◆ 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, Senior Scientist

As Member

- ◆ Assessment panel of experts visits in support of seafood industries located in Andhra Pradesh, Odisha and West Bengal

Dr. Toms C. Joseph, Senior Scientist

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
- ◆ Examiner and question paper setter for B.F.Sc. course, KUFOS, Cochin and TNVASU, Chennai

Dr. J. Charles Jeeva, Senior Scientist

As Member

- ◆ Examiner for the UG and PG courses of CIFE, Mumbai, KAU, Thrissur, TANUVAS, Thoothukudi, CAU, Tura, Meghalaya, TNAU, Coimbatore and Madras University, Chennai

Dr. Rakesh Kumar, Senior Scientist

As Member

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

Dr. S.K. Panda, Senior Scientist

As Member

- ◆ Inter Departmental Panel of experts for approval of seafood processing plants for EU
- ◆ Expert group for drafting international standard (ISO/TC 234) on Traceability of shellfishes including crustaceans and molluscs

Dr. L.N. Murthy, Scientist

As Member

- ◆ Assessment panel of experts visits in support of seafood industries located in Andhra Pradesh, Odisha and West Bengal
- ◆ Interview panel for selection of Field Assistants, MPEDA, Visakhapatnam

Dr. K.K. Asha, Scientist

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 Fish hold 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

Shri Ankur Nagori, Scientist

As Member

- ◆ Expert committee on Tuna long line and fish hold subsidy scheme of MPEDA
- ◆ Technical committee for Evaluation of bids for the procurement of solar dryers for raw fish and related services at SPMU, ICZMO, Bhubaneswar
- ◆ Panel for Apprentice trainees in the discipline B. Tech. (Mechanical and Electrical and Electronics)

Shri C.G. Joshy, Scientist

As Member

- ◆ Faculty, course work for Ph.D. programmes, CUSAT, Cochin

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
- ◆ Editorial Board as Chief Editor, Science India, Cochin



Visitors

The following were some of the dignitaries who visited the Institute during the period:

- ◆ Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR, New Delhi (CIFT, Cochin on 5 April, 2012)
- ◆ Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi (CIFT, Cochin on 5 April, 2012, 21 April, 2012 & 22 June, 2012)
- ◆ Dr. G. Syda Rao, Director, CMFRI, Cochin (CIFT, Cochin on 5 April, 2012 & 17 August, 2012)
- ◆ Shri R.C. Sinha, Director, CIFNET, Cochin (CIFT, Cochin on 28 April, 2012)
- ◆ Shri A.K. Sreevastava, Deputy Director (Implementation), Official Language, Bangalore (CIFT, RC, Visakhapatnam on 4 May, 2012)
- ◆ Dr. S. Mauria, Assistant Director General (IP & TM), ICAR, New Delhi (CIFT, Cochin 5 April, 2012)
- ◆ Dr. Bangali Baboo, National Director, NAIP, ICAR, New Delhi (CIFT, Cochin 5 April, 2012)
- ◆ Dr. K.K. Singh, Assistant Director General (Engineering), ICAR, New Delhi



Visit of Shri A.K. Sreevastava



Visit of Shri Purnachandra Rao

(CIFT, Cochin on 22 June, 2012)

- ◆ Shri J. Purnachandra Rao, Commissioner of Police, Visakhapatnam (CIFT, RC, Visakhapatnam on 7 August, 2012)
- ◆ Shri P.A. Sheik Pareeth, IAS, District Collector, Ernakulam (CIFT, Cochin on 17 August, 012)
- ◆ Dr. K.D. Kokate, Deputy Director General (Extension), ICAR, New Delhi (CIFT, Cochin on 17 August, 2012)
- ◆ Dr. Karunasagar Iddya (FAO Senior Research Officer), Shri Fransisco Blaha (FAO Consultant) and Shri Raju K. Joseph (Deputy Director, MPEDA) (CIFT, RC, Visakhapatnam on 21 August, 2012)
- ◆ Dr. C. Mohana Kumaran Nair, Pro-Vice Chancellor, KUFOS, Cochin (CIFT, Cochin on 14 September, 2012)
- ◆ Professor Anil K. Gupta, Indian Institute of Management, Ahmedabad and Shri P. Mohanasundaram, Director, MPEDA, Cochin (CIFT, Cochin on 30 October, 2012)
- ◆ Dr. Y.S. Yadava, Director, BOBP-IGO, Chennai (CIFT, Cochin on 31 October, 2012)
- ◆ Dr. E.G. Silas, former Vice Chancellor, Kerala Agricultural University, Thrissur and Former Director, CMFRI, Cochin (CIFT, Cochin on 20 November, 2012)
- ◆ Dr. D.K. Gulati, Zonal Director, Fishery Survey of India (CIFT, Cochin on 20 November, 2012)
- ◆ Dr. A. Ramachandran, Registrar, CUSAT, Cochin (CIFT, Cochin on 10 December 2012)
- ◆ Shri K. Praveen Kumar, Commissioner of Fisheries, Govt. of Andhra Pradesh (CIFT, RC, Visakhapatnam on 18 December, 2012)
- ◆ Dr. K. Gopakumar, former DDG (Fisheries), ICAR (CIFT, Cochin on 4 April, 2012, 18 January, 2013 & 16 February, 2013)
- ◆ Shri K. Babu, Hon'ble Minister for Fisheries, Ports and Excise, Govt. of Kerala (CIFT, Cochin on 16 February, 2013)
- ◆ Dr. A. Bandyopadhyay, National Coordinator, NFBSFARA, ICAR, New Delhi (CIFT, Cochin on 16 February, 2013)



Shri Anwar Hashim, Dr. K. Gopakumar, Dr. Bangali Baboo, Dr. S. Ayyappan, Dr. T.K. Srinivasa Gopal, Dr. B. Meenakumari, Dr. S. Mauria and Dr. G. Syda Rao releasing the book on Oyster Delights on 5 April, 2012



On-going Research Projects

Institute Projects

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
1.	Studies on fortified natural biocides and corrosion resistance of fishing craft and gear composite materials for protection	Dr. Saly N. Thomas	Cochin	Cochin	Dr. Leela Edwin Dr. P. Muhamed Ashraf
2.	Responsible fishing systems for marine sector	Dr. P. Pravin	Cochin	Cochin	Dr. Saly N. Thomas Dr. M.P. Remesan Dr. V.R. Madhu Shri A.K. Jha Dr. K.K. Prajith
3.	Development of appropriate fishing systems for rivers	Dr. M.P. Remesan	Cochin, Visakhapatnam, Veraval & Barrackpore	Cochin Visakhapatnam Veraval Barrackpore	Dr. P. Pravin Shri. M.V. Baiju Dr. V.R. Madhu Dr. K.K. Prajith Dr. G. Rajeswari Dr. R. Raghu Prakash Dr. U. Sreedhar Shri A.K. Jha Dr. R.K. Manna (CIFRI) Dr. A.K. Sahoo (CIFRI)
4.	Development of sustainable fishing technologies for exploitation of fishery resources in the east coast of India	Dr. G. Rajeswari	Visakhapatnam	Visakhapatnam	Dr. R. Raghu Prakash Dr. U. Sreedhar
5.	Species specific interventions in value addition of commercially important and emerging species of freshwater fish	Dr. George Ninan	Cochin & Mumbai	Cochin Mumbai	Dr. K.V. Lalitha Shri P.K. Vijayan Dr. A.A. Zynudheen Dr. J. Bindu Shri C.G. Joshy Shri Ankur Nagori Dr. A. Jeyakumari Dr. S. Vishnuvinayagam Dr. P.K. Binsi Smt. P. Viji
6.	Utilization of fish processing waste for the development of innovative products	Dr. A.A. Zynudheen	Cochin	Cochin	Dr. George Ninan Dr. R. Anandan Dr. S.K. Panda Dr. P.K. Binsi Shri C.G. Joshy Dr. S. Vishnuvinayagam Smt. V. Renuka
7.	Innovative packaging techniques for processing and preservation of fish products	Dr. C.N. Ravishankar	Cochin	Cochin	Dr. K.V. Lalitha Dr. J. Bindu Dr. C.O. Mohan Dr. P.K. Binsi Shri Ankur Nagori



Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
8.	Technologies for utilization of fishery resources at Maharashtra coast	Dr. R. Chakrabarti	Mumbai	Mumbai	Dr. S. Vishnuvinayagam Smt. P. Viji Dr. P.K. Binsi
9.	Processing and quality improvement of seafoods in Gujarat	Dr. R. Badonia	Veraval	Veraval	Dr. G.K. Sivaraman Dr. C.O. Mohan Shri A.K. Jha Shri V. Chandrasekar Smt. V. Renuka Smt. S. Remya
10.	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. S.K. Panda Dr. K.K. Asha Dr. C.O. Mohan
11.	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. V. Ronda Dr. A. Jeyakumari Shri C.G. Joshy Dr. C.O. Mohan Dr. M.M. Prasad
12.	Diversity of seafood-borne pathogenic and commensal bacteria and bioscreening for novel genes and biocatalysts	Dr. K.V. Lalitha	Cochin & Visakha patnam	Cochin Visakha patnam	Dr. Sanjoy Das Dr. Toms C. Joseph Dr. V. Murugadas Dr. B. Madhusudana Rao
13.	Bio-monitoring and bio-evaluation of marine resources and formulation of nutraceuticals in human nutrition and health	Dr. P.T. Lakshmanan	Cochin & Visakha patnam	Cochin Visakha patnam	Dr. Suseela Mathew Dr. R. Anandan Dr. K.K. Asha Dr. Niladri S. Chatterjee Dr. B. Madhusudana Rao Dr. L.N. Murthy Kum. Jesmi Debbarma
14.	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. Niladri S. Chatterjee
15.	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 & Cochin	Visakha patnam Cochin	Dr. B. Madhusudana Rao Dr. L.N. Murthy Kum. Jesmi Debbarma Dr. Sanjoy Das



Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
16.	Enhancing fuel efficiency and safety of mechanized fishing vessel systems	Shri M. Nasser	Cochin & Visakha patnam	Cochin Visakha patnam	Dr. V. Geethalakshmi Dr. S. Ashaletha Shri Ankur Nagori Smt. Arathy Ashok
17.	Evaluation of technology transfer models in fisheries sector	Dr. S. Balasubramaniam	Cochin & Visakha patnam	Cochin Visakha patnam	Dr. S. Ashaletha Dr. George Ninan Dr. J. Charles Jeeva Smt. P. Jeyanthi Smt. Arathy Ashok
18.	Management dimensions in the fisheries sectors - policies, issues and implications	Dr. Nikita Gopal	Cochin Visakha patnam & Veraval	Cochin Visakha patnam Veraval	Dr. V. Geethalakshmi Dr. J. Charles Jeeva Shri V. Radhakrishnan Nair Smt P. Jeyanthi Smt. Arathy Ashok Shri V. Chandrasekar
19	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 Nitin Singh (Business Manager) Shri Rakesh Thomas Kurien* Dr. Elizabeth Carolin* Shri P. Vineethkumar* Dr. B. Madhusudana Rao

Indian Council of Agricultural Research (ICAR) Projects

20	Intellectual property management and technology transfer/commercialization	Dr. T.V. Sankar Dr. C.N. Ravishankar	Cochin	Cochin	Shri M. Kiran Das* Smt. K.A. Anju*
21.	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 P.A. Aneesh* Shri Jones Varkey*

National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA) Projects

22.	Green fishing systems for tropical seas	Dr. Leela Edwin Shri Raghuvveer Singh Shri Sanjay V. Rout Shri Rakesh Gaikwad	Cochin, Goa, Pune & Maumbai	Cochin	Dr. Saly N. Thomas Dr. P. Pravin Dr. M.P. Remesan Shri M.V. Baiju Dr. V.R. Madhu
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Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
				Goa Pune Mumbai	Shri P.H. Dhiju Das* Shri Renju Ravi* Shri P.M. Muhammed Sherif* Shri P.T. Sreejith* Smt. K.A. Sayana* Shri Rithin Joseph* Shri P. Shameer* Shri V.R. Kiran* Shri Jinu Krishnan* Shri P.M. Vipin* Shri B.K. Upadhyay Shri Maruti D. Bhat Shri Ravindranath Savasere Shri Kishore Darda Ms. Margot Wunnik-van
23.	Development of multiplex micro array for detection of food-borne and shrimp pathogens	Dr. Toms C. Joseph	Cochin	Cochin	Dr. K.V. Lalitha Dr. G.K. Sivaraman Shri Thobias P. Antony*
National Agriculture Innovation Projects (NAIP)					
24.	Responsible harvesting and utilization of selected small pelagics and freshwater fishes	Dr. K.V. Lalitha	Cochin	Cochin	Dr. S. Sanjeev Shri M. Nasser Dr. R. Anandan Dr. V. Geethalakshmi Dr. S. Ashaletha Shri T.N. Nishil* Shri Muhammed Azharuddin* Shri Ratheesh Mathew* Shri John Philip Corrya* Shri C.G. Rakesh* Kum. Rohan Maria Peter* Kum. E.S. Sumi* Kum. K. Rajeswari*
25.	Bioprospecting of genes and allele mining for abiotic stress tolerance	Dr. Toms C. Joseph	Cochin	Cochin	Dr. K.V. Lalitha Kum. Anju Baby* Kum. Aswathy Mary Varghese*
26.	Oceanic tuna fisheries of Lakshadweep seas - A value chain approach	Dr. T.K. Srinivasa Gopal	Cochin & Lakshadweep	Cochin	Dr. P. Pravin Dr. K. Ashok Kumar Dr. Suseela Mathew Shri M.V. Baiju Dr. J. Bindu Dr. Toms C. Joseph Shri K.V. Aneesh Kumar* Shri P.S. Khanolkar*



Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
					Shri T.R. Anantha narayanan* Shri C.T. Nithin*
27.	Studies on high pressure processing (HPP) of 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*
28.	Mobilizing mass media support for sharing agro information	Dr. S. Ashaletha	Cochin	Cochin	Shri Aswin Antony*
29.	Utilization strategy for oceanic squids (cephalopods) in Arabian sea - A value chain approach	(Dr. K.S. Mohamed, CMFRI, Cochin)	Cochin & Mumbai	Cochin	Shri M.V. Baiju Dr. K.K. Asha Kum. K.R. Remyakumari*

Centre for Marine Living Resources & Ecology (CMLRE) Projects

30.	Resource assessment of deep-sea fishes along the continental slope of Indian EEZ and the central Indian Ocean	Dr. U. Sreedhar	Cochin & Visakha patnam	Cochin Visakha patnam	Dr. Suseela Mathew Dr. G. Rajeswari Dr. R. Raghu Prakash
31.	Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies	Dr. M.P. Remesan	Cochin & Visakha patnam	Cochin Visakha patnam	Shri P.K. Vijayan Dr. Sanjoy Das Dr. George Ninan Dr. A.A. Zynudheen Dr. R. Anandan Dr. K.K. Prajith Shri T. Jose Fernandez* Shri V.G. Jinoy* Shri F. Daniel Raj* Shri R. Navaneethan* Shri M.M. Lijin Nambiar* Shri Rahul Ravindran* Dr. G. Rajeswari Dr. R. Raghu Prakash
32.	Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications	Dr. P.T. Lakshmanan	Cochin	Cochin	Dr. Suseela Mathew Dr. R. Anandan Dr. K.K. Asha Dr. Niladri Sekhar Chatterjee Shri B.P. Bijulal* Shri Jomy George* Kum. K.R. Remya Kumari* Kum. N.B. Jayasree*
33.	Characterization of harmful algal blooms along Indian coast	Dr. K. Ashok Kumar	Cochin	Cochin	Dr. T.V. Sankar Dr. R. Anandan Dr. S.K. Panda



Sl. NO	Name of Project	Principal investigator	Location of Project	Co-investigators
				Kum. R. Rajisha* Kum. Rose Mary Mathew*
Department of Biotechnology (DBT) Project				
34.	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 Dr. George Ninan Kum. G.S. Hema* Kum. K. Shiny*
Department of Science and technology (DST) Project				
35.	Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala	Dr. Femeena Hassan	Cochin	Cochin (Dr. Saleena Mathew) Dr. J. Charles Jeeva
36	Food safety Intervention for women in fishery based microenterprises in costal Kerala	Dr. Femeena Hassan	Cochin	Cochin Dr. P.T. Lakshamanan Dr. S. Balasubramaniam Kum. P.A. Asja Parveen* Kum. Milu Mathews*
Coconut Development Board (CDB) Project				
37.	Techno-economic feasibility of coconut wood canoes for the small- scale fisheries sector in the south west coast of India and Lakshadweep	Dr. Leela Edwin	Cochin	Cochin Dr. Nikita Gopal Shri M.V. Baiju Dr. V.R. Madhu Shri Shiran Kalappurakkal* Shri K.A. Roshan* Kum. P. Sruthi* Shri K.R. Midhun*
Indian National Center for Ocean Information (INCOIS) Projects				
38.	Retrieval of Phytoplankton and associated optical constituents based on long term bio-optical studies	Dr. P. Muhamed Ashraf	Cochin	Cochin Kum. V.P. Sauda* kum. P. Minu* Kum. U. Smitha*
39.	Validation of PFZ along Gujarat coast	Dr. V.R. Madhu	Veraval	Veraval Shri A.K. Jha Shri. Shib Sankar Das* Shri Jithendra Vaghela*

*Research Fellow



Papers Published in Refereed Journals

- ◆ Anandan, R., Ganesan, B., Obulesu, T., Suseela Mathew, Kumar, R.S., Lakshmanan, P.T. and Zynudheen, A.A. (2012) - Dietary chitosan supplementation attenuates isoprenaline-induced oxidative stress in rat myocardium, *Intl. J. Biol. Macromolecules*, 51: 783-787.
- ◆ Anandan, R., Ganesan, B., Obulesu, T., Suseela Mathew, Kumar, R.S., Lakshmanan, P.T. and Zynudheen, A.A. (2013) - Antiaging effect of dietary chitosan supplementation on glutathione dependent antioxidant system in young and aged rats, *Cell Stress Chaperones*, 18(1): 121-125.
- ◆ Aneesh Kumar, K.V., Paresh, S.K., Pravin, P., Madhu, V.R. and Meenakumari, B. (2013) - Effect of hook design on long line catches in Lakshadweep sea, India, *Indian J. Fish.*, 60(1): 21-27.
- ◆ Aneesh Kumar, K.V., Paresh, S.K., Pravin, P., Meenakumari, B. and Radhakrishnan, E.V. (2013) - First record of the grey reef shark *Carcharinus amblyrynchus* (Bleeker, 1850) from Lakshadweep sea, India, *J. Threatened Taxa*, 5(1): 3580-3582.
- ◆ Aneesh, P.A., Jones Varkey, Anandan, R., Suseela Mathew, Asha, K.K., Lakshmanan, P.T. and Sankar, T.V. (2012) - Proximate composition, amino acid and fatty acid profiles of Commerson's anchovy (*Stolephorus commersonii*) and Indian mackerel (*Rastrelliger kanagartha*), *Biochem. & Cellular Archives*, 12(2): 371-376.
- ◆ Asha, K.K. and Devadasan, K. (2013) - Protective effect of taurine on the mitochondria of albino rats induced with fulminant hepatic failure, *Biomed. Prev. Nutr.*, <http://dx.doi.org/10.1016/j.bionut.2012.12.007>
- ◆ Asha, K.K., Suseela Mathew and Lakshmanan, P.T. (2012) - Effect of PUFA from fish oil on lipid metabolism of heart in streptozotocin-induced diabetes in male albino rats, *J. Biomed. Sci.*, 1(1):
- ◆ Asha, K.K., Suseela Mathew and Lakshmanan, P.T. (2012) - Flavonoids and phenolic compounds in two mangrove species and their antioxidant property, *Indian J. Geo Marine Sci.*, 41(3): 259.
- ◆ Bindu, J., Ginson, J., Kamalakanth, C.K., Asha, K.K. and Srinivasa Gopal, T.K. (2013) - Physico-chemical changes in high pressure (HP) treated Indian white prawn (*Fenneropenaeus indicus*) during chill storage, *Innovative Food Sci. & Emerging Technol.*, 17: 37-42.
- ◆ Binsi, P.K., Ravishankar, C.N. and Srinivasa Gopal, T.K. (2013) - Development and characterization of an edible composite film based on chitosan and virgin coconut oil with improved moisture sorption properties, *J. Food Sci.*, 78(4): 526-534.
- ◆ Boopendranath, M.R. (2012) - Waste minimization in fishing operations, *Fish. Technol.*, 49(2): 109-119.
- ◆ Boopendranath, M.R. and Shahul Hameed, M. (2012) - Energy analysis of the ring seine operations, off Cochin, Kerala, *Fish. Technol.*, 49(2): 141-146.
- ◆ Boopendranath, M.R. and Shahul Hameed, M. (2013) - Gross energy requirement in fishing operations, *Fish. Technol.*, 50(1): 27-35.
- ◆ Charles Jeeva, J., Ramasubramanian, V., Amrender Kumar, Bhatia, V.K., Geethalakshmi, V., Sarvesh Kumar Premi and Ramasundaram, P. (2013) - Forecasting technological needs and prioritizing factors for the post harvest sector of Indian fisheries, *Fish. Technol.*, 50(1): 87-91.
- ◆ Dhiju Das, P.H., Nikita Gopal and Leela Edwin (2012) - Labour deployment and wage distribution in ring seine fishery of central Kerala, *Agri. Econ. Res. Rev.*, 25(1): 107-114.
- ◆ Dwivedi, R.M., Chaudary Rajeswari, Solanki, H.V., Raman Mini, Matondkar, S.G.P., Madhu, V.R. and Meenakumari, B. (2012) - Study of ecological consequence of the bloom (*Noctiluca miliaris*) in off-shore waters of the northern Arabian sea, *Indian J. Geo Marine Sci.*, 41(4):
- ◆ Femeena Hassan, Geethalakshmi, V., Charles Jeeva, J. and Babu, R.M. (2013) - Combined effect of lime (*Citrus aurantifolia*) and drying on reducing bacteria of public health significance in edible oyster (*Crassostrea madrasensis*), *J. Food Sci. & Technol.* 50: 203-207.
- ◆ Femeena Hassan, Sangeetha K. Prathap, Charles Jeeva, J., Saleena Mathew and Remya Babu, M. (2013) - An economic feasibility analysis of fisherwomen based microenterprises, *Indian J. Fish.*, 60(1): 125-130.
- ◆ Geethalakshmi, V., Charles Jeeva, J., Balasubramaniam, S., Parvathy, R. and Nasser, M. (2012) - Information and training needs of coastal fisherfolk of Ernakulam district in Kerala, *J. Global Commun.* 5(1): 9-15.



- ◆ Gibinkumar, T.R., Sabu, S., Pravin, P. and Boopendranath, M.R. (2012) - Bycatch characterization of shrimp trawl landings off southwest coast of India, *Fish. Technol.*, 49(2): 132-140.
- ◆ Hema, G.S., Shyni, K., Suseela Mathew, Anandan, R., George Ninan and Lakshmanan, P.T. (2013) - A simple method for isolation of fish skin collagen - Biochemical characterization of skin collagen extracted from Albacore tuna (*Thunnus alalunga*), Dog shark (*Scoliodon sorrakowah*) and Rohu (*Labeo rohita*), *Annals of Biol. Res.*, 4(1): 2772-2778.
- ◆ Jeyanthi, P. and Nikita Gopal (2012) - Growth and instability in Indian frozen scampi export, *Fish. Technol.*, 49(2): 187-192.
- ◆ Lakshmisha, I.P., Sankar, T.V., Anandan, R., Geethalakshmi, V. and Jose Joseph (2012) - Changes in muscle protein during fat oxidation in Indian mackerel *Rastrelliger kanagurta* (Cuvier, 1817) and Threadfin bream *Nemipterus japonicus* (Bloch, 1791) under accelerated conditions, *Fish. Technol.*, 49(2): 147-154.
- ◆ Lalitha, K.V. and Nirmala Thampuran (2012) - Bacterial flora of farmed mud crab, *Scylla serrata* (Forsk., 1775) and farm environments in Kerala, India, *Indian J. Fish.*, 59(2): 153-160.
- ◆ Madhusudana Rao, B., Floyd Inman III, Len Holmes and Lalitha, K.V. (2013) - Chitinase production in a fed-batch fermentation of colloidal chitin using a mixed culture of *Vibrio harveyi* and *Vibrio alginolyticus*, *Fish. Technol.*, 50(1): 66-74.
- ◆ Madhusudana Rao, B. and Surendran, P.K. (2013) - Detection of ctx gene positive non-O1/non-O139 of *V. cholera* in shrimp aquaculture environments, *J. Food Sci. & Technol.*, 50(3): 496-504.
- ◆ Mathen Mathew, Martin Xavier, K.A., Suseela Mathew, Asha, K.K., Anandan, R. and Ashok Kumar, K. (2012) - Effect of *Rhizophora* root extracts on wound healing and yeast-induced pyrexia in rats, *Fish. Technol.*, 49(2): 161-166.
- ◆ Mohanty, B.P., Paria, P., Das, D., Ganguli, S., Mitra, P., Verma, A., Sahoo, S., Mahanty, A., Aftabuddin, M., Behera, B.K., Sankar, T.V. and Sharma, A.P. (2012) - Nutrient profile of Giant river - catfish *Sperata seenghala* (Sykes), *Natl. Acad. Sci. Lett.* DOI 10.1007/s40009-012-0014-1
- ◆ Mohanty, B.P., Paria, P., Mahanty, A., Behera, B.K., Suseela Mathew, Sankar, T.V. and Sharma, A.P. (2012) - Fatty acid profile of Indian Shad *Tenualosa ilisha* oil and its dietary significance, *Natl. Acad. Sci. Lett.* DOI 10.1007/s40009-012-0042-x
- ◆ Muhamed Ashraf, P. and Leela Edwin (2013) - Corrosion behavior of nano metre sized cerium oxide and titanium oxide incorporated aluminium in NaCl solution, *J. Alloys and Compounds*, 548: 82-88.
- ◆ Muhamed Ashraf, P., Shaju, S.S., Gayathri, D., Minu, P. and Meenakumari, B. (2013) - In situ time series estimation of down welling diffuse alternators craft and Southern Bay of Bengal, *J. Indian Sci. Remote Sensing*, DOI 10.1007/s 12524-012-0244-1.
- ◆ Murthy, L.N., Panda, S.K. and Rajanna, K.B. (2012) - Effect of cryo-protectants on the functional properties of proteins from tilapia (*Oreochromis mossambicus*) during frozen storage, *Fish. Technol.*, 49(2): 155-160.
- ◆ Nikita Gopal, Jeyanthi, P., Chandrasekar, V. and Meenakumari, B. (2013) - A study on the availability and utilization of microcredit in the traditional fisheries sector of Kerala, India, *Asian Fish. Sci.*, 25: 243-250.
- ◆ Nikita Gopal, Parvathy, R., Mohamed Azharudeen and Nasser, M. (2012) - Issues and challenges in the formation of women activity clusters in fisheries, *J. Global Commun.* 5(1): 33-38.
- ◆ Rajamoorthy, K., Pradeep, K., Anandan, R., Libin Baby, Sankar, T.V. and Lakshmanan, P.T. (2013) - Biochemical composition of myctophid species *Diaphes watasei* and *Myctophus obtusirostre* caught from Arabian sea, *Fish Technol.*, 50(1): 41-44.
- ◆ Rakesh Kumar and Lalitha, K.V. (2013) - Digoxigenin-labeled probe -based colony blotting assay for rapid quantification of *Salmonella* serovars in seafood and water, *J. AOAC Intl.*, 95: 1652-1656.
- ◆ Rakesh Kumar and Lalitha, K.V. (2013) - Prevalence and molecular characterization of *Vibrio cholera* O1, non-O1 and non-O139 in tropical seafood of Cochin, *Food-borne Pathogens & Disease*, 10: 278-283.
- ◆ Remesan, M.P., Pravin, P. and Meenakumari, B. (2012) - Inland fishing gear and fishing techniques of India, *J. Inland Fish. Soc. India*, 43(2): 55-72.
- ◆ Sanjoy Das, Lalitha, K.V., Nirmala Thampuran and Surendran, P.K. (2012) - Isolation and characterization of *Listeria monocytogenes* from tropical seafood of Kerala, India, *Ann. Microbiol.*, DOI 10.1007/s 13213-012-0566-9



- ◆ Sankar, T.V., Anandan, R., Suseela Mathew, Asha, K.K., Lakshmanan, P.T., Jones Varkey, Aneesh, P.A. and Mohanty, B.P. (2013) - Chemical composition and nutritional value of anchovy (*Stolephorus commersonii*) caught from Kerala coast, India, *European J. Exptl. Biol.*, 3(1): 85-89.
- ◆ Srinivasa Gopal, T.K. and Boopendranath, M.R. (2013) - Seafood ecolabelling, *Fish. Technol.*, 50(1): 1-10.
- ◆ Srinivasa Gopal, T.K. and Leela Edwin (2013) - Development of fishing industry in India, *J. Aquatic Biol. & Fish.*, 1(1): 44-59.
- ◆ Sivaperumal, P. and Sankar, T.V. (2013) - Toxicity of organophosphorus insecticide - Methyl Parathion on rohu (*Labeo rohita*), *Fish. Technol.*, 50(1): 45-49.
- ◆ Tanuja, S., Viji, P., Zynudheen, A.A. and Joshy, CG. (2012) - Composition, functional properties and antioxidative activity of hydrolysates prepared from the frame meat of striped catfish (*Pangasianodon hypophthalmicus*), *Egyptian J. Biol.*, 14: 27-35.
- ◆ Usha Bhagirathan, Panda, S.K., Meenakumari, B., Madhu, V.R. and Vaghela, D.T. (2012) - Effects of bottom trawling on the ecological integrity of macrobenthos off Veraval, Gujarat, *J. Marine Biol. Assoc. India*, 54(1): 5-12.
- ◆ Vijayan, P.K. and Surendran, P.K. (2012) - Quality aspects of dried fish marketed in the north eastern states of India, *Fish. Technol.*, 49(2): 167-171.
- ◆ Williams, M.J., Porter, M., Choo, P.S., Kusakabe, K., Vuki, V., Nikita Gopal and Bondard-Reantaso (2012) - Guest Editorial: Gender in aquaculture and fisheries - Moving the agenda forward, *Asian Fish. Sci.*, 25: 1-13.
- ◆ Zynudheen, A.A., George Ninan and Ramachandran Nair, K.G. (2013) - Fermented fish powder based cookies from *Johnius* sps., *Fish Technol.*, 50(1): 97-99.

Publications Brought out

- ◆ Fish harvesting systems for resource conservation, Saly N. Thomas, Leela Edwin, P. Pravin, P. Muhamed Ashraf, M.V. Baiju and V.R. Madhu (Eds.) (2012), Winter School Manual, CIFT, Cochin, 349 p.
- ◆ Laboratory training manual on Biochemical analyses of seafood, P.T. Lakshmanan, Suseela Mathew, R. Anandan, K.K. Asha and Niladri Sekhar Chatterjee (2013), CIFT, Cochin, 100 p.
- ◆ Microbiological and molecular methods of detection of *Listeria monocytogenes* in seafood, Sanjoy Das and K.V. Lalitha (2012), Manual, CIFT, Cochin
- ◆ Trawl design developed at CIFT for small, medium and large trawlers, P. Pravin, M.P. Remesan, V.R. Madhu and M.R. Boopendranath (2013), Technology Advisory series, CIFT, Cochin
- ◆ Molecular detection of *Listeria monocytogenes* in seafood, Sanjoy Das and K.V. Lalitha (2012), Extension Bulletin, CIFT, Cochin
- ◆ Biofilm formation by food-borne pathogens, possible danger and control strategies, Sanjoy Das and K.V. Lalitha (2012), Extension Bulletin, CIFT, Cochin
- ◆ Detection of enterotoxions in *Bacillus cereus* by PCR (In Hindi), Sanjoy Das and K.V. Lalitha (2012), Extension Bulletin, CIFT, Cochin
- ◆ Biological significance of betaine - A non-protein amino acid present in seafood in rich quantities, R. Anandan, B. Ganesan, Suseela Mathew, K.K. Asha and P.T. Lakshmanan (2013), Pamphlet, CIFT, Cochin
- ◆ Squalene - A potent antioxidant marine isoprenoid for human healthcare, R. Anandan, B. Ganesan, Suseela Mathew, K.K. Asha, P.T. Lakshmanan and T.K. Thankappan (2013), Pamphlet, CIFT, Cochin
- ◆ Meenina undegalu (Fish balls) (In Kannada), L.N. Murthy, B.M. Rao, Jesmi Debbarma and M.M. Prasad (2012), Pamphlet, CIFT RC, Visakhapatnam
- ◆ Meenina wafers/chips (Fish wafers) (In Kannada), L.N. Murthy, B.M. Rao, Jesmi Debbarma and M.M. Prasad (2012), Pamphlet, CIFT RC, Visakhapatnam
- ◆ Meenina katlettu (Fish cutlet) (In Kannada), L.N. Murthy, B.M. Rao, Jesmi Debbarma and M.M. Prasad (2012), Pamphlet, CIFT RC, Visakhapatnam



- ◆ Meenina uppinakayi (Fish pickle) (In Kannada), L.N. Murthy, B.M. Rao, Jesmi Debbarma and M.M. Prasad (2012), Pamphlet, CIFT RC, Visakhapatnam
- ◆ Aangaa aachaar (Fish pickle) (In Idu Mishmi language and Adi language of Arunachal Pradesh), T.J. Ramesha, L.N. Murthy, B.M. Rao, Jesmi Debbarma, Jimmy Mize and M.M. Prasad (2012), Pamphlet, CIFT RC, Visakhapatnam
- ◆ Seafood nutritional facts (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Why seafood safety and quality important? (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Seafood - Sources and routes of contamination (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Processing factors and seafood quality (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Assessing the quality of seafood (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Seafood hygiene - What you should do? (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Sea food safety and quality (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Sound seafood handling practices (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Cleaning and sanitizing practices in seafood industry (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin
- ◆ Fact sheet - Safety tips for buying and storing seafood (In English and Malayalam), Femeena Hassan, Charles Jeeva, J. and Saleena Mathew (2012 & 2013), Pamphlet, CIFT, Cochin



Dr. A.P.J. Abdul Kalam, former President Govt. of India releasing the book on Fishing Craft and Gears of Assam during ICAR Foundation Day celebrations at New Delhi on 16 July 2012

List of Personnel in CIFT

(as on 31st March, 2013)

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, Principal 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. S. Visnuvinayagam, Scientist

Administration & Accounts

Senior Administrative Officer I/c	:	Shri R. Anil Kumar
Asst. Finance & Accounts Officer	:	Shri K.S. Sreekumaran Nair

Other Personnel

Headquarters, Cochin

Scientific Personnel

Principal Scientist

1. Shri P.K. Vijayan
2. Dr. S. Sanjeev
3. Shri M. Nasser
4. Dr. Saly N. Thomas
5. Dr. P. Pravin
6. Dr. K. Ashok Kumar
7. Dr. Suseela Mathew
8. Dr. M.P. Remesan

Senior Scientist

1. Dr. V. Geethalakshmi
2. Dr. R. Anandan
3. Dr. Nikita Gopal
4. Dr. Femeena Hassan
5. Dr. A.A. Zynudheen
6. Dr. S. Ashaletha
7. Dr. Sanjoy Das
8. Dr. J. Bindu
9. Dr. P. Muhamed Ashraf
10. Dr. George Ninan
11. Shri M.V. Baiju
12. Dr. Toms C. Joseph
13. Dr. J. Charles Jeeva

14. Dr. Rakesh Kumar

15. Dr. K.K. Asha

16. Dr. S.K. Panda

Scientist

1. Shri V. Radhakrishnan Nair
2. Dr. V.R. Madhu
3. Smt P. Jeyanthi
4. Dr. Venkateswaralu Ronda
5. Shri Ankur Nagori
6. Dr. V. Murugadas
7. Shri C.G. Joshy
8. Dr. A. Jeyakumari
9. Smt. S.J. Laly
10. Dr. K.K. Prajith
11. Dr. Niladri Sekhar Chatterjee

Technical Personnel

T-9 (Technical Officer)

1. Dr. A.R.S. Menon

T-7-8 (Technical Officer)

1. Shri C.R. Gokulan
2. Smt. K.B. Beena

T-6 (Technical Officer)

1. Dr. M. Baiju
2. Dr. G. Usha Rani





3. Smt. T. Silaja
4. Shri T.V. Bhaskaran
5. Smt. M. Rekha
6. Shri K.D. Jos
7. Smt. P.K. Shyma
8. Dr. B. Ganesan
9. Smt. K.K. Kala
10. Shri Sibasis Guha
11. Shri P.S. Babu

T-5 (Technical Officer)

1. Shri T.N. Sukumaran
2. Shri Jose Kalathil
3. Shri Thomas Teles
4. Shri K.B. Thampi Pillai
5. Smt V.C. Mary
6. Shri K.P. Vijayan
7. Shri T.R. Sreekumaran

T4 (Technical Assistant)

1. Shri T.P. Haridasan : Carpenter
2. Smt K.S. Mythri : Junior Laboratory Assistant
3. Smt P.K. Geetha : Junior Laboratory Assistant
4. Shri C. Subash Chandran Nair : Project Operator
5. Shri Sajith K. Jose : Draughtsman
6. Shri P.V. Sajeevan : Draughtsman
7. Shri V.K. Siddique : Refrigeration Mechanic
8. Smt. P.A. Jaya : Junior Laboratory Assistant
9. Shri T. Mathai : Junior Laboratory Assistant
10. Shri A.K. Naik : Mechanic
11. Shri T.B. Assisse Francis : Driver
12. Smt. N. Lekha : Junior Laboratory Assistant
13. Shri K.S. Babu : Turner
14. Shri P. Bhaskaran : Senior Library Assistant
15. Smt. Bindu Joseph : Media Assistant

8. Shri P.T. Viswambharan
9. Shri C. Rajendran
10. Smt. K.G. Sasikala
11. Shri V.N. Dileepkumar
12. Shri G. Omanakuttan Nair
13. Shri P. Shankar
14. Smt. G. Remani
15. Shri P.S. Nobi
16. Shri P.N. Sudhakaran
17. Shri Aravind S. Kalangutkar
18. Shri K.S. Leon
19. Shri K.K. Narayanan
20. Smt. K.P. Leelamma
21. Shri P.S. Raman Namboodiri
22. Shri Arockia Sami
23. Smt. Ancy Sebastian
24. Shri Tomy Rebellow
25. Shri K.C. Gopalan

16. Shri T.P. Saju : Engineer - Civil
17. Smt. N.C. Shyla : Field Assistant

T3 (Technical Assistant)

1. Shri P.D. Padmaraj : Junior Laboratory Assistant
2. Shri N. Sunil : Plant Attendant
3. Shri P.S. Sunil Kumar : Driver
4. Shri R.N. Sahoo : Driver (Launch)
5. Shri V.A. Sudhakaran : Plumber
6. Smt. Tessa Francis : Field Assistant
7. Shri K.V. Mohanan : Driver
8. Shri C.K. Suresh : Machine Operator
9. Shri N. Krishnan : Junior Laboratory Assistant
10. Shri K.D. Santhosh : Junior Laboratory Assistant
11. Shri K. Dinesh Prabhu : Junior Laboratory Assistant

T-I-3 (Technical Assistant)

1. Shri V.T. Sadanandan : Junior Laboratory Assistant





T2 (Technical Assistant)

1. Shri G. Gopakumar : Carpenter
2. Shri N. Krishnan : Junior Laboratory Assistant
3. Shri K. Nakulan : Driver
4. Shri T. Jijoy : Junior Laboratory Assistant
5. Shri K.C. Anish Kumar : Junior Laboratory Assistant

T1 (Technical Assistant)

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. Kum. 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. Anil Kumar : Admn. Officer
2. Smt. Pushpalatha Viswambharan : Asst. Admn. Officer
3. Shri P. Krishna Kumar : Asst. Admn. Officer
4. Shri T. Viswanathan : Asst. Admn. Officer
5. Shri P.P. Anil Kumar : Asst. Fin. & Accts. Officer
6. Dr. C. Jessy Joseph : Dy. Director (Official Language)
7. Smt. V.P. Vijayakumari : Private Secretary
8. Shri P.K. Reghu : Private Secretary

Assistant

1. Shri K.B. Sabukuttan
2. Smt. T.D. Usheem
3. Smt. P.K. Thankamma
4. Smt. A.A. Cousallia
5. Shri K.K. Sasi
6. Smt. A.R. Kamalam
7. Smt. T.K. Shyma
8. Smt. V.S. Aleyamma
9. Smt. G.N. Sarada
10. Shri C.K. Sukumaran
11. Smt. V.K. Raji
12. Smt. K. Renuka
13. Shri M.N. Vinodh Kumar
14. Shri K. Das
15. Shri P.K. Somasekharan Nair
16. Smt. G. Surya
17. Kum. Nilina Elais
18. Shri S. Vishnu
19. Kum. N.R. Akhila
20. Shri Anand Priya Kushwaha
21. Smt. Asha Gopalan
22. Smt. A.R. Raji

Personnel Assistant

1. Smt. S. Kamalamma
2. Smt. N. Leena
3. Shri K.V. Mathai
4. Shri R.D. Goswamy
5. 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. E. Jyothilakshmy
6. Smt. Shiji John
7. Shri P.G. David
8. Shri Santhosh Mohan



Lower Division Clerk

1. Shri P. Rajeev
2. Smt. K.V. Suseela
3. Shri T.D. Bijoy
4. Shri P.P. George
5. Shri Subin George
6. Smt. Suni Surendran
7. Kum K.S. Sobha
8. Kum. T. Deepa
9. Shri Deu Umesh Aroskar

Supporting Personnel

Skilled Support Staff

1. Shri P.A. Sivan
2. Shri G.B. Mahanandia
3. Shri C.D. Parameswaran
4. Smt. C.G. Radhamoney
5. Shri E. Damodaran
6. Shri P.V. Raju
7. Shri A.V. Chandrasekharan

8. Shri M.M. Radhakrishnan
9. Shri K.K. Karthikeyan
10. Shri M.N. Sreedharan
11. Smt. U.K. Bhanumathy
12. Shri O.P. Radhakrishnan
13. Shri P. Raghavan
14. Shri T.M. Balan
15. Shri V. Deepak Vin
16. Shri T.K. Rajappan
17. Smt. P.T. Mary Vinitha
18. Shri K.R. Rajasaravanan
19. Shri K. Thinakaran
20. Shri P.N. Nikhil Das
21. Shri A. Vinod
22. Shri Kedar Meher
23. Shri K.S. Ajith
24. Shri S.N. Dash

Auxiliary

1. Shri M.V. Rajan : Bearer

Visakhapatnam Research Centre

Scientific Personnel

Principal Scientist

1. Dr. G. Rajeswari

Senior Scientist

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

Scientist

1. Dr. L.N. Murthy
2. Smt. Arathy Ashok
3. Kum. Jesmi Debbarma

Technical Personnel

T-7-8 (Technical Officer)

1. Dr. M.S. Kumar

T-6 (Technical Officer)

1. Shri K.V.S.S.S.K. Harnath

2. Shri B.K. Panda

3. Dr. Santhosh Alex

4. Shri A.K. Panigrahi

T-5 (Technical Officer)

1. Shri U. Alagumalai

2. Shri Damodar Rout

T-4 (Technical Assistant)

1. Shri P. Radhakrishna

T-3 (Technical Assistant)

1. Shri M. Prasanna Kumar

2. Shri H.S. Bag

T-2 (Technical Assistant)

1. Shri S.N. Dishri

T-1 (Technical Assistant)

1. Shri G. Bhushanam



Administrative Personnel

Assistant Administrative Officer

1. Shri G.C. Adhikari

Assistant

1. Smt. B. Hemalatha

Personnel Assistant

1. Smt. D.A.L. Satyanarayanamma
2. Shri G. Chinna Rao

Upper Division Clerk

1. Shri Y. Kanakaraju

Lower Division Clerk

1. Shri S. Appa Rao

2. Shri D.L. Pattanaik

3. Shri Amit Vengraj

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
7. Shri S.K. Mehar

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
4. Smt. S. Remya
5. Smt. V. Renuka

Technical Personnel

T-7-8 (Technical Officer)

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

T-5 (Technical Officer)

1. Shri K.U. Sheikh

T-3 (Technical Assistant)

1. Shri G. Kingsely
2. Shri S.H. Ummer Bhai

T-2 (Technical Assistant)

1. Shri H.V. Pungera

T1 (Technical Assistant)

1. Shri K. Ajesh

2. Shri J.B. Malmadi

3. Shri Y.D. Kriplani

Administrative Personnel

Assistant Administrative Officer

1. Shri M.M. Damodara

Assistant

1. Shri S.B. Purohit

Upper Division Clerk

1. Shri D.P. Parmar
2. Shri Arockia Shaji

Lower Division Clerk

1. Shri Ramesh Mirdha

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. Smt. P. Viji
2. Dr. P.K. Binsi

Technical Personnel

T-7-8 (Technical Officer)

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

T-5 (Technical Officer)

1. Shri P.S. Gadankush

T-2 (Technical Assistant)

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
4. Smt. Priyanka P. Bait

Burla Research Centre

Technical Personnel

T-7-8 (Technical Officer)

1. Shri B.K. Pradhan

T-5 (Technical Officer)

1. Shri Kirtan Kisan

Administrative Personnel

Assistant

1. Shri L.N. Badi

Supporting Personnel

Skilled Support Staff

1. Shri Jaisingh Oram
2. Shri T.N. Banchoor

