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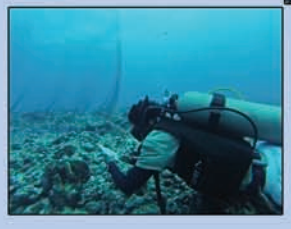

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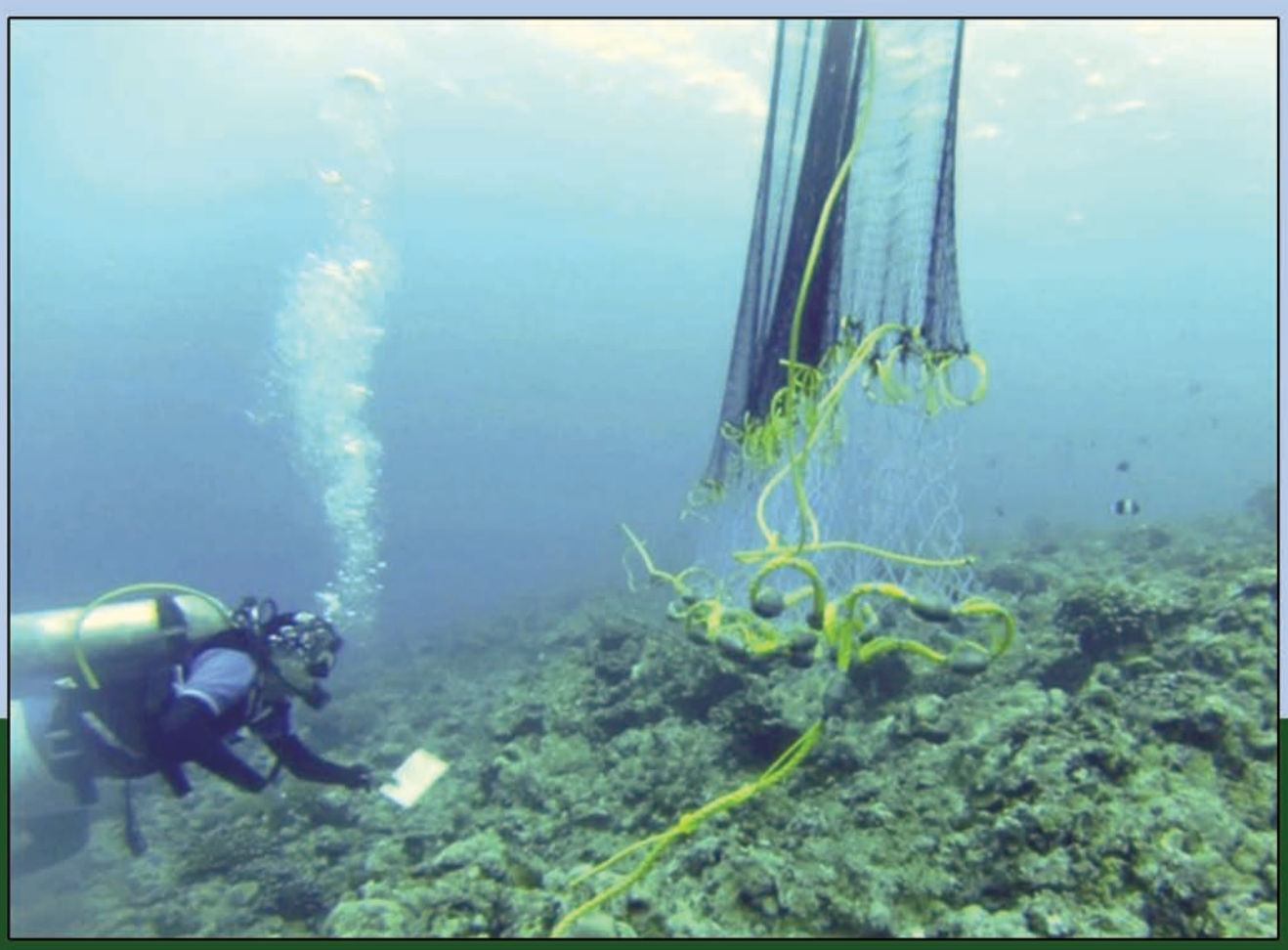

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(An ISO 9001: 2008 certified institution)

CIFT Annual Report 2013-2014

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(Cover : Purse seine sinking speed studies)

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Contents

Abbreviations used in the text

AAS	-	Atomic Absorption Spectrometer
AC	-	Alternate Current
ACHe	-	Acetylcholine esterase
AFM	-	Atomic Force Microscope
AP	-	Andhra Pradesh
APC	-	Aerobic Plate Count
APFC	-	Asia Pacific Fisheries Commission
APHA	-	American Public Health Association
ASC	-	Acid Soluble Collagen
ASTM	-	American Society for Testing and Materials
ATCC	-	American Type Culture Collection
ATIC	-	Agricultural Technology Information Centre
BATH	-	Bacterial Adhesion To Hydrocarbon
BHC	-	Benzene Hexa Chloride
BIC	-	Business Incubation Centre
BIS	-	Bureau of Indian Standards
BMP	-	Better Management Practices
BOBP	-	Bay of Bengal Programme
BOD	-	Biological Oxygen Demand
BPD	-	Business Planning and Development
BPL	-	Below Poverty Line
BRD	-	Bycatch Reduction Device
BTB	-	Bromo Thymol Blue
BV	-	Biological Value
CC	-	Chilled Control
CCA	-	Copper Chrome Arsenic
CCB	-	Copper Chrome Boron
CCRF	-	Code of Conduct on Responsible Fishing
CDOM	-	Chromophoric Dissolved Organic Matter
CFTRI	-	Centre Food Technological Research Institute
CFU	-	Colony Forming Unit
CIFRI	-	Central Inland Fisheries Research Institute
CIFT	-	Central Institute of Fisheries Technology
CIFNET	-	Central Institute of Fisheries Nautical Engineering and Training
CIPET	-	Central Institute of Plastic Engineering Technology
CMFRI	-	Central Marine Fisheries Research Institute
CMLRE	-	Centre for Marine Living Recourses & Ecology
COFISKI	-	Community Fish Smoking Kiln
CONS	-	Coagulase Negative Staphylococci
CPCRI	-	Central Plantation Crops Research Institute
CPS	-	Coagulase Positive Staphylococci
CPUE	-	Catch Per Unit Effort
CSIR	-	Council of Scientific and Industrial Research
CT	-	Cholera Toxin
DC	-	Direct Current
DEM	-	Digital Elevation Model
DFRL	-	Defence Food Research Laboratory
DG	-	Director General
DHA	-	Dicosa Hexaenoic Acid
DKMA	-	Directorate of Knowledge Management in Agriculture
DNA	-	Deoxyribo Nucleic Acid
DO	-	Dissolved Oxygen
DPPH	-	Di Phenyl Picryl Hydrazyl

DST - Department of Science and Technology
DW - Distilled Water
EEZ - Exclusive Economic Zone
EIA - Export Inspection Agency
ELISA - Enzyme Linked Immuno Sorbant Assay
EPA - Eicosa Pentaenoic Acid
EPEC - Entero Pathogenic *E. coli*
ERIC - Enterobacterial Repetitive Intergenic Consenses
EST - Expressed Sequence Tag
ETEC - Entero Toxigenic *E. coli*
ETP - Effluent Treatment Plant
EU - Europian Union
EVOH - Ethyl Vinyl Alcohol
FAO - Food and Agriculture Organization
FCR - Feed Conversion Ratio
FDIS - Final Draft International Standard
FFA - Free Fatty Acid
FORV - Fisheries Oceanic Research Vessel
FPH - Fish Protein Hydrolysate
FRP - Fibreglass Reinforced Plastic
FS - Faecal Streptococci
FSSAI - Food Safety Standards Authority of India
FTIR - Fourier Transmission Infra Red
FWDCS - Fishermen Welfare Development Co-operative Society
GAG - Glycosaminoglycans
GCMS - Gas Chromatography Mass Spectro-photometry
GEO - Ginger Essential Oil
GHG - Green House Gasses
GHP - Good Hygienic Practices
GIS - Global Information System
GMS - Godavari Maha Samkhya
GOI - Government of India
GSH - Reduced Glutathione
GPS - Global Positioning System
GPx - Glutathione Peroxidase
GR - Glutathione Reductase
HACCP - Hazard Analysis and Critical Control Point
HAP - Hydroxyapatite
HDL - High Density Lipoprotein
HDPE - High Density Poly Ethylene
HF - High Frequency
HILIC - Hydrophilic Interaction Liquid Chromatography
HIPP - High Impact Poly Propylene
HIPS - High Impact Poly Styrene
HL - Head Less
HLSO - Head-less Shell-on
HO - Head On
HOBT - High Opening Bottom Trawl
HP - High Pressure
Hp - Horse Power
HPP - High Pressure Processing
HPLC - High Pressure Liquid Chromatography
HPP - High Pressure Processing
HPV - Hepatopancreatic Parvo Virus
HSDT - High Speed Demersal Trawl
HTST - High Temperature Short Time
ICAR - Indian Council of Agricultural Research
ICPAES - Inductively Coupled Plasma Atomic Emission Spectroscopy
IDEI - Innovation Decision Efficiency Index
IEC - Ion Exchange Chromatography
IHHNV - Infectious Hypodermal Haematopoetic Necro Virus
ILC - Inter Laboratory Comparison
INCOIS - Indian National Centre for Ocean Information Services
IP - Intellectual Property
IPR - Intellectual Property Rights
IQF - Individually Quick Frozen
IR - Infra Red
ISO - Indian Standards Organization
ITMC - Institute Technology Management Committee
ITMU - Institute Technology Management Unit
JFE-SSD - Juvenile Fish Excluder Cum Shrimp Sorting Device
KFDC - Karnataka Fisheries Development Corporation
KIED - Kerala Institute of Entrepreneurship Development
KSCADC - Kerala State Coastal Area Development Corporation

KVK - Krishi Vigyan Kendra
LCMS - Liquid Chromatography Mass Spectrograph
LDL - Low Density Lipoprotein
LDPE - Low Density Poly Ethylene
LF - Low Frequency
L_{OA} - Length Over All
LOD - Limit of Detection
LOQ - Limit of Quantification
LPG - Liquefied Petroleum Gas
LPO - Lipid Peroxidation
LS - Liquid Smoke
LT - Little Tuna
MAP - Modified Atmospheric Package
MBV - Monodon Baculo Virus
MDR - Multi Drug Resistance
MFP - Myo Fibrillar Protein
MIC - Minimum Inhibitory Concentration
MLST - Multi Locus Sequence Typing
MoU - Memmorandum of Understanding
Mpa - Mega Pascal
MPEDA - Marine Products Export Development Authority
MPN - Most Probable Number
MRM - Multiple Reactions Monitoring
MRSA - Methicillin Resistant *Staphylococcus aureus*
MSSA - Methicillin Sensitive *Staphylococcus aureus*
MT - Metric Tonne
MUFA - Mono Unsaturated Fatty Acid
MUG - Methyl Umbilliferyl beta D-Glucuronide
MWCNT - Multiwalled Carbon Nanotube
NaCl - Sodium chloride
NaCSA - National Centre for Sustainable Aquaculture
NAIP - National Agriculture Innovation Project
NBAII - National Bureau of Agriculturally Important Insects
NEH - North East Hill
NFDB - National Fisheries Development Board
NGO - Non Gazetted Organization
NIO - National Institute of Oceanography
nm - nano meter
NPN - Non Protein Nitrogen
NPU - Net Protein Utilization
NRCP - National Research Centre on PIG
OC - Open Circular
OCP - Organo Chloro Pesticide
OD - Optical Density
OTR - Oxygen Transmission Rate
PA - Poly Amide
PAH - Poly Aromatic Hydrocarbon
PCR - Polymerase Chain Reaction
PBDE - Poly Brominated Di-phenyl Ethers
PD - Peeled and Deveined
PDC - Pepsin Digestible Collagen
PE - Poly Ethylene
PEG - Poly Ethylene Glycol
PER - Protein Efficiency Ratio
PEST - Poly Ester
PFZ - Potential Fishing Zone
PI - Principal Investigator
PL - Post Larvae
PLA - Poly Lactic Acid
PME - Priority setting, Monitoring and Evaluation
PP - Poly Propylene
Ppb - Parts per billion
ppm - parts per million
PPS - Probability Proportion to Size
ppt - parts per trillion
PRA - Participatory Rural Appraisal
PUD - Peeled and Un Deveined
PUFA - Poly Unsaturated Fatty Acid
PV - Peroxide Value
PV - Photo Voltaic
PVC - Poly Vinyl Chloride
QIM - Quality Index Method
RC - Revealed Competitiveness
RCA - Revealed Comparative Advantage
R & D - Research and Development
RPLA - Reverse Passive Latex Agglutination
rpm - rotations per minute
RRA - Rapid Rural Appraisal

RSM - Response Surface Methodology
RS PCR - Ribosomal gene Spacer sequence Polymerase Chain Reaction
RT - Room Temperature
RT PCR - Reverse Transcriptase Polymerase Chain Reaction
SAC - Space Application Centre
SAF - Society for Assistance to Fisherwomen
SC - Scheduled Caste/Super Coiled
SD - Standard Deviation
SDS-PAGE - Sodium Dodecyl Sulphate - Poly Acrylamide Gel Electrophoresis
SE - Standard Error
SEAI - Seafood Exporters Association of India
SEEI - Socio-Economic Evaluation Index
SEM - Scanning Electron Microscopy
SFA - Saturated Fatty Acid
SHG - Self Help Group
SOD - Super Oxide Dismutase
SP - Semi Pelagic
SPT - Semi Pelagic Trawl
SPTS - Semi Pelagic Trawl System
SRC - Sulphite Reducing Clostridium
SS - Stainless Steel
SSOP - Standard Sanitation Operation Procedures
ST - Scheduled Tribe
STPP - Sodium Tri Poly Phosphate
TA - Titrable Acidity
TBA - Thio Barbituric Acid
TBARS - Thio Barbituric Acid Reductase Substances
TBC - Total Bacterial Count
TCA - Tri Chloro Acetic Acid
TCD - Training cum Demonstration
TCP - Toxin Co-regulated Pilus
TDH - Thermostable Direct Heamolysin
TDS - Total Dissolved Solids/Tax Deducted at Sourse
TE - Total Enterobacteria
TED - Turtle Excluder Device
TFA - Tri Flouro Acetic Acid
TFS - Tin Free Steel
TLC - Thin Layer Chromatography
TMA - Tri Methyl Amine
TMAN - Tri Methyl Amine Nitrogen
TIN - Triangulated Irregular Network
TOC - Total Organic Carbon
TOT - Transfer of Technology
TPC - Total Plate Count
TSB - Tryptic Soya Broth
TSH - Total Sulfhydral
TSP - Tribal Sub Plan
TSS - Total Soluble Sugar/Total Suspended Solids
TVBN - Total Volatile Base Nitrogen
UV - Ultra Violet
VC - Vacuum Control
VHF - Very High Frequency
VNTR - Variable Number Tandem Repeats
VT - Vacuum Treated
WSSV - White Spot Syndrome Virus
WTO - World Trade Organization
WTP - Willingness To Pay
WVTR - Water Vapour Transmission Rate
YHV - Yellow Head Virus

Preface

I am pleased to introduce this Annual Report because 2013-14 was a very remarkable and satisfying year for the Central Institute of Fisheries Technology. In preparing this report, we have endeavoured to provide readers with a useful and informative picture of the Institute's performance over the past 12 months. CIFT has again proved its strength in achieving the central mission set by the Indian Council of Agricultural Research for R&D institutions, and we have successfully fulfilled and retained our central relevance to the society.

I am proud to announce that CIFT, Cochin was awarded ISO 9001:2008 Certificate for provision of Research and Development Services to Promote Sustainable and Responsible Harvest and Post Harvest Technologies in Fisheries Sector, including Consulting, Training, Testing, Business Incubation and Transfer of Technologies. The Institute has NABL accreditation (ISO 17025) and has been recognized as a Referral Lab in fish and fishery products for both export and import items.

All departments of CIFT catering to diverse research spectrums of the same discipline, have showed positive operating results for this year. Several activities were taken up to fulfil stakeholder expectations, with a view to promote responsible and sustainable harvest and post harvest technologies in fisheries sector by conducting basic, strategic and applied research, and undertaking consultancy, training, testing and technology transfer.

This year also CIFT conducted regular and on-demand training programmes on responsible fishing, fish processing, value addition, packaging and quality assurance systems for seafood. CIFT has organized a total 123 training programmes on varied topics and 38 outreach programmes in different parts of the country. Through these activities CIFT was able to reach out to large number of stakeholders representing fishermen communities, processing establishments, students, officials from state and central government organizations, and others. CIFT also undertook several analytical services of the samples from fish processing and allied industries and issued certificates.

The Fishing Technology Division of CIFT, for catering to the harvest technologies and responsible fishing, conducted studies on synthesizing polyaniline curcumin-copper-cobalt composite, mutli-walled carbon nanotubes, nano sized Cerium oxide and nano sized Copper oxide coatings. Studies on the post-release mortality associated with the hooking using Circle and J-hooks, showed that 30.4% of the fishes released from J-hook died within 48 h of release, while no mortality was observed in fishes hooked and released from Circle hooks. The Institute was successful in designing and fabricating a rigid sorting grid consisting of three frames for bycatch reduction in trawl system. CIFT has developed solar powered boat "Sunboat" which can be put to use in aqua farms for aquacultural purposes and for gillnetting, line fishing, transportation and aqua-tourism. The boat is capable of running for 2.5 to 3.0 hours after complete charging and attains a speed of nearly 4.0 knots in calm waters. The boat is twin hulled and is solely propelled by solar power.

As part of research work in the post harvest field, the Fish Processing Division has developed value added products from fishery resources with extended shelf life. Studies were conducted to extend the shelf life of Monosex Tilapia and combination sausages prepared from the mince of Nemipterus and Pangasius. Spray dried prawn flavour extract was prepared from the shell of *L. vannamei*, and the technology for the production of fish calcium capsules (CALCIFT) was up-scaled. Two types of extruded products incorporating prawn mince and cereal flour was standardized. The treatment of oxygen absorber along with the curry leaf essential oil was found to be effective in reducing the undesirable changes in the bio-chemical and microbiological quality of Cobia fish steaks.

The Quality Assurance and Management Division undertook the research work on food safety, and analysis of fish for pesticides and heavy metals to ensure safety of fish. Surveillance monitoring of fish and fishery products sold across 28 markets and 33 ice plants across Kerala were conducted. Developed advanced protocol for determination of Ethoxyquin from shrimp and shrimp feed, and conducted studies on biogenic amine formation dynamics of Indian oil sardine. Quality of commercially important fishes stored in tube ice was compared to flake ice. Essential oil extracted from Rosemary, Oregano, curry leaf and ginger were applied to improve the microbiological quality and to prevent the lipid oxidation of Indian mackerel. A Quality Index Scheme for chilled Indian Mackerel (*Rastrelliger kanagurta*) was finalized with 14 descriptors with a total demerit score of 33.

The Biochemistry and Nutrition Division developed a tandem mass spectroscopic method for trace level analysis of all eight B vitamins in rat plasma and fish. A new enzymatic sample preparation protocol was developed for extraction of water soluble B vitamins from fish tissues and for multi residue analysis of 119 multiclass contaminants in fatty fish matrix. Chitosan was modified by grafting phenolic acids and four chitosan derivatives were synthesized. Succinyl chitosan based hand sanitizer - A hydro-alcohol hand sanitizer containing Succinyl chitosan, 67% ethanol and 0.1% Coumaric acid was developed.

The Microbiology, Fermentation and Biotechnology Division conducted studies in identifying spoilage bacteria and recovering fish pathogens from farmed Catfish. Pathogens were isolated from seafood and aquatic environments using improved isolation methods. A duplex PCR was standardized for simultaneous detection of *L. monocytogenes* and *Campylobacter jejuni* from seafood samples targeting beta-haemolysin gene of *L. monocytogenes* and *hipO* gene of *C. jejuni*.

The Engineering Division carried out data analysis for manufacturing and construction facilities across Kerala. Fabricated prototypes for water chilling unit using solar energy, and band saw machine for frozen fish mince blocks/fresh fish. A new method for validation and certification of diesel engine for marine applications was developed. A cost effective table top descaling machine and a washing vessel for prawn shell were designed and developed.

The Extension, Information and Statistics Division collected and analyzed data on the socio-economic variables of fishermen at Kabini Reservoir of Karnataka and, Frasergunj and Nimpith of West Bengal. Conducted trainings and technology transfer programmes on hygienic fish handling and value added fishery products. Under the project on Management dimensions, the performance indicators of stakeholder organizations were identified. 3D Map of Malampuzha reservoir was developed with TIN data model using data collected by hydrographic survey in the reservoir. A field survey was conducted at Meenkara reservoir on harvest and post harvest loss of fish, and a study was undertaken to assess the role of 'Godavari Maha Samakhya', and NGO on household welfare and empowerment of fishermen community.

Veraval Research Centre of CIFT conducted the quantification of stress in fish caught in trawl and gillnet. Different species of fish caught from trawlnet and gillnet were collected and different stress enzymes were standardized to evaluate stress associated with catching methods. Extracted the antioxidant compounds using plant sources Rosemary leaf and Oregano.

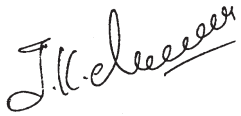
Visakhapatnam Research Centre designed food grade plastic mold for the preparation of stretched shrimp. Study was conducted on the impact of introduction of Pacific white shrimp on shrimp production and processing industry in Andhra Pradesh. Selectivity experiments were carried out onboard CIFTECH off Visakhapatnam coast using a 30 m demersal trawl fitted with 40mm square mesh codend. GIS database of craft and gear of Andhra Pradesh was created on an RDBMS platform and linked to QGIS to use GIS as a tool for effective fisheries management.

Mumbai Research Centre prepared bioactive hydrolysate from gills of Mackerel using protease enzyme. Shelf life enhancement studies were conducted on Pangasius fillets and a methodology was developed for modifying the flavour characteristics of Pangasius meat using herbal extracts. Fish and vegetable cocktail was developed to reduce the muddy flavour of Rohu meat. Protocols were standardized for preparing battered and breaded Bombay duck fillet and for reducing moisture content in Bombay duck mince.

The Business Incubation Centre established under the project Zonal Technology Management - Business Planning and Development Unit completed one more successful year through safeguarding and managing ICAR technologies, creating sustainable companies, growing jobs, fostering sustainable and inclusive development and taking scientific ideas to market. The Institute Technology Management Unit made remarkable activities in IP management and commercialization of CIFT technologies.

We have recently launched e-repository facility of all information related to our Institute publications.

I sincerely hope that these achievements will inspire further advances, promote worldwide collaborations with our Scientists, and ultimately contribute to improved research methodologies. We have every reason to be confident about the future, as we have been successful in recognizing the society's needs and thinking ahead. I would like to express my compliments to all my colleagues for the credible work, and I am grateful to the Institute Management Committee and Research Advisory Committee for their constructive support and pleasant cooperation.



Cochin
30 June, 2014

(Dr. T.K. Srinivasa Gopal)
Director

भूमिका

मुझे 2013-14 का यह वार्षिक रिपोर्ट प्रस्तुत करने में खुशी हो रही है क्योंकि 2013-14 के मा प्रौ सं के लिए एक संतोषजनक साल रहा। इस रिपोर्ट के माध्यम से पाठकों को संस्थान के पिछले बारह महीनों का उपयोगी और सूचनचार्थक तस्वीर प्रस्तुत करने की कोशिश की गई है। के मा प्रौ सं ने फिर से अनुसंधान और विकास के क्षेत्र में भारतीय कृषि अनुसंधान परिषद् द्वारा निर्धारित केंन्द्रीय लक्ष्य को पाने में अपनी समर्थता दिखाई और हमने समाज के प्रति अपनी केंद्रीय प्रासंगिकता सफलतापूर्वक बनाए रखा।

मैं यह घोषणा करते हुए गर्व महसूस कर रहा हूँ कि के मा प्रौ सं कोचिन को ISO 9001 : 2008 प्रमाण पत्र दिया गया। मात्स्यिकी क्षेत्र में जिम्मेदार प्रग्रहण और पश्च प्रग्रहण को अनुसंधान और विकास सेवाओं को बढाने के लिए यह प्रमाण पत्र दिया गया। इसमें परामर्श, प्रशिक्षण, जांच, व्यापार, उष्मायन और प्रौद्योगिकी हस्तांतरण शामिल है। संस्था के पास एन ए बी एल प्रत्यायन (ISO 170251) मौजूद है और इसे मत्स्य और मात्स्यिकी से संबंधित चीज़ों के आयात और निर्यात के लिए संदर्भित प्रयोगशाला के रूप में मान्यता मिली है।

के मा प्रौ सं के सभी विभागों ने अनुसंधान क्षेत्र में इस साल सकारात्मक प्रचालन परिणाम दर्शाया है। पणधारियों के अपेक्षाओं के मद्दे नजर जिम्मेदार और धारणीय प्रग्रहण और पश्च प्रग्रहण प्रौद्योगिकियों को बढ़ावा देने के लिए मूल, युद्वनीतिक और अनुप्रयोग अनुसंधान, परामर्श, परीक्षण, जांच और प्रौद्योगिकी हस्तांतरण के लिए संस्थान काम कर रही है।

इस साल भी के मा प्रौ सं ने नियमित रूप से और मांग के अनुसार जिम्मेदार मत्स्यन, मत्स्य संसाधन, मूल्य जोड, संवेष्ठन और समुद्री आहार का गुणता आश्वासन पर प्रशिक्षण कार्यक्रम चलाया। के मा प्रौ सं ने देश के भिन्न भागों पर भिन्न विषयों पर 123 प्रशिक्षण कार्यक्रम और 38 बाहरी कार्यक्रमों को आयोजित की। इन गतिविधियों से के मा प्रौ सं, मात्स्यिकी की समाज, संसाधन संस्थाएं, छात्र, राज्य और केंद्र सरकार के कार्यालय और अन्य तक पहुंच पाया। के मा प्रौ सं ने मत्स्य संसाधन, संबंधित उद्योग आदि से नमूने ग्रहण कर कई विश्लेषणात्मक सेवाएं प्रदान की।

के मा प्रौ सं का मत्स्य प्रौद्योगिकी विभाग, पैदावार प्रौद्योगिकियों और जिम्मेदार मत्स्यन के मद्दे नजर, पोली अमाइन करकूमिन कापर कोबाल्ट कंपोजिट, बहु दीवारीय कार्बन नानोट्यूब, छोटे आकार की सिरियम आवसाइड, कॉपर आक्साइड कोटिंग पर अध्ययन किया है। हुकिंग से संबधित पश्च निर्मुक्त नश्वरता जो वृत्त और जेहुक द्वारा हुकिंग से संबद्ध है, दर्शाया कि जे हुक से छोडे गए 30.4 % मत्स्यों को मुक्त करने के 48 घंटों में मृत्यु हो गई। जबकि वृत्त हुक से छोडे गए मत्यों में नश्वरता दर दिखाई नहीं दी। संस्थान ने सफलतापूर्वक कठोर पृथक्क ग्रिड का संविरचन किया जिसके तीन फ्रेम होते हैं। यह ट्राल पद्वित में उप पकड कटौती के लिए उपयोग में लाया जाता है। के मा प्रौ सं ने सौर ऊर्जा से चलनेवाले सौर बोटको विकसित किया जिसे जलकृषि खेतों में, गिलजालन, लाइन मात्स्यिकी, परिवहन एवं जलकृषि पर्यटन के लिए उपयोग किया जा सकता है। यह बोट पूरे चार्जिंग के बाद 2.5 से 3.00 घंटों तक चल सकती है और शांत पानी में 4 कनोट की गति पकड सकती है। यह बोट दो पोतखोलों का है और सौर ऊर्जा से चलती है।

पश्च पैदावार क्षेत्र में अनुसंधान काम के तहद मत्स्य संसाधन विभाग ने फैले कवच आयु के साथ मात्स्यिकी संपदाओं से मूल्य जोड उत्पादों को विकसित किया। मोनोसेक्स तिलापिया और नेमिट्रेस और पंगाशियस से तैयार किए गए गुलमा की कवच आयु को बढाने के लिए

अध्ययन किया गया। स्प्रे द्वारा सुखाए गए झींगा सुगंध निचोड को एल. वन्नमी के कवच से तैयार किया गया और मत्स्य केलशियम केपसूल के उत्पादन की प्रौद्योगिकी को बेहतर बनाया गया। दो किस्मों के निष्कासित उत्पाद जिसमें झींगां कीमा और आटा शामिल है, इसे स्तरीयकृत किया गया। कोबिया मत्स्य टुकडों में जैव रासायनिक और सूक्ष्म जैविक गुणों में अवांछनीय बदलावों को कम करने के लिए प्राणवायु सोखनेवाले और कड़ी पत्ता जरूरी तेल का उपचार प्रभावकारी रहा।

गुणता आश्वासन और प्रबंधन विभाग मत्स्य सुरक्षा को सुनिश्चित करने के लिए आहार सुरक्षा, कीटनाशकों और भारी धातुओं के लिए विश्लेषण की जिम्मेदारी ली है। केरल में 28 बाजार, 33 हिमीकृत संयत्रों में मत्स्य और मात्स्यिकी उत्पादों की निगरानी की गई। झींगा एवं झींगां आहार से एथोक्सियुन के निर्धारण के लिए नया तरीका विकसित किया गया। भारतीय तेल सारडीन की बयोजेनिक अमाइन रूपायन गतिक पर अध्ययन किया गया। ट्यूब बर्फ में वाणिज्यपरक महत्व के मत्स्यों की गुणता को पत्रक बर्फ के साथ तुलना किया गया, रोसमेरी, ओरिगानो, कड़ी पत्ता और अदरक से निचोडे गए जरूरी तेल को सूक्ष्मजैविक गुण बढ़ाने के लिए उपयोग किया गया। हिमीकृत भारतीय मेकरेल (*रास्ट्रेलिगर कनागुरता*) के लिए गुणता इंडेक्स स्कीम रूपायित किया गया। इसमें 14 विनाशक हैं और कुल 33 दोष अंक है।

जैव रसायन और पौष्टिक विभाग ने चूहा प्लास्मा और मत्स्य में सभी आठ बी विटामिनों में अनुरेख स्तर विश्लेषण के लिए टेंडम मास स्पेक्ट्रोस्कोपिक तरीका विकसित किया गया। मत्स्य ऊतक से पानी में घुलनेवाले B विटमिन के निचोड के लिए नया किण्वक नमूना तरीका विकसित किया। फीनोलिक अम्लों को रोपण द्वारा कैटोसन सुधार किया गया और चार कैटोसन अवकलज का संश्लेषण किया गया। सकिनल कैटोसन आधारित स्वच्छकारी हस्त विकसित किया गया जिसमें सकिनल कैटोसन, 67% इथनोल और 0.1% कौमारिक अम्ल विकसित किया गया।

सूक्ष्मजैविक, किण्वन और जीव प्रौद्योगिकी विभाग ने खेतीकृत केट मत्स्य से रद्दी जीवाणु को पहचानने और मत्स्य पाथेयम को पुनः प्राप्त करने के लिए अध्ययन किया। समुद्री आहार एवं जलकृषि पर्यावरणों से रोगाणु को सुधारित पृथक्कीकृत तरीकों द्वारा अलग किया गया। समुद्री आहार नमूनों से *एल. मोनोसैटोजीनस*, *कैपिलोबैक्टर जेजूनी* को जांचा गया। यह *एल. मोनोसैटोजीनस* का बेटाहीमोलिसिन और *सी. जेजूनी* का हिपोजीन का पता लगाने के लिए था।

अभियांत्रिकी प्रभाग ने केरल में निर्माण के लिए आंकडा विश्लेषण किया। सौर किरण द्वारा पानी के हिमीकरण के लिए और हिमीकृत मत्स्य कीमा टुकडे/स्वच्छ मत्स्य के लिए आदिप्ररुप का संविरचन किया गया। प्रभावकारी टेबल टाप डीस्केलिंग मशीन और झींगा कवच के लिए सफाई बर्तन को अभिकल्पित और विकसित किया गया।

विस्तार, सूचना और सांख्यकी प्रभाग ने कर्नाटक के कबिनी हौज, पश्चिम बंगाल के फ्रेसरगंज और निम्पित के मछुवारों के सामाजिक व आर्थिक संबंधित जानकारी इकटठा कर विश्लेषित किया। स्वास्थ्यपरक मत्स्य हस्तन और मूल्य जोड मात्स्यिकी उत्पादों के प्रौद्योगिकी हस्तांतरण कार्यक्रम पर प्रशिक्षण चलाए गए। प्रबंधन के परियोजनाओं के तहद, पणधारी संगठनों का निष्पादन सूचकों को पहचाना गया। टिन आंकडों द्वारा मलप्पुषा हौज का 3D मानचित्र विकसित किया गया। मत्स्य के संग्रहण एवं पश्च संग्रहण पर मीनकारी हौज में एक क्षेत्र सवैक्षण चलाया गया। गोदावरी महासमैक्या की भूमिका को निर्धारित करने पर अध्ययन किया गया। पारिवारिक कल्याण और मछुवारों के समाज पर एन जी ओ की भूमिका पर भी अध्ययन किया गया।

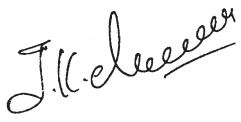
वीरावल अनुसंधान केंद्र ने ट्राल और गिल जाल में पकडे गए मत्स्य की दबाव का परिमाणन किया। ट्राल जाल और गिल जाल से इकट्ठे किए गए मत्स्य के भिन्न जातियों के पकड तरीकों से संबंद्ध दबाव मूल्यांकन के लिए भिन्न दबाव किण्वकों को स्तरीयकृत किया गया। रोसमेरी पत्ता औरिगानों द्वारा गैर आक्सीकारक यौगकों को निचोडा गया।

विशाखपट्टणम अनुसंधान केंद्र में लचीले झींगों के लिए आहार ग्रेड प्लास्टिक मोल्ड की अभिकल्पना का झींगा उत्पादन और आंध्रप्रदेश के संसाधन उद्योग में पेसिफिक सफेद झींगों के प्रभाव पर अध्ययन किया गया। 30 m तलमज्जी ट्राल जिसमें 40 mm चौकोर मेश कोड एंड जोडा गया, इसे सिफटेक ओनबोर्ड में चयन परीक्षण किए गए। RDBMS प्लेटफार्म में क्राफ्ट और गिअर का जी आइ एस डाटाबेस तैयार किया गया और इसे QGIS से लिंक किया गया, प्रभावकारी मात्स्यिकी प्रबंधन हेतु मुंबई अनुसंधान केंद्र मेकरेल के गिल से जैव सक्रिय हैटोस्लेट तैयार किया। पंगेशियस फिलेटों पर कवच मत्स्य वृद्वि अध्ययन किया गया और जडी बूटी निचोडों द्वारा पंगेशियस मांस के गंध गुणों

को सुधारने के लिए एक तरीका विकसित किया। रोहू मांस के मिट्टीदार गंध को कम करने के लिए मत्स्य और वनस्पति तेल विकसित किया गया। बेटर्ड और ब्रेडेड बांबेडक उत्पादों के लिए और बांबेडक कीमा के लिए प्रोटोकॉल निर्धारित किया गया।

जेड टी एम बी डी एकक के तहद बिजिनस उष्मायन केंद्र स्थापित किया गया जो एक और सफल साल पूरा किया। इस केंद्र ने भा कृ अनु प प्रौद्योगिकियों की सूक्ष्म और प्रबंधन करते हुए, धारणीय कंपनियों की सृष्टि करते हुए, बढती नौकरियॉं, धारणीय और विकास को बढावा देते हुए और बाजार में वैज्ञानिक सोचों को कार्यान्वित हुए काम किया। ITMU ने IP प्रबंधन और के मा प्रौ सं के वाणिज्यीकरण में सराहनीय कार्य किए।

हमने हमारी संस्थान के प्रकाशनों से संबंधित जानकारी हेतु ई रिपोसिटरी सुविधा शुरू की है, मैं आशा करता हूँ कि यह उपलब्धियॉं आगे के लिए प्रेरणादायक होगी, हमारे वैज्ञानिकों के साथ सहयोग बढाएगा, और अंततः सुधार किए गए तरीकों को प्रस्तुत करेगी। हमें भविष्य के प्रति आश्वास्त होने के कई कारण हैं, कि हमने समाज की जरूरतों को पहचान पाए और आगे के बारे में सोचा। मैं अपने सहयोगियों को उनके उंदा काम के लिए बधाई देता हूँ। मैं संस्थान प्रबंधन समिति और अनुसंधान परामर्श समिति के प्रति सहयोग के लिए आभार हूँ।



कोचिन
30 जून 2014

डॉ. टी.के. श्रीनिवास गोपाल
निदेशक

Executive Summaray

- Solar energy was successfully used to power a 3.6 m L_{OA} FRP boat. A 0.5 kw solar panel could successfully power the boat and achieve 3 knots speed during the trial run.
- The first all India baseline survey on craft and gear, that covered the major landing centres along the Indian coast revealed 65 design variants of fishing vessels. The gear designs were based on local species availability and design details of 215 variants of fishing gears including trawlnets, gillnets, purse siene, ring siene and dolnets were studies and digitized.
- Fuel cost contributed to the bulk of the operational expenses, ranging from 70 to 85% depending on the type of operation. An increasing trend was observed with respect to the installed engine power of the fishing vessels and this was more pronounced along the southern states. The power of the engines installed varied from 45 to 550 Hp depending on the type of vessel and region.
- Survey among the fishermen using wooden canoes along Southwest coast revealed that Aini (*Artocarpus hirsuta*) and Mango (*Mangifera indica*) were commonly used for canoe construction. Canoes with an L_{OA} of 3.04 to 7.62 m are commonly used and the cost ranged from ₹ 18,000/- to ₹ 50,000/- respectively.
- The validation experiments along Gujarat coast showed an average CPUE from the PFZ regions as 15.40 kg h^{-1} and fishing in the non-notified areas recorded an average CPUE of 12.08 kh h^{-1}. The benefit/cost ratio were 1.51 and 0.81 respectively in the notified and non notified areas.
- Polyaniline curcumin-copper-cobalt composite was synthesized and the evaluation by visual and electrochemical methods revealed that it had excellent capability to sense ammonia, methyl, dimethyl and trimethyl amines.
- Nano sized Copper oxide coating over nylon multifilament netting showed lower microfouling accumulation.
- Studies on the post-release mortality associated with hooking using Circle and J-hooks, showed that 30.4% of the fishes released from J-hook died within 48 h of release, while no mortality was observed in fishes hooked and released from Circle hooks.
- The selectivity estimates of Hilsa in 50 mm square mesh windows installed bagnets were as follows L50 %= 46.9 mm, Selection range = 20.3 mm, L75% = 57.1 and L25 % = 36.8.
- Bycatch constituted 30-60% of the total catch of the trawlers operating along Kerala coast and the major species that constituted the bycatch were *Oratosquilla nepa*, *Portunus* sp., *Lagocephalus* sp., *Secutor insidiator* and *Platycephalus* sp.
- *Asperoteuthis acanthoderma* was recorded for the first time from India in the FORV Sagar Sampada Cruise No. 320 during 4-16 October, 2013.

- Nanophytoplankton fraction contributed 60% of the total chlorophyll in all months and exhibited higher chlorophyll specific absorption (a*ph(λ)) at 440 and 665 nm.
- Designed and fabricated a rigid sorting grid consisting of three frames connected by hinges for bycatch reduction in trawl system.
- Selectivity experiments carried out onboard CIFTECH off Visakhapatnam coast, using a 30 m demersal trawl fitted with 40 mm square mesh codend showed that the L25, L50 and L75 values for *Parastromateus niger* was 13.09, 11.78 and 12.30 respectively. The α and β values were 11.02 and 0.80 respectively. Selection range and selection factor for *P. niger* were 0.50 and 2.61 respectively.
- Economic evaluation of mechanized fishing system in Visakhapatnam and Kakinada revealed that major operational expenditure is incurred for fuel.
- GIS data base of craft and gear of Andhra Pradesh was created on an RDBMS platform and linked to QGIS to use GIS as a tool for effective fisheries management.
- Experimental field trials were conducted with stake nets fabricated with HDPE twine attached with 50 mm square mesh window for Hilsa fish juvenile conservation at Odalarevu, East Godavari district of Andhra Pradesh.
- Designed and developed nylon polyamide multifilament stakenet installed with fish eye BRD and field tested at Odalarevu, East Godavari district of Andhra Pradesh for Hilsa fish juvenile conservation.
- Data was collected during deep-sea fisheries expedition in Fisheries and Oceanographic Research Vessel (FORV) Sagar Sampada and studied the taxonomical, biological and residual contamination of deep-sea fishes as well as demersal fishes.
- Season-wise catch data was collected from the Tuna long lining operators off Visakhapatnam coast for development of Tuna advisory services. The analysis of season-wise catch showed a hooking rate of 0.96 kg/hook for pre-monsoon period, 1.42 kg/hook for the monsoon period and 1.94 kg/hook during post-monsoon period.
- Studies on phytoplankton biodiversity along Visakhapatnam coast has reported 30 planktonic species belonging to three Classes namely Chlorophyceae, Bacillariophyceae and Dinophyceae.
- Sampling of the fish caught in the bagnet supplied to the local fisherman of Bharuch district was done. During the sampling, incidence of Anchovy, Hilsa, Baracuda, Sole fish, Mudskipper, and prawns were observed both in codend and codend cover. The fish caught in codend and codend cover indicates efficient escapement of juveniles through the BRD used in the bagnet.
- Twenty one fishing trials were conducted during the quarter ending in December 2013. The catch comprised of 30 species of finfish, three molluscan species and two crustacean species.
- Shelf life of monosex Tilapia under iced condition was found to be 27 days, while steaks developed off-flavour after 19 days and gutted and cleaned samples remained acceptable up to 23 days under iced conditions.
- Assessment of shelf life of combination sausages prepared from the mince of Nemipterus and Pangasius indicated that sausages with 100% Pangasius mince had a shelf life of 41 days in chilled condition followed by those with 60% Pangasius mince (38 days), 80% Pangasius mince (32 days), 60% Nemipterus mince (29 days), 100% Nemipterus mince (28 days) and 80% Nemipterus mince (27 days).
- Incorporation of chitosan (0.75%) reduced the rate of oxidation and enhanced the shelf life of restructured products prepared using Pangasius mince.

- Microwave heating coupled with quick-chilling and vacuum packing significantly improved the colour, texture, stability and shelf life (21 days) of Sutchi catfish fillets compared to unblanched vacuum-packed samples (12 days).
- Compositional analysis of myctophid samples collected from Sagar Sampada cruise showed that *Benthosema fibulatum* had crude protein content of 17.99%.
- Dip treatment of White snapper fillets in 15% gelatin solution enhanced the shelf life to 4-5 days in iced conditions under vacuum.
- Spray dried prawn flavour extract prepared from the shell of *L. vannamei* had 4.3% moisture and 82.5% protein, 4.5% fat and 8.3% ash. The APC in the product was $4.8x10^4$cfu/g.
- Ensilaging of squid waste for a period of 60 days indicated a gradual decrease in saturated fatty acid (42.30% to 30.63%) and mono unsaturated fatty acid (17.60% to 10.48%) while poly unsaturated fatty acid was increased from 51.64 to 55.90%.
- The pilot model fish meal plant designed and fabricated with 10 kg loading capacity with an attached multipurpose hydraulic pressing device was found to be suitable for preparation of fish meal.
- Up-scaled the technology of fish calcium capsules (CALCIFIT) production.
- Appropriate container was fabricated for live mud crab transportation.
- Two types of extruded products incorporating prawn mince and cereal flour was standardized and the shelf life determined.
- A tapioca and fish based value added product was standardized and the shelf life evaluation were done.
- Orange peel extract and mint extract was found capable of extending shelf life of gutted Mackerel during vacuum packaging and chilled storage.
- Dip treatment in Rosemary leaf extract and addition of oxygen absorber while packing enhanced the shelf life of Horse mackerel.
- Oxygen absorber along with curry leaf essential oil treatment was effective in reducing the undesirable changes in the bio-chemical and microbiological quality of Cobia fish steaks.
- Studies on changes in colour and quality of cooked-peeled vannamei showed that there was a decrease in a* value in cooked-peeled shrimp (15.63) compared to the regular peeled-cooked shrimp (18.05). TPC of cooked-peeled shrimp (150 cfu/g) was relatively higher compared to the regular peeled-cooked shrimp (55 cfu/g) which reduced after blanching.
- Studies on the influence of iron content on the colour of Pangasius fillets showed that Lightness (L*) of Pangasius fillets dipped in iron solution ($FeCl_3$ and $FeSO_4$) decreased and b* value (yellowness) increased with the increase in iron concentration.
- Attempt to improve the colour of Pangasius fillets using different food grade chemicals showed that Ascorbic acid (0.5%) and combination of Ascorbic acid and Sodium metabisulfite (1% and 0.5%) improved colour.
- Biochemical, microbiological and sensory quality of fresh squid dried in solar drier was compared with sun dried squid samples. The moisture content was reduced to 24% in 36 hrs in sun dried samples and in 12 hrs in solar dried samples. Compared to open sun drying, moisture reduction was three times faster in solar drying. Values of other quality indicators such as shrinkage and rehydration ratio were also better for the solar dried squid samples.
- The drying time for salted Silver croaker was 18h for solar dryer compared to 38h for sun drying to achieve a final moisture content of 30%. Moisture content was 32.7 and 38.1% for the salted and dried Silver croaker during pre-monsoon and monsoon period.

- A flavouring agent was prepared from the dried non-penaeid shrimp, *Acetes indicus* by extraction of nitrogenous compounds with 1% brine and incubated at 100 °C for 60 minutes. Shrimp flavour extract was dried using Sodium chloride as binder in a hot air oven at 50 °C for 72 hrs.
- Quality and shelf-life of air and vacuum packed Malabar tongue sole in refrigerated storage was assessed. Sole can be stored in an acceptable condition for 10 days in vacuum pack in refrigerated condition compared to six days in air pack.
- Freshly caught Ribbonfishes were dried in solar drier and the quality was compared with the sun-dried Ribbonfish. Spoilage parameters and organoleptic score during storage indicated that the solar dried Ribbonfish stored at ambient temperature had a better quality compared to the sun dried Ribbonfish.
- Effect of collagen-chitosan pre-coating on the oil uptake and quality characteristics of battered and breaded fish fingers from Mahi-mahi was evaluated. There was a 2% reduction in the oil uptake when the fish finger was pre-coated with collagen-chitosan solution.
- Effect of dried Rosemary leaves dip treatment on the quality of Horse mackerel was assessed. A shelf life of ~15-16 days were observed for 2% Rosemary treated samples compared to ~11-12 and ~8-9 days for 1% Rosemary treated and control air packed samples, respectively.
- Effect of reduced oxygen packaging on the quality of Cobia pre-treated with curry leaf essential oil and stored at refrigerated condition (5 ± 2 °C) was evaluated. The fish steaks treated with curry leaf essential oil and packed with O_2 scavenger had an extended shelf life of 35 days while the control air pack was sensorily rejected at Day 18. Essential oil treated fish steaks and fish packed with O_2 scavenger without essential oil pre-treatment were sensorily acceptable till 24 and 30 days of storage respectively.
- *Sous vide* processing prolonged the shelf life of whole clean Indian mackerel (24 days) compared to conventional cook-chill method (13 days). Control samples packed in air and stored at 1-2 °C were acceptable only up to eight days.
- The combined effect of Ginger essential oil (GEO) treatment and *sous vide* processing on the quality of Indian mackerel steaks during refrigerated storage (2 °C) was assessed. A shelf life extension of 21 and 16 days was observed for the *sous vide* processed Mackerel with and without GEO treatment, respectively compared to eight days for control sample.
- Moisture content, TBA and TPC of sun and solar dried Mahi-mahi decreased with increased salt concentrations. Histamine content was decreased when the salt concentration increased in case of sun drying. Mahi-mahi dried by solar drier had lower concentration of histamine when compared to sun drying.
- Carotenoids were extracted from non-penaeid shrimp, *Acetes indicus* using different solvent mixtures, cotton seed oil and castor oil.
- Bioactive hydrolysate was prepared from the gill of Mackerel using protease enzyme.
- Partial drying and quick chilling has proved to enhance the shelf life of Pangasius fillets.
- Ready to cook dehydrated fish roe cubes with 37% protein and 5% moisture content was prepared from the roe of Catla, with textural properties similar to that of fish meat chunks used in curry and soup preparations.
- Ready to eat fish flakes with 40% protein and less than 5% moisture was prepared from Catla roe following a simple drying process. The product showed porosity and crispness values similar to that of breakfast cereal products.
- A protocol for developing dried Catfish roe from marine Catfish was standardized.
- A methodology for modifying the flavor

characteristics of Pangasius meat using herbal extracts was developed.

- Edible coating was given to dried Bombay duck and Croaker fish. Coating imparted a glazy tint to the dried fish samples and improved surface characteristics compared to uncoated samples.
- Inoculation studies on Pangasius mince during microwave cooking were carried out. *V. cholera* and *V. parahaemolyticus* are completely destroyed after 80 seconds. *L. monocytogenes* were destroyed after 120 seconds. But, *Salmonella* species were able to survive even after 120 seconds.
- Comparison of fish scale peptone with commercial bacteriological peptone from Oxoid, Difco and Himedia indicated no significant difference between these media.
- The protocol for preparing battered and breaded Bombay duck fillet was standardized.
- A protocol for reducing moisture content in Bombay duck mince for developing mince based products was standardized.
- The synergistic effects of orange peel and mint leaf extracts and vacuum packaging on the quality characteristics of gutted Mackerel during chill storage was evaluated.
- A protocol for preparing a value added product based on Tilapia meat and Jawala shrimp extract was standardized.
- The quality index scheme for Indian mackerel was finalized and has 14 descriptors with a total demerit score of 33.
- Heat-stressed coagulase positive Staphylococci i.e. *Staphylococcus aureus* exhibits negative coagulase test when grown in normal medium. Additional nutrients are required to resuscitate the culture and get usual positive result.
- Fish samples brought from neighbouring states were collected from local market tested for pathogenic organisms as part of its source tracking showed the prevalence rate of *Escherichia coli*, *Staphylococcus aureus*, *Vibrio parahaemolyticus*, *Yersinia enterocolitica*, *E. coli* O157, *Aeromonas hydrophila* and *Vibrio vulnificus* as estimated to be 28, 4, 8, 4, 12, 4 and 4% respectively.
- Marginally low levels of formaldehyde (0.07-0.33 ppm) and ammonia (3-47 ppm) were detected in the fish samples coming from neighboring states.
- In surveillance monitoring of fish and fishery products sold across 28 markets of Kerala, level of adulterants like ammonia and formaldehyde were detected as high as 130.65 ppm and 4.52 ppm respectively. Higher incidence of pathogens such as *Escherichia coli* (27.9%), Coagulase positive Staphylococci (13.95%) and *Listeria monocytogenes* (7%) indicated urgent food safety intervention measures in fish markets.
- Surveillance monitoring of 33 ice plants across Kerala indicated very high levels of non-compliance (43.75%) in terms of residual ammonia content.
- Studies on biogenic amine formation dynamics during chilled storage of Indian Oil sardine indicated that histamine production was not observed for the first seven days but trace of histamine and other biogenic amines were detected towards the end of storage of 21 days.
- Advanced protocol for determination of Ethoxyquin from shrimp and shrimp feed was developed using LC-MS-MS.
- High pressure treatment (200-300 MPa) resulted in loss of histamine forming ability of artificially inoculated *Morganella morganii* in Tuna chunks.
- Temperature assisted high pressure treatment was found to be highly effective in elimination of *Yersinia enterocolitica* from seafood compared to HPP alone.
- Mixture of 0.1% each of Sodium benzoate and Potassium sorbate effectively retarded increase in APC, yeast and mold count in fish gravy

concentrate upto 14 days of ambient storage.

- *Shigella flexneri* and *Staphylococcus aureus* required very high energy values (106.76 and 88.22 J/cm^2) for one log reduction in pulse light treatment.
- *Serratia liquefaciens* was identified as the major spoilage flora in cooked Tuna sausages during frozen storage.
- Chilled storage studies on White prawn and Bluefin travelly with flake ice and gel ice showed superiority of gel ice in fish preservation.
- Increased mishandling of fish leading to microbial contamination occurs in markets compared to fish landing harbours and retail centres.
- Quality of commercially important fishes like Seerfish and Cobia stored in tube ice was compared to flake ice. Seerfish stored in flake ice had a shelf life of two days compared to three days in tube ice while Cobia stored in flake ice and tube ice was sensorily acceptable till 3rd and 4th day of storage, respectively. The study reveals that tube ice is more suitable than flake ice during long term storage and transportation of fish compared to flake ice.
- Essential oil extracted from Rosemary, Oregano, Curry leaf and Ginger was used alone (0.2%) and in combination to improve the microbiological quality and to prevent the lipid oxidation of Indian mackerel steaks. When used alone, maximum antioxidant property was shown by Rosemary essential oil treated fish steaks and Ginger essential oil treated sample had better microbiological quality.
- Presence of formaldehyde in frozen fishes in Veraval, Gujarat has been checked. In Indian mackerel, the formaldehyde content ranged between 0.2-4 ppm and it was between 0.3-9 ppm in different varieties of Tuna (Long tail tuna, Bonito and Skipjack tuna). There were significant differences in the formaldehyde content in different fish samples of the same species.
- Mercury content varied between 0.002 ppm to 0.008 ppm in Squid and Cuttlefish while it ranged from 0.008 ppm to 0.009 ppm in Octopus. Cadmium content was in between 0-0.049 ppm, 0.0-0.57 ppm and 0-0.11 ppm in Cuttlefish, Squid and Octopus respectively.
- Mean values of histamine content in fresh Mackerel and frozen Mackerel were 14.33 mg/Kg and 49.14 mg/Kg sample. In fresh fish, the value ranged between 2.75 to 108 mg/Kg while it was between 4.71 to 206.5 mg/Kg in frozen samples collected from various units. Fifty percenatage of the frozen fish samples and 80% of fresh fish sample contained less than 10 mg/Kg histamine.
- Spoilage bacteria of farmed Catfish were identified as *Aeromonas sobria, A. hydrophila, Chryseobacterium, Pseudomonas* and *Sphingobacterium*.
- Fish pathogens *Edwardsiella tarda, Aeromonas hydrophila* and *Chryseobacterium* spp. were recovered from farmed Catfish *Pangasius* sp.
- A virulent strain of *Edwardsiella tarda* with LD_{50} of $1.4X10^6$ $CFUg^{-1}$ was isolated from farmed Catfish *P. hypophthalmus*.
- Pathogens such as TDH positive *V. parahaemolyticus*, Methicillin-resistant *Staphylococcus aureus*, Salmonella and *Y. enterocolitica* were isolated from seafood and aquatic environments.
- Improved method for isolation of Methicillin-resistant *Staphylococcus aureus* from fishery environment was developed.
- Multi Locus Sequence typing (MLST) analysis for seven housekeeping genes of *S. aureus*; *arcC*, *aro*E, *glp*f, *gmk*, *pta*, *tpi* and *yqil* revealed that strain SA192 isolated from fish from market belongs to ST641 sequence type.
- Staphylococcal Protein A (SPA typing) of the strain of MRSA SA192 revealed that the strain belong to t002 ridom type.

- Developed Duplex PCR assay for simultaneous detection of *Listeria monocytogenes* and *Campylobacter jejuni* from seafood samples.
- Developed PCR-based diagnostic method for detection of Hepatopancreatic parvovirus infection in shrimp.
- Pathogenic *Vibrio vulnificus* strain was recovered from infected farmed shrimp.
- Multidrug resistant *Aeromonas hydrophila* was recovered from fish farms.
- Ectoine biosynthesis genes from *Haerere-halobacter* spp. was cloned in heterologous expression system.
- Chitinise gene from *Paenibacillus elgii* was cloned in heterologous expression system.
- Studies were conducted to know the status of cholera toxin gene positive *V. cholerae vis-à*-vis other virulence factors. 83%, 66% and 50% of the *ctxAB* positive *V. cholerae* were positive to *tcp, zot* and *ace* genes, respectively. 83% of the *ctxAB* positive *V. cholerae* belonged to O1 serogroup while one *ctxAB* positive *V. cholerae* isolate belonged to the non-O1/non-O139 serogroup.
- Three water samples and three sediment samples from *L. vannamei* shrimp farms were positive for the presence of *V. parahaemolyticus* (0.3 MPN/g), but the isolated *V. parahaemolyticus* strains were negative for the virulent *tdh* gene.
- A total of 18 samples consisting of Lobster harvesting cage culture water samples (n=11), Fish processing industry's effluent water (n=4) and ice samples (n=3) were analyzed for microbiological quality such as total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, Faecal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolyticus* and *Listeria monocytogenes* in April-June, 2013.
- A total of 25 isolates of coagulase positive *S. aureus* isolates were isolated from 17 dry fish samples and 30 spoilage bacteria from the chilled and frozen stored fish samples in April-June, 2013. The DNA isolation was done for these isolates by pelleting the revived young culture, washed in 0.5M TE buffer twice and DNA was isolated by using DNA isolation kit (Sigma). The quality of the DNA was checked on 1% Agarose and the DNA was preserved in TE buffer for further PCR characterization.
- A total of 21 samples consisting of Prawn (n=3) Ribbonfish (n=1), Squid (n=1), Sole (n=2), prawn cultured water samples (n=4), dried fish (n=8) and water (n=2) were analyzed for microbiological quality such as total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, Faecal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolyticus*, *Listeria monocytogenes* and total fungal counts in July-September, 2013.
- A total of 30 isolates of *E. coli* (confirmed on EMB & IMViC) isolates were isolated from the above samples and 20 spoilage bacteria from PIA from the chilled and frozen stored fish samples in July-September, 2013. The DNA isolation was done for these isolates by pelleting the revived young culture, washed in 0.5M TE buffer twice and DNA was isolated by using DNA isolation kit (Sigma) and were preserved in TE buffer for further PCR characterization.
- A total of 19 samples consisting of prawn culture water samples (n=3), wild fish samples (n=8) and shellfish (n=8) were tested for total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, Feacal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolyticus* and *Listeria monocytogenes* in the quarter January-March 2014.
- A total of 25 isolates of coagulase positive *S. aureus* isolates were isolated from 17 dry fish samples in January-March, 2014.
- Bombay duck intestinal microbial diversity was identified. Most of the isolates belonged to *Proteus* genus. Antibiogram analysis of the isolates revealed high resistance of most of these

isolates to Cepodoxime (45%).

- A tandem mass spectroscopic method for trace level analysis of eight B vitamins in rat plasma and fish was developed.
- A new enzymatic sample preparation protocol was developed for extraction of water soluble B vitamins from fish tissue. The protocol was successfully applied for determination of water soluble B vitamin content in three fish species, Mackerel, Sardine and Dogshark.
- It was observed that these species are rich source of Vitamin B_{12} and Folic acid.
- A new sample preparation method was developed for multiresidue analysis of 119 multiclass contaminants in fatty fish matrix by GC-MS/MS. The method was presented in AOAC Annual Meeting and Exposition, Chicago, 2013 and was accepted in the Proceedings.
- A rapid sample preparation method for analysis of 13 Organochlorine pesticides by GC-ECD in shrimp was developed.
- A tandem mass spectrometric method for analysis of 85 persistent organic pollutants including OCPs, PAHs and PBDEs was developed. The method will be significant since PBDEs are emerging contaminants in environment and new analytical methods are required for their monitoring.
- Chitosan was modified by grafting phenolic acids (Gallic acid/ Ferulic acid/ Coumaric acid/ Vanillic acid) by a simple chemical reaction. Four chitosan derivatives were synthesized.
- Phenolic acid grafted chitosan derivatives showed excellent antioxidant and antimicrobial activity. Ferulic acid grafted chitosan was best in terms of antibacterial activity. These derivatives will have potential application as nutraceuticals and functional foods.
- Glycosamino glycans (GAGs) were isolated and characterized from squid ink. It was observed that the GAGs are sulfated polysaccharides and contain 13.5 mg of sulfate per 100 mg.
- FTIR spectrum of GAGs showed regions that were specific for sulphur, sugar, nitrogen and carbon residues.
- Protective effect of the purified squid peptide against hydroxyl-radical-induced DNA damage was studied. It was observed that DNA treated with the purified peptide protected DNA from hydroxyl radical damage indicating the positive antioxidant effect.
- Squid peptide showed antipyretic effect in albino rats against Brewer's yeast induced pyrexia. It was observed that low concentration of peptide (0.5g/Kg body weight) has reported maximum antipyretic effect compared to high concentration of peptide treatment.
- Anti-inflammatory effect of squid peptide in albino rats against formalin-induced paw edema was studied. It was observed that squid peptide at doses 500 and 1000 mg/kg bodyweight significantly prevented the increase in thickness of paw edema in a dose dependent manner compared to the control rats.
- Anti-ulcer effect of squid peptide in albino rats against ethanol-HCl induced gastric ulcer was studied and 0.5 g/kg body weight peptide was found to possess antiulcer property.
- Partial characterization of squid peptide was carried out by MALDI-TOF/TOF.
- A one pot synthesis of Succinyl Chitosan-Fish Collagen and PEG based composite ternary hydrogel was achieved. Microencapsulated curcumin was incorporated in the hydrogel.
- The developed hydrogel was tested for its wound healing activity in animal model. Histopatho-logical analysis of healed wound tissue clearly showed excellent wound healing capability of the hydrogel.
- A succinyl chitosan based hydro-alcohol hand

sanitizer was developed for fish processing industry workers. The efficacy of the hand sanitizer was established by ASTM approved glove juice method.

- Synergistic effects of dietary squalene and n-3 poly unsaturated fatty acids (PUFA) in modulating aging process were studied. The results indicated that the combined dietary supplementation of squalene and n-3 PUFA might be the viable therapeutic potential to ameliorate the age-associated oxidative stress in brain tissue.
- Anti arthritic effect of collagen peptide was established by Anti Cyclic Citrullinated Peptide Ab assay. Collagen peptide was partially characterized by determining molecular weight range (m/z 500-4500) by MALDI-TOF/TOF analysis.
- Shark liver oil from *Echinorhinus brucus* was found to possess potential antiulcer effect.
- Quality evaluation of Little tuna has been conducted using Hurdle concept. Lipid quality parameters like PV increased after 10 days of storage from 8.61 to 26.78 milliequivalents/kg of fat in control vacuum packed fillets and 6.6 to 13.56 milliequivalents/kg of fat in vacuum treated fillets. In general, all biochemical and microbiological quality indices exceed the permitted level after 12 days of storage in vacuum control and treated control products.
- Quantification of stress was done in fish caught from trawl and gillnet. The result shows slightly higher activity of both the enzymes in fish caught from gillnetters but the difference is not significant.
- Moisture and protein contents of the dried air bladder of Eel were 14 and 83% respectively.
- Total phenolic content of the Rosemary extract was 4.1 g Gallic acid equivalent $100g^{-1}$. The antioxidant activity determined as 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity of Rosemary extract was lower (IC_{50} 0.021mg mL^{-1}) compared to BHA (IC_{50} 0.038 mg mL^{-1}). Total phenolic content of the Rosemary extract was 90.5 mg Gallic acid equivalent g^{-1}. The antioxidant activity determined as 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity was 201.8 mg AAE/g.
- Different species of fish sample caught from trawl net and gill net was collected and different stress enzymes *viz*. Super oxide dismutase (SOD) and catalase were standardized to evaluate stress associated with catching methods.
- Chemical composition of the curry leaf essential oil was analyzed using GCMS-QP2010 Ultra (Shimadzu, Japan). Analysis revealed that alpha-pinene, beta-caryophyllene, beta-elemene, alpha-humulene, (E)-beta-ocimene, beta-phellandrene, alpha-terpinene, sabinene and beta-pinene are the main constituents of curry leaf essential oil collected from Veraval.
- Carried out analysis of the data on manufacturing and construction facilities available throughout Kerala for catering fishing vessel production.
- Data were collected and analyzed on the mechanical equipment used in fishing vessels, *viz.*, winch system, engine, safety equipment and alternate energy backup systems from 10 fishing vessels at Diu.
- Fabricated a small prototype of Water Chilling Unit using solar energy.
- Fabrication of a prototype of band saw machine for frozen fish mince blocks/fresh fish is nearing completion.
- Introduced a new method for validation and certification of diesel engine for marine applications.
- Designed and developed a cost effective table-top De-scaling Machine to remove the scales of marine as well as freshwater fishes in food grade SS 304.
- Designed and developed a washing vessel for prawn shell which removes Sodium hydroxide

from the prawn shell for further processing.

- Designed and developed food grade plastic mold for value addition of shrimp as stretched shrimp. The mean stretching obtained was 2.26 cm, 2.64 cm, 2.41 and 2.46 cm for 31-40, 41-50, 51-60 and 61-70 grades, respectively.
- Fishermen at V.R. Sagar, Andhra Pradesh had a symbolic adoption index score of 15.38% on improved fishing and hygienic fish handling was which indicated their negative decision on the adoption of improved technological practices.
- The mean Socio-Economic Evaluation Index (SEEI) of these fishermen was found to be 49.46 (S.D: 3.21).
- Technology transfer programmes were conducted at Thaikkal, Alappuzha; Meenkara, Palakkad and Mangamaripeta, Andhra Pradesh on the subject of 'Hygienic fish handling and value added fishery products' in collaboration with NGOs.
- An analysis of decision making behavior of marine fishermen (n: 32) was carried out at Peddajalaripeta, Visakhapatnam. The innovation decision efficiency index (IDEI) of marine fishermen in Andhra Pradesh was calculated and the overall decision making index was 53.67.
- The operational cost of the dolnet fishery in Raigad, Maharashtra revealed high maintenance and repairing cost of craft, gear and engine due to over-use of crafts by the fishermen beyond their effective life.
- A logistic model has been fitted to assess the fishermen co-operative members' willingness-to-pay (WTP) for the improved marketing services.
- Stakeholders/SHGs belonging to the consortium for fisherwomen empowerment in Andhra Pradesh, namely, women SHGs *Godavari Maha Samakhya* (GMS), Tallarevu, East Godavari district had an average overall empowerment index score of 79.55.
- With the introduction of Pacific white shrimp in the processing industries of Andhra Pradesh, the average installed capacity of the firms was raised from 30 MT/day to 50 MT/day.
- A GIS based conceptual model for reservoir fisheries information management system was developed.
- Survey conducted among fishermen engaged in hook and line fisheries in Peddajalaripeta fishing village of Visakhapatnam to assess the decision making behavior associated with fishing related innovation/practices revealed that the overall decision making index was 53.67.
- A technology training intervention was organized on hygienic handling of fish and preparation of value added fish products in Mangamaripeta fishing village for the benefit of 30 women belonging to fishermen community. Effectiveness of the training programme was assessed and results showed that there is 43.5 percent increase in the awareness index and 42.3 percent increase in the average adoption score of the trainees after attending the two days training programme.
- Study was conducted on the impact of introduction of Pacific white shrimp on shrimp production and processing industry in Andhra Pradesh. Results of the study showed that 83.6 per cent of the cultured shrimp production in Andhra Pradesh is attributed to *L. vannamei*. 37.12 per cent increase in the installed capacity and 53.10 per cent increase in capacity utilization of shrimp processing firms has been observed after introduction of *L. vannamei*.
- Collected information regarding the dry fish marketing channels for Catfish, Bombay duck and shrimp of Okha and Navabandar region.
- Data relating to raw material cost, drying cost, packing, transportation cost, marketing cost and margin involved and finally the price realized in the traditional methods of drying fishes were collected.

Introduction

The Central Institute of Fisheries Technology (named at the time of inception as Central Fisheries Technology Research Station) was set-up following the recommendation of a high power committee constituted by the Ministry of Food and Agriculture, Government of India. It started functioning at Cochin on 29 April, 1957 under the Department of Agriculture of the then Ministry of Food and Agriculture with a small nucleus of staff for research work in fishing craft and gear. Other Divisions soon followed. The administrative control of the Institute was brought under the Indian Council of Agricultural Research on 1 October, 1967.

The 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 maters including those connected with research projects handled by the Institute and implementation of Right to Information Act-2005. Official Language Implementation Section is headed by the Deputy Director (Official Language).

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

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

The Institute has well equipped laboratories with modern, sophisticated, state-of-the-art equipment for both fundamental and applied research, an excellent library, a workshop and an animal house, an Agricultural Knowledge Management Unit (AKMU) and Agricultural Technology Information Centre (ATIC). The laboratories of the Institute also cater to the needs of the industry by testing processed fishery products, ice, water, and other materials like fishing gear and craft materials, packaging materials, marine paints, fishing craft and engines. A Business Planning & Development (BPD) Unit 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 2013-2014 - ₹ in Lakhs)

Particulars	Non-Plan		Plan	
Budget Head	Allocation	Expenditure	Allocation	Expenditure
Establishment charges	1810.00	1809.44	-	-
Overtime allowances	0.50	0.29	-	-
Traveling allowances	17.00	17.00	50.00	50.00
Works (Maintenance)	109.00	47.67	-	0.11
Other charges (Equipments)	35.00	34.86	100.00	100.00
Other charges (Contingency)	150.62	211.94	350.00	349.90
Furniture and Fixtures	10.00	8.98	15.00	15.00
Library books	5.00	5.00	30.00	30.00
Information Technology	-	-	25.00	24.99
NEH programme	-	-	37.00	36.99
Tribal sub plan	-	-	20.00	20.00
Total	**2137.12**	**2135.18**	**627.07**	**626.99**

Staff Position

(As on 31 March, 2014)

Category	Sanctioned	Filled
Scientific	95	56
Technical	127	111
Administrative	81	65
Supporting	63	45
Auxiliary	5	3
Total	**371**	**280**

Address of Headquarters and Research Centres

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cift@ciftmail.org
Website: www.cift.res.in

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Research Centre of CIFT
Ocean View Layout, Pandurangapuram
Andhra University P.O.
Visakhapatnam - 530 003, Andhra Pradesh
Ph: 0891-2567856, Fax : 0981-2567040
Email: cift@itpvis.ap.nic.in

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E mail: ciftmum@bom.nic.in

Organogram


DIRECTOR
AUDIT & ACCOUNTS
TECHNICAL SECTION
BPDU
LIBRARY & DOCUMENTATION
AKMU
ADMINISTRATION
SCIENTIFIC DIVISIONS
RESEARCH CENTRES
BIOCHEMISTRY & NUTRITION
QUALITY ASURANCE & MANAGEMENT
MICROBIOLOGY, FERMENTATION & BIOTECHNOLOGY
EXTENSION, INFORMATION & STATISTICS
ATIC
FISHING TECHNOLOGY
FISH PROCESSING
ENGINEERING
WOOD PRESERVATION FACILITY
MATERIAL SCIENCE & MARINE POLLUTION
FISHING SYSTEM DESIGN CENTRE
GEAR
PROCESSING
BY-PRODUCTS
PACKAGING
PILOT PLANT
PROCESS ENGINEERING
INSTRUMENTATION
FISHING VESSEL DESIGN
ADMINISTRATION
CO-ORDINATION
BILLS
STORES
OFFICIAL LANGUAGE IMPLEMENTATION
VISAKHAPATNAM
VERAVAL
MUMBAI

A Quick Glance at Past Research Achievements

- CIFT has developed and introduced 12 standard designs of mechanized wooden fishing boats in the size range of 7.6 to 15.2 m LOA for coastal and intermediate range. It is estimated that over 80% of the nearly 54,000 mechanized wooden fishing crafts in the Indian fishing fleet confirm to the popular CIFT designs or its later adaptations.
- Hull maintenance of the fishing vessels is important for increasing its service life. CIFT has developed a package of technologies for protection from bio-deterioration, fouling and corrosion for increasing the life span, substantially reducing maintenance cost of fishing vessels.
- Aluminium-Magnesium alloy sheathing with cathodic protection and prescribed coating system was developed as a cost-effective substitute for Copper sheathing for wooden hulls as protection against marine borers. This technology is widely used in the small-scale mechanized vessels.
- Epoxy resin-based coating developed has improved the life span of cast Iron 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, netting yarn and netting twine used for fishery purposes. These developments have led to an increase in the productivity of the fishing gear and increase in net profits due to low maintenance and long service life of the nets.
- CIFT has made significant contributions in the development of fishing gear and methods for the traditional sector, traditional motorized sector, small-scale mechanized sector and large-scale industrial sector in Indian fisheries, which is reflected in the increase in fish production.
- Improvements were made in the design and durability of lobster traps as substitute for traditional traps of short life span and low efficiency, for harvesting of spiny lobster.
- A mini-trawl for operation from traditional crafts powered by outboard motors of 8-15 Hp, for shallow water shrimp trawling was introduced.
- The purse seine was introduces 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 fin fishes without compromising on shrimp catch.
- In high opening trawls, vertical opening of the trawl is increased by innovative design improvements, facilitating capture of demersal as well as off-bottom resources.
- Large mesh trawl with relatively large meshes in the front portion resulted in significant reduction in trawl resistance, making use of the herding effect of large meshes on fin fishes. These deigns have been well accepted by the trawler fishermen of Gujarat, Karnataka and Kerala.
- Otter boards are sheer devices used in trawls for keeping the trawl mouth horizontally open. Different sizes of flat rectangular boards and vertically cambered otter boards have been introduced by CIFT for the benefit of small-scale mechanized fleet, during the course of its 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 gill net optimized for catching Sardine, Mackerel, Spanish mackerel, Pomfret and Hilsa, in terms of material and mesh size were introduced for the benefit of non-motorized and mechanized segments of the industry.
- Gear systems have improved the capture fishery production from the inland open water resources significantly over the years. Trammel nets and monolines were also introduced in reservoir systems.
- Technology for the extraction of chitin from shrimp shell and conversion to chitosan has successfully addressed a very serious environmental threat due to the careless disposal of the waste. A number of parties have already taken this technology and started production and marketing. Nearly 20% of the available shell waste is being used by these industries for conversion to chitin and chitosan. In addition to creating employment, this has become a highly remunerative industry.
- Ready-to-serve fish curry products in retortable pouches can be stored at ambient temperature. This revolutionary technology has been given to more than a dozen parties who have already started production and marketing. This technology has long term impact in terms of value addition.
- Isinglass is a product that has got application as a clarifying agent in breweries, mainly in the beer industry. The technology was transferred to an industry for commercialization. This has resulted in the production of a value added product which has got demand in domestic and foreign market.
- The technology for extraction of Poly Unsaturated Fatty Acids (PUFA) from fish oil is a very important contribution towards nutritional security by providing a vital nutritional component. Many multinational companies are importing PUFA-enriched products and this technology will lead to import substitution. This value-added product will help in increasing the income of the fishermen.
- Collagen-chitosan film has wide applications as

a wound dressing material and in dental surgery. It replaces the imported Teflon membrane used in dental surgery and the cost will be only a small fraction of that of the imported material. The raw material is fish air bladder, which does not find any use now. This technology can utilize the industrial waste and thus can enhance the income of the fishermen.

- 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 the antibiotic residues to a level of 0.1 ppm. About 65 seafood factories in Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat exporting seafood to EU and US are direct beneficiaries of this technology.
- A two step nested PCR method for the detection of White Spot Syndrome Virus in shrimps was developed, standardized, assessed and introduced for commercial use. This method 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 WTO.
- An improved ELISA method for detection of residues of Chloramphenicol, a 'zero tolerant' antibiotic, in processed seafood for export to EU, US and Japan was evolved. This improved method was assessed and commercialized in 2003. It is now regularly used to monitor Chloramphenicol level in farmed and processed shrimps. Hundreds of shrimp farmers and seafood exporters have gained by the technology.
- The 'Chloritest paper' developed for detection of ppm levels of Chlorine in process water, an essential requirement to implement sanitation and hygiene practice in food processing industry, was transferred to M/s Glaxo Laboratories. This has resulted in the 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 deigned to treat the effluents confirming to the Pollution Control Board standards.
- The following engineering equipment have been developed by CIFT for use in fishing and fish processing:
  - SS Tilting Kettle
  - Oil fryer for battered and breaded products
  - 15.5 M fuel efficient steel fishing vessel
  - Fiberglass canoes
  - Environmental data acquisition system
  - Temperature-Salinity meter
  - Ship-borne data acquisition system
  - Speed and distance log
  - Trawl depth meter
- The following aspects having management and policy level implications in fisheries have been studied by the Institute:
  - Idle capacity in fish processing plants in India
  - Price analysis of Indian seafood in the export

market

- Economics of artisanal fisheries
- Economics of operation of fishing vessels of both west and east coast of India
- Price spread in domestic fish markets of Kerala and Gujarat
- Fuel utilization pattern by the fishing industry in India
- Assessment of harvest and post harvest losses in fisheries
- Estimation of inland fish landings in reservoirs
- Harvest and post harvest losses in fisheries

- The Institute also undertakes research studies which provide feedback for technology development and transfer. The following are some of the works undertaken:
  - Socio-economic profile of fisher folk in different parts of the country and development of socio-economic status scale.
  - The areas and extent of participation of women in fisheries related activities.
  - The types and activities of Co-operatives and other organizations in fisheries and the role played by them in small scale fisheries.
  - Adoption behavior including extent of adoption, communication, decision making, response to technological gaps of fishermen in traditional, mechanized and motorized sectors and fish curers in relation to technology transfer by the Institute.
  - Evaluation of the training and extension programmes taken up by the Institute in terms of gain in knowledge, awareness, practices and constraints.
  - Studies on ban on monsoon trawling, costal zone management and socio-legal issues.

RESEARCH ACHIEVEMENTS - HEAD QUARTERS, COCHIN

Fishing Technology Division

Research projects handled

- Nanotechnological interventions to mitigate fishing craft and gear material degradation
- 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
- Oceanic Tuna fisheries in Lakshadweep sea - A value chain approach
- 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
- Retrieval of phytoplankton biomass and associated optical constituents based on long term bio-optical studies
- Studies on ecological linkages between plankton production and *Acetes* sp. abundance along Gujarat coast

Chief findings

- Solar energy was successfully used to power a 3.6 m L_{OA} FRP boat. A 0.5 kw solar panel could successfully power the boat and achieve 3 knots speed during the trial run.
- The first all India baseline survey on craft and gear, that covered the major landing centres along the Indian coast revealed 65 design variants of fishing vessels. The gear designs were based on local species availability and design details of 215 variants of fishing gears including trawlnets, gillnets, purse siene, ring siene and dolnets were studies and digitized.
- Fuel cost contributed to the bulk of the operational expenses, ranging from 70 to 85% depending on the type of operation. An increasing trend was observed with respect to the installed engine power of the fishing vessels and this was more pronounced along the southern states. The power of the engines installed varied from 45 to 550 Hp depending on the type of vessel and region.
- Survey among the fishermen using wooden canoes along Southwest coast revealed that Aini (*Artocarpus hirsuta*) and Mango (*Mangifera indica*) were commonly used for canoe construction. Canoes with an L_{OA} of 3.04 to 7.62 m are commonly used and the cost ranged from ₹ 18,000/- to ₹ 50,000/- respectively.
- The validation experiments along Gujarat coast showed an average CPUE from the PFZ regions as

15.40 kg h^{-1} and fishing in the non-notified areas recorded an average CPUE of 12.08 kh h^{-1}. The benefit/cost ratio were 1.51 and 0.81 respectively in the notified and non notified areas.

- Polyaniline curcumin-copper-cobalt composite was synthesized and the evaluation by visual and electrochemical methods revealed that it had excellent capability to sense ammonia, methyl, dimethyl and trimethyl amines.
- Nano sized Copper oxide coating over nylon multifilament netting showed lower microfouling accumulation.
- Studies on the post-release mortality associated with hooking using Circle and J-hooks, showed that 30.4% of the fishes released from J-hook died within 48 h of release, while no mortality was observed in fishes hooked and released from Circle hooks.
- The selectivity estimates of Hilsa in 50 mm square mesh windows installed bagnets were as follows L50 %= 46.9 mm, Selection range = 20.3 mm, L75% = 57.1 and L25 % = 36.8.
- Bycatch constituted 30-60% of the total catch of the trawlers operating along Kerala coast and the major species that constituted the bycatch were *Oratosquilla nepa*, *Portunus* sp., *Lagocephalus* sp., *Secutor insidiator* and *Platycephalus* sp.
- *Asperoteuthis acanthoderma* was recorded for the first time from India in the FORV Sagar Sampada Cruise No. 320 during 4-16 October, 2013.
- Nanophytoplankton fraction contributed 60% of the total chlorophyll in all months and exhibited higher chlorophyll specific absorption (a*ph(λ)) at 440 and 665 nm.

Report of the work done

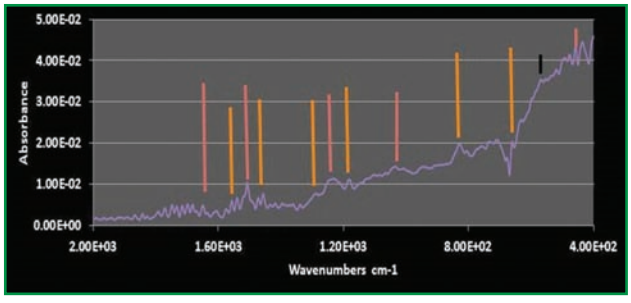
Nanotechnological interventions to mitigate fishing craft and gear material degradation

Principal Investigator : Dr. P. Muhamed Ashraf

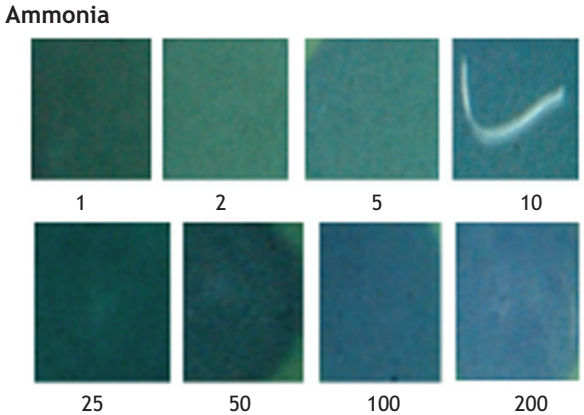
Co-Investigators : Dr. Leela Edwin and Dr. Saly N. Thomas

Synthesis of polyaniline composites for sensing ammonia and amines

The objective was to synthesise a polyaniline composite by introducing different amine responsive molecules. Synthesised polyaniline-curcumine-copper-cobalt composite and was characterized using FTIR. The FTIR evaluation exhibited the formation of the composite by showing the characteristic peaks of curcumin, copper and cobalt. The composite was tested for the detection of ammonia, methyl, dimethyl and trimethylamines (TVBN). TVBN detection was done through cyclic voltammetry, electro-chemical impedance spectroscopy and visual methods. The composite responded to TVBN from concentrations from 1 ppm to 200 ppm by exhibiting gradation of bluish-green colours with increasing concentration. The ammonia and amine molecules responded with similar colour pattern. The intensity of colour increased with increasing concentrations of the compounds. Detection of very low concentration of TVBN can be carried out by cyclic voltammetric and impedance techniques. The results showed that the sysnthesised composite is a potential candidate



FTIR spectra of polyaniline-curcumin-copper-cobalt composite

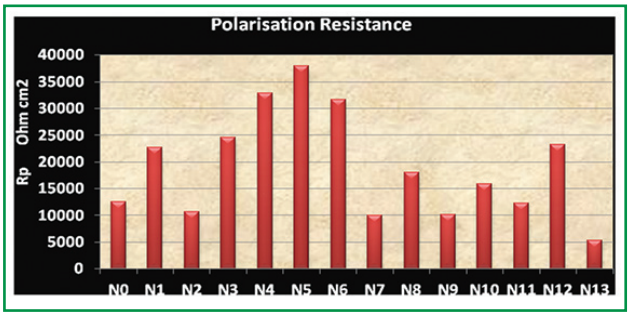


Response of polyaniline composite with different concentrations (1 to 200 ppm) of ammonia and methylamine

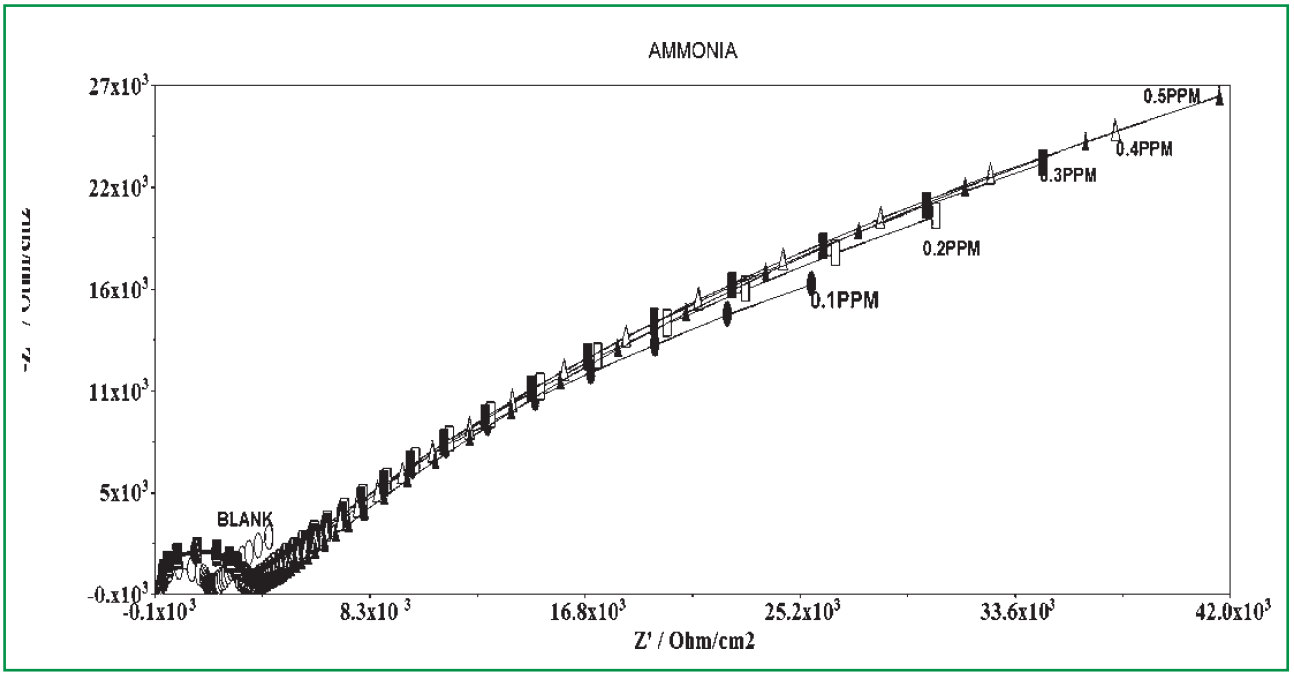
for the detection of ammonia, methyl, dimethyl and trimethyl amines and the method can be utilized for the detection fish spoilage and adulteration quantitatively. The response using electrochemical technique highlights that it can be utilized for detection through electronic devices.

Nano Cerium oxide and Multi Walled Carbon Nano Tube (MWCNT)-incorporated aluminium

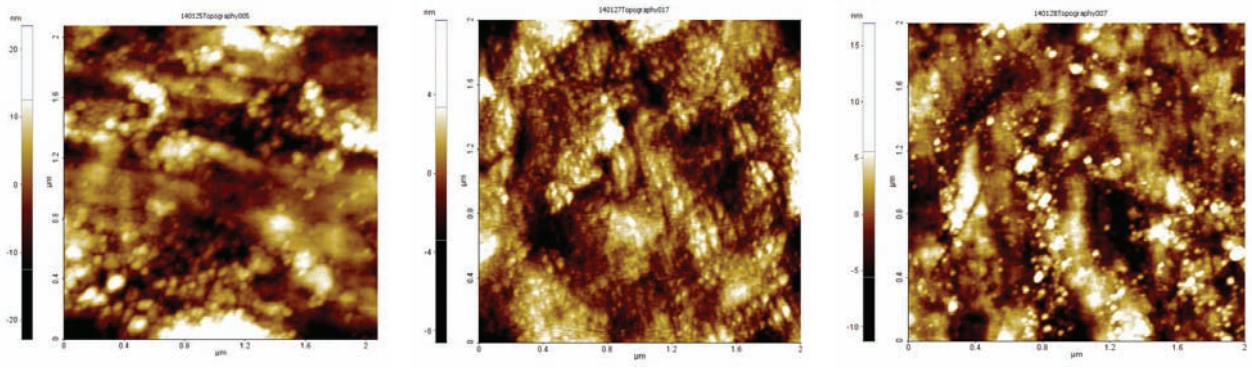
Nano sized Cerium oxide and multiwalled carbon nanotube mixtures in 13 combinations were incorporated into pure aluminium and the composite was tested for corrosion resistance in marine environments. The surface characteristics of aluminium metal matrix composite were evaluated using atomic force microscope and are shown in the Figure. The



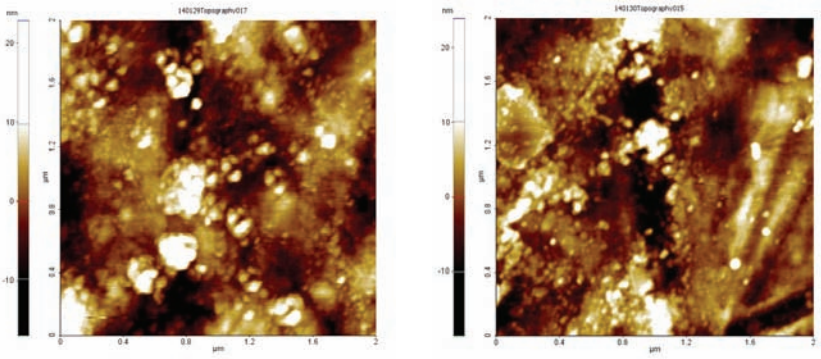
Polarisation resistance of MWCNT and nano Cerium oxide-incorporated aluminium during electrochemical impedance measurement



Electrochemical impedance spectral response of different concentrations of ammonia



Pure aluminium | 0.02% MWCNT aluminium | 0.005% each of MWCNT and nano CeO_2



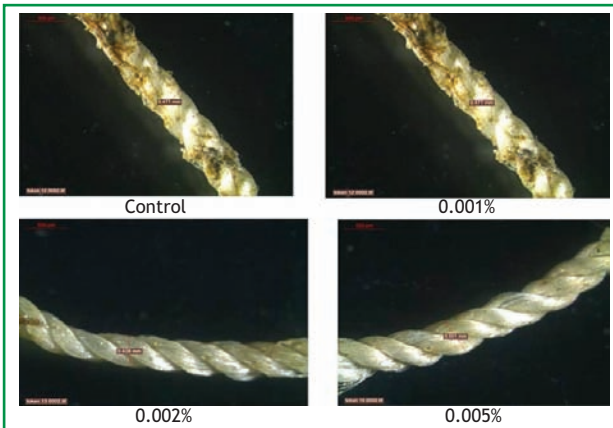
0.01% MWCNT 0.01% nano CeO_2 | 0.02% MWCNT and 0.01% nano CeO_2

Atomic force micrographs of MWCNT and nano sized Cerium oxide-incorporated aluminium

MWCNT alone incorporated aluminium showed uniform distribution of MWCNT in the matrix. The aluminium with nano Cerium oxide and MWCNT mixtures-incorporated aluminium showed uniform distribution of both the constituents in the matrix. MWCNT and nano Cerium oxide incorporated aluminium showed maximum corrosion resistance as evidenced by electrochemical evaluation using linear sweep voltammetry and electrochemical impedance. Lowest corrosion rate and stable open circuit potential was showed by the above composite during long term evaluation in 3.5% NaCl.

Nano material based antifouling strategies for fishing nets: Preliminary evaluation

Nylon multifilament netting of 210 x 2 x 2 and 30 mm mesh size were coated with nano sized Copper oxide (APS 40 nm) at three different concentrations *viz.*, 0.001, 0.002 and 0.005%. Sixteen samples of the netting (10 x 10 meshes each) of each treatment and control were immersed in estuarine waters for four days to evaluate the micro fouling on these samples. Results showed reduced micro fouling accumulation on netting treated with nano Copper oxide compared to untreated control. Micro fouling biomass on treated samples was less than that of control *viz.*, 3.61 mg on control netting and 1.59 mg on treated netting (0.005% nano Copper oxide) at the end of four days



Images (30x) of microfouling accumulation on control and nano Copper oxide coated nylon netting (Day 4)

Sample/ copper oxide treatment details	Weight increase (mg)			
	Day 1	Day 2	Day 3	Day 4
Control	1.17	1.614	2.99	3.61
Netting treated with 0.001%	1.17	1.43	2.16	1.82
Netting treated with 0.002%	0.94	1.33	1.46	1.63
Netting treated with 0.005%	1.12	1.6	2.06	1.59

Wet biomass of microfoulers on nylon netting samples (control and Copper oxide coated) exposed to estuarine waters

exposure. Hydrographic parameters (Dissolved oxygen, pH, temperature and turbidity) of the water at the test site were also monitored during exposure. Dissolved oxygen (mg/l), pH, turbidity (NTU) and temperature (°C) ranged between 1.9-2.3, 7.92-8.18, 16.1-18.2 and 29-30 respectively.

Responsible fishing systems for the marine sector

Principal Investigator : Dr. P. Pravin

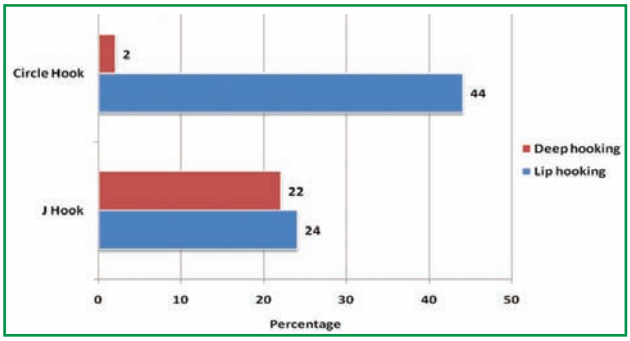
Co-Investigators : Dr. Saly N. Thomas, Dr. M.P. Remesan, Shri M.V. Baiju, Dr. V.R. Madhu, Dr. K.K. Prajith, Shri G. Kamei and Dr. A.K. Jha (At Veraval RC)

Development of improved semi pelagic trawls and fishing and field trials

Field demonstration of CIFT semi pelagic trawl system was carried out on board Astapathy, a private trawler at Munambam on 21 February, 2014. Suberkrub otterboards were used and the sweep line length was 40 m. Fishing operations were carried out off Munambam in the depth range of 20-25 m with trawling speed of 3.3 knots The catch consisted of squids, carangids and other miscellaneous fishes. The CPUE was 13 kg per hour.

Field trials for studying injury pattern in fish with different hooks

Experimental trials were carried out off Kavarathi island of Lakshadweep, to study hooking location of Circle and J-hooks and the post release mortality of hooked fishes. Circle hook (8/0) and J-hook (Size 9) were simultaneously set and the fishes caught by each hook were observed for hooking location and severity of injury/presence of bleeding.



Hooking location of fishes caught by J-hook and Circle hook

Studies on post-release mortality of hooked fishes

Hooks were removed from the fish carefully and were placed in seawater tanks kept onboard the boat. After reaching shore, the fishes were transferred to floating tanks of length 125, breadth 85 and depth 60 cm kept in sea water. The tanks were provided with numerous small holes for exchange of water continuously. Fishes were monitored for three days for mortality, if any. Results showed that 30.4% of the fishes released from J-hook died within 48 h of post release, while none of the fishes released from C hook died. Analysis of the post release mortality of fishes hooked in J-hook showed that 42.9, 14.3, 14.3 and 28.6% of fishes died within 1, 2, 18 and 48 hours post release.

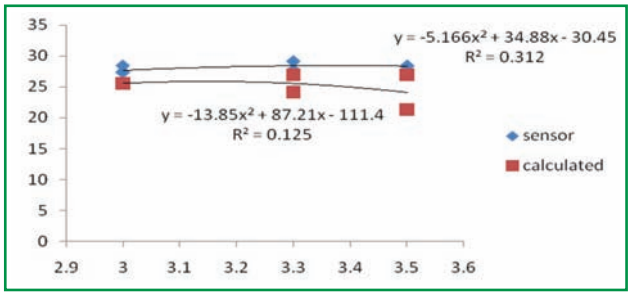
Fishing trials with long lines

A hydraulic long line hauler and setter was installed onboard the Training vessel M.V. Prashikshini of CIFNET and trials were conducted onboard to test the system. A total of 270 hooks (both Japanese tuna hooks and Circle hooks) were operated onboard Tuna long liner at 50 nautical miles east of Cochin at a depth of 1200-1700 m.

Hauler installed onboard CIFNET vessel M.V. Prashikshini

Evaluation of trawl gear parameters using sensors

The horizontal spread of otter board, depth and height of the net of improved semi pelagic trawls were observed using the SIMRAD Sensors (Depth, height, bottom and spread sensors). The spread sensor was used to study the performance of the semi pelagic trawl systems. The otter board spread values generated by the sensor was compared with the values derived from the empirical formula for deriving otter board spread. The average spread of the otter board derived using sensor was 27.7 m and from the calculations, this value was 26.26 m. The average difference in the values at different speeds was 1.45 m. The relationship between speed (knots) and otter board spread from the sensors and from empirical formula is shown in Figure below. GLM analysis with speed and length of warp as factors showed that the increase in speed from 3.0 to 3.5 knots increased the horizontal spread as indicated by the sensors, but the difference was not significant statistically. More observations are required for substantiating.



Relationship between speed and otter board spread

Use of BRD in bagnets in Bharuch

Sampling of the fish caught in the bagnet supplied to the local fisherman of Bharuch, Gujarat was done. During the sampling, incidence of Anchovy, Hilsa, Baracuda, Solefish, Mudskipper, and prawns were observed both in codend and codend cover. The length of Anchovy, Hilsa, Barracuda, Solefish and Mudskipper caught in codend were 5.2cm, 6.1cm, 12.76cm, 9.8cm and 16.5cm respectively whereas the length of Anchovy, Hilsa, Barracuda, Solefish and Mudskipper caught in codend cover were 4.4cm, 4.8cm, 11cm, 9.5cm and 14.62cm respectively. The fish caught in codend and codend cover indicates efficient escapement of juveniles through the BRD used in the bag net.

Fishing trials of Sagar Kripa

Twenty one fishing trials were conducted during the quarter ending in December 2013. The catch comprised of 30 species of finfish, three molluscan species and two crustacean species. Among finfish the major catch were *Otolithus* sp. (Dhoma) 19.8%, *Scomberomorus guttatus* (Seerfish) 6%, *Rastrelliger kanagurta* (Indian mackerel) 5.3%, *Trichurus lepturus* (Ribbonfish) 3.4% and *Polynemus* sp. (Threadfin bream) 2.4%. Among molluscs, *Loligo duvauceli* (Squid) 5.7% and *Sepia* sp. (Cuttlefish) 1.8% formed the major catch. Crustacean catch was represented by crab 0.2%.

Development of appropriate fishing systems for rivers

Principal Investigator : Dr. M.P. Remesan

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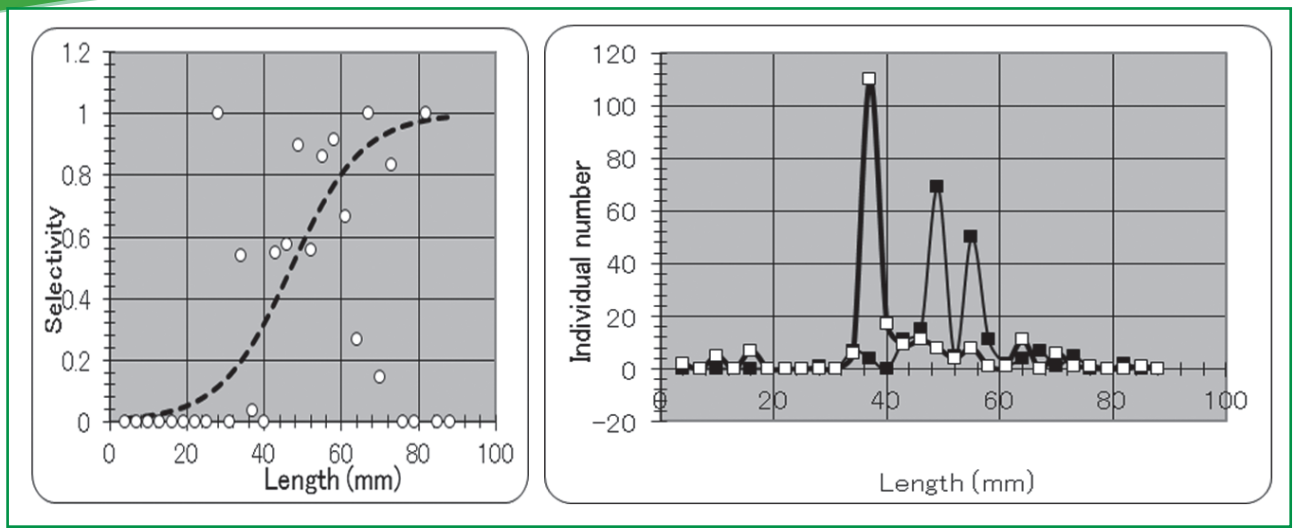
Designing and field trials of Bycatch Reduction Device (BRD) for the bagnets

The selectivity estimates of Hilsa in 50 mm square mesh windows installed in bagnets were as follows:



Selectivity estimates of Hilsa

L50%= 46.9 mm, Selection range = 20.3 mm, L75% = 57.1, L25% = 36.8. Since the fishes encountered in the bagnets consisted exclusively of juveniles, the estimates of all size classes could not be obtained for deriving the selectivity estimates. Highest exclusion in terms of weight per operation were observed at Tribeni and Fraserganj centres, which were 50.83% and 49.95% respectively. The exclusion rate per operation from the square mesh window was 27.1% at Godhakali of which 9.3% were Hilsa juveniles. Bigeye BRD of 150 mm slit opening across the funnel of the bagnet has been fabricated at Godhakali in Hooghly and comparative trials are in progress.

Characterization of catches from bagnets

Characterization of catches from the experimental bagnets operated along Fraserganj, Ghodhakali and Tribeni centres of Hooghly estuary was carried out. The catches were normalized based on the hours of operation and used for the analysis. Diversity analysis of catches from the different stations are as follows:

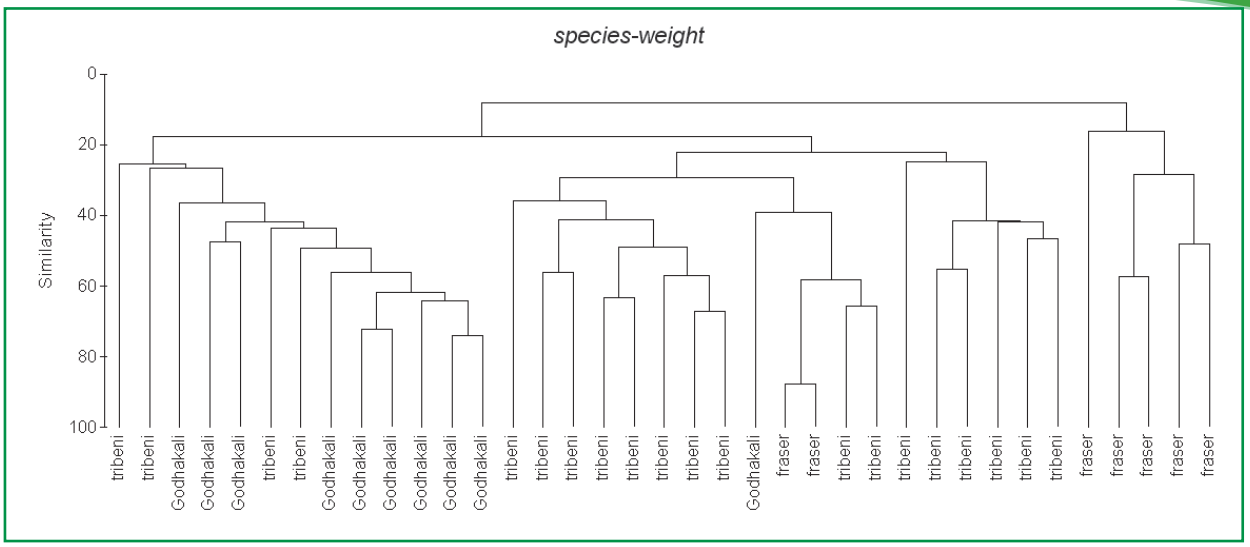
Index	Fraser-ganj	Godha-kali	Tribeni
Total species	12	13	11
Margalef diversity	1.45	1.75	1.54
Pielou's evenness	0.64	0.68	0.72
Shannon index	1.61	1.73	1.71
Simpson index	0.63	0.73	0.73

ANOSIM test of the results showed that the assemblages captured in the bagnets from Fraserganj was significantly different ($P<0.01$) from species captured from Godhakali and Tribeni centres. The species assemblages from Godhakali and Tribeni were not significantly different. Cluster analysis substantiated the depictions of the MDS and the ANOSIM test and is shown in the following Figure. The assemblages from Fraserganj showed a separate cluster at 20% similarity.

SIMPER analysis using the data showed the average dissimilarity between the Fraserganj and Tribeni centres (87.46%) and the main species contributing to the dissimilarity were crabs and *Odontamblyopus rubicundus*. Fraserganj and Godhakali centres showed the highest dissimilarity percentage of 88.36 and the main species responsible were *Tenualosa ilisha* and *Macrobrachium mirabile*. *M. mirabile* and *T. ilisha* were the major species that differentiated between Tribeni and Godhakali stations. The highest abundance of juveniles of *T. ilisha* was observed at Tribeni centre.

Field trials of stakenets fitted with 50 mm square mesh window

Experimental field trials were conducted with stakenet fabricated with HDPE twine attached with 50mm square mesh window for Hilsa fish juvenile conservation at Odalarevu, East Godavari district of Andhra Pradesh. The total catch observed in the main codend was 4-10kg/per operation/ in six hours. Escapement through the square mesh window was



Cluster analysis of catches from different stations

25%. The catches comprised of prawns - 35% (*Metapenaeus dobsoni* - 6-9cm, *Penaeus monodon* - 18-20cm), Anchovies - 20% (*Stolephorus commersonii* - 5-8cm), Ribbonfish - 10% (*Trichiurus lepturus* - 33-35cm), shads - 10% (*Hilsa kelee* - 13-15cm and *Tenualosa ilisha* - 15-17cm), mullets - 5% (*Mugil cephalus* - 9-11cm), Sciaenids - 5% (*Johnieops vogleri* - 11-13cm), Cuttlefish (5%), Silver bellies (5%) and crabs (5%).

Selectivity studies onboard CIFTECH 1

Inboard motorized fishing crafts in Kakinada fishing harbor are mainly engaged in gillnetting and troll lining and the duration of fishing trip is 3-4 days. Total operational expenditure for 3-4 days fishing trip is ₹ 31000/- out of which 48.38 per cent is towards fuel expenses. Small scale motorized crafts of 22'-40' L_{OA} crafts with 10 Hp engine from Pudimadaka fishing village, Visakhapatnam showed that the average investment on craft, gear and engine varies between ₹ 155000/- to ₹ 255000/- depending on the length of the craft. Operational expenditure mainly includes fuel charges and the average fuel expenditure per fishing trip in case of gillnet fishing is ₹ 250/- where as it goes up to ₹ 1500/- in case of hook and line fishing. Average revenue per fishing trip in case of gillnetting varies between ₹ 800-1000/-. Gillnetting using small scale motorized crafts of Vasuvanipalem fishing village of Visakhapatnam district showed that average investment on the fishing system which include craft, engine and 3-4 types of gillnets is ₹ 3.1 lakhs, average investment on fuel is ₹ 1600/- and the average income per day is ₹ 1900/-.

Development of multi-purpose solar powered boat

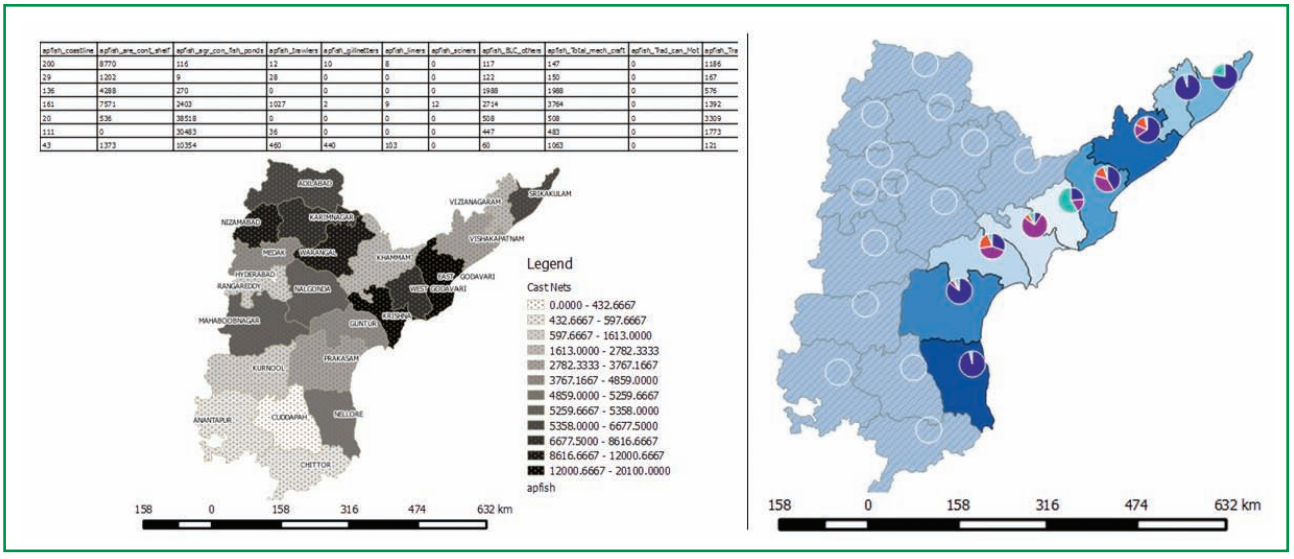
A multi-purpose (inland fishing/recreational fishing/transportation of catch, etc.) solar powered (0.5 kw solar panel) FRP boat of 3.6 m L_{OA} with twin hull, and two propellers each of 0.6 kw, has been fabricated. The boat achieved above three knots speed during the trial running and was used for gillnet fishing in the backwaters of Azheekode.

Multi-purpose solar powered boat

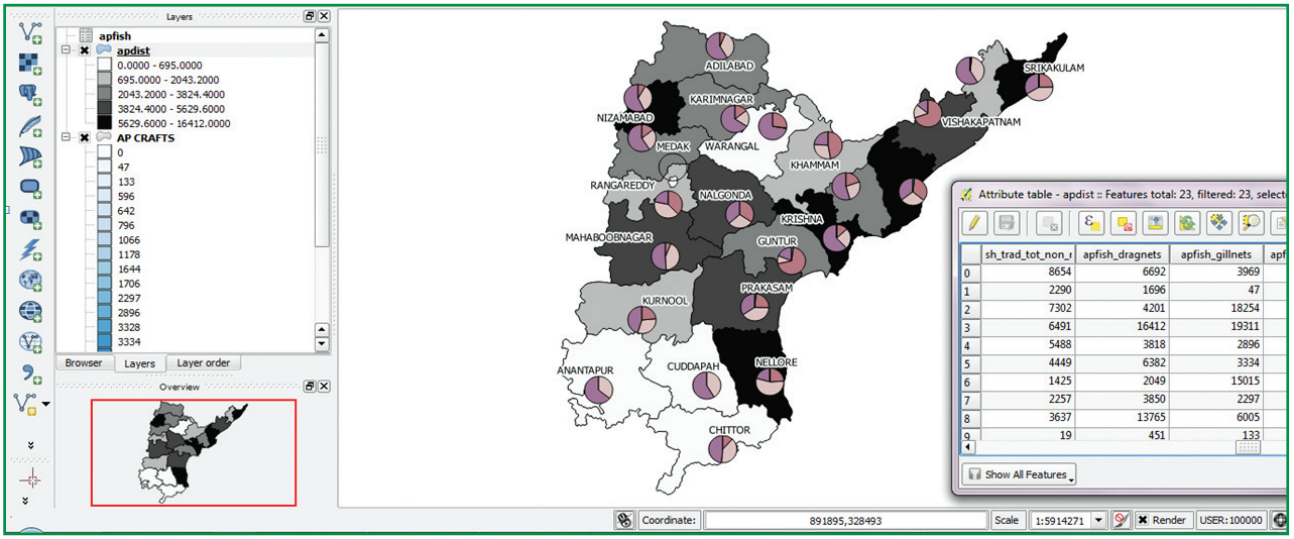
GIS data base for craft and gear

GIS data base of craft and gear Andhra Pradesh was created on an RDBMS platform and linked to QGIS to use GIS as a tool for effective fisheries management using QGIS. Thematic maps were generated using this data base. The data will be linked to more special data to facilitate to help fishery managers use this

data for disaster management, extension activities, fisheries marketing and overall fisheries management.



Thematic map of mechanized boats and their categories in Andhra Pradesh



Themate map of castnets of Andhra Pradesh using QGIS

Fish Processing Division

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
- Thermal and non-thermal technologies for processing and packaging of fish products
- Zonal Technology Management - Business Planning and Development Unit
- Studies on high pressure processing (HPP) of high value perishable commodities
- A value chain on oceanic Tuna fisheries in Lakshadweep sea
- Development of bioplastic based sustainable nano bio-composite food package
- Isolation and characterization of collagen and gelatin from aquatic sources and development of food grade and pharmaceutical products of commercial importance
- Use of natural resins and gums for preservation and value addition of fishery products
- Assessment of myctophid resources in the Arabian sea and development of post harvest technologies

Chief findings

- Shelf life of monosex Tilapia under iced condition was found to be 27 days, while steaks developed off-flavour after 19 days and gutted and cleaned samples remained acceptable up to 23 days under iced conditions.
- Assessment of shelf life of combination sausages prepared from the mince of Nemipterus and Pangasius indicated that sausages with 100% Pangasius mince had a shelf life of 41 days in chilled condition followed by those with 60% Pangasius mince (38 days), 80% Pangasius mince (32 days), 60% Nemipterus mince (29 days), 100% Nemipterus mince (28 days) and 80% Nemipterus mince (27 days).
- Incorporation of chitosan (0.75%) reduced the rate of oxidation and enhanced the shelf life of restructured products prepared using Pangasius mince.
- Microwave heating coupled with quick-chilling and vacuum packing significantly improved the colour, texture, stability and shelf life (21 days) of Sutchi catfish fillets compared to unblanched vacuum-packed samples (12 days).
- Compositional analysis of myctophid samples collected from Sagar Sampada cruise showed that *Benthosema fibulatum* had crude protein content of 17.99%.
- Dip treatment of White snapper fillets in 15% gelatin solution enhanced the shelf life to 4-5 days in iced conditions under vacuum.
- Spray dried prawn flavour extract prepared from the shell of *L. vannamei* had 4.3% moisture and 82.5% protein, 4.5% fat and 8.3% ash. The APC in the product was 4.8×10^4cfu/g.
- Ensilaging of squid waste for a period of 60 days

indicated a gradual decrease in saturated fatty acid (42.30% to 30.63%) and mono unsaturated fatty acid (17.60% to 10.48%) while poly unsaturated fatty acid was increased from 51.64 to 55.90%.

- The pilot model fish meal plant designed and fabricated with 10 kg loading capacity with an attached multipurpose hydraulic pressing device was found to be suitable for preparation of fish meal.
- Up-scaled the technology of fish calcium capsules (CALCIFIT) production.
- Appropriate container was fabricated for live mud crab transportation.
- Extraction of antioxidant compounds from Rosemary was standardized and the antioxidant activity determined.
- Two types of extruded products incorporating prawn mince and cereal flour was standardised and the shelf life determined.
- A tapioca and fish based value added product was standardized and the shelf life evaluation were done.
- Orange peel extract and mint extract was found capable of extending shelf life of gutted Mackerel during vacuum packaging and chilled storage.
- Dip treatment in Rosemary leaf extract and addition of oxygen absorber while packing enhanced the shelf life of Horse mackerel.
- Oxygen absorber along with curry leaf essential oil treatment was effective in reducing the undesirable changes in the bio-chemical and microbiological quality of Cobia fish steaks.

Species specific interventions in value addition of commercially important and emerging species of freshwater fish

Principal Investigator : Dr. George Ninan

Co-Investigators : Shri P.K. Vijayan, Dr. K.V. Lalitha, Dr. J. Bindu, Dr. A.A. Zynudheen, Shri Ankur Nagori, Dr. V. Ronda, Shri C.G. Joshy, Dr. A. Jeyakumari, Smt. U. Parvathy, Smt. S.J. Laly, Dr. S. Visnuvinayagam (At Mumbai RC), Smt. P. Viji (At Mumbai RC) and Dr. P.K. Binsi (At Mumbai RC)

Studies on the composition and shelf life of monosex Tilapia in iced conditions

The proximate composition study of monosex Tilapia indicated a moisture content of 73.44 ± 0.24%, 17.11 ± 0.16% protein, and 6.75 ± 0.04% fat and 1.18 ± 0.01% ash. The fatty acid composition study indicated that Oleic and Palmitic acid were found in higher levels whereas Caprylic acid was the most limiting one. The amino acid analysis indicated higher levels of Aspartic acid, Glutamic acid, lysine and alanine whereas tryptophan was the most limiting amino acid. Proline, tyrosine and methionine were also found in low levels.

Ice storage studies of monosexTilapia was carried

Whole cleaned Tilapia | Gutted and cleaned Tilapia | Tilapia steaks

out. The sample was divided into three lots *viz.*, whole cleaned, gutted and cleaned and steaks. The sample lots were analyzed for quality parameters *viz.*, pH, TBA, PV, FFA, TMA, TVBN as well as colour and texture. The moisture content of all the samples remained steady throughout the storage period whereas in all the samples there was a slight increase in pH value. Peroxide value and free fatty acids were also on an increase for all the samples indicating oxidation of fish lipids taking place during the storage. TMA and TVBN values showed a slight increase during the study. Sensory evaluation showed a gradual reduction in the quality during ice storage of the sample. Whole cleaned samples had the maximum shelf life followed by gutted samples and steaks.

Fish mince based combination sausages

Prepared combination sausages from the mince of Nemipterus and Pangasius. The mince combination of Nemipterus and Pangasius was optimized using mixture response surface methodology based on data generated from a simple lattice mixture experimental design on bio-chemical responses of sausage. The maximum shelf life was found to be for sausages with higher quantity of Pangasius mince. First order linear regression model fitted to the experimental data and the optimum combination of mince was found 40% Nemipterus and 60% Pangasius as well as 20% Nemipterus and 80% Pangasius for a best quality of sausage in terms of bio-chemical responses. The microbiological evaluation has shown that TVC in all samples did not cross the acceptable limits during the storage period. *S. aureus*, *E. coli* and Streptococci were absent in all the samples. The rejection of samples was based on sensory evaluation. Sausages with 100% Pangasius mince had a shelf life of 41 days in chilled condition followed by those with 60% Pangasius mince (38 days), 80% Pangasius mince (32 days), 60% Nemipterus mince (29 days), 100% Nemipterus mince (28 days) and 80% Nemipterus mince (27 days).

Fish combination sausage

Restructured products from freshwater fish

Restructured products were prepared by using Pangasius fish mince at four different formulations using chitosan (0.75%) and corn starch (4%). Shelf life of the products were evaluated under chilled condition up to 21 days. It was observed that rate of oxidation was less in the products prepared with chitosan (0.803mg malonaldehyde/kg on 10th day) than the products prepared without chitosan (3.026mg malonaldehyde/kg on 10th day). Sensory evaluation revealed that product prepared without chitosan was good up to eight days and it was rejected on 10th day. Further, products prepared with chitosan were good up to 17th day.

Restructured product before and after cooking

Quality evaluation of value added fishery products during storage under different conditions

Fillets separated from Pangasius were subjected to partial drying for texture and shelf life improvement. The fillets were subjected to drying under hot air oven for 1 h. followed by quick chilling before being stored under chill storage. A reduction of the moisture content of the fillets by 13-15% was observed after drying and it enhanced the texture characteristics of the fillets compared to the soft fresh fillets. The process also enhanced the colour of the fillets during chill storage.

Microbial profile of restructured products

Microbial flora associated with sausage products prepared from farmed Catfish (*Pangasianodon hypophthalmus*) and marine fish (Nemipterus) minced meat, either alone or in combinations and treated with spice mix (ginger, green chilly, mint) and spice

concentrate (clove: cinnamon 1:1) and stored under ice for 48 days were determined and shelf life evaluated. During the entire storage period, the total aerobic count was fluctuating between 2.0 and 3.0 log in all the samples except samples prepared from Catfish mince 100%. In this sample, count reached 6.0 log on Day 32. *E. coli* and S. *aureus* could not be detected.

Microbial profile of restructured mince based products from Catfish

Microbial attributes of restructured mince based products prepared from farmed Catfish (*Pangasianodon hypophthalmus*) coated with starch and chitosan either alone or in combination were tested for microbial quality. The aerobic count in Catfish mince and products prepared from mince coated with starch exceeded the limit count on Day 10 where as products treated with chitosan alone, the count exceeded the limit on Day 12 and samples treated with chitosan and starch, the count exceeded the maximum limit of 10^7 cfu/g on Day 17 and shelf life was 12 days.

Restructured products from fish mince with shrimp flavour

A methodology has been standardized for preparing a value added product from Tilapia meat and Jawala shrimp. Jawala extract was prepared from Jawala shrimp using citrate buffer. The extract showed good sensory properties in terms of odour and taste that of shrimp. Surimi was prepared from Tilapia mince using two washing steps in chilled water. The mince was manually pressed by using a muslin cloth and was ground with sucrose, salt, corn starch, Jawala extract and oil in a grinder. The total grinding time given was 15 minutes. Temperature of the mixture was maintained below 10 °C during grinding. Different starch sources like potato, rice flour and corn flour were tried and corn starch was found to give the required texture. The finely ground paste was made into a layer of 1 cm thickness and was cooked by steaming for 15 min. Addition of Jawala extract imparted a light pink colour to the product. The cooked product was cut into the shape of fingers and then battered, breaded and fried. Both the boiled and coated product imitated the flavour of shrimp. The coated fingers showed very good sensory acceptability by the sensory panel of experts.

Jawala flavor concentrate

Restructured product from Tilapia with shrimp flavour

Quality evaluation of cooked fish meat during chill storage

In order to prepare cooked fish flakes from Rohu fish, gutted fish were cooked in: a) water and boiling water and cooked for 5 and 10 min. and, b) steamed for 5 and 10 min. Based on the sensory analysis and proximate composition, cooking for 5 min. in boiling water and steaming for 10 min. was selected for further study. Quality evaluation of fish meat cooked by two methods (boiling and steaming) during chill storage was carried out. Quality of the cooked meat during storage at 4 °C was assessed by microbial, chemical and sensory methods. Mesophilic counts and TVBN was higher in boiled sample than that in steamed one. Boiled and steamed samples remained in acceptable condition for 12-14 days and 14-16 days, respectively during storage.

Partial drying and quick chilling to enhance the chill storage life of fish fillets

Pangasius fillets were subjected to a partial drying process under hot air oven for 1 hr followed

by quick chilling before being stored under chill storage. Drying under forced circulation of hot air reduced the moisture content of the fillets by 13-15%. In addition, drying enhanced the texture characteristics of the fillets compared to the soft fresh fillets. Further, the dried fillets showed superior colour characteristics during chill storage.

Modification of flavor characteristics of Pangasius catfish using herbal extracts

Farmed Catfish is characterized by strong muddy flavor on cooking. Hence, the modification of the flavor characteristics of Pangasius catfish was attempted using various plant extracts such as Oregano, Rosemary, sage, turmeric, and green tea extracts on partially dried Pangasius catfish fillets. Out of the various plant extracts tested, essential oil from Oregano was found to be most effective with respect to sensory evaluation, where as the fillets treated with turmeric scored the least.

Fish-n-Veg cocktail preparation from Rohu mince

A cocktail preparation of 'Fish-n-vegetable' was developed using the blanched meat of Rohu fish. Fish meat was blanched for 10 and 20 min., whereas a short term blanching for 3 min. was given for vegetables. The products were further tray packed under normal air and vacuum atmospheres, and stored under chilled condition. The results indicated negligible difference in shelf life between the two samples. Both the packs were microbiologically stable for more than 30 days, with a maximum load of 4 $\log^{10}$ cfu/g. Even though, vacuum packed samples showed better colour stability during extended chill storage, air packed samples excelled in overall appearance during initial period of storage.

Fish-n-Veg cocktail preparation from Rohu mince

Utilization of fish processing waste for the development of innovative products

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Co-Investigators : Dr. George Ninan, Dr. R. Anandan, Dr. S.K. Panda, Dr. V. Murugadas, Shri C.G. Joshy, Smt. U. Parvathy, Dr. S. Visnuvinayagam (At Mumbai RC), Dr. P.K. Binsi (At Mumbai RC), Smt. V. Renuka (At Veraval RC) and Smt. S. Remya (At Veraval RC)

Formulation and preparation of feed incorporated with low value fish and silage

Fish head from industries were used for the preparation of meal in the pilot scale fish meal unit. Head waste of Sardine, Tilapia, Threadfin bream and Anchovy were cooked, pressed and dried. Quality of the meal prepared was compared with whole Sardine meal. The products were dried to moisture content between 1.42-5.90% in an electrical drier. The protein content ranged between 60.9 to 43.2% and ash content was between 22.60-35.85%. The results indicated that the protein content in Tilapia and Anchovy samples were almost same as that of whole Sardine meal. Feeds were formulated at equal protein and compounded with the prepared fish head meal and other ingredients. It was extruded into pellets and dried. The pellets were analyzed for proximate composition and amino acid profile. The protein content was found to be almost similar in all feeds. However the feed procured from market had higher levels of protein.

Nutritional evaluation of developed feed in albino rats

Feeding studies were conducted in albino rats with fish meal prepared from cutting waste of different species of fish. The study was conducted

for a period of six weeks and the weekly increments in weight were noted. After the feeding study period, the animals were sacrificed and blood serum and liver were collected for biochemical analysis. The body weight increase was found to be maximum for the Sardine head feed followed by Nemipterus head feed, Anchovy head feed and Tilapia head feed.

Development of foliar spray

Foliar spray was prepared from the head waste of Anchovy and shell waste of Vannamei prawn by fermentation. The changes in biochemical and physical quality parameters were assessed during the period of fermentation. Changes in pH, titrable acidity, TVBN content, NPN, PV, FFA etc. were monitored for one month period. The changes in fatty acid profile of both the products during fermentation were also assessed.

Extraction of prawn flavour from fresh prawn shell

Fresh quality wet prawn shell (*L. vannamei*) was collected from the processing plants and brought to the laboratory under chilled condition. The washed shell was pressed to extract the liquor and boiled to concentrate the protein. It was spray dried and the product was assessed for various quality parameters. The product had 4.3% moisture and 82.5% protein, 4.5% fat and 8.3% ash. The APC was observed to be $4.8x10^4$cfu/g.

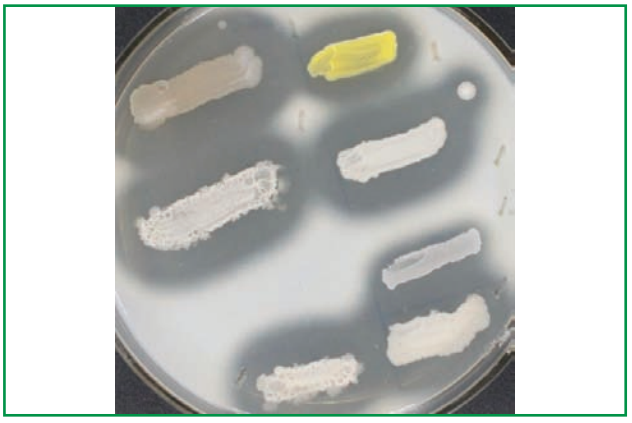
Extraction of polysaccharides from marine sources and quality evaluation

Carrageenan was extracted from dried wild Red seaweed *Kappaphycus* sp. The soaked seaweed was dipped in hot water and macerated and carrageenan was extracted with hot water. The extracted product was subjected to spray drying and quality was evaluated. Quality evaluation of seaweed and spray dried carrageenan powder was also carried out. Red seaweed had a protein content of 10.12%, whereas the spray dried carrageenan powder had a protein content of 12.12%. It was also found that raw seaweed contain 39.49% ash while spray dried powder had only 34.53% ash. Fish soup powder was prepared with the addition of carrageenan powder at four concentrations which includes 1%, 3%, 5%, and 7%. Fish soup powder with the addition of corn flour served as control. Sensory evaluation and viscosity of the soup revealed that 5% carrageenan added sample was comparable with control. Results indicated that fish soup powder can be prepared with the supplementation of carrageenan at 5% level without affecting consistency and flavor characteristics of soup and thereby increase the nutritional value of healthy soup for human consumption.

Microbial protease on fish waste utilization

Bacterial isolates from fish gut were screened for protease activity and several potential strains were identified. Out of these, four strains showed maximum activity and they were studied for its activity at different pH and temperature. Three strains producing alkaline protease were identified and the optimal activity was at pH 10.5. Studies on effect of temperature on protease activity revealed that protease activity of one strain reduced at 60 °C after 1h of incubation. Two strains which showed maximum activity and stability at higher temperature were used for the preparation of fish protein hydrolysate from fish waste.

Nemipterus japonicus was screened for bacteria producing protease. Out of 84 strains of bacteria screened, 10 were found to have protease activity. Among 10 potential isolates MPNJ-5, 6, 29, 52, 61, 73 showed prominent protease activity.



Bacteria showing prominent protease activity in Casein Agar

Hydrolysate from fish gill

Hydrolysate was prepared from the gill of Mackerel using alkalase enzyme by a serial extraction method. The proximate composition of hydrolysate indicated a protein content of 60%. The yield of the product was around 14% with a degree of hydrolysis of 21%. The solubility of hydrolysate powder in

Bioactive hydrolysates from Mackerel gill

distilled water was found to be about 76% at room temperature. The hydrolysate was further screened for its antioxidant properties based on standard activity assays. The results indicated a DPPH radical scavenging activity of 4.3 mg/ml IC_{50}. Mineral profiling of the hydrolysate indicated abundance of Fe, Ca and K. The hydrolysate indicated poor sensory properties and needs further modification for incorporation into edible products.

Hydroxyapatite (HAP) as a dental restorative material

A study has been initiated for testing the dental restorative properties of hydroxyapatite, in collaboration with MES Dental College, Perintalmanna. HAP was tested for its efficacy as a dental restorative and dental cleansing agent. Dental restorative material prepared out of 100% HAP showed poor impact resistance and binding properties, where as partial replacement with commercially available dental restorative materials showed some promisive results. Similarly high molecular weight HAP improved the colour of enamel when applied as dental cleansing agent.

Pilot scale production of fish calcium capsules and acceptability trials

Calcium was extracted from Tuna bones in pilot scale and was encapsulated. It was tested for acceptability and was found to be acceptable. One lot of 5000 capsules were sent to Shri Nikhil Roy, Perna Health Care Pvt. Ltd., Delhi for trial marketing and acceptability assessment.

Encapsulated fish calcium capsules

Thermal and non-thermal technologies for processing and packaging of fish products

Principal Investigator : Dr. J. Bindu

Co-Investigators : Dr. C.N. Ravishankar, Dr. S.K. Panda, Dr. C.O. Mohan, Dr. V. Ronda, Shri Ankur Nagori, Dr. L.N. Murthy (At Visakhapatnam RC), Smt. V. Renuka (At Veraval RC), Smt. S. Remya (At Veraval RC) and Smt. P. Viji (At Mumbai RC)

Extraction of antioxidant compounds from Rosemary and determination of the antioxidant activity

Phenolic plant extracts from Rosemary (*Rosmarinus officinalis*) are sources of natural bioactive compounds, which can inhibit the rate of food spoilage due to its antioxidant properties. For this, 2 g dried Rosemary was extracted with 100 ml methanol at 40 °C under vacuum. Final drying of the extract was carried out at 30 °C in an oven. The yield of the Rosemary extract was 17.5%. Total phenolic content of the Rosemary extract was 4.1 g Gallic acid equivalent $100g^{-1}$. The antioxidant activity determined as 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity of Rosemary extract was lower (IC_{50} 0.021mg mL^{-1}) compared to BHA (IC_{50} 0.038 mg mL^{-1}).

Development of extruded snacks incorporating prawn mince and cereal flours

Ready to eat extruded snack using prawn and besan flour was standardized. Initially a combination of flours consisting of rice flour and besan in varying propositions was carried out to arrive at the optimum combination. The flour mix was extruded with a feeding rate of 30 rpm, screw speed of the extruder 360 rpm and 400 rpm cutter speed. The product was packed in metalized polyester under inert packaging and evaluated monthly. Shelf evaluation of the product indicated that the product was acceptable for a period of four months after which it lost its crispiness.

Ready to eat extruded snack

Development of shelf stable cocoa-based extruded products

Ready to eat extruded snack using prawn and cocoa powder and cereal flours was standardized. Initially a combination of rice, corn, milk powder, cocoa flour, sugar etc. in varying propositions was tested to arrive at the optimum combination. Prawn mince added was at 5, 10 and 15% and the same was extruded. The 10% mince was standardized and the product was packed in metalized polyester/polythene films under inert conditions. Shelf life evaluation of the product indicated that the cocoa based snacks were acceptable for a period of three months. With further storage it was observed that there was an increase in water activity and the crispiness of the product was lost.

Standardization of tapioca and fish-based value added product and shelf life evaluation

A ready to fry ethnic product incorporating cooked tapioca with Lizardfish and Sardine mince was prepared as per standardized recipe and the product was vacuum packed in high impact polypropylene trays for conducting shelf life studies at frozen temperatures. Biochemical parameters like peroxide value, free fatty acid, thiobarbituric acid value and proximate composition and microbiological parameters were determined at monthly intervals. The product prepared using Sardine fish meat was acceptable only up to six months and afterwards rancid flavor developed. The Lizard fish bonda was acceptable even after nine months of storage.

Ready to fry ethnic product

Extension of shelf life of vacuum packed chill stored gutted Mackerel using orange peel and mint extracts

The study was undertaken to evaluate the efficiency of plant extract on enhancing the shelf life of gutted Mackerel during chill storage at 2 °C. The dressed Mackerel was dipped in 1% solutions (1:1 ratio w/w) of mint (*Mentha arvensis*) leaf and orange (*Citrus sinensis*) peel extracts for 30 min. The treated and control (without extract treatment) Mackerel were packed separately in polyethylene pouches and stored at 2 °C. The samples were drawn periodically for biochemical, microbiological and sensory evaluation. The analyses revealed a shelf life of nine days of control and 11 and 14 days for orange peal treated and mint treated Mackerels respectively, during storage.

Antioxidant property of Oregano leaves

Aqueous extracts from Oregano (*Origanum vulgare*), which is one of the common plant variety of the mint family was assessed for its natural antioxidant characteristics. For this 2 g Oregano dry leaves was mixed with 100 ml hot demineralised water

for 10 min. at 70 °C. Total phenolic content of the Rosemary extract was 90.5 mg Gallic acid equivalent g^{-1}. The antioxidant activity determined as 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity was 201.8 mg AAE / g.

Effect of *sous vide* processing on the shelf life of Indian mackerel

Fatty fishes have limited shelf life in iced storage. The heat treatment and vacuum packaging techniques used in *sous vide* technology delay the oxidation of lipids and muscle pigments and slow down the microbiological spoilage of cooked foods during refrigerated storage. The shelf life of *sous vide* cooked products is extended compared to food prepared by traditional cooking-cooling methods. The biochemical, microbiological and sensory quality of whole clean Indian Mackerel *(Rastrelliger kanagurta)*, a dark meat fish processed by *sous vide* and cook chill methods were compared. *Sous vide* processing prolonged the shelf life of the sample (24 days) compared to conventional cook-chill method (13 days). Control samples packed in air and stored at 1-2 °C were acceptable only up to eight days.

Shelf life enhancement of vacuum packed chill stored Eel steaks

Biochemical, microbiological and sensory attributes of fresh steaks from Eels packed in EVOH films and packed in ice were determined. Initial mesophilic, H_2S-producing bacteria and lactic acid bacteria counts of the steaks were 3.3 log cfu /g, 2.95 log cfu/g and 2.17 log cfu/g, respectively. After 14 days of storage in ice, mesophilic count of the control air packed sample reached a value of 7.7 log cfu/g while the mesophilic count of the vacuum packed sample was well below 7 log cfu/g. pH of the fish steaks increased from 6.4 to 8 and then decreased to 7.2 in vacuum packed sample after 20 days. At the end of the storage period the counts of mesophilic bacteria and H_2S-producing bacteria were 7.4 and 7.2 log cfu/g. TVBN values of air packed and vacuum packed samples were 35 and 23 mg N/100 g respectively on 14th and 20th day of storage. Based on the microbiological and sensory quality attributes the shelf life of air and vacuum packed Eel was estimated to be of 14 and 20 days respectively.

Effect of Rosemary leaf extract treatment and addition of oxygen absorber on the shelf life of Horse mackerel

Quality comparison of Rosemary leaves dip treatment (2%) on Horse mackerel (*Megalapsis cordyla*) packed with and without O_2 absorber was assessed. The fat content of the fish used was 6.4%. The TBA value of fresh Horse mackerel (0.29mg MDA/ kg fish) increased to 3.13 mg MDA/ kg fish on 11th day for control air packed sample compared to 2.18 mg MDA/ kg fish on 18th day for control fish sample with O_2 absorber. The Rosemary treatment inhibited the formation of TBA value significantly. TBA value of 1.77 and 1.91 mg MDA/ kg fish was observed for Rosemary treated fish packed with and without O_2 absorber on 18th and 24th day, respectively. Browning index and fluorescence index was least for fish treated with O_2 absorber compared to control air packed samples. A shelf life of 11, 18, 18 and 24 days were observed for control air packs, Rosemary treated samples without O_2 absorber, control sample with O_2 absorber and Rosemary treated sample with O_2 absorber.

Quality improvement of Cobia fish steaks by curry leaf essential oil treatment and addition of oxygen absorber

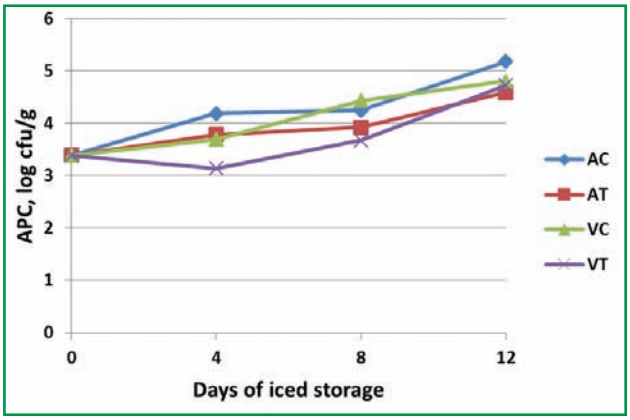
Effect of reduced oxygen packaging on the quality of Cobia (*Rachycentron canadum*) pre-treated with curry leaf essential oil and stored at refrigerated condition (5 ± 2 °C) was evaluated. Fresh Cobia, was made into 2 cm thick steaks and divided into four batches which included; (i) Steaks dipped in 1% curry leaf essential oil for 15 minutes and packed with an O_2 scavenger (Ageless® ZPT 200 EC O_2 absorber) in a multilayer film of ethylene vinyl alcohol (EVOH), (ii) Steaks with O_2 scavenger, (iii) Steaks treated with curry leaf essential oil and packed in EVOH pouches, and (iv) Steaks packed without O_2 scavenger (control). Over the period of storage there was an increase in the pH, peroxide value, free fatty acid content, TMA, TVBN and TBA content, total mesophilic count, psychrophilic count, Pseudomonas count etc. The fish steaks treated with curry leaf essential oil and packed with O_2 scavenger had an extended shelf life of 35 days while the control air pack was rejected on 18th day. Essential oil treated fish steaks and fish packed with O_2 scavenger without essential oil pre-treatment were acceptable till 24 and 30 days of storage respectively.

Quality evaluation of natural sun dried and solar dried fishes by Hurdle concept

Fish is a highly perishable food product and can be stored only by refrigeration or drying. But the problem affecting the quality of the dried fish is the unhygienic way in which fish is prepared and dried. The open beach drying, results in insects laying egg inside the fish, that renders the product non-consumable. In India approximately 3.70 lakh tons of dry fish is produced per year, out of which 2.96 lakh tons of dry fish is of inferior quality. Only 20% cured fish is fit for human consumption - i.e 74,000 tons. Spoiled and decayed fish is sold for human consumption, quality reduction results in economic loss and valuable protein source. This results in fishermen losing considerable portion of their profit apart from the loss of considerable nutritional food to the common man. To address this problem low cost solar dryer was designed to dry commodities under hot and humid conditions prevailing in Visakhapatnam region of Andhra Pradesh where throughout the year fish can be dried uniformly. This dryer can be operated from for easy loading and unloading the material. The drying was carried out by loading the weighted fish in dryer from 11:00 am to 4:00 pm. The Anchovies and *Acetus* sp. were dried up to the final moisture content of 17.3% and 22.43%, respectively. The chamber has a temperature minimum of 30 °C and maximum of 52 °C. Moisture loss in *Acetus* sp. Was 82.7% and in Anchovies it was77.57% in the span of Six hours controlled condition. Yield percentage from *Acetus* sp. was 3.47% and Anchovies 1.98%. To study the natural drying and solar drying with different preservative (Hurdle concept) like Calcium propionate 1%, 1.5% and 2% in natural sun drying and solar drying is planned and the research is progressing.

Quality evaluation of Little tuna by Hurdle concept

Little tuna (Kawa kawa, *Euthynnus affinis*), an average size of 776 g and average length of 40 cm was procured from Visakhapatnam fishing harbor. Fish were dressed and processed as steaks (each steak weighing 77 g). Proximate composition analysis of fresh *Euthynnus affinis* revealed that moisture is 74.26%, total protein 20.75%, fat 2.32% and ash 2.04% respectively. Freshness parameters like Salt Soluble Nitrogen (SSN) and Water Soluble Nitrogen (WSN) were 8.75% and 3.68% respectively. Lipid quality parameters like peroxide value (PV) was 1.32 milliequivalents / kg of fat and free fatty acid (FFA) was found to be 6.25% of Oleic acid. Steaks were packed in four batches - Batch 1: consist of steaks packed in air, Batch 2: steaks packed under vacuum, Batch 3: steaks treated with 2% Potassium sorbate for 30 min. and packed in air, and Batch 4: steaks treated with 2% Potassium sorbate for 30 min. and vacuum packed. In storage studies control air packed fillets SSN reduced from 9.12% to 2.87% after 10 days of storage whereas in vacuum packed fillets SSN increased from 3.5% to 6.68% but in treated air packed fillets SSN reduced from 1.87% to 0.77% and also in treated vacuum packed fillets SSN increased from 0.43% to 1.02% respectively. Whereas WSN after 10 days of storage reduced from 3.75% to 2.30% and 3.12% to 2.12% in control air packed fillets and control vacuum packed fillets. Lipid quality parameters like PV was increased after 10 days of storage from 8.61 to 26.78 milliequivalents/kg of fat and in control vacuum packed fillets 7.69 to 20.93 milliequivalents/kg of fat, in treated air fillets 7.27 to 16.25 milliequivalents/ kg of fat and vacuum treated fillets 6.6 to 13.56 milliequivalents/kg of fat. Whereas FFA in control air packed fillets increased from 12.53 to 23.5%. One percent Oleic acid and treated air packed fillets after 10 days of storage showed an increase of FFA from 14.84 to 20.14. Tuna steaks packaged in air (AC), Tuna steaks treated with Potassium sorbate and packaged in air (AT), Tuna steaks packaged in vacuum (VC), Tuna steaks treated with Potassium sorbate and packaged in vacuum (VT) were analyzed at 0, 4, 8 and 12 days of storage in iced condition. Aerobic Plate Count (APC) of fresh Tuna steaks was 3.39 log cfu/g. During iced storage, the APC of AC steaks showed an



APC of Tuna steaks during storage

increasing trend and reached 5.19 log cfu/g at the end of 12 days of iced storage. The VC steaks also showed an increasing trend but the values were relatively lower and reached 4.81 log cfu/g at the end of 12 days of iced storage. The APC of Potassium sorbate treated Tuna steaks were lower than the corresponding control steaks. The APC of AT steaks showed a steady increase and reached 4.59 log cfu/g at the end of 12 days of storage. However, VT steaks showed a decrease in APC (3.14 log cfu/g) at the end of four days of iced storage and thereafter increased and reached a count of 4.73 log cfu/g at the 12 days of iced storage.

Anaerobic count of Tuna steaks stored under vacuum (VC) showed an increasing trend and reached a count of 6.04 log cfu/g at the end of 12 days of iced storage. However, Tuna steaks treated with Potassium sorbate and stored under vacuum (VT) showed a decrease in anaerobic count till the end of eight days of storage (2.9 log cfu/g) and increased thereafter reaching a value of 5.62 log cfu/g at the end of 12 days of iced storage.

Utilization and production of high value dried products from small sized *Litopenaeus vannamei*

Andhra Pradesh being the leading state in cultured shrimp production and *Litopenaeus vannamei* showed huge leap in production during recent years, an experiment has been conducted to utilize high value dried products from higher counts (small size) of *L. vannamei* which are mainly sold in local/ domestic markets. Fresh *L. vannamei* of 15.84 g weight and 13.4 cm length was procured from local fish market and divided in to four batches *viz.*, 1) Natural sun drying control, 2) Treated with 3% STPP for 60 min., 3) Sloar drying control, and 4) Solar drying treated with 3% STPP. All four samples were subjected to rehydration capacity, biochemical composition, spoilage indices, organoleptic evaluation and determination of colour and texture profile parameters. The analysis is in progress.

Effects of plant extracts on the shelf life of Indian mackerel during chill storage

A study on the evaluation of effects of plant extracts on enhancing the shelf life of gutted Mackerel during storage at 0 °C was carried out. Gutted Mackerel was dipped in 0.5% mint leaf extract and 1% orange peel extract for 30 minutes. Two fishes each from the treated samples were packed after draining in HDPE pouches. One batch of control samples (without plant extract treatment) was also packed. All the samples were stored in insulated boxes with ice and the boxes were kept in a vertical chiller maintained at 2 °C. Biochemical analysis revealed that mint extract has delayed lipid oxidation in the sample followed by orange extract as indicated by its lower PV and TBARS than the control samples. TVBN of any of the samples did not cross the acceptable limit of 30-35 mg% throughout the storage period. Total mesophilic count of the samples exceeded the acceptable limit of 7 log 10^{-1} on control, orange treated and mint treated samples on 18th, 20th, and 22nd day of storage, respectively. Based on the sensory evaluation, the control, orange treated and mint treated samples were found to be acceptable up to 16 days, 18 days, and 22 days respectively, when stored at 0 °C.

Synergistic effect of plant extracts and vacuum packaging on the shelf life of Indian mackerel during chill storage

A study on the evaluation of synergistic effects of plant extracts and vacuum packaging on enhancing the shelf life of gutted Mackerel during storage at 0-1 °C was carried out. Gutted Mackerel was dip treated in orange and mint extracts for 30 minutes. The treated samples were packed under vacuum in EVOH pouches. One batch of control samples (without plant extract treatment) were packed under vacuum (control vacuum) and another set of control was packed under air (control) in the same material of pouch. All the samples were stored at 0-1 °C in chill room. The samples were withdrawn periodically for biochemical, microbiological, textural and sensory evaluation. Biochemical analysis revealed that mint extract has delayed lipid oxidation in the sample followed by orange extract as indicated by its lower PV and TBARS than the control samples. As indicated by the hardness values, textural deterioration was in the order of control>vacuum control>orange treated >mint treated samples. Based on the sensory evaluation, the control air, vacuum control, orange treated and mint treated samples were found to be acceptable up to 15 days, 18 days, 21 days and 23 days respectively, when stored at 0-1 °C.

Quality Assurance and Management Division

Research projects handled

- Risk assessment of emerging food-borne pathogens and chemical residues in aquatic ecosystem
- Development of quality index system for commercially important Indian fishes
- Food safety interventions for women in fishery based microenterprises in coastal Kerala

Chief findings

- The Quality Index Scheme for Indian mackerel was finalized and has 14 descriptors with a total demerit score of 33.
- Heat-stressed coagulase positive Staphylococci i.e. *Staphylococcus aureus* exhibits negative coagulase test when grown in normal medium. Additional nutrients are required to resuscitate the culture and get usual positive result.
- Fish samples brought from neighbouring states were collected from local market tested for pathogenic organisms as part of its source tracking showed the prevalence rate of *Escherichia coli*, *Staphylococcus aureus*, *Vibrio parahaemolyticus*, *Yersinia enterocolitica*, *E. coli* O157, *Aeromonas hydrophila* and *Vibrio vulnificus* as estimated to be 28, 4, 8, 4, 12, 4 and 4% respectively.
- Marginally low levels of formaldehyde (0.07-0.33 ppm) and ammonia (3-47 ppm) were detected in the fish samples coming from neighboring states.
- In surveillance monitoring of fish and fishery products sold across 28 markets of Kerala, level of adulterants like ammonia and formaldehyde were detected as high as 130.65 ppm and 4.52 ppm respectively. Higher incidence of pathogens such as *Escherichia coli* (27.9%), Coagulase positive Staphylococci (13.95%) and *Listeria monocytogenes* (7%) indicated urgent food safety intervention measures in fish markets.
- Surveillance monitoring of 33 ice plants across Kerala indicated very high levels of non-compliance (43.75%) in terms of residual ammonia content.
- Studies on biogenic amine formation dynamics during chilled storage of Indian Oil sardine indicated that histamine production was not observed for the first seven days but trace of histamine and other biogenic amines were detected towards the end of storage of 21 days.
- Advanced protocol for determination of Ethoxyquin from shrimp and shrimp feed was developed using LC-MS-MS.
- High pressure treatment (200-300 MPa) resulted in loss of histamine forming ability of artificially inoculated *Morganella morganii* in Tuna chunks.
- Temperature assisted high pressure treatment was found to be highly effective in elimination of *Yersinia enterocolitica* from seafood compared to HPP alone.
- Mixture of 0.1% each of Sodium benzoate and Potassium sorbate effectively retarded increase in APC, yeast and mold count in fish gravy concentrate upto 14 days of ambient storage.
- *Shigella flexneri* and *Staphylococcus aureus*

required very high energy values (106.76 and 88.22 J/cm^2) for one log reduction in pulse light treatment.

- *Serratia liquefaciens* was identified as the major spoilage flora in cooked Tuna sausages during frozen storage.
- Chilled storage studies on White Prawn and Bluefin travelly with flake ice and gel ice showed superiority of gel ice in fish preservation.
- Increased mishandling of fish leading to microbial contamination occurs in markets compared to fish landing harbours and retail centres.

Report of the work done

Risk assessment of emerging food-borne pathogens and chemical residues in aquatic systems

Principal Investigator : Dr. S. Sanjeev

Co-Investigators : Dr. T.V. Sankar, Dr. C.N. Ravishankar, Dr. K. Ashok Kumar, Dr. Femeena Hassan, Dr. S.K. Panda, Smt. S.J. Laly, Dr. G.K. Sivaraman (At Veraval RC) and Dr. C.O. Mohan (At Veraval RC)

Effect of high pressure processing on microbial profile seafood

Bacterial inactivation studies in high pressure processing revealed 0.96 log reduction of *Yersinia enterocolitica* (ATCC 23715) in Tuna chunks at 300 MPa pressure for 5 minutes holding time. At 250 MPa the D value for this pathogen was determined to be 14.46 seconds. With temperature-assisted HPP trials, *Y. enterocolitica* reduced by 5 logs in 6 minutes at 250 MPa and at 60 °C.

Known prolific histamine forming bacteria *Morganella morganii* was inoculated to sterile Tuna meat and subjected to high pressure treatment of 200 and 300 MPa for 5 minutes. The samples were incubated at 28 °C and sampled at 6, 24 and 48 hrs of interval. There was significant reduction in the load of *M. morganii* upto 6h duration. The load of *M. morganii* in all HPP treated samples remained lower than in control. The load of *M. morganii* increased to $1.01x10^9$ cfu/g in control, whereas it increased to $7.3x10^8$ cfu/g & $6.4x10^8$ cfu/g in 200 and 300MPa treated samples respectively. Histamine content in control increased from 1 ppm to 160 ppm in 48hrs. It increased to 102 and 39.3 ppm in 200 and 300MPa treated sampes. At the end of 48hrs there was comparable load of histamine forming bacteria in untreated and treated Tuna meat. This result indicated the loss of histamine forming ability of *M. morganii* with HPP treatment.

Response Surface Methodology (RSM) was used to optimize quantum of pressure (400-600 Mpa), holding time (5-15 min.) and temperature (30-50 °C) for high pressure treatment of Pink perch sausages. Second order response surface regression was fitted to the Aerobic Plate Count data generated from Box-Behnkem experimental design with three points in the centre. The model fitted well to the data with r^2 of 0.87. With reference to APC, optimum combination was found to be Pressure: 530 Mpa; Holding Time: 10min.; Temperature: 50 °C. Microbial growth kinetics in high pressure treated Tuna sausage (500 and 600 MPa, 10 min.) was studied during chilled storage for 36 days and compared with cooked sausage. The mesophilic count of treated and control samples were modelled using Baranyi and Roberts Model (1994). The values of λ (Lag phase; days) estimated for cooked, 500 MPa and 600 MPa treated samples were 5.51, 2.31 21.14 days respectively, whereas the corresponding μmax (max. growth rate) were 0.0942, 0.0244 and -0.0094 day^{-1}. High lag phase and lower growth rate in HPP treated sausages indicated higher shelf life than cooked sausages.

Microbial inactivation of seafood-borne pathogens in Yellowfin tuna with respect to pulse light treatment

Inactivation kinetics of major food-borne pathogens was carried out in artificial substratum as well as Yellowfin tuna. Current FDA recommended dose of (12 J/cm^2, max) is inadequate for complete elimination of pathogens.

Survival of *Escherichia coli* in Tuna chunks was studied with respect to multiple hurdles. Inclusion of treatment with Lactic acid based additive (3%, 10 minutes) along with pulse light (10 seconds) exposure was most effective as it reduced the load of *E. coli* by 1.57 log compared to 0.2 and 1.4 log reduction by pulse light and additive alone.

Microbial kinetics of selected seafood-borne pathogens with respect to pulse light treatment

Pathogen	D value (Sec)	
	BHI	Tuna Homogenate
Escherichia coli O157	18.99	12.38
Staphylococcus aureus ATCC 6538	39.83	56.89
Salmonella Typhimurium ATCC 51512	39.95	30.15
Morganella morganii ATCC 25829	24.97	26.46
Yersinia enterocolitica ATCC 23715	22.23	19.85
Vibrio cholerae O1 NICED	22.16	22.07
Aeromonas hydrophila ATCC 36564	22.66	21.58
Listeria monocytogens ATCC 19112	35.80	37.80
Klebsiella pneumonia ATCC 13882	26.68	29.21
Shigella flexneri ATCC 9199	35.47	43.08
Vibrio parahaemolyticus ATCC 17802	18.46	19.47

Survival of *Vibrio alginolyticus* in frozen breaded fishery products

Based on the request by an export oriented seafood industry, survival of *Vibrio alginolyticus* was assessed in the manufacture of breaded shrimp products. By PCR method, presence of *V. alginolyticus* in the export consignment of following value added fishery products were evaluated: lightly fried squid rings, lemon pepper fish popcorn, tikka fish fillet, multi-grain fish finger, corn flakes fish cute, shrimp ball, salt and pepper shrimp popcorn, bubble breaded shrimp, light pop shrimp, coconut pop shrimp, shrimp burger, light and crisp shrimp, breaded shrimp tail on, garlic butter shrimp, spicy garlic shrimp and golden butterfly shrimp. Presence of *Vibrio alginolyticus* was detected in 12.5% of samples indicating poor sanitation during pre-processing of the samples prior to breading.

Source tracking of pathogens in seafood

Fish samples were collected along the pre-established track points soon after landing and at corresponding fish markets and examined for the presence of pathogenic bacteria. Out of six different categories of fish tracked, pathogen entry point was only observed for Anchovy (*Stolephorus* spp.). Fish market was observed to be the entry point for *Salmonella*.

All samples were found free from pathogenic organisms. APC of the samples varied from 4.8x10^5 to 4.1x10^6 cfu/g and *Escherichia coli* load varied from <20 to 2.2x10^3 cfu/g.

Source	Bacterial Load (APC; Log $_{10}$ CFU/g); n=25	
	Range	Mean
Fish harbour	4.61-5.83	4.97
Fish market	4.17-6.94	5.63
Aquaculture farms	4.08-7.34	5.12

Twenty five fresh fish samples comprising of freshwater, brackish water and marine origin including fishes brought from neighboring states were collected and screened for pathogenic organisms, mainly emerging pathogens. All samples were found to be free from *Vibrio cholerae*, *V. parahaemolyticus*, *Salmonella* and *L. monocytogenes*, but emerging pathogens i.e. *Y. enterocolitica*, *Edwardsiella tarda*, *Vibrio vulnificus* and enterohemorrhagic *E. coli* O157 were isolated from samples including fish brought

Pathogen/Indicator Organism	Prevalence (%)	Level
Escherichia coli	28	<10-2000 cfu/g
Staphylococcus aureus	4	<10-20 cfu/g
Vibrio cholerae	Nil	-
Salmonella	Nil	-
Vibrio parahaemolyticus	8	-
Listeria monocytogenes	Nil	-
Yersinia enterocolitica	4	-
E. coli O157	12	-
Aeromonas hydrophila	4	-
Vibrio vulnificus	4	-

from neighboring states.

Risk assessment of chemical and microbial hazards in fish markets of Kerala

In collaborative surveillance monitoring with FSSAI, 28 fish markets of Kerala were sampled for presence of chemical and microbiological hazards in fish and fishery products. The range of ammonia, formaldehyde, Mercury, Lead, Cadmium, Arsenic, Chromium and Nickel in fish and fishery products were in the range of 0-130.65, 0.042-4.516, 0-0.042, 0.004-0.372, 0.001-0.662, 0.03-13.11, 0-2.435 and 0-11.96 ppm respectively. Similarly, incidence of *Escherichia coli*, coagulase positive Staphylococci, *Vibrio parahaemolyticus* and *Listeria monocytogenes* was found to be 27.9, 13.95, 4.65 and 6.98% respectively. Bacterial load of fishes in the fish markets of Kerala ranged from $1.1x10^4$-$2.1x10^7$ cfu/g. Level of *E. coli* and Coagulase positive Staphylococci was observed to be <3.0-1100 MPN/g and <10-200 cfu/g respectively. *Salmonella* and *Vibrio cholerae* was absent in all samples. The study indicated a need of stringent sanitation measures in fish market environments and provision of good quality ice and water in fish markets.

Chemical hazard assessment - Fish markets of Kerala

Parameter	Mean (±S.E.); ppm	Range (ppm)
Ammonia	28.77 (±4.23)	0-130.65
Formaldehyde	0.95 (±0.11)	0.042-4.516
Total Mercury	0.022 (±0.01)	0-0.042
Lead	0.121 (±0.02)	0.004-0.372
Cadmium	0.0962 (±0.017)	0.001-0.662
Total Arsenic	1.86 (±0.42)	0.03-13.11
Chromium	0.3 (±0.07)	0-2.435
Nickel	1.22 (±0.74)	0-11.96

Protocol for determination of Ethoxyquin from shrimp

Ethoxyquin is a common primary antioxidant used to protect a variety of unsaturated hydrocarbon systems. The most common use is in fishmeal and fish oils, but it is also found in other oils, fats, and meat meals. Its purpose is to protect lipids and preserve carotene and vitamins A and E.

A new method for estimating Ethoxyquin, both in shrimp as well as feed matrices, was developed using LCMSMS. The parent ion 218.3 was tuned with three transitions *viz*: 1607.00, 174.400 and 146.700. The sample is extracted using hexane and partitioned, and dissolved in methanol water and is injected into

Microbiological hazard assessment - Fish markets of Kerala

Parameter	Level (Mean ±S.E.)	Incidence (%)	Range
Aerobic Plate Count	$2.8x10^6$ ($\pm7.7x10^5$) cfu/g		$1.1x10^4$ - $2.1x10^7$ cfu/g
Escherichia coli	39.9 (±25.7) MPN/g	27.9%	<3.0-1100 MPN/g
Coagulase positive Staphylococci	11.16 (±5.9) cfu/g	13.95%	<10-200 cfu/g
Salmonella	Absent in 25g	0	
Vibrio cholerae	Absent in 25g	0	
Vibrio parahaemolyticus	Present in 25g	4.65%	
Listeria monocytogenes	Present in 25g	6.98%	

ABSCIEX API4000 QTRAP LCMSMS in a positive ion mode. The separation is effected using an Waters ACQUITY UPLC BEH C18 RP Column, 130Å, 1.7 µm, 2.1 mm X 150 mm. Mobile phase used is 10% ACN and 90% H_2O with 0.1% HCOOH, Flow-rate: 0.6 mL/min in a gradient mode : 0% ACN to 100 % ACN from 0 to12 min.

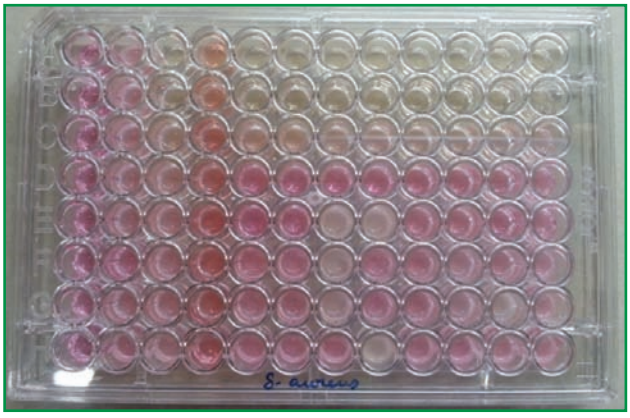
Chromatophore-based lipstick

Chormotophore isolated from squid was used as colourant for the preparation of lipstick which has been subjected to test among the lipstick users and has been found acceptable. The technical knowhow was transferred to M/s. Travancore Aquapets, Cochin, on consultancy basis.

Chromatophore-based lipstick

Antibacterial activity of phytochemicals

Phytochemicals were extracted from mint (*Mentha arvensis*) leaves using solvents of various polarities. The extracts concentrated and re-dissolved in DMSO were tested for antibacterial assay against 19 food-borne spoilage and pathogenic bacteria following CLSI method. Ethanolic extract of Mint leaves exhibited broad spectrum activity against most of the pathogens. The minimum inhibitory concentration (MIC) of the mint extract was carried out by microtitre plate method using resazurin indicator. MIC of mint extract as determined by microtitre assay was found to be 1.66% against *Staphylococcus aureus*, 0.83% against *Yersinia enterocolitica* and 3.32% against *Morganella morganii*, *Aeromonas hydrophila* and *Salmonella* Paratyphi A.



Antibacterial assay of phytochemicals

Formaldehyde in fish

Recently fish sellers and fishermen started using the poisonous chemical, formaldehyde for preserving fish. Presence of formaldehyde in different freshly frozen fishes in Veraval, Gujarat has been checked. In Indian mackerel, the formaldehyde content ranged between 0.2-4 ppm and it was between 0.3-9 ppm in different varieties of Tuna (Long tail tuna, Bonito and Skipjack tuna). There were significant differences in the formaldehyde content in different fish samples of the same species.

Heavy metal contamination in cephalopods

Heavy metal contamination in cephalopods such as Squid, Cuttlefish and Octopus in Gujarat coast was monitored. Mercury content varied between 0.002 ppm to 0.008 ppm in Squid and Cuttlefish while it ranged from 0.008 ppm to 0.009 ppm in Octopus. Cadmium content was in between 0-0.049 ppm, 0-0.57 ppm and 0-0.11 ppm in Cuttlefish, Squid and Octopus respectively.

Cephalopods used for the study

Development of Quality Index Scheme for commercially important Indian fishes

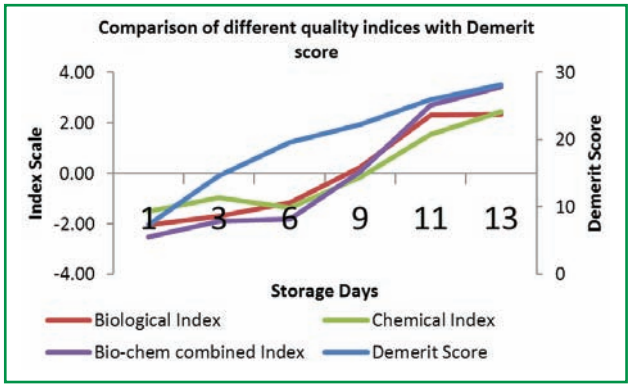
Principal Investigator : Dr. T.V. Sankar

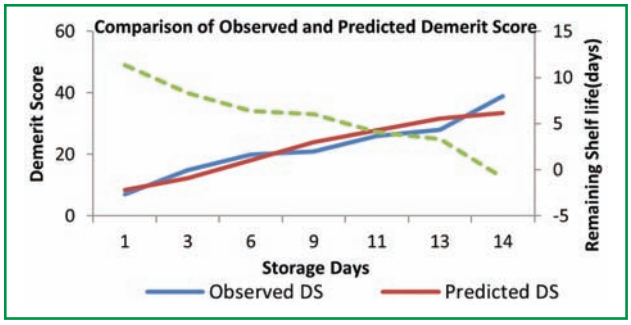
Co-Investigators : Dr. S. Sanjeev, Dr. K. Ashok Kumar, Dr. Femeena Hassan, Dr. S.K. Panda, Dr. V. Ronda, Shri C.G. Joshy, Dr. A. Jeyakumari, Smt. S.J. Laly, Dr. C.O. Mohan (At Veraval RC), Dr. M.M. Prasad (At Visakhapatnam RC) and Smt. P. Viji (At Mumbai RC)

Development of Quality Index Scheme for Indian Mackerel

The quality index scheme for Indian mackerel (*Rastralliger kanagurta*) was finalized and has 14 descriptors with a total demerit score of 33. The data were pooled and analyzed statistically to get a relation between the different data on different parameters. The quality indices of biological, chemical and combined showed an increasing trend with storage days and they are in conformity with increasing trend of demerit score.

Based upon the validated QIM scheme developed with 14 descriptors, a quality index prediction model (simple linear regression model) was developed to predict the quality index score as a function of storage days in ice condition. The fitted model is given as "Quality index score = 6.60173+1.9261* Storage days" with an adj R^2 = 0.87. The observed and predicted quality index score along with 95% upper and lower confidence limits is depicted in the below given figure.





Shelf life = 0.38013*Demerit Score; Adj R2 = 0.95
Demerit Score=6.60173+1.93 *days; Adj R2 = 0.90

Heavy metal analysis of aquacultured shrimp and fish

Shrimp, water and sediment samples were procured from an aquaculture farm and the heavy metal (Cu, Cd, Fe, Zn, Pb, Fe and Cr) content was analyzed. Sediment showed higher heavy metal content than shrimp and water samples. The content of Cd, Cr and Pb in shrimp and sediments samples were 0.033, 1.79, 0.206 and 0.142, 8.138, and 0.354 ppm, respectively. Heavy metal content in the shrimp was below the permissible limits. Pond water showed low content of heavy metals than shrimp and sediment sample. Tilapia samples (three lots) were procured from local fish market, Vashi and analyzed for its biochemical, microbial, sensory quality and heavy metal contents. Cd was not detectable in any of the samples. All the samples were of fresh quality as indicated from the results of biochemical, sensory and microbial analysis. The content of Cr, Cu, Fe, Ni, Pb and Zn varied from 0.032-0.046 ppm, 0.267-0.324 ppm, 8.365-10.764 ppm, 0.856-0.997ppm, 0.414-0.609 ppm and 2.635-4.674 ppm, respectively.

Comparison of quality of Cobia (*Rachycentron canadum*) and Seerfish (*Scomberomorus guttatus*) stored in tube ice versus flake ice chilling method

The two most important types of small ice are flakes and cylinders/tube ice. Flake ice is a preservation method extensively used to remove heat rapidly from fishes and to extend their shelf life. Tube ice, made as hollow cylinders, also has all the advantages of flake ice. A study was carried to investigate the improvement in the quality of

commercially important fishes like Seerish and Cobia, if any, stored in tube ice compared to flake ice. Seerfish and Cobia, procured from Veraval fish landing centre were brought to CIFT laboratory in respective forms of ice. Both the fishes were beheaded, gutted, washed with potable water and cut into steaks. The steaks were packed in polyethylene packs and stored in thermocol boxes with lid. In one box each of Cobia and Seerfish steaks, flake ice was added in alternate layers and tube ice was added to second box of both the fishes. Fish and ice ratio was maintained as 1:1. Biochemical and microbial quality of fishes stored in both the ice was monitored daily up to five days. During storage loss through melting was more in flake ice which affected the quality of fish after two days of storage. Seerfish stored in flake ice had a shelf life of two days compared to three days in tube ice while Cobia stored in flake ice and tube ice was sensorily acceptable till 3rd and 4th day of storage respectively. There was an extension of one day shelf life in case of fishes stored in tube ice when ice was not replaced. Under similar conditions, tube ice melts slower than flake ice. To ensure that cooling is continued for the required length of time, more flake ice is required than tube ice. The study reveals that tube ice is more suitable than flake ice during long term storage and transportation of fish compared to flake ice.

Microbiology, Fermentation and Biotechnology Division

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
- Utilization of fish processing waste for development of innovative products
- Species specific technologies for the improved utilization of the fishery resources of Maharashtra region
- Responsible harvesting and utilization of selected small pelagics and freshwater fishes
- National surveillance programme on aquatic animal diseases
- Bioprospecting of genes and allele mining for abiotic stress tolerance
- Development of multiplex microarray for detection of food-borne and shrimp pathogens
- Oceanic Tuna fisheries in Lakshadweep sea - A value chain approach
- Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- Studies on high pressure processing (HPP) of high value perishable commodities

Chief findings

- Spoilage bacteria of farmed Catfish were identified as *Aeromonas sobria, A. hydrophila, Chryseobacterium, Pseudomonas* and *Sphingobacterium.*
- Fish pathogens *Edwardsiella tarda, Aeromonas hydrophila* and *Chryseobacterium* spp. were recovered from farmed Catfish *Pangasius* sp.
- A virulent strain of *Edwardsiella tarda* with LD_{50} of $1.4X10^{6}$ $CFUg^{-1}$ $Fish^{-1}$ was isolated from farmed Catfish *P. hypophthalmus.*
- Pathogens such as TDH positive *V. parahaemolyticus,* Methicillin-resistant *Staphylococcus aureus*, Salmonella and *Y. enterocolitica* were isolated from seafood and aquatic environments.
- Improved method for isolation of Methicillin-Resistant *Staphylococcus aureus* from fishery environment developed.
- Multi Locus Sequence typing (MLST) analysis for seven housekeeping genes of *S. aureus*; *arcC*, *aro*E, *glp*f, *gmk*, *pta*, *tpi* and *yqil* revealed that strain SA192 isolated from fish from market belongs to ST641 sequence type.
- Staphylococcal Protein A (SPA typing) of the strain of MRSA SA192 revealed that the strain belong to t002 ridom type.
- Developed duplex PCR assay for simultaneous detection of *Listeria monocytogenes* and *Campylobacter jejuni* from seafood samples.

- Developed PCR-based diagnostic method for detection of Hepatopancreatic parvovirus infection in shrimp.
- Pathogenic *Vibrio vulnificus* strain was recovered from infected farmed shrimp.
- Multidrug resistant *Aeromonas hydrophila* was recovered from fish farms.
- Ectoine biosynthesis genes from *Haererehalobacter* spp. was cloned in heterologous expression system.
- Chitinase gene from *Paenibacillus elgii* was cloned in heterologous expression system.

Report of the work done

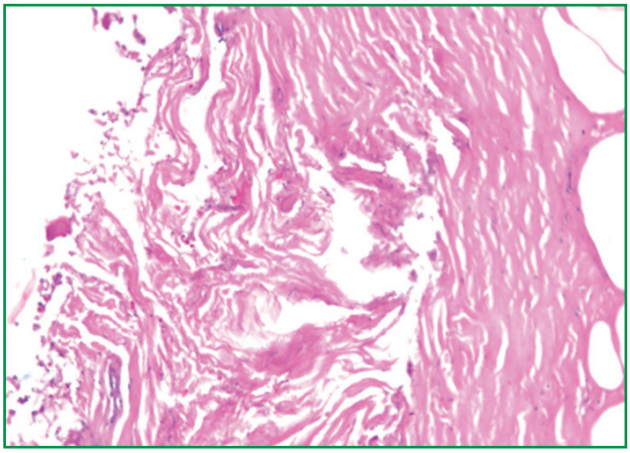
Diversity of seafood-borne pathogenic and commensal bacteria and bioscreening for novel genes and biocatalysts

Principal Investigator : Dr. K.V. Lalitha

Co-Investigators : Dr. Sanjoy Das, Dr. Toms C. Joseph, Dr. V. Murugadas and Dr. B. Madhusudana Rao (At Visakhapatnam RC)

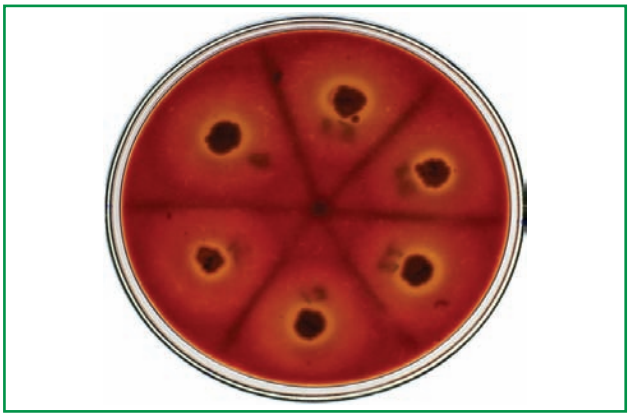
Diversity of pathogens in farmed fish

Five farmed Catfish samples from Thrissur district were tested for fish pathogens. *Chryseobacterium* spp. *Edwardsiella tarda* and *Aeromonas hydrophila* were identified in farmed Catfish. The levels of *Aeromonas hydrophila* and *A. sobria* were >3 log cfu/g. All five *Aeromonas hydrophila*, one *Chryseobacteria* sp. and one *Aeromonas sobria* isolated from the Pangasius fish were resistant to Amoxicillin, Clavulanic acid. One *A. hydrophila* strain was resistant to Cefpodoxime. Multidrug resistance was observed in one *A. hydrophila* and one *A. sobria* strain. *Edwardsiella tarda*, a fish pathogen of zoonotic importance was recovered from the lesions in fish. The *E. tarda* strain was found to be pathogenic using LD_{50} studies. The isolates exhibited strong virulence to farmed Catfish *P. hypophthalmus* with LD_{50} of $1.4X10^6$ CFU $Fish^{-1}$. Histopathological examination of gross lesion from tail ulcer revealed loss of structural integrity of epidermal layer with haemorrhages.



Histopathology of ulcer in tail region of farmed Catfish *P. hypophthalmus* infected with *E. tarda* (40x magnification) showing loss of structure of epidermal layer due to haemorrhages

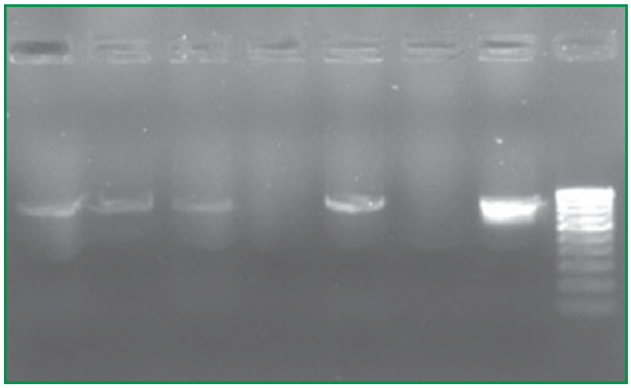
Fourty three strains of *V. paraheamolyticus* were isolated from eight water and mud samples from aquaculture ponds in Thrissur and Ernakulam districts, of which 31 strains showed Kanagawa phenomenon on Wagatsuma agar. Fifteen isolates carried the



Kanagawa phenomenon on Wagatsuma agar of environmental strains of *V. parahaemolyticus*

pathogenic marker, the *tdh* gene, indicating the virulence potential of the strains.

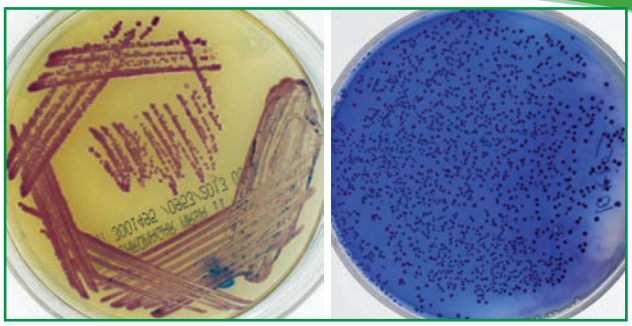
Screening of water and sediment samples collected from *L. vannamei* shrimp farms in Nellore and Bhimavaram areas of Andhra Pradesh revealed presence of *V. parahaemolyticus* (0.3 MPN/g). All the *V. parahaemolyticus* isolates yielded the specific amplicon of 897bp (*fla*E sequence) by PCR and were negative for haemolytic activity on Wagatsuma agar and for *tdh* gene by PCR. All the *V. parahaemolyticus* isolates were positive for DNAse, lipase, amylase and phosphatase activities; 67% of *V. parahaemolyticus* isolates were positive for protease (casienase) activity; 17% of *V. parahaemolyticus* isolates were positive for urease activity.



V. parahaemolyticus in sediment and water samples collected from *L. vannamei* shrimp ponds in Andhra Pradesh (Lane 1, 2 ,3: Sediment samples (+ve) from Nellore area; Lane 4: Sediment sample (-ve) from Nellore area; Lane 5: Water sample (+ve) from Nellore area; Lane 6: Water sample (-ve) from Nellore area; Lane 7: *V. parahaemolyticus* type culture; Lane 8: 100bp Marker)

Diversity of pathogenic bacteria in fish and fish products

Sixty five seafood samples screened for Methicillin-resistant Staphylococcus from retail fish markets of Ernakulam and Thrissur districts revealed that the prevalence of Methicillin-resistant Staphylococcus was 27.6% (18/65). Sixteen strains of Methicillin-resistant Staphylococci including Methicillin-resistant *Staphylococcus aureus* (MRSA) was recovered from fish samples collected from landing centre located at Chempu, Kottayam district. PCR amplification of *mec*A and *nuc*A genes in Methicillin-resistant Staphylococci strains confirmed



Mauve Colony of MRSA isolated from fish sample in BD ChromAgar MRSA II

Deep blue colonies of MRS isolated from fish sample in ORSAB agar

ten strains as MRSA.

Thirty seven samples of fish and shellfish collected from retail outlets at Ernakulam and Thrissur districts and five farmed Catfish samples from Thrissur district were screened for *Yersinia enterocolitica*. *Y. enterocolitica* was detected in two fish samples from retail outlets.

A total of 33 samples including 21 fish and shellfish, six water and six mud samples collected from local fish markets as well as aquaculture farms were screened for the presence of *Salmonella*. Eleven samples harbored *Salmonella* spp. (Nine fish and shellfish, one water and one mud sample). Twenty five samples (22 fish and shellfish, one ice and three water) were screened for the presence of emerging pathogen thermophilic *Campylobacter*. Thermophilic *Campylobacter* was not detected in any of the samples tested.

V. parahaemolyticus in marine fish

A total of 20 samples of marine fish procured from the fish markets in Visakhapatnam were analyzed for the halophilic bacterial pathogen, *Vibrio parahaemolyticus*. Nine samples (*Rastrelliger kanagurta, Sardinella* sp., *Pampus argenteus, Parastromateus niger, Upeneus* sp., *Leiognathus* sp., *Scomberomorus guttatus, Mugil cephalus, Euthynnus afinis*) were positive for the presence of *V. parahaemolyticus* based on biochemical tests. All the isolates yielded the specific amplicon of 897bp in the PCR targeting the *flaE* sequence of *V. parahaemolyticus*. *V. parahaemolyticus* O3:K6 serotype is responsible for many *V. parahaemolyticus* outbreaks in several parts of the world, including epidemics in India, Russia, Southeast Asia, Japan and

North America. All the *V. parahaemolyticus* isolated from marine fish were negative for the 369bp amplicon indicating that none of the isolates belonged to the pandemic O3:K6 serotype.

Diversity of commensal and spoilage bacteria of farmed Catfish

Microbial profile of farmed Catfish (*Pangasianodon hypophthalmus*) collected from three farms located at Kodungallur, Thrissur district was studied. Microflora was dominated by Genera *Pseudomonas, Aeromonas,* Enterobacteriaceae, *Burkholderia, Stenotrophomonas, Micrococcus, Staphylococcus* and *Bacillus*. Spoilage bacteria were identified as *Chryseobacterium, Pseudomonas, Sphingobacterium* and *Aeromonas*. *Chryseobacterium* spp. was psychrotolerant and proteolytic.

Effect of chlorine on the vegetative cells of *L. monocytogenes*

The effect of chlorine on *L. monocytogenes* was studied. On 5 min. exposure, 130 ppm chlorine was found to totally destroy the vegetative cells of *L. monocytogenes* ATCC 19115 in tryptic soya broth (TSB). On the other hand, 95 ppm chlorine was enough to completely inactivate the local fish (Catla) isolate of *L. monocytogenes* in TSB.

Effect of Potassium sorbite on *V. parahaemolyticus*

The effect of Potassium sorbate on the growth and survival of *V. parahaemolyticus* isolates was tested using different concentrations of Potassium sorbate *viz.*, 0.25%, 0.5%, 0.75%, 1%, 2%, 3%, 4% and 5% (w/v). Growth was evident up to 0.75% concentration and Potassium sorbate at 1% level completely inhibited the growth of *V. parahaemolyticus* isolates.

Effect of salt and pH on *Staphylococcus aureus*

Studies on the effect of salt concentration (0% to 10%) and pH (5 to 8) on reference cultures MSSA (Methicillin Sensitive *Staphylococcus aureus*) ATCC 29213 and MRSA (Methicillin resistant *Staphylococcus aureus*) ATCC 43300 revealed that the growth performance of MSSA ATCC 29213 and MRSA ATCC 43300 at pH 6 and 7 was good compared to pH 5 and pH 8. At pH 7, both MSSA and MRSA cultures showed better growth. The results were statistically analyzed to determine the optimal combination of salt and pH. Both the strains grew best at pH 6-7 and salt concentration of 0-5% at an incubation temperature of 35 °C.

PCR assay developed for detection of *Campylobacter jejuni*

A PCR assay was developed standardizing annealing temperature using primers HIP400F and HIP1143R for detection of thermophilic *Campylo bacter* spp. 62 °C was the most suitable annealing temperature. This PCR yielded 735 bp amplicon only in case of *C. jejuni*.

Duplex PCR for *Listeria monocytogenes* and *Campylobacter jejuni*

A duplex PCR assay has been standardized for simultaneous detection of *L. monocytogenes* and *Campylobacter jejuni* targeting beta-haemolysin gene of *L. monocytogenes* and *hipO* gene of *C. jejuni*. This assay could detect these two pathogens in a single PCR reaction. This PCR assay yielded products 128 and 336 bp in case of *C. jejuni* and *L. monocytogenes*, respectively. This PCR assay was standardized using annealing temperatures (55, 57, 59, 61, 63 and 65 °C) and it was observed that 57 °C was the most suitable annealing temperature. The cross-reactivity was checked with *Bacillus cereus*, *B. subtilis*, *Lactobacillus plantarum*, *L. acidophilus*, *Salmonella* Welterverden, *Edwardsiella tarda*, *Aeromonas hydrophila*, *Escherichia coli* and *Staphylococcus aureus* but no cross-amplification was observed with any of them.

Development of PCR-based diagnostic method for Hepatopancreatic parvovirus infections in farmed shrimp

A single step highly specific, rapid and sensitive PCR method has been developed for detection of Hepatopancreatic parvovirus (HPV) infection in shrimp. The specific primer set was designed for non-structural protein gene-1 (NS-1). The designed primers were highly specific to HPV and yielded a product of 350 bp. Based on this PCR assay, a kit was developed for detection of Hepatopancreatic parvovirus (HPV) of shrimp and the kit was validated.

Minimum Inhibitory Concentrations (MICs) of antibiotics against *Listeria monocytogenes* and *Campylobacter jejuni*

Minimum Inhibitory Concentrations of different antibiotics were estimated against *L. monocytogenes*

ATCC 19115 and one local fish isolate of *L. monocytogenes*. MICs of Ampicillin, Chloramphenicol, Kanamycin, Vancomycin, Streptomycin, Trimethoprim, Cephalothin, Sulfamethoxazole and Novobiocin were estimated as 10, 10, 10, 0.7, 10, 0.06, 7, 60 and 4 µg/ml, respectively. MICs of those antibiotics to the local fish isolate of *Listeria monocytogenes* were found similar to ATCC 19115 except for Ampicillin. MIC of Ampicillin against the local fish isolate was found to be 9 µg/ml.

The minimum inhibitory concentrations (MICs) of *C. jejuni* white shrimp isolate to Ampicillin, Chloramphenicol, Streptomycin, Vancomycin and Kanamycin were found to be 9, 12, 10, 0.8 and 0.4 µg /ml, respectively.

Antibiotic resistance profile of *V. parahaemolyticus* isolates

All the six strains of *V. parahaemolyticus* isolates from shrimp *L. vannamei* farms showed resistance to Tetracycline, Oxytetracycline, Methicillin and Gentamicin. 50% of the *V. parahaemolyticus* isolates showed resistance to Penicillin-G and Co-trimoxazole. However, 67% of *V. parahaemolyticus* isolates were sensitive to Ciprofloxacin, Nitrofurantoin and Nalidixic Acid.

Multidrug resistance in *Aeromonas* spp. from farmed fish

All five *Aeromonas hydrophila*, one *Chryseobacteria* sp., and one *Aeromonas sobria* isolated from the farmed Pangasius fish were resistant to Amoxycillin, Clavulanic acid, one *A. hydrophila* strain was resistant to Cefpodoxime, multidrug resistance to Amoxicillin-Clavulanic acid, Amikacin, Tobramycin, Gentamicin, Trimethoprim-Sulfamethaxazole and Chloramphenicol was observed in one *A. hydrophila* isolates.

Molecular typing of Methicillin-resistant *Staphylococcus aureus*

A PCR protocol for a surface virulent protein (Protein A) variable region was standardized and the characterization using this Staphylococcal protein A typing of Methicillin-resistant *S. aureus* strain SA192 isolated from fish from market revealed that the strain is t002 ridom type.

PCR protocols were standardized for the Multi Locus Sequence typing (MLST) analysis for seven housekeeping genes of *S. aureus* such as *arcC*, *aro*E, *glpf*, *gmk*, *pta*, *tpi* and *yqil*. The MLST analysis revealed that the strain SA192 isolated from fish from market belonged to ST641 sequence type.

Molecular characterization of enterotoxigenic *Bacillus cereus*

Seven enterotoxigenic *Bacillus cereus* isolates from fish samples from Visakhapatnam, Andhra Pradesh were screened for the presence of *hbla*, *entFM* and *bceT* genes by PCR. The *hbla* and *entFM* genes were detected in all the isolates. However, *bceT* gene was not detected in any of the isolates.

Diversity of viral pathogens in shrimp/prawn for development of control measures

Eleven samples were tested for HPV, YHV and TSV. Only HPV was detected in seven samples. Out of nine samples tested for IHHNV and MBV, IHHNV was detected in three samples. None of the 14 samples analyzed harbored WSSV.

Comparative genomics of *Listeria monocytogenes* and *L. innocua*

The secondary structures of all 41 genes, which were identified previously to be present only in case of *Listeria monocytogenes* (not in *L. innocua*) were predicted by EMBOSS tools. The model of 3D tertiary structures 22 out of 41 proteins were predicted so far by using automated modeling systems of SWISS-MODEL. The evaluations of the predicted models using suitable bioinformatics tools are in progress.

Submission of 16s rDNA partial sequences in NCBI Gen Bank database

Seven 16s rDNA partial sequences were submitted in the public domain NCBI Gen Bank Database (*Pseudomonas fragi* KF379759-1, *Pseudomonas* spp. KF379758-1, *Morganella* spp. KF379757-1, *Hafnia* alvei KF379756-1, *Staphylococcus saprophyticus* KF317835-1, *Staphylococcus* spp. KF317833-1, and KF317834-1).

Plastic degrading bacteria from aquatic environment

Four strains selected out of 89 strains isolated from plastic contaminated soil with highest reduction in turbidity of 27%, 22%, 24% and 90% based on BATH assay were further screened for its ability to degrade

LDPE. UV irradiation enhanced the biodegradation (measured as dry weight loss) compared with non-irradiated polyethylene. One strain *Gordonia* spp. was able to reduce weight by 7.14% of initial weight while other three strains showed 5% reduction in weight. Environmentally weathered LDPE showed around 12.5% reduction in weight in seven days of incubation.

Antifungal activity of chitinase

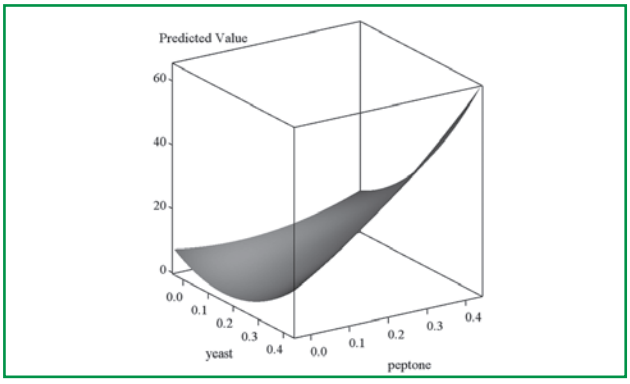
Thirteen chitinase producing bacteria isolated from Visakhapatnam were grown in LBC broth containing colloidal chitin (All the bacteria showed clear chitinase activity between 48h to 72h, on solid media). After 72h of incubation at 37 °C, the culture supernatant containing the chitinase enzyme was tested for antifungal activity by employing agar diffusion assay. The fungus, *Aspergillus niger* was isolated from the dried fish (*Upeneus* sp. procured from the local market) was spread on MH agar. 50 µl of culture supernatant from LBC culture of chitinase producing bacteria was loaded in each well. The culture supernatant of five chitinase producing bacteria showed antifungal activity.

Antibacterial activity of chito oligosaccharides

Commercial chitinase was used for producing chito oligosaccharides from colloidal chitin. 500 µl of chitinase enzyme (0.5Units) was mixed with 1.25% colloidal chitin (1:4 ratio) and incubated for 2 hours. Later, the mixture was centrifuged at 10,000rpm and the supernatant (50µl/well) containing the crude chito oligosaccharides was tested for antibacterial activity against *E. coli*, *Salmonella*, *Staphylococcus aureus*, *V. cholerae* and *V. parahaemolyticus* isolates from Visakhapatnam. Antibacterial activity of crude chito oligosaccharides was observed towards *Staphylococcus aureus*.

Optimization of chitinase production by Response Surface Methodology

The important media components controlling the production of chitinase by *Peanibacillus elgii* were identified as chitin, colloidal chitin and glycerol as carbon sources and peptone, yeast, ammonium sulphate and ammonium nitrate as nitrogen sources in media using response surface methodology. Statistical approach was found to be very effective in optimizing the medium components in convenient

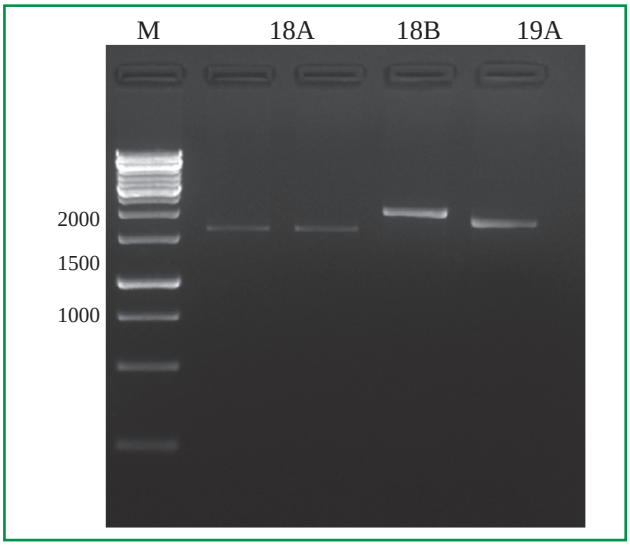


Three-dimensional response plot showing the effect of yeast (g/100ml^{-1}) and peptone (g/100ml^{-1}) on chitinase production (U ml^{-1}) of *Peanibacillus elgii*

number of experimental runs with overall 5.8-fold increase in chitinase production.

Cloning of chitinase genes from *Paenibaccilus elgii*

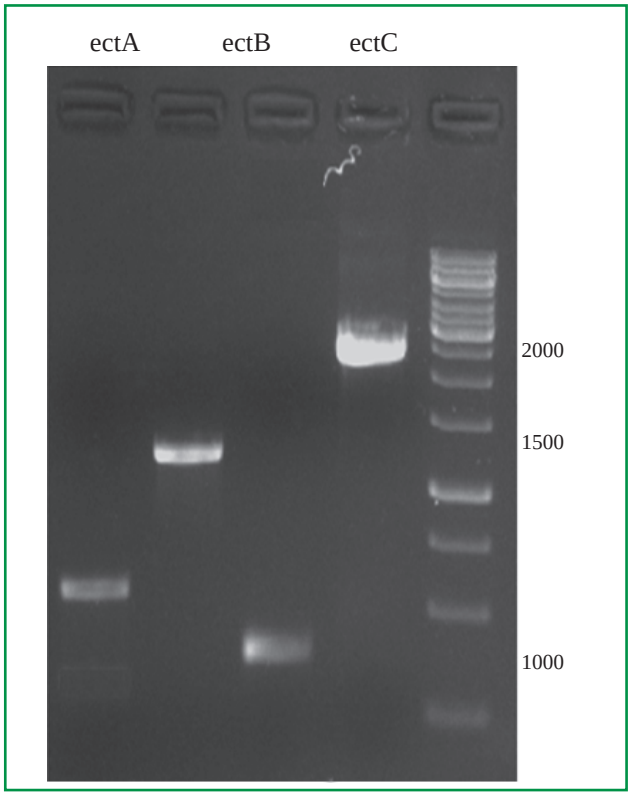
Three chitinase genes; 18A, 18B and 19A from *P. elgii* were PCR amplified using designed primers with molecular weights of 1852, 2028 and 1761 bp. The PCR products were confirmed by sequencing. The genes were cloned in a heterologous expression system to characterize the proteins.



PCR amplification of chitinase genes

Ectoine biosynthesis genes from aquatic bacteria

Thirty five bacterial isolates including 24 strains of halophilic bacteria isolated from saltpans were screened for ectoine production by HPLC. Twenty two strains produced ectoine in the range of 2.50 to 4mM. The strain with maximum ectoine production will be



PCR amplification of ecotine biosynthesis genes

used further for commercial production of ectoine.

Ectoine biosysnthesis genes from *Haererehalobacter* spp. was PCR amplified using primers designed for the purpose. The ectoine biosynthesis operon is around 2300 bp.

Characterization of aquatic bacteria with hydrocarbon degradation potential

Fifty strains of bacteria isolated from aquatic environment were screened for the presence of *alk*B, *xyl*E, *ndo*B, *cat* and *tod*M genes. Nine bacterial strains belonging to Genera *Pseudomonas, Bacillus* and *Enterobacter* had *alk*B gene while 11 had *tod*M gene. None of the bacterial strains had *xyl*E, *ndo*B and *cat* gene.

Biochemistry & Nutrition Division

Research projects handled

- Biomonitoring and bioevaluation of marine resources and formulation of nutraceuticals in human nutrition and health
- Nutritional and pharmacological evaluation of marine molecules in alleviating diseases and disorders
- Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications
- Isolation and characterization of collagen and gelatin from aquatic sources and development of food grade and pharmaceutical products of commercial importance
- Exploration and assessment of demersal fishery resources along the continental slope of Indian Central Ocean and Indian EEZ
- Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- Nutrient profiling and evaluation of fish as a dietary component
- Oceanic Tuna fisheries in Lakshdweep – A value chain approach
- Responsible harvesting and utilization of selected small pelagics and freshwater fishes

Chief findings

- A tandem mass spectroscopic method for trace level analysis of eight B vitamins in rat plasma and fish was developed.
- A new enzymatic sample preparation protocol was developed for extraction of water soluble B vitamins from fish tissue. The protocol was successfully applied for determination of water soluble B vitamin content in three fish species, Mackerel, Sardine and Dogshark.
- It was observed that these species are rich source of Vitamin B_{12} and Folic acid.
- A new sample preparation method was developed for multiresidue analysis of 119 multiclass contaminants in fatty fish matrix by GC-MS/MS. The method was presented in AOAC Annual Meeting and Exposition, Chicago, 2013 and was accepted in the Proceedings.
- A rapid sample preparation method for analysis of 13 Organochlorine pesticides by GC-ECD in shrimp was developed.
- A tandem mass spectrometric method for analysis of 85 persistent organic pollutants including OCPs, PAHs and PBDEs was developed. The method will be significant since PBDEs are emerging contaminants in environment and new analytical methods are required for their monitoring.
- Chitosan was modified by grafting phenolic acids (Gallic acid/ Ferulic acid/ Coumaric acid/ Vanillic acid) by a simple chemical reaction. Four chitosan

derivatives were synthesized.

- Phenolic acid grafted chitosan derivatives showed excellent antioxidant and antimicrobial activity. Ferulic acid grafted chitosan was best in terms of antibacterial activity. These derivatives will have potential application as nutraceuticals and functional foods.
- Glycosamino glycans (GAGs) were isolated and characterized from squid ink. It was observed that the GAGs are sulfated polysaccharides and contain 13.5 mg of sulfate per 100 mg.
- FTIR spectrum of GAGs showed regions that were specific for sulphur, sugar, nitrogen and carbon residues.
- Protective effect of the purified squid peptide against hydroxyl-radical-induced DNA damage was studied. It was observed that DNA treated with the purified peptide protected DNA from hydroxyl radical damage indicating the positive antioxidant effect.
- Squid peptide showed antipyretic effect in albino rats against Brewer's yeast-induced pyrexia. It was observed that low concentration of peptide (0.5g/Kg body weight) has reported maximum antipyretic effect compared to high concentration of peptide treatment.
- Anti-inflammatory effect of squid peptide in albino rats against formalin-induced paw edema was studied. It was observed that squid peptide at doses 500 and 1000 mg/kg body-weight significantly prevented the increase in thickness of paw edema in a dose dependent manner compared to the control rats.
- Anti-ulcer effect of squid peptide in albino rats against ethanol-HCl induced gastric ulcer was studied and 0.5 g/kg body weight peptide was found to possess antiulcer property.
- Partial characterization of squid peptide was carried out by MALDI-TOF/TOF.
- A one pot synthesis of Succinyl Chitosan-Fish Collagen and PEG based composite ternary hydrogel was achieved. Microencapsulated curcumin was incorporated in the hydrogel.
- The developed hydrogel was tested for its wound healing activity in animal model. Histopathological analysis of healed wound tissue clearly showed excellent wound healing capability of the hydrogel.
- A succinyl chitosan based hydro-alcohol hand sanitizer was developed for fish processing industry workers. The efficacy of the hand sanitizer was established by ASTM approved glove juice method.
- Synergistic effects of dietary squalene and n-3 poly unsaturated fatty acids (PUFA) in modulating aging process were studied. The results indicated that the combined dietary supplementation of squalene and n-3 PUFA might be the viable therapeutic potential to ameliorate the age-associated oxidative stress in brain tissue.
- Anti arthritic effect of collagen peptide was established by Anti Cyclic Citrullinated Peptide Ab assay. Collagen peptide was partially characterized by determining molecular weight range (m/z 500-4500) by MALDI-TOF/TOF analysis.
- Shark liver oil from *Echinorhinus brucus* was found to possess potential antiulcer effect.

Biomonitoring and bioevaluation of marine resources and formulation of nutraceuticals in human nutrition and health

Principal Investigator : Dr. P.T. Lakshmanan / Dr. Suseela Mathew

Co-Investigators : Dr. R. Anandan, Dr. K.K. Asha, Dr. Niladri Sekhar Chatterjee, Dr. B. Madhusudana Rao (At Visakhapatnam RC), Dr. L.N. Murthy (At Visakhapatnam RC) and Kum. Jesmi Debbarma (At Visakhapatnam RC)

Tandem mass spectroscopic method for trace level analysis of B vitamins in rat plasma and fish

Vitamin B complex constitutes a group of eight organic compounds with diverse polarities. The group consists of thiamine (B1), riboflavin (B2), nicotinamide /nicotinic acid (B3), pantothenic acid (B5), pyridoxine

(B6), biotin (B7), folate/folic acid (B9) and cyanocobalamin (B12). Because of their critical role in nutrition and their relative instability, qualitative and quantitative analyses are important issues and a challenging task for analysts. The broad physico-chemical properties of these compounds complicate their analysis as a unity. LC-MS/MS analysis can provide an effective solution for these problems. However ion pair reagents used for separation of these vitamins are not always compatible with mass spectrometry. Excellent separation of eight water soluble B vitamins in a HILIC (Hydrophilic Interaction Liquid Chromatography) silica column could be achieved without any use of ion pairing reagent.

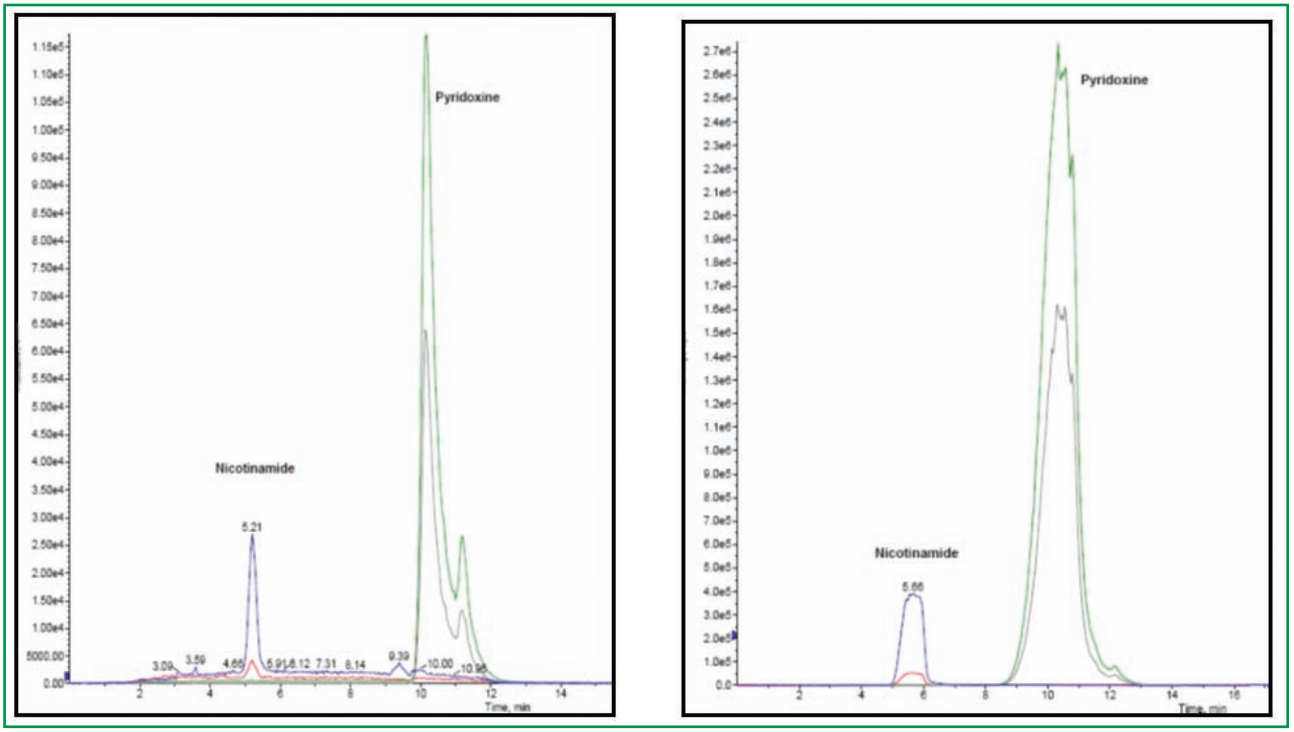
Very low level of sensitivity was achieved (less than 3 ppb) in mass spectrometric analysis employing ABSCIEX QTRAP 4000. The method was successfully employed in analysis of eight water soluble B vitamins in rat plasma and fish tissue. Diluent for samples was also optimized to get better peak shape and intensity for all the analytes. It was observed that when the sample was diluted with acetonitrile: water (90:10), peak shape and sensitivity for nicotinamide and pyridoxine improved. However response of folic acid reduced slightly. This can be accepted as a compromise to achieve overall good peak shape and sensitivity of all eight water soluble vitamins.

Sample preparation method for analysis of water soluble vitamins in plasma

A sample preparation method was developed for analysis of eight water soluble vitamins in rat plasma. Recovery study was carried out by spiking the plasma at 10 ppb level with all eight water soluble vitamins studied. The plasma was deprotinised by vortexing with acetonotrile and finally the sample diluents was adjusted to 80:10 ACN: water. The method will be particularly useful in metabolomics studies since water soluble vitamins are involved in many metabolic functions of the body.

Development of a sample preparation method for analysis of bound water soluble vitamins in fish tissue

Fortified water soluble vitamins in nutritional mix and baby food are easy to extract with hot water and plenty of methods are available for analysis of water soluble vitamins in fortified food. However when it comes to water soluble vitamins bound in animal tissue, very few sample preparation method deals with it effectively. In such cases normally 0.1 N HCl



Improved peak shape of nicotinamide and pyridoxine (A), improved when the sample was diluted with 90:10 ACN : Water as compared to 50:50 ACN : Water (B)

has been used for extraction of water soluble vitamins from animal tissue. This leads to incomplete extraction and partial extraction of few vitamins. An enzymatic method for extraction of water soluble vitamins from fish tissue with combination of different enzymes, for high sensitive analysis by LC-MS/MS was developed. This could successfully extract all eight water soluble B vitamins. This method will be helpful in evaluating the water soluble B vitamin content in fish tissue.

The method was successfully applied to determine water soluble vitamin content in Mackerel, Sardine and Dog Shark tissue. The result is as given in the Table below:

Vitamin content in selected fish species

Vitamins	Mackerel (µg/100g)	Sardine (µg/100g)	Dog Shark (µg/100g)
Nicotinamide (B3)	14 ± 2	13 ± 1	9 ± 1
Pyridoxine (B6)	46 ± 3	39 ± 2	52 ± 3
Pantothenic acid (B5)	90 ± 5	269 ± 4	113 ± 3
Biotin (B7)	764 ± 2	717 ± 4	349 ± 1
Thiamine (B1)	73 ± 2	53 ± 3	51 ± 3
Riboflavin (B2)	141 ± 3	189 ± 2	41 ± 2
Folic acid (B9)	51 ± 4	31 ± 6	0
Cyanocobalamin (B12)	2950 ± 4	2600 ± 3	1970 ± 5

Validation of a new sample preparation method for analysis of pesticides in fish and shellfish

A new sample preparation method for multiresidue analysis of multiclass pesticides and poly aromatic hydrocarbons (Simultaneous analysis of 119 contaminants) in fatty fish was developed. Complete validation of the developed method was also carried out. Assessment of sensitivity, matrix effect, precision, accuracy and uncertainty were carried out for validation of the method. The paper was presented in AOAC Annual Meeting and Exposition held at Chicago during 25-28 August, 2013 and was accepted in the Proceedings.

Rapid sample preparation method for analysis of organochlorine pesticides in shrimp

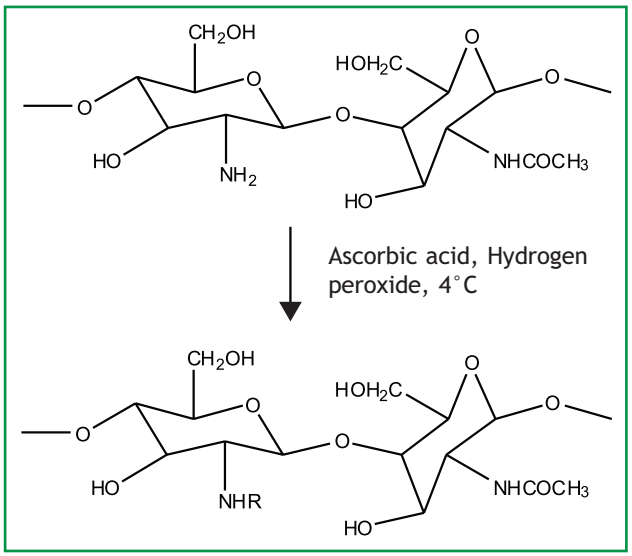
QuEChERS based rapid method for determination of 13 organochlorine pesticides in shrimp by Gas Chromatography-ECD was also developed. Partial validation of the method was carried out for sensitivity and recovery. A limit of detection (LOD) of 15 ppb and a limit of quantification (LOQ) of 25 ppb were achieved. Recovery was more than 80% for all 13 organochlorine pesticides.

GC-MS/MS analytical method development for analysis of OCPs, PCBs and PBDEs

GC-MS/MS analytical parameters were optimized for analysis of major OCPs, PCBs and PBDEs (Total 85 compounds). Chromatographic separation parameters, mass detector parameters and Multiple Reaction Monitoring (MRM) parameters were optimized using GC-MS/MS of NRL, NRC Grapes. PBDEs (Poly Brominated Di-phenyl Ethers) are emerging contaminants in marine environment. In this context, the developed method will be highly significant for monitoring such emerging contaminants in Indian marine environment.

Functionalization of chitosan by grafting phenolic acids

Phenolic acids are natural antioxidants and associated with various health-promoting bioactivities. Phenolic acid grafted chitosan is a new class of novel antioxidant biomaterial with potential application in food sector. A simple synthesis protocol for four phenolic acid grafted chitosan derivatives, namely gallic acid grafted chitosan, coumaric acid grafted chitosan, ferulic acid grafted chitosan and vanillic acid grafted chitosan was optimized. Antioxidant activity of these derivatives was compared.



Reaction scheme of phenolic acid grafting in chitosan

R= Gallic acid/ Coumaric acid/ Ferulic acid/ Vanillic acid moiety

A RedOx pair reagent, Hydrogen peroxide containing Ascorbic acid was used for grafting chitosan with the phenolic acids. Spectrophotometric and FTIR analysis of the derivatives confirmed the success of synthesis.

Antioxidant activity of the derivatives

Antioxidant activity of the derivatives was evaluated by DPPH assay. Ferulic acid grafted chitosan showed best antioxidant activity (0.199 µg/mL) followed by vanillic acid grafted chitosan (0.462 µg/mL), gallic acid grafted chitosan (0.532 µg/mL) and coumaric acid grafted chitosan (0.536 µg/mL). Antimicrobial activity of these derivatives is being investigated.

Antibacterial activity of chitosan derivatives

In initial screening, coumaryl, vanillyl, galloyl and ferulyl chitosan exhibited antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* with an inhibition zone diameter of 26-36 mm. Minimum inhibitory concentrations of these substances were estimated by microtitre plate based antibacterial assay method.

Minimum inhibitory concentration (MIC) of chitosan derivatives

Chitosan derivatives	MIC (percentage)	
	Pseudomonas aeruginosa	*Staphylococcus aureus*
Coumaryl Chitosan	0.087	0.0435
Vanillyl Chitosan	0.131	0.087
Galloyl Chitosan	0.0625	0.0625
Ferulyl Chitosan	0.50	0.025

Detailed antibacterial screening was carried out against 17 pathogenic and spoilage bacteria. Ferulyl chitosan showed antibacterial activity against *Vibrio cholerae*, *Pseudomonas fluorescens*, *Salmonella enteritidis*, *S. arizonae*, *Morganella morganii*, *S. typhimurium* and *Yersinia enterocolitica*. Vanillyl chitosan showed antibacterial activity *against Vibrio cholerae*, *Pseudomonas fluorescens*, *Klebsiella pnemoniae*, *S. enteritidis*, *Aeromonas hydrophila* and *Yersinia enterocolitica*. Coumaryl chitosan showed antibacterial activity *against Vibrio cholerae*, *Pseudomonas fluorescens*, *S. enteritidis*, *Morganella morganii*, *S. typhimurium* and *Yersinia enterocolitica*. Galloyl Chitosan showed antibacterial activity against *Salmonella* Paratyphi A, *Escherichia coli*, *Vibrio cholerae*, *Pseudomonas fluorescens*, *Morganella morganii*, *Shigella flexneri*, *Aeromonas hydrophila*, *S. typhimurium* and *Yersinia enterocolitica*. In terms of susceptibility of food-borne pathogens, *Salmonella* Paratyphi A was most susceptible against galloyl chitosan with an inhibition zone diameter of 30 ± 2 mm. The prolific histamine former *Morganella morganii* was most susceptible against ferulyl chitosan with an inhibition zone diameter of 30 ± 1 mm. Moderate to low inhibition was observed against remaining pathogens by these chitosan derivatives.

Characterization of GAGs from Cuttlefish ink

Glycosaminoglycans (GAGs) are long carbohydrate chains of amino sugars found in all animal life. They combine with protein or lipids as components of tissues, and are largely responsible for the form and organization of the human system. GAGs occur on the surface of the cell and in the gel-like intercellular matrix suggesting a significant biological role.

Glycosaminoglycans were previously isolated by DEAE Ion Exchange Chromatography (IEC) from Cuttlefish ink. They were proved by experiments to possess bioactive potential like anti-oxidant and anti-microbial activities. As part of the characterization process, the fractions collected by DEAE IEC were estimated for sulphate content by the method of Dogson *et al.*, 1956, and FTIR spectrum of GAG sample was also determined.

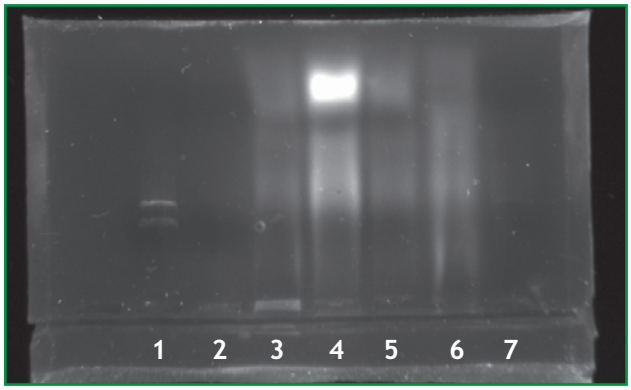
The results revealed that 100 mg of GAG contains 13.5 mg of sulphate content. FTIR Spectrum showed regions that were specific for sulphur, sugar, nitrogen and carbon residues.

GAGs isolated from Cuttlefish have sulphur residues indicating that they are the sulphated type and the sulphate groups may be responsible for the antioxidant property of the isolated GAGs.

Protective effect of the purified squid peptide against hydroxyl-radical-induced DNA damage

Squid peptide was investigated to evaluate the protective effect on free radical induced plasmid pBR

322 DNA damage. Compared with plasmid DNA control, the super coiled (SC) form in DNA was completely converted to the open circular (OC) form due to hydroxyl radical generated from the Fenton reaction. DNA treated with the purified peptide protected DNA from hydroxyl radical damage indicate the positive antioxidant effect.

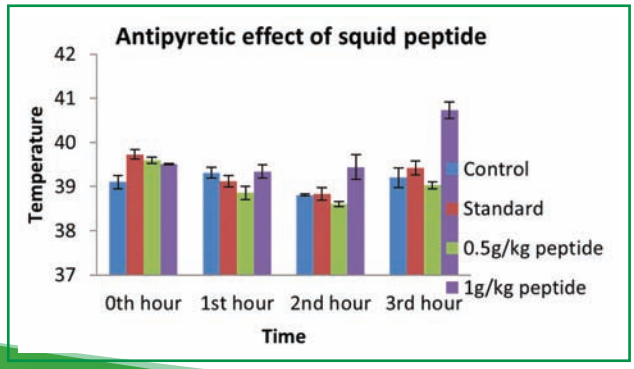


Peptide protection for plasmid DNA

(Lane 1: Negative control plasmid, Lane 2: Positive control plasmid, Lane 3: Squid protein hydrolysate, Lane 4: Above 10kDa, Lane 5: Below 10kDa, Lane 6 : Above 3 kDa, Lane 7: Below 3 kDa)

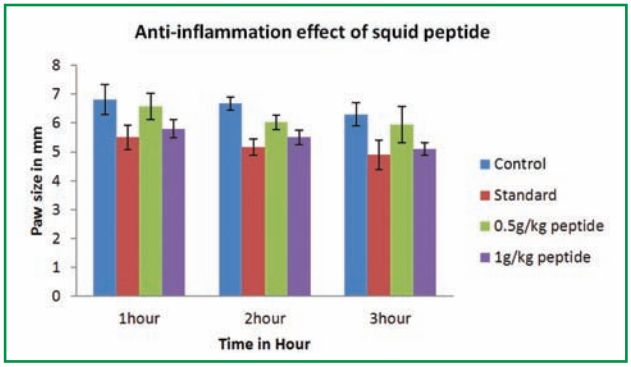
Antipyretic effect of squid peptide in albino rats against Brewer's yeast-induced pyrexia

Adult albino rats (Wistar strain) were divided into four groups of six rats each. The normal body temperature of each rat was measured rectally at pre-determined intervals and recorded. Fever was induced as per the method described by Smith and Hambourger (1935). After measuring the basal rectal temperature, animals were given a subcutaneous injection of 10 ml/kg body wt. of 15% w/v yeast suspension in saline solution. After 19 h of yeast injection, the animals were again restrained in individual cages for the recording of their rectal temperatures. After 19 h of yeast injection, the squid peptide of different concentration 0.5g/kg and 1g/kg was administered orally. The fourth group of animals received the standard drug, Paracetamol (150 mg/kg body wt.) orally. Rats were restrained for recording of their rectal temperatures at the 19th hour, immediately before Paracetamol administration, and again at one hour's interval up to the 23rd h, after yeast injection. Low concentration peptide has reported maximum antipyretic effect compared to high concentration peptide treatment.



Anti-inflammatory effect of squid peptide in albino rats against formalin-induced paw edema

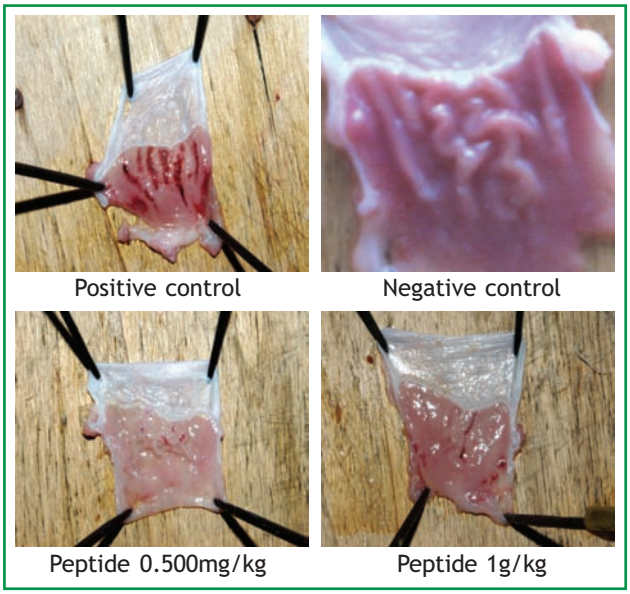
The acute inflammation in rats was induced by formalin according to the modified method described by Galani and Patel (2011). Four groups of six animals each were used for the study. Increased paw thickness was induced by sub-plantar injection of 0.1 mL 1% formalin in normal saline into the right hind paw. The squid peptide was administered at 500 and 1000 mg/kg orally 30 min. before formalin induction. Ibuprofen 100mg/kg was used as standard drug. The control group received the vehicle only. The mean increase in paw size was measured with screw guage at 0, 1, 2, 3 and 4 hours after formalin injection in each group. Initial hour reading was considered as the initial paw size of the animals. The data is shown as an increase in paw thickness and percentage inhibition of paw edema was produced by the treatment groups calculated in comparison with control animals. Pre-treatment with the standard drug; Iibuprofen (100 mg/kg) and squid peptide at doses 200 and 400 mg/kg significantly prevented the increase in thickness of paw edema in a dose dependent manner compared to the control rats.



Anti-ulcer effect of squid peptide in Albino rats against Ethanol-HCl induced gastric ulcer

The study was done according to Takeuchi *et al.*,

1976. Rats were allotted into different groups; each group was containing six animals and fasted for 12 hours prior to ulcer induction. Control group receiving an oral dose of saline (9% NaCl, 5 ml/kg), next second group was received squid extract of different concentration 0.5g/kg and 1g/kg respectively administered continuously for 14 days prior to HCl/EtOH used ulcer induction. 1.5 ml/kg HCl/EtOH was used to induce ulcer and animals were killed four hours after the administration of ulcerogenic agent; their stomach were excised and opened along the great curvature, washed and stretched on cork plates. The surfaces were examined for the presence of lesions and the extent of the lesions was measured. The photographs of stomach lesions have been taken as evidence. Low concentration (0.5mg/kg) peptide treated animals showed less susceptiblity to ulcer, since limited lesions were seen after treatment whereas high concentration (1g/kg) peptide was found to be inferior to low concentration in antiulcer property.



Anti-ulcer effect of squid peptide

Nutritional and pharmacological evaluation of marine molecules in alleviating diseases and disorders

Principal Investigator : Dr. R. Anandan

Co-Investigators : Dr. P.T. Lakshmanan, Dr. Suseela Mathew, Dr. A.A. Zynudheen and Dr. Niladri Sekhar Chatterjee

Stabilization of Succinyl chitosan-fish collagen-PEG hydrogel

A wound healing hydrogel based on Succinyl chitosan and PEG containing encapsulated curcumin was earlier developed. However there was problem of long term gel stability. Again including collagen in the gel was also considered because of its efficacy in tissue regeneration. It has been reported that phenolic acids can be used to crosslink gelatin. Taking this lead experiments were done to crosslink ternary gel of Succinyl chitosan-Fish collagen-PEG with Coumaric acid. Gelation was achieved successfully by heating the mixture at 60°C for one hour, followed by freezing at -20°C for one hour. The gel when brought to room temperature maintained its gel property. Stability of the gel was studied by storing the gel at room temperature for two months. No change in viscosity of the gel was observed.

Hydrogel formulation

One pot gelation of ternary blend hydrogel containing microencapsulated curcumin

The manufacturing process was simplified by an innovative one pot gelation technique. This could avoid excess use of alcohol for precipitation of Succinyl

chitosan and prolonged concentration steps could be avoided. The experiment was a success in making the hydrogel in the same reaction pot of Succinyl chitosan synthesis. Coumaric acid was used as a crosslinker and a short heating, freezing and thawing cycle lead to single pot gelation of the hydrogel.

Histopathological analysis of healed wound tissue

The developed hydrogel was evaluated for its efficacy for wound healing in experimental animal model against a commercial hydrogel formulation. Histopathological analysis of healed skin tissue was carried out which showed comparable efficacy of the developed hydrogel with that of commercial hydrogel.

Succinyl chitosan based hydro-alcohol hand sanitizer

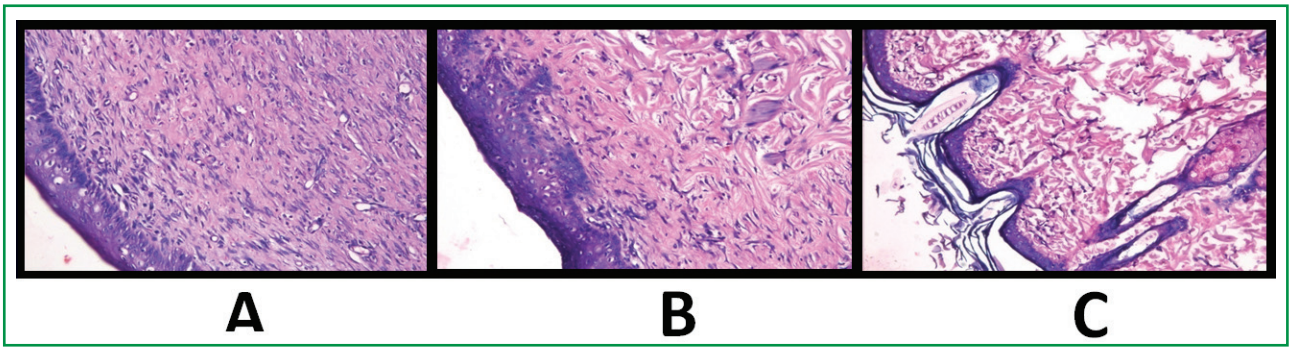
Hand sanitizer

Hand sanitizers available in the market containing synthetic antibacterial compounds (mostly containing Triclosan) cannot be used by workers in fish processing plants due to regulatory reasons. Again these market available hand sanitizers mostly contain synthetic acrylogel polymers. Succinyl chitosan is a semi synthetic biopolymer with excellent biocompatibility and moisture retention capacity.

Synthesis of an amphiphilic Succinyl chitosan polymer was optimized and a hydro-alcohol hand sanitizer based on this was developed. The hand sanitizer contains 67% ethanol and 0.1% Coumaric acid. Coumaric acid was used as an ionic crosslinker of the hand gel, as well as a natural antibacterial agent. The efficacy of the hand sanitizer was evaluated by ASTM Glove Juice method with positive results.

Synergistic effects of dietary squalene and n-3 poly unsaturated fatty acids (PUFA) in modulating aging process

Oxidative stress induced aberrations in the fatty acid composition of the central nervous system during progression of aging are known to alter homeostatic processes of the whole organism. Antioxidants that accumulate in the brain and neural tissue are potential candidates for prevention or treatment of disorders involving oxidative damage during disease progression. An attempt has been made to examine the antioxidant effect of squalene against n-3 poly unsaturated fatty acids (PUFA)-mediated oxidative stress in young and aged rats with respect to the changes in lipid peroxidation, enzymatic and non-enzymatic antioxidant status. Dietary co-intake of squalene significantly attenuated n-3 PUFA-mediated oxidative stress in different regions of brain tissue of young and aged rats and maintained the cerebral antioxidant status at near normalcy. Though *per se* dietary supplementation of n-3 PUFA significantly elevated the enzymic and non-enzymic antioxidant levels in young rats, it diminished the antioxidant profiles in aged brain striatum, cortex and hippocampus regions. The results of the present study indicated that the combined dietary supplementation of squalene and n-3 PUFA might be the viable therapeutic potential to ameliorate the age-associated oxidative stress in brain tissue.



A. Healed skin tissue treated by commercial formulation; B. Healed tissue treated by Developed Hydrogel Formulation; C. Control tissue (No treatment)

Engineering Division

Research projects handled

- Enhancing the fuel efficiency and safety of mechanized fishing vessel systems
- Innovative packaging techniques for processing and preservation of fish products
- Thermal and non-thermal technologies for processing and packaging of fish products

Chief findings

- Carried out analysis of the data on manufacturing and construction facilities available throughout Kerala for catering fishing vessel production.
- Data were collected and analyzed on the mechanical equipment used in fishing vessels, *viz.*, winch system, engine, safety equipment and alternate energy backup systems from 10 fishing vessels at Diu.
- Fabricated a small prototype of Water Chilling Unit using solar energy.
- Fabrication of a prototype of band saw machine for frozen fish mince blocks/fresh fish is nearing completion.
- Introduced a new method for validation and certification of diesel engine for marine applications.
- Designed and developed a cost effective table-top De-scaling Machine to remove the scales of marine as well as freshwater fishes in food grade SS 304.
- Designed and developed a washing vessel for prawn shell which removes Sodium hydroxide from the prawn shell for further processing.

Report of the work done

Enhancing the fuel efficiency and safety of mechanized fishing vessel systems

Principal Investigator : Shri M. Nasser

Co-Investigators : Dr. V. Geethalakshmi, Dr. S. Ashaletha, Shri Ankur Nagori and Smt. Arathy Ashok (At Visakhapatnam RC)

Analysis of the data of boat building facilities

Study has revealed that fishermen had started building steel fishing vessels from the second half of 1980's. This has been started for the first time in Kerala on the west coast at Cochin for Munambam fishermen and later spread to Kollam and recently to Kozhikode. Higher powered engines were available only as marine engines and unaffordable to the operators. The change over in material of construction has removed the limitation in going for higher engines. Introduction of higher powered Chinese engines at around 60% of the cost of Indian engines and drop in fish catch has encouraged the operators to increase power of the

fishing vessels considerably in a bid to get more power for fishing. Selection of higher powered engines leads to higher length of vessel for obtaining higher possible speed.

Data has been collected regarding mechanical systems and hardware items for safety used on the fishing vessel like winch system, alternate energy backups like generators, invertors, main engine parts, water pumping systems for different fishing vessels of various categories (based on dimensions and type of fishing methods) etc. from Kerala and Diu.

Analysis has shown that 91% of trawlers operating in Cochin and Munambam area are steel vessels. Out of this 41% are fitted with engines in the range 100-200 Hp, 26% with engines of 200-300 Hp range, 17% with engines of 300-400 Hp range and 16% with engines above 400 Hp. 44% of the vessels are below 20m whereas 56% are above 20m in length. 72% of trawlers in Kollam area have been built in steel. 69% use 100-200 Hp engines, 15% use 200-300 Hp engines, 5% use 300-400 Hp engines and 4% use above 400 Hp engines. 67% of the vessels are in 15-20m range whereas 11% are above 20m. Around 18% trawlers in Kozhikode region has been built in steel. 46% are fitted with 100-200 Hp engines, 21% fitted with 200-300 Hp, 19% fitted with 300-400 Hp and 11% fitted with above 400 Hp engines. 87% of the vessels are below 20m whereas 13% above 20m in length.

Data collection

Under the project, detailed secondary data on dimensions, type and installed power of mechanized boats were collected. The main landing centres at Diu are Vanakbara, Saudwadi, Diu and Ghogla. Vanakbara is a major mechanized landing centre with 965 mechanized boats engaged in fishing of which 642 are wooden and 311 are made of fiberglass. The profile of these landing centres along with the various facilities available for boat building, repair, hardware requirements, etc. was collected from Diu. Based on the dimensions, the boats were categorized into four groups and a pps sample was selected for detailed hull profiling study envisaged under the project.

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 with regard 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 ($n_{h)}$ were estimated and sub-samples drawn for detailed study.

Based on the data collected, the technology transformations with respect to operational characteristics, variations in size and installed power, propulsion characteristics, materials for construction and manufacturing methods were recorded.

The major observations made considering the relevance for the study were the transformations in boat material from wood to steel and FRP coated wood, increase of boat length from 25 to 75', increase in store size from 10 X 3 feet to 45 X 10 feet, duration of trip from three to 15-20 days, modifications in gear types carried in a vessel for a trip from two or three types of 35-40 mm to 15 types of 400-3000 mm size, change in propeller size-length of blade from 28" to 60", material for propeller from gun metal to manganese and bronze, escalation in engine power from 150 to 490 Hp over a period of 15-20 years from 1985 etc. It was observed that a reduction in size of fishing vessels from 60-65 feet to 35-40 feet is being implemented in some locations by considering the economics.

Some observations to be specially mentioned were also there like the change in material used for making boat was brought in from wood to steel and FRP, the appropriate changes in boat designs were not done, as the local craftsmen had no idea of the variations in specific parameters of different materials to be taken into account. The change was brought in through trial and error wasting money and effort, which are still not standardized. The rapidly changing

demands of fisherfolk regarding boat dimensions are another issue pointed out by the craftsmen. Steps are initiated for assessment of the consequences of the major transformations recorded.

Water chilling unit using solar energy

Fabrication work of a prototype for water chilling unit has been completed. It is based on vapour compression refrigeration system using solar energy. A 24V DC condensing unit has been used to provide the chilling effect inside the leak proof vessel which is wrapped around by cooling coils. 24 V battery backup charged by solar energy is provided to run the condensing unit. Water at the room temperature is sprayed through a very fine spray nozzle inside the vessel and chilled water is collected at the bottom of the vessel.

Literature regarding steam generation/boiling of water using renewable energy is collected and procurement of materials for fabrication of water boiling unit through solar /biomass energy is started.

Water chilling unit using solar energy

Band Saw Machine

Fabrication work of a prototype for indigenous band saw machine for cutting frozen fish mince blocks as well as fresh fish is nearing completion. At a time two blocks can be cut by the machine. Chain drive is used to drive the follower pulley on which band saw is mounted. A 2 Hp motor is used to drive the driver pulley along with RPM reduction through belt drive.

Drying trials in the CIFT solar dryer

Drying trials has been performed for 10 kg turmeric in solar dryer developed by CIFT.

New method for engine validation

As the 12 hour testing of diesel engines for ensuring their adequacy for good performance onboard vessel has been found unacceptable owing to wide change in engine use pattern over years as revealed by studies, new validation methods were proposed last year. A validation method of 264 hours has been fixed for engines above 30 Hp and 144 hours has been fixed for engines below 30 Hp. An MoU has been signed with M/s Mahindra and Mahindra for validating and certifying their engines for next two years and accordingly the110 Hp industrial engine IND61105N manufactured by M/s Mahindra and Mahindra was validated in their test bed at the Mahindra Research Valley, near Chennai. The validation consisted of 12 days continuous running of the engine and recording of various performance parameters every 30 minutes. The data was analyzed and found that the performance of the engine satisfy the ongoing use pattern of engine onboard commercial fishing vessels. A test certificate has been issued.

Engine testing

Another MoU has been signed with M/s Lombardini India Ltd. for validating and certifying their engines for next two years and accordingly the 7 KW industrial engine 15LD440 manufactured by M/s Kholer Power India was validated in their test bed at Aurangabad. The validation consisted of seven days continuous running of the engine and recording of various performance parameters every 30 minutes. The data was analyzed and found that the performance of the engine satisfy the ongoing use pattern of engine onboard commercial fishing vessels. A test certificate has been issued. Data on the performance of this engine onboard two commercial fishing vessels are being monitored to validate the procedure.

Also validated and certified a diesel engine of 110 Hp for marine application of M/s Mahindra and Mahindra, Mumbai during June 2013.

Washing vessel for prawn shell

Designed and developed a washing vessel for prawn shell which removes Sodium hydroxide (NaOH) from the prawn shell for further processing.

Extension, Information and Statistics Division

Research projects handled

- Evaluation of technology transfer models in fisheries sector
- Management dimensions in the fisheries sector - Policies, issues and implications
- Enhancing the fuel efficiency and safety of mechanized fishing vessel systems
- Mobilizing mass media support for sharing agro information
- Responsible harvesting and utilization of selected small pelagics and freshwater fishes

Chief findings

- Fishermen at V.R. Sagar, Andhra Pradesh had a symbolic adoption index score of 15.38% on improved fishing and hygienic fish handling which indicated their negative decision on the adoption of improved technological practices.
- The mean Socio-Economic Evaluation Index (SEEI) of these fishermen was found to be 49.46 (S.D: 3.21).
- Technology transfer programmes were conducted at Thaikkal, Alappuzha; Meenkara, Palakkad and Mangamaripeta, Andhra Pradesh on the subject of 'Hygienic fish handling and value added fishery products' in collaboration with NGOs.
- An analysis of decision making behavior of marine fishermen (n: 32) was carried out at Peddajalaripeta, Visakhapatnam. The innovation decision efficiency index (IDEI) of marine fishermen in Andhra Pradesh was calculated and the overall decision making index was 53.67.
- The operational cost of the dolnet fishery in Raigad, Maharashtra revealed high maintenance and repairing cost of craft, gear and engine due to over-use of crafts by the fishermen beyond their effective life.
- A logistic model has been fitted to assess the fishermen co-operative members' willingness-to-pay (WTP) for the improved marketing services.
- Stakeholders/SHGs belonging to the consortium for fisherwomen empowerment in Andhra Pradesh, namely, women SHGs *Godavari Maha Samakhya* (GMS), Tallarevu, East Godavari district had an average overall empowerment index score of 79.55.
- With the introduction of Pacific white shrimp in the processing industries of Andhra Pradesh, the average installed capacity of the firms was raised from 30 MT/day to 50 MT/day.
- A GIS based conceptual model for reservoir fisheries information management system was developed.

Evaluation of technology transfer models in fisheries sector

Principal Investigator : Dr. S. Balasubramaniam

Co-Investigators : Dr. S. Ashaletha, Dr. George Ninan, Dr. J. Charles Jeeva, Smt. P. Jeyanthi and Smt. Arathy Ashok (At Visakhapatnam RC)

Evaluation of technology transfer models

The data on socio-economic and technological (n:26) variables of reservoir fisherfolk at P.M. Valasa, V.R. Sagar, AP had revealed that the fishermen had invested (on an average) ₹ 14,500/- per fishing unit and their annual income was estimated at ₹ 43,135/-. The average age was found to be 40 with 17 years of experience in fishing and most of them had education up to primary school. The extent of awareness and adoption of improved fishing and hygienic fish handling practices were assessed among these reservoir fisherfolk and their mean Awareness Score was 61.05%. The extent of adoption of eight improved practices was found to be 15.38%. The technological needs of fishermen were also estimated.

To evaluate the socio-economic conditions of fishermen, a generic model of Socio-Economic Evaluation Index (SEEI) has been developed in the study and used. The index consisted of the components such as age (6%), experience (8%), educational level (8%), family size (4%), occupation (6%), social participation (5%), crew engaged (4%), sources of information (4%), land ownership (6%), house ownership (6%), fishing craft owned (4%), fishing nets owned (4%), total investment on fishing unit (7%), total annual income (22%) and entrepreneurial activity undertaken (6%), making a total of 100.

The mean Socio-Economic Evaluation Index of these fishermen was found to be 49.46 with a standard deviation of 3.21. Though they had higher scores on socio-personal variables (mean : 66%), it is seen that they had lower scores on economic variables (mean : 34%) resulting in the average SEEI score of 49.46%.

The data on socio-economic variables were collected from 40 fishermen respondents in four villages *viz.*, Hosamala, N. Begur, Ankananthapura and Udboor of H.D. Kotte Taluk located near Kabini reservoir area. Fishermen had used bamboo made coracles (₹ 3000/- to ₹ 5000/-) and nylon monofilament gillnets for fishing. The total investment on craft and gear was about ₹ 7,500/- to ₹ 20,000/-. The fishing trip duration was about 8 to 10 hrs per day, the number of fishing days was 250 to 300 per year and the number of crew members were two per coracle.

The average catch was 10 kg per day during lean season (5 months) and 25 kg per day during peak

Technological assessment of fisherfolk in progress at V.R. Sagar

Data collection in progress

Tribal fishers with FRP coracle

season (4 months). The average price of fish sold to the Society was ₹ 50/- per kg. The annual income varied from ₹ 50,000/- to ₹ 1,00,000/-. The fishermen felt that it would take time to replace all the bamboo coracles (in each hamlet,100-140 coracles) with FRP coracles in the reservoir areas.

During the period, two technology interventional programmes were conducted in the subject of 'Responsible fishing and extension methods' at Frasergunj and Nimpith Centres in West Bengal in collaboration with Frasergunj Tribal Fishermen Association and R.A. Krishi Vigyan Kendra, Nimpith, respectively. Data were collected from 24 tribal fisherfolk respondents from Frasergunj and 25 tribal fisherfolk respondents from Nimpith regarding their socio-economic conditions. For measuring socio-economic parameters, the socio-economic evaluation index developed earlier has been used in the study. Data were also collected on the extent of awareness and adoption of selected improved practices/ technologies. It is observed that the respondents were aware about the technologies such as the use of FRP crafts, use of inboard/outboard engines, use of ice for fish preservation and hygienic fish handling methods. On responsible fishing techniques, the fisherfolk reported a training need requirement during the pre-training evaluation. The post training evaluation revealed that the trainees had increased their extent of awareness on the responsible fishing techniques.

Responsible fishing and extension methods training

Based on the technology needs assessed, awareness classes were held on selected theme areas like fuel saving fishing methods, value addition of fish, entrepreneurship development. Accordingly, in collaboration with Society for Assistance to Fisherwomen, Department of Fisheries, Govt. of Kerala, the first programme was conducted at Kuzhippilly, Ernakulam for 25 women comprising of two women each representing different self help groups. An awareness cum demonstration programme was held on making value added products from fish and also on entrepreneurship development.

The technology transfer model followed at Kuzhippilly was the Dissemination model, where the perspective is that transfer processes can be successful when experts transfer specialized knowledge to a willing recipient. But here the technology transfer process was almost in the following pattern. The extent of technology need perception by clients was at a lower level as the programme was visualized by the development agency, SAF.

The TOT should have followed different pattern as shown below for effectiveness. SGHs can either approach CIFT directly or through SAF. Demand driven

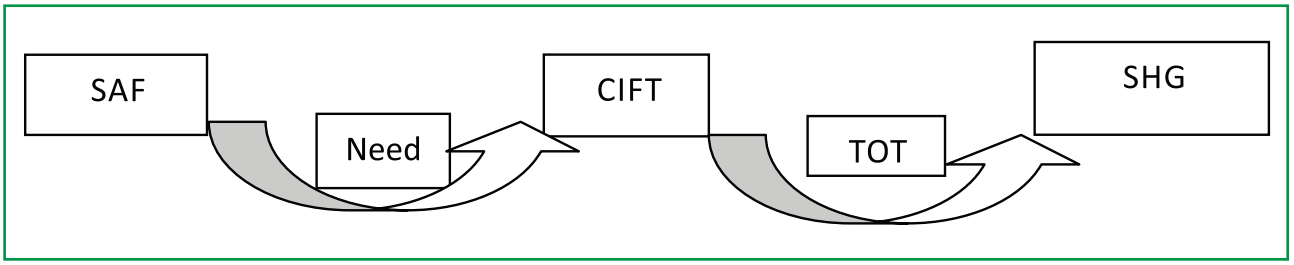
model is nullified here. In this connection, a study is initiated to analyze the TOT efforts taken by different agencies in similar lines among coastal fisherfolk, the lessons of which will be highly helpful for achieving the project objectives.

Another training was organized in ATIC in collaboration with ATMA and RHSSP project of CIFT, following Knowledge utilization model which emphasizes strategies that effectively deliver knowledge to the recipients. The effectiveness of the training was comparatively better. Here the model followed was as in Figure shown below:

Later, interactive discussions were continued with fishery stakeholders for appraisal of the problems experienced by them in the sector and for assessing technology needs. During the second phase of the study, one meeting was arranged for fisherfolk involved in ring seine sector, which contribute 30% of the total landings.

Technology support sought by fishermen (N=24)

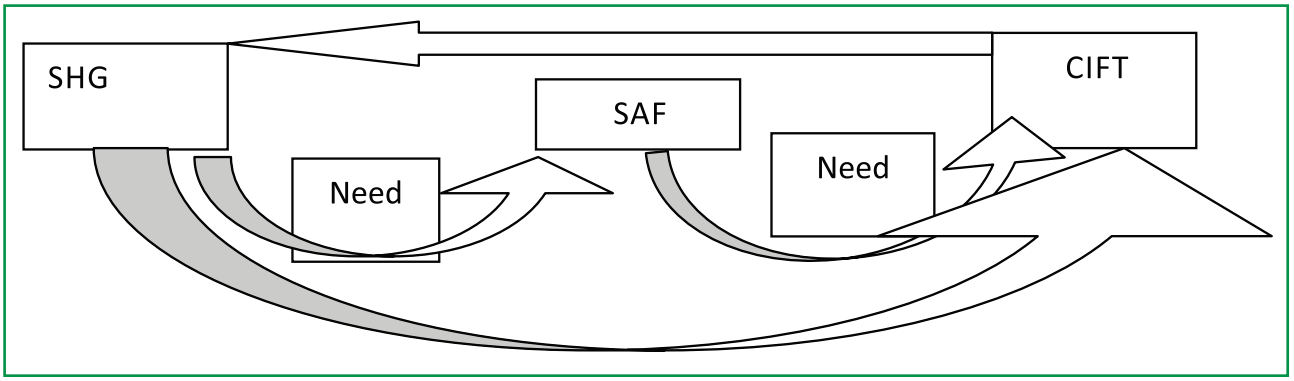
No	Technology supports sought	Priority Ranks
1	Support to identify the right engine-gear and propeller to get maximum speed at less fuel	I
2	Good landing facility at harbour, which will equip them to safely land at peak time also	II
3	Support to use the electronic devices like GPS, eco sounder with full efficiency etc.	III
4	Unfelt needs like methods to estimate annual profit loss	IV
5	Methods to assess fuel usage during fishing (active and passive time)	V
6	Any method to reduce investment and increase income	VI



Flawed Model

The fishermen were welcoming any method to reduce investment and increase income from the occupation. They were all admitting that, though they are investing heavy amounts in making boat, the technical know-how on ideal boat, engine power requirement, gear combination, propeller dimension, pitch etc. are almost lacking among fisherfolk.

As per the responses collected, training programmes are being planned. Further, the TOT models followed by different development agencies were observed. A successful transfer of technology, however, might not be guaranteed simply by using a



Ideal model

particular model, as nature and purpose of technology varies and also application is diversified according to stakeholder interests and location.

Under this project, a technology transfer interventional programme on "Hygienic fish handling and production of value added fishery products" was also conducted at Thaikkal, Alappuzha district during 25-26 February, 2014. Fourty sponsored group members of Fishermen Welfare Development Co-operative Society (FWDCS), Thaikkal participated in the training. Data on the socio-economic conditions of the respondents were collected. The average age was found to be 39 years and most of them had high school education. 76% of respondents belonged to fishermen households and 23.5% of the respondents had entrepreneurial activity in addition to household work. Besides, the membership in the Cooperative Society, all of them had association with SHGs/NGOs. Their family annual income (men) was estimated at ₹ 97,206/- per year.

Shri K.C. Sivanand, Matsyafed inaugurating the training

The awareness of respondents and their symbolic adoption (decision to use) about ten improved practices on hygienic fish handling and production of value added fish products were evaluated. The pre-training and post-training evaluation results revealed that their mean awareness scores (46.76% to 91.17%) and symbolic adoption scores (42% to 91%) had significantly increased ($t = 12.40^{**}$ at 1% level of significance) after the training.

A technology training intervention was conducted on Hygienic handling of fish and Preparation of value added fish products at Mangamaripeta fishing village for the benefit of 30 women belonging to fishermen

Training programme at Mangamaripeta, Visakhapatnam

community. The training programme was arranged in collaboration with the NGO, District Fishermen Youth Welfare Association. Effectiveness of the training programme has been assessed as change in awareness and symbolic adoption of 10 selected practices related to hygienic handling of fish and preparation and marketing of value added fish products. Awareness and decision to adopt the practice for each individual were noted before and after the training programme.

The average age of the trainees were found to be 31.97. Thirteen percent of the trainees were illiterate and the average family size of the members was 4.63. All the trainees belong to fishermen community and their average monthly family income was found to be ₹ 6313.67/-. Their social participation status revealed that all of them were members in different Self Help Groups (SHGs). Ninety percent of the trainees were unemployed and 70 percent of the people have undergone some sort of training before. After attending the training programme, the results showed that there is a significant increase in the awareness scores as well as symbolic adoption scores. There was 43.5 percent increase in the awareness

Participants attending practical training

Technological needs assessment of fisherfolk at Meenkara

index and 42.3 percent increase in the average adoption score of the trainees after attending the two days training programme. Thus the study revealed that the training had a positive impact on the awareness and adoption levels of the trainees on different hygienic handling practices of fish and preparation of value added fish products.

Data were also collected from 25 respondents from Meenkara SC/ST Reservoir Fishermen Cooperative Society regarding their socio-economic conditions and technological needs. For measuring the socio-economic variables, the Socio-Economic Evaluation Index (SEEI) developed earlier in the study (with 15 components and weightages) was used.

Using the structured schedules, the pre-training and post-training evaluation were conducted. The results of evaluation of pre-training and post-training (Training on hygienic fish handling and value added products) revealed that their mean awareness index scores and symbolic adoption scores had significantly increased after the training.

Analysis of the decision making behaviour of fishermen with reference to fishing related innovations and the associated factors of Visakhapatnam

A questionnaire was prepared to analyze the decision making behaviour of fishermen with regard to fishing related innovations/practice and survey was conducted among 32 fishermen engaged in hook and line fisheries in Peddajalaripeta fishing village of Visakhapatnam. The questionnaire include different dimensions *viz*; socio-personal variables, asset ownership, access to inputs, technology use details, organizational participation and the perceived stage of fishermen in the adoption of fishing related technology/practice. Eight technologies/practices *viz*; improved craft material/design, use of improved gear materials, use of inboard/outboard engine, use of ice/ice box, use of fish aggregating devices, use of navigation tools, responsible fishing and conservation methods in fisheries and use of improved packaging materials for transport/sale. The operationalization or measurement of decision-making was done based on Jeeva *et al*. (2011) in which relative position of the individual in the five stages of decision making viz; knowledge, persuasion, decision, implementation and confirmation for each selected technology/ practice was measured. The innovation decision efficiency index was calculated based on the formula; IDEI = (Total score of an individual passing through the five stages/ Maximum score)*100.

Based on the innovation decision making index, overall decision making index was found to be 53.67. The indices on passing through the five stages of innovation decision process *viz*., knowledge, persuasion, decision, implementation and confirmation were 73.44, 67.19, 42.58, 42.58, and 42.58 respectively. The results showed that the lowest levels of innovation decision scores were obtained in case of use of fish aggregating devices, responsible fishing and conservation methods in fisheries and use of improved packaging materials for transport or sale. It also revealed that the individual who has passed the decision stage were passing through the implementation and confirmation stages also. Appropriate extension models which can facilitate the persuasion and decision regarding the technologies

Training programme at Mangamaripeta, Visakhapatnam

can enhance the decision making efficiency and further adoption of the technologies.

In an inland fishing centre at C.Valasa, V.R. Sagar reservoir site, AP, the decision making behavior index developed was used for the selected technologies and it was calculated taking into consideration four stages of decision making *viz.*, awareness, interest, evaluation and symbolic decision to use the practice. The index score was found to be 15.38 per cent only.

Determining the economic efficiency of the motorized and non-motorized fishing units

Data had been collected from motorized and non-motorized fishing units, *viz.*, plywood craft (motorized), Catamaran (motorized) and Catamaran (non-motorized) at Cheriyamuttam (Poonthura), Thiruvananthapuram. Data collection of small scale fishing units at Raigad district, Maharashtra had also been initiated among dolnetters and gillnetters of both motorized and non-motorized category.

In India, small scale fisheries contributed 81 per cent to the fisheries sector (Kathiah, 2008). According to FAO (1999), small scale fisheries/traditional fisheries is defined as 'fishing households using relatively small amount of capital and energy, relatively small fishing vessels, making short fishing trips, close to shore, and mainly for local consumption'. Dolnets are the fixed bagnets which are used indigenously in two states, Maharashtra and Gujarat exclusively along the north-west coast of India (Mane and Sundaram, 2011). In Maharashtra, it is one of the prominent gears used by the fishermen which are popularly known as 'Bokshi' in local language. The species caught by the dolnet are Bombay duck, Catfishes, Croackers, Ribbon fishes, pomfrets, lobsters and prawns etc. and the major targeted species by the gear are prawns and Bombay duck in Maharashtra and Gujarat respectively (Manojkumar and Dineshbabu, 1999). The economics of dolnet fishing operation in Maharashtra were worked out as part of a larger study. Dolnet - motorized fishermen use wooden craft with length varied from 6.1 to 8.22 m and use 2 to 5 nets of 50-60 kg per net.

Wooden craft (6.1 – 8.22m L_{OA}) used by fishermen at Raigad district, Maharashtra

Data collection at Raigad district, Maharashtra

The total fixed cost comprises of costs of craft, gear and engine in which more than 80 per cent is on investment on craft alone. Total variable cost includes expenditure on fuel, repair and maintenance, charges on crew and ice. Major share of variable cost is on repair and maintenance (37%) due to their practice of operating craft, gear and engine beyond their productive life period without replacement. Fuel cost is low (13%) among the variable cost as their fishing grounds are near to shore.

The economics of operation of dolnet craft (motorized) with 6.1 to 8.22 m L_{OA} showed that the total cost and net income earned by the dolnet fisher was ₹ 91250/- and ₹ 58750/- per annum. The operational cost of the dolnet fishery revealed high maintenance and repairing cost of craft, gear and engine.

The Cobb-Douglas Production Function was fitted to assess the efficiency of the plywood craft in the selected fishing village based on resource use efficiency. The explanatory variables selected were craft length, cost of craft, cost of gear, cost of engine, fuel charges, cost of ice, crew charges, repair cost of craft, repair cost of gear and repair cost of engine. The fishermen income was taken as dependent variable which was calculated by multiplying the quantity of species caught with their respective prices for the particular year. It was observed from the results that cost of craft, cost of gear, cost of engine,

repair cost of craft, gear and engine showed positive and significant influence on fishermen income. The craft length, fuel charges and crew charges had negative effect on fishermen income and reduced the same by 15.00, 5.60 and 24.93 per cent.

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

Principal Investigator : Dr. Nikita Gopal

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Data generation

The following three types of stakeholder organizations were selected for data generation under the component on "Success indicators for the functioning of stakeholder organizations in input delivery and market interventions" : i) Fishermen and Fisherwomen Co-operative Societies: The Nagai District Fishermen Sangams Federation, Nagapattinam; and Fishermen Co-operative Society Njarakkal, Ernakulam, ii) Aquaculture sector in Andhra Pradesh, and iii) Boat builders in Gujarat.

For the Nagai District Fishermen Sangam Federation, Nagapattinam the analysis revealed that the members were fishermen operating traditional FRP crafts or *Vallams* and going on single day fishing trips. Survey covered 27 respondent fishermen from the villages of Nagapattinam, Karakkal and Tharangampadi belonging to two primary Societies (out of a total 26 Societies under the Federation). The Federation had total transactions of ₹ 1. 05 crore during 2012-13.

Auctioning is facilitated by the Society and two commission agents and five traders are involved in marketing. Low value fishes are auctioned on landing and high value fishes are iced and auctioned to merchants. 5% of the sales amount goes for commissions and savings, 2% for administrative expenses of the Society, 1% to the auctioneer engaged by Society and 2% as compulsory savings (for meeting lean season expenses).

'Valloms' opetrated in the Nagapattinam region

From the Fishermen Co-operative Society, Njarakkal, Ernakulam, data regarding the perception of members on Co-operative Services were collected from 40 fishermen. The perception on a five point scale for the following aspects were collected: co-operative as a potential and attractive credit source; ensuring unity; satisfying the needs; marketing avenue for fish catch; and improvement in standard of living of fishermen.

The willingness-to-pay for the respondents on improving the co-operative services has also been collected. A logistic model has been fitted to assess the fishermen co-operative members' willingness-to-

Logistic results of Willingness-To-Pay for improved fish marketing services

Parameter	Estimate
Intercept	11.965
Age	0.767
Education	- 0.653
Membership	- 0.571
Member's satisfaction	11.082**
Fish Marketing through Co-operatives	- 23.720**
Likelihood ratio	21.802 **

** *Significant at 1% level*

Members of the Kanaka Mahalakshmi Fisher women Co-operative Society undergoing training at Visakhapatnam

pay (WTP) for the improved marketing services. Improved marketing services include establishment of cold storage facilities by the Co-operatives for facilitating the fish marketing activities of respondents towards reducing loss due to post-harvest handling. The model has been run using the variables *viz*., age, education, membership, satisfaction and fish marketing activities of respondents. The likelihood ratio (chi-square value) was highly significant. Among the variables studied, member's satisfactions on co-operative activities were the most significant factor deciding their willingness-to-pay for the improved marketing services. The variables such as age, education and membership were insignificant.

For Fisherwomen Co-operatives, a survey was conducted among the members of different SHGs in the two selected villages of CBV Palem and Uppada. These SHGs belonged to a consortium for fisherwomen empowerment in Andhra Pradesh, *Godavari Maha Samakhya* (GMS). The consortium is located in Tallarevu, East Godavari district of Andhra Pradesh. The consortium was formed as a part of Andhra Pradesh Rural Poverty Reduction Programme which aims at the poverty reduction of the households through women empowerment. Results of the study revealed the following: Average age of respondents is 35.83. Even though 33.33 per cent of the respondents have no formal education, 100 per cent of the respondents were able to read and write. On an average 36.27 per cent of the family income is contributed by the women members only. 48.19 per cent of the family income is spent towards household food needs and 17.06 per cent towards educational expenses of children.

Household vulnerability index were calculated which gave an average index of 75.00 and the households can be put under less vulnerable category. Empowerment indices have also given high scores *viz*; access or control over assets (66.67), gain in awareness and skill (70.00), household decision making (94.44), psychological empowerment (95.83) and political/ legal empowerment (70.83). Average overall empowerment score was 79.55. Results showed that GMS Society play a major role in improving the household welfare as well as empowerment of women.

Study on impact of introduction of *Litopenaeus vannamei* on shrimp production and processing industry of Andhra Pradesh

Export oriented shrimp production has been showing an increasing trend in the last decade. Introduction of new shrimp species *Litopenaeus vannamei* has brought a sea change in the Indian mp production and processing. Andhra Pradesh being the leading State in cultured shrimp production, a study was conducted to analyze the changing trends in cultured shrimp production, and it's impact on the seafood processing scenario of the state. Results of the study showed that 83.6 per cent of the cultured shrimp production in Andhra Pradesh is attributed to *L. vannamei*. With the increase in production, structural changes became a pre-requisite for the seafood processing firms and they have incorporated changes such as establishment of additional plants, increasing the capacity utilization of existing plants and installation of more efficient equipments. 37.12 per cent increase in the installed capacity and 53.10 per cent increase in capacity utilization of shrimp

Seafood processing in progress

processing firms has been observed during the study. Spill over effects are visible in increased employment opportunities and income of the employees. Strict implementation of scientific farming techniques and quality management is vital to sustain the growth of seafood processing industry. Organizations like CIFT and MPEDA can act as potential mediators for product diversification and solving in trade related issues of *L.vannamei*.

Economic analysis of fish drying methods

Data related to raw material cost, drying cost, packing, transportation cost, marketing cost and margin involved and finally the price realized in the traditional methods of drying fishes were collected. Also collected information regarding the dry fish marketing channels for Catfish, Bombay duck and shrimp, the major dry fish species in Okha and Navabandar region. Studies have been conducted to compare the economics of operation of drying fish between the traditional sun drying method and using CIFT solar dryer using 5kg of fish samples of Ribbonfish, Horse mackerel and Croakers from Veraval fish market. The drying season is from September to May. The fishes used for drying purpose were Catfish, Leather jacket, Bombay duck and shrimp. Export of dry fish is to Sri Lanka. Fish meal from waste is used as a poultry feed which is transported to different states like Punjab, Maharashtra, Andhra Pradesh and Gujarat by lorry of capacity 17 tonnes charging at a rate of ₹ 3,500 per tone. The labour used for dry fish industry were both gents and ladies, Normally gents are used for operations like cutting, loading and unloading, packing and transportation etc., whereas ladies are used for cleaning, washing, salting, heaping, drying etc. The monthly salary for men and wemen was ₹ 8,000/- and ₹ 6,200/-, respectively.

Study on boat building in Gujarat

Data were collected on economics of construction of traditional wooden boats in Veraval. It was found that the cost of steel boat under 62 feet is ₹ 12 lakhs whereas wooden boat of the same size cost ₹ 13.7 lakhs excluding the cost of engines and other accessories, cold storage, diesel tank, driver's cabin and toilet etc. In case of wooden boat building, the labour cost is lower than the construction of steel boat to the tune of 38 per cent.

Economics of boat construction survey at Veraval

Assessment of the losses occurring at different stages of harvest and post harvest activities in marine and inland fisheries

Post harvest losses during marketing at two wholesale markets of Chennai, Tamil Nadu were estimated as 6.16% (fresh) and 12.34% (dry). For three retail markets at Chennai, the mean losses were estimated as 3.45% (fresh) and 10.17% (dry). Losses from motorized (1.21%) and mechanized fishing boat operators (9.12%) at Kannur, Kerala and selected centres of Tamil Nadu (12.21%) were also estimated. Analysis of month-wise catch details of Meenkara reservoir, Palghat, Kerala was carried out and it was observed that no loss at harvest and post harvest stages were reported as fish had high demand from local population and sale was facilitated through a counter by the Meenkara Fishermen Co-operative Society.

For assessment of harvest losses, design based on a multi-stage stratified random sampling developed by CIFT was used, where the different strata included

Post harvest loss assessment in the fish landing centre

the channels of production and distribution of fish. A modified estimation procedure was developed incorporating the number of hauls and catch/loss during these hauls.

Economic evaluation of fishing and fish processing technologies

A technology evaluation model was developed for rubber wood that could be a generic model for rural innovations. The model included the modified PME cycle, patent profiling, economic evaluation and social benefit evaluation. The High Pressure Processing technology was also analyzed. It was observed that commercially available models in the world had production rates beyond 40 million pounds per year. With reference to India, the equipment cost would be ₹ 2.5 to 12.5 crore and to be comparable to international standards, atleast 9000 tonnes of product every year have to be produced. The cost of production is dependent on equipment operation and maintenance, skill of labour and energy. The energy requirement is considerably less than that required for conventional thermal processing. There is no recorded commercial HPP processing activity in India as on today. As demand for HPP equipment grows, capital cost and operating cost will decrease.

Integrating GIS into fisheries management

Ground truth data and border points were collected from the bathymetirc area of the Malampuzha reservoir. A GIS based conceptual model for reservoir fisheries information management system was developed as depicted below:

Hydrographic survey to collect 3-D data of latitude, longitude and elevation of the bathymetric area of the reservoir

↓

Development of Triangulated Irregular Network (TIN) of the reservoir using the 3-D data

↓

Development of Digital Elevation Model (DEM) of the reservoir

↓

Generation of Contour map of the bathymetry of the reservoir

↓

Estimation of the water spread area and storage of the reservoir

↓

Estimation of the silt due to sedimentation in the reservoir over the years using the spatial model

↓

Generation of 3-D map and three dimensional visualization of the reservoir

↓

Incorporation of fisheries data for selectivity of gears for capture fishery and identification of hot-spots for fish culture

↓

Suggesting strategies and providing advisories for sustainable management of fishery in the reservoir

Visakhapatnam Research Centre

Research projects handled

- Reduction of environmental impact from trawling systems through bycatch reduction technologies and development of region-specific sustainable fishing systems for east coast of India
- Development of appropriate fishing systems for rivers
- Exploration and assessment of demersal fishery resources along the continental slope (200-1200 m) of Indian EEZ and Central Indian Ocean
- Validation of Tuna advisories off east coast
- Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- 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 bio-screening for novel genes and biocatalysts
- Bio-monitoring of bivalve molluscs and crustaceans from Indian waters as health promoters and indicators of environmental contaminants
- Thermal and non-thermal technologies for processing and packaging of fish products
- 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

Chief findings

- Designed and fabricated a rigid sorting grid consisting of three frames connected by hinges for bycatch reduction in trawl system.
- Selectivity experiments carried out onboard CIFTECH off Visakhapatnam coast, using a 30 m demersal trawl fitted with 40 mm square mesh codend showed that the L25, L50 and L 75 values for *Parastromateus niger* was 13.09, 11.78 and 12.30 respectively. The α and β values were 11.02 and 0.80 respectively. Selection range and selection factor for *P. niger* were 0.5 and 2.61 respectively.
- Economic evaluation of mechanized fishing system in Visakhapatnam and Kakinada revealed that major operational expenditure is incurred for fuel.
- GIS data base of craft and gear of Andhra Pradesh was created on an RDBMS platform and linked to QGIS to use GIS as a tool for effective fisheries management using QGIS.
- Experimental field trials were conducted with stake net fabricated with HDPE twine attached

with 50 mm square mesh window for Hilsa fish juvenile conservation at Odalarevu, East Godavari district of Andhra Pradesh.

- Designed and developed nylon polyamide multifilament stake net installed with fish eye BRD and field tested at Odalarevu, East Godavari district of Andhra Pradesh for Hilsa fish juvenile conservation.
- Data was collected during deep-sea fisheries expedition in Fisheries and Oceanographic Research Vessel (FORV) Sagar Sampada and studied the taxonomical, biological and residual contamination of deep-sea fishes as well as demersal fishes.
- Season-wise catch data was collected from the tuna long lining operators off Visakhapatnam coast for development of Tuna advisory services. The analysis of season-wise catch showed a hooking rate of 0.96 kg/hook for pre-monsoon period, 1.42 kg/hook for the monsoon period and 1.94 kg/hook during post-monsoon period.
- Studies on phytoplankton biodiversity along Visakhapatnam coast has reported 30 planktonic species belonging to three Classes namely Chlorophyceae, Bacillariophyceae, and Dinophyceae.
- Studies on changes in colour and quality of cooked-peeled vannamei showed that there is a decrease in a* value in cooked-peeled shrimp (15.63) compared to the regular peeled-cooked shrimp (18.05). TPC of cooked-peeled mp (150 cfu/g) was relatively higher compared to the regular peeled-cooked mp (55 cfu/g) which reduced after blanching.
- Studies on the influence of iron content on the colour of Pangasius fillets showed that Lightness (L*) of Pangasius fillets dipped in iron solution ($FeCl_3$ and $FeSO_4$) decreased and b* value (yellowness) increased with the increase in iron concentration.
- Attempt to improve the colour of Pangasius fillets using different food grade chemicals showed that Ascorbic acid (0.5%) and combination of Ascorbic acid and Sodium metabisulfite (1% and 0.5%) improved the colour.
- Studies were conducted to know the status of cholera toxin gene positive *V. cholerae vis-à-vis* other virulence factors. 83%, 66% and 50% of the *ctxAB* positive *V. cholerae* were positive to *tcp, zot* and *ace* genes, respectively. 83% of the *ctxAB* positive *V. cholerae* belonged to O1 serogroup while one *ctxAB* positive *V. cholerae* isolate belonged to the non-O1/non-O139 serogroup.
- Three water samples and three sediment samples from *L. vannamei* shrimp farms were positive for the presence of *V. parahaemolyticus* (0.3 MPN/g), but the isolated *V. parahaemolyticus* strains were negative for the virulent *tdh* gene.
- Quality evaluation of Little tuna has been conducted using Hurdle concept. Lipid quality parameters like PV increased after 10 days of storage from 8.61 to 26.78 milliequivalents/kg of fat in control vacuum packed fillets and 6.6 to 13.56 milliequivalents/kg of fat in vacuum treated fillets. In general all biochemical and microbiological quality indices exceeded the permitted level after 12 days of storage in vacuum control and treated control products.
- Designed and developed food grade plastic mold for value addition of mp as stretched mp. The mean stretching obtained was 2.26 cm, 2.64 cm, 2.41 cm and 2.46 cm for 31-40, 41-50, 51-60 and 61-70 grades, respectively.
- Survey was conducted among fishermen engaged in hook and line fisheries in Peddajalaripeta fishing village of Visakhapatnam to assess the decision making behavior associated with fishing related innovation/practices revealed that the overall decision making index was 53.67.
- A technology training intervention was organized on hygienic handling of fish and preparation of value added fish products in Mangamaripeta fishing village for the benefit of 30 women belonging to fishermen community. Effectiveness of the training programme was assessed and results showed that there was 43.5 percent increase in the awareness index and 42.3 percent increase in the average adoption score of the trainees after attending the two days training programme.

- Study was conducted on the impact of introduction of Pacific white shrimp on shrimp production and processing industry in Andhra Pradesh. Results of the study showed that 83.6 per cent of the cultured shrimp production in Andhra Pradesh is attributed to *L. vannamei*. 37.12 per cent increase in the installed capacity and 53.10 per cent increase in capacity utilization of shrimp processing firms has been observed after introduction of *L. vannamei*.

Report of the work done

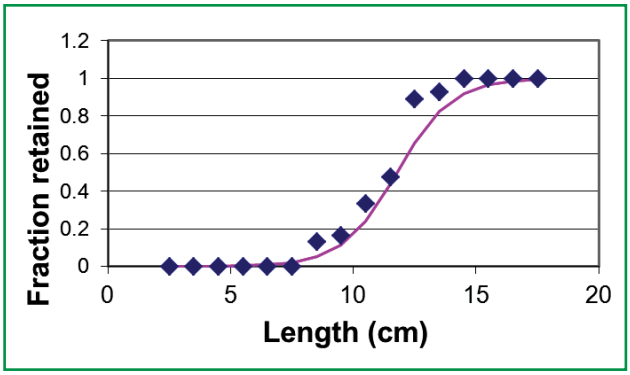
Reduction of environmental impact from trawling systems through bycatch reduction technologies and development of region specific sustainable fishing systems for east coast of India

Principal Investigator : Dr. R. Raghu Prakash

Co-Investigators : Dr. G. Rajeswari, Dr. U. Sreedhar and Smt. Arathy Ashok

Development of selectivity profile of trawling systems

Selectivity experiments were carried out onboard CIFTECH off Visakhapatnam coast, using a 30 m demersal trawl fitted with 40 mm square mesh codend. Covered codend method was followed. The square mesh codend was covered with a cover made of polyamide netting with 20 mm diamond mesh size, about one and a half times the codend in dimensions. Hauls of 1 h duration were made at a depth of 30-40 m. Towing speed was about 2.3 to 2.5 km. The length frequency data were collected for the catch in the codend and cover.



Selectivity curve of *Stolephorus indicus*

Experimentation of covered codend onboard CIFTECH Vessel

A total of 14 species were retained in the 40 mm square mesh cod end. Three species escaped. The total percentage of escapement was 15.2 %. Goatfish,

Diversity of indices of retained and escaped catch from 40 mm square mesh codend

	Retained	Escaped
Total number of organisms	1814	800
Total number of species	14	3
Average population size	266.7	129.6
Simpson Index	1.393	0.9205
Simpson Index Approximation	0.6965	-
Dominance Index	0.3926	0.07947
Dominance Index Approximation	0.3035	0.5391
Reciprocal Simpson Index	0.7181	1.086
Alternate Reciprocal Simpson Index	1.436	2.169
Shannon Index	1.025	1.329
Berger-Parker Dominance Index	0.8269	0.625
Shannon Index	0.7102	0.9215

	Retained	Escaped
Inverted Berger-Parker Dominance Index	1.209	1.6
Shannon Index	-0.3085	-0.4002
Margalef Richness Index	1.733	0.2992
Menhinick Index	0.3287	0.1061
Rényi Entropy/Hill Numbers (r=0,1,2,≈∞)	14, 2.06, 1.436, ≈∞	3, 2.514, 2.169, ≈∞
Buzas and Gibson's Index	0.1453	0.8377
Gini Coefficient	1.415	0.7188
Equitability Index	0.2691	0.8388
In () of Hill Numbers (0,1,2,∞)	2.639, 0.7226, 0.3617, ≈ 0.1903	1.099, 0.9218, 0.7745, ≈ 0.4705

Anchovies and Silver bellies showed an escapement of 19.30%, 99% and 4.74% respectively. The length-frequency data were collected for the catch in the codend and cover for selectivity analysis.

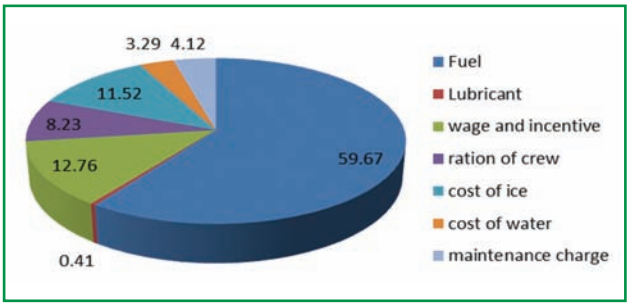
The L25, L50 and L75 values for *Parastromateus niger* with 40 mm square mesh codend was 13.09, 11.78, 12.30 respectively. The α and β values were 11.02 and 0.80 respectively. Selection range and selection factor for *P. niger* were 0.5 and 2.61, respectively.

Development of devices for bycatch reduction in trawl system

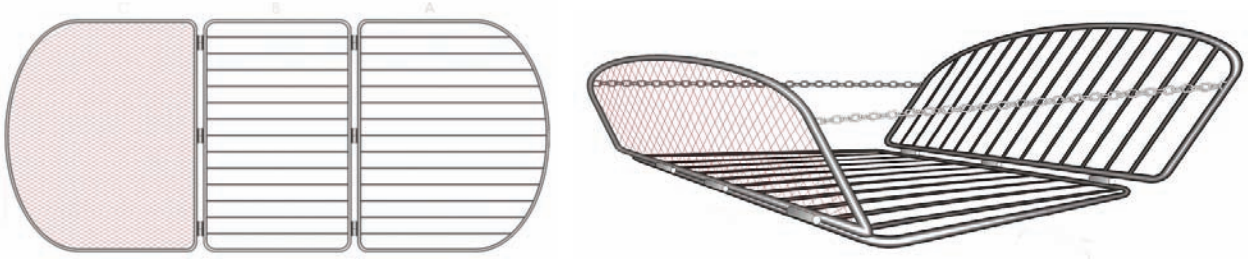
Designed a rigid sorting grid consisting of three frames connected by hinges. Two chains are attached to the end frames to give shape. The front part consists of an iron frame with vertical bars and the back part also consists of an iron frame fited with mesh netting instead of iron bars.

Economic evaluation of different fishing systems

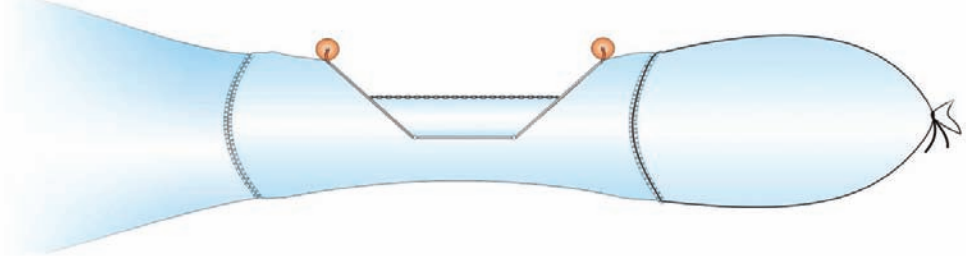
As a part the project, the following fishing systems were selected and the technological and economic aspects were studied. Different fishing systems studied include 15m L_{OA} mechanized vessel engaged in long lining and gillnetting in Visakhapatnam fishing harbor, 36 feet 'Sona boats' (mechanized) engaged in 20 days fishing trip in Visakhapatnam fishing harbor, 34 ft Sona boat in



Operational expenditure of 36 feet Sona boats



Rigid sorting grid developed



Sorting grid in the trawlnet

Kakinada fishing harbor engaged in 10 days fishing, inboard motorized fishing crafts engaged in gillnetting and troll lining in Kakinada fishing harbor and different small scale fishing systems engaged in gill netting and hook and line operations.

Stakenet with square mesh window for juvenile fish exclusion (Inset : Catch obtained in stakenet with square mesh window)

Nearly 30 mechanized vessels in Visakhapatnam fishing harbor are engaged in long lining. Main season for operation of long lines are between October to February in a year. Recent trend shows that during the other season vessels are engaged in gillnet fisheries using large mesh gillnets. A comparative economic analysis has been done between economics of operation of long lines and gillnets using the vessels of 15m $L_{OA.}$ The results of the study showed that the total operational profit from long lining is ₹ 32350/- per trip whereas in case of gillnetting it is ₹ 35000/- per trip. Operational expenses of the 36 feet Sona boats (mechanized) in Visakhapatnam harbor showed that 59.67 per cent of the expenses are incurred on fuel.

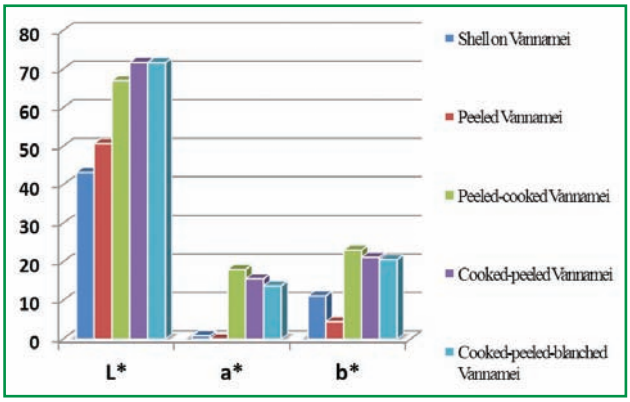
Nutritional profiling and hazard assessment of fish and fishery products of marine and lacustrine environs of the east coast of India

Principal Investigator : Dr. M.M. Prasad

Co-Investigators : Dr. B. Madhusudana Rao, Dr. L.N. Murthy, Kum. Jesmi Debbarma and Dr. Sanjoy Das (At CIFT, Cochin)

Studies on the changes in colour and quality of cooked-peeled *L. vannamei*

Peeling the shrimp after cooking (shell-on) is a product that shrimp processors are interested as it is supposed to yield a product with relatively better colour. *L. vannamei* of mean weight of 25.2 ± 3.6g were divided into five batches. First batch comprised of shell-on HL vannamei. Second batch comprised of peeled vannamei. Third batch of shrimps were cooked shell-on at 100 °C for 5 min.; cooled on flake ice and later peeled (cooked-peeled). Fourth batch of shrimp were peeled and later cooked at 100 °C for 5 min. (peeled-cooked). The fifth batch comprised of cooked-peeled shrimp that were blanched at 70 °C for 1 min. (cooked-peeled-blanched). All the batches of shrimp were analyzed for colour, texture and microbiological quality parameters.



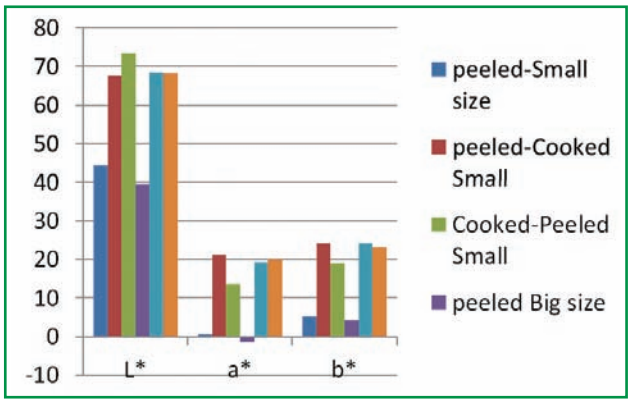
Changes in colour characteristics of cooked-peeled vannamei

The results show that there was a decrease in a* value in cooked-peeled shrimp (15.63) compared to the regular peeled-cooked shrimp (18.05). Moreover lightness (L*) increased in cooked-peeled shrimp (71.73) compared to the regular peeled-cooked shrimp (67.04). The total plate count (TPC) of peeled shrimp was 5350 cfu/g. TPC of cooked-peeled shrimp (150 cfu/g) was relatively higher compared to the regular peeled-cooked shrimp (55 cfu/g). However, blanching the cooked-peeled products reduced the TPC to 35 cfu/g. Faecal Coliforms and *E. coli* were

not detected in cooked products. Hygienic handling assumes greater significance during processing of cooked-peeled product as a ready-to-eat product is being handled. Moreover, no improvement in redness was observed in peeling the shrimps after cooking. If processing the shrimp as cooked-peeled product is necessary, then it would be better to include a blanching step to reduce the surface microbial load. Moreover blanching the shrimp after cooking did not significantly affect the colour parameters.

Influence of shrimp size on colour parameters of cooked-peeled shrimp

The experiment was repeated using two different sizes of *L. vannamei* shrimps *viz.*, small size (16.7 ± 2g) and big size (25.6 ± 2g). Similar trend of very little to no improvement in a* value and an increase in total plate count of cooked-peeled shrimp compared to peeled cook shrimp was observed. The change in colour and total plate count during frozen storage at -20 °C is being studied.



Colour changes of different sizes of peeled-cooked and cooked-peeled *L.vannamei* shrimp

Textural properties of *Litopenaeus vannamei*

Texture Profile Analysis (TPA) of shell-on vannamei, peeled vannamei, cooked-peeled, peeled-cooked and cooked-peeled-blanched vannamei was measured. Hardness for fresh sample and cooked-peeled-blanched were 24.26 N and 10.41 N, respectively. There is no significant difference between the hardness of peeled-cooked (8.29 N) and cooked- peeled shrimp (8.65N).

TPA results of *Litopenaeus vannamei* during different processing methods are as given in Table:

Studies on the influence of iron on meat colour of Pangasius fillets

Pond water, pond sediment, fish feed and farmed Pangasius fish were collected from aquaculture farms in West Godavari, Andhra Pradesh. The iron content of pond water ranged between 0.002 ppm and 0.018 ppm. Iron content of pond sediment was higher ranging from 9566 ppm to 19,902 ppm. Iron content of fish feed samples ranged between 297.76 ppm and 484.3 ppm. A study was conducted to determine whether iron is responsible for yellow discolouration of Pangasius fillets.

TPA parameters	Shell On	Peeled	Peeled-cooked	Cooked-peeled	Cooked-peeled-blanched
Hardness 1 (N)	24.26	9.53	8.29	8.65	10.41
Hardness 2 (N)	16.25	6.94	5.84	6.27	7.50
Cohesiveness	0.29	0.20	0.36	0.32	0.32
Springiness (mm)	2.23	1.43	1.19	1.21	1.17
Springiness Index	0.67	0.52	0.70	0.69	0.66
Gumminess (N)	7.39	1.98	3.02	2.75	3.37
Chewiness (Nmm)	17.17	2.98	3.64	3.33	3.94
Fracture Force (kgf)	0.01	0.34	0.44	0.24	0.03
Adhesive Force (N)	0.63	0.32	0.51	0.63	1.33
Adhesiveness (kgf/mm)	0.06	0.02	0.01	0.02	0.05
Stiffness (kgf/mm)	2.04	0.78	0.88	1.04	1.15

Absorption of iron by Pangasius meat

Farmed Pangasius were filleted and the fillets were dipped in chilled solutions of iron $FeCl_3$ (1000 ppm and 2000 ppm) and $FeSO_4$ (1000 ppm and 2000 ppm) for one hour. The fillets were analyzed for colour and iron content. The iron content of the Pangasius fillets increased with the increase in iron concentration. Iron content of Pangasius fillets dipped in $FeCl_3$ solution (46.95ppm and 112.8ppm of iron in 1000ppm and 2000ppm solution, respectively) was higher than fillets dipped in $FeSO_4$ solution (41.06ppm and 49.04ppm of iron in 1000ppm and 2000ppm solution, respectively). Lightness (L*) of Pangasius fillets dipped in iron solution decreased with the increase in iron concentration. Control fillets had L* value of 59.94. The L* value of Pangasius fillets dipped in $FeCl_3$ solution (57.36 and 55.67 in 1000ppm and 2000ppm solution, respectively) was lower than fillets dipped in $FeSO_4$ solution (58.01 and 58.55 in 1000ppm and 2000ppm solution, respectively). The b* value (yellowness) of Pangasius fillets increased with the increase in iron concentration. Control fillets had b* value of 14.96. The b* value of Pangasius fillets dipped in $FeCl_3$ solution (17.68 and 17.28 in 1000ppm and 2000ppm solution, respectively) was higher. Iron content may be one of the factors responsible for yellowish discolouration of Pangasius meat.

Colour improvement of Pangasius fillets

An attempt was made to improve colour of Pangasius fillets using different food grade chemicals such as Ascorbic acid (0.5%), Sodium tripolyphosphate (STPP, 2%), Hasinosa (2.5%), H_2O_2 (2%), Sodium metabisulfite (1.25%), Potassium sorbate (2%), Tri sodium citrate (2.5%), Sodium sorbate (2%) and combination of Ascorbic acid and Sodium metabisulfite. The colour of Pangasius fish fillets dipped in different chemicals were measured after 30 minutes, using a Hunter's colourimeter (ColorFlex EZ, Hunter Lab). Initial L*, a* and b* values of Pangasius fillets were 55.065, 6.73 and 15.835, respectively. It is observed that Ascorbic acid (0.5%) and combination of Ascorbic acid and SMS (1% and 0.5%) improved colour of Pangasius fillets.

Nutritional profile of bio-processed fishery products

Nutritional composition of fermented fish (n=16) and smoked fish (n=11) procured from markets in North-East Hilly regions of India was analyzed. Protein content of smoked fish was higher than the fermented fish. The protein content of smoked fish ranged between 49.9% and 62.9% with a mean protein of 55.6 ± 4.6%, whereas the protein content of fermented fish ranged between 26.3% and 52.9% with a mean protein content of 34.2 ± 7.2%. The mean fat content of fermented fish (20.1 ± 4.6%) was higher than that of smoked fish (14.8 ± 4.5%). Moisture content of fermented fish was 34.7 ± 5.7% while the mean moisture content of smoked fish was 9.9 ± 2.3%. Sodium content of fermented fish was relatively higher. The mean sodium content of fermented fish was higher at 2042 ± 1749 mg% whereas the mean sodium content of smoked fish was 428 ± 255mg%. Mean potassium content of fermented fish (418 ± 164mg%) was also higher than in smoked fish (201 ± 35mg%). Calcium content of fermented fish ranged between 1237 and 3318 mg% with a mean value of 2382 ± 640mg%.

Microbiology of fermented fish (*Seedhal*)

The fermented fish procured from NEH region was analyzed for microbiological parameters. The Seedhal had a TPC of 7.5 x 10^5 cfu/g and an anerobic count of 620 cfu/g. Faecal Streptococci (20 cfu/g), faecal Coliforms (3.6 MPN/g) were detected in Seedhal but *E. coli* was not detected. Proteolytic, amylolytic and lipolytic counts of Seedhal were 44,000cfu/g, 82,000cfu/g and 1,880 cfu/g, respectively.

Production of sausage and value added products to mask the muddy flavor of Pangasius

Fresh and mechanically deboned frozen fillets were procured from fish processing plants and frozen fillets were thawed and grinded with bowl chopper/ silent cutter (Scharfen, M TC11, Germany) and mixed with ingredients like starch (9%), salt (2%), oil (5%), spices (0.4%), water (11%) and colour (1.5%) for 15 min. The paste was then stuffed using Hydraulic sausage filler (Sirman spa M IS15IDRA, Italy) at the rate of 100g per piece in to synthetic casing of 18 mm diameter and heat set in water bath at a temperature of 88-90 °C for 45 min., cooled for about 15 min. using chilled water (4 °C) surface dried, labelled and stored at refrigeration condition. The Pangasius fish sausage was subjected to 10 semi-trained panellists using nine point hedonic scale and all panellists expressed texture, taste, odour and

flavour as excellent, but appearance needs to be improved. Farmed Pangasius fish catch is suffering in export market due to yellow discolouration of fillets and also lower demand in domestic markets due to muddy flavour of the meat. So utilization of Pangasius fish for the production of value added products like sausage with local recipes may be one of the effective options to mask the muddy flavour.

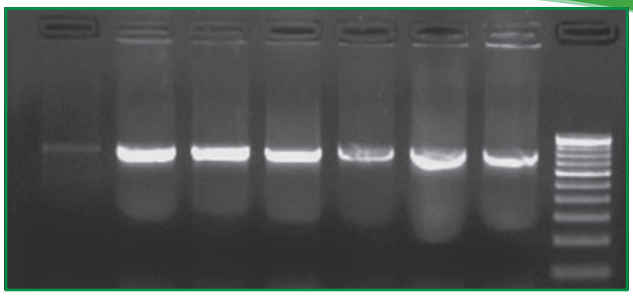
Studies on the incidence of virulent genes *viz.*, *ctxAB*, *tcp*, *zot* and *ace* in *V. cholerae* isolated from fish/shrimp

The pathogenesis of Cholera is a complex process and the major virulence factors of *V. cholerae* are the Cholera toxin (CT) encoded by the *ctxAB* genes and toxin co-regulated pilus (TCP), encoded by the *tcpA* gene. *V. cholerae* also relies on the synergistic action of a number of other genes and part of the Cholera toxin genetic elements comprising zonula occludens toxin (*zot*), which increases the permeability of the small-intestinal mucosa by affecting the structure of the tight junction, and accessory cholera enterotoxin (*ace*), which is capable of causing fluid accumulation in rabbit ileal loops.

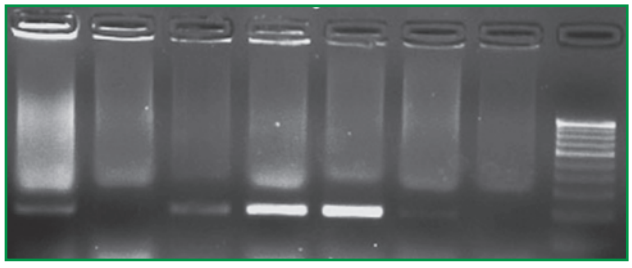
A study was taken up to know the status of Cholera toxin gene positive *V. cholerae vis-à-vis* other virulence factors. Six isolates of Cholera toxin gene (*ctxAB*) positive *V. cholerae* were isolated from fish and shellfish and screened for the presence of O1, O139, *tcp*, *ace* and *zot* genes employing PCR methods. 83% of the *ctxAB* positive *V. cholerae* were positive for the presence of *tcp* gene (453bp amplicon), 66% of the *ctxAB* positive *V. cholerae* were positive for the presence of *zot* gene (947bp amplicon) and 50% of the *ctxAB* positive *V. cholerae* were positive for the presence of *ace* gene (316bp amplicon). 83% of the *ctxAB* positive *V. cholerae* belonged to O1 serogroup (192bp amplicon) while one *ctxAB* positive *V. cholerae* isolate belonged to the non-O1/non-O139 serogroup. Two isolates of *V. cholerae*, one from *Catla catla* and the other from *L. vannamei* were positive for all the virulence genes i.e *ctxAB*, *tcp*, *zot* and *ace* and both the isolates belonged to the *V. cholerae* O1 serogroup.

Microbial gel

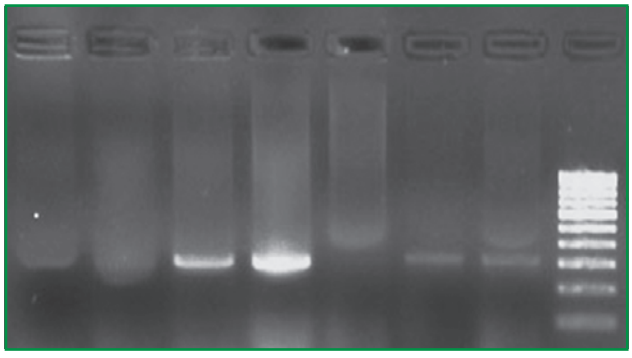
A microbial gel was prepared using *Lactobacillus plantarum* and sodium alginate. *L. plantarum* survived in the gel during anaerobic incubation at ambient



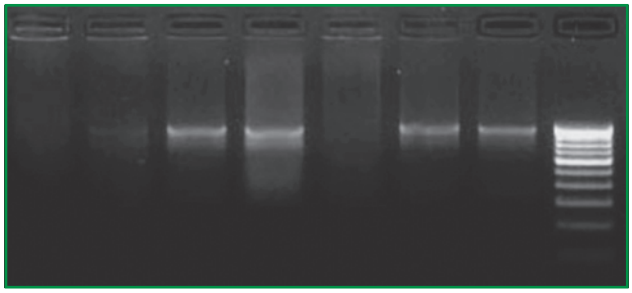
Distribution of *ctx* gene (777bp) in *V. cholera* (Lanes 1 to 6 ctx^+ *V. cholerae* isolates from fish and fishery environment; Lane 7: MTCC 3904; Lane 8: 100 bp marker)



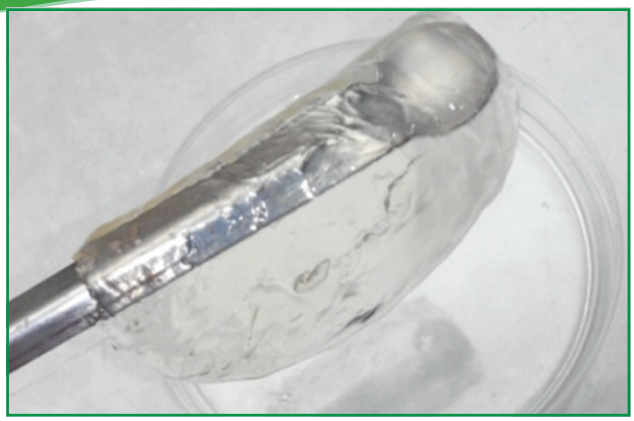
O1 status (192bp) of *ctx* gene positive *V. cholerae* (Lanes 1,3,4,5,6 O1 positive) (Lanes 1, 3, 4, and 5 $O1^+$ ctx^+ *V. cholerae* isolates from fish and fishery environment; Lane 6: MTCC 3904; Lane 7 MTCC 3906; Lane 8: 100 bp marker)



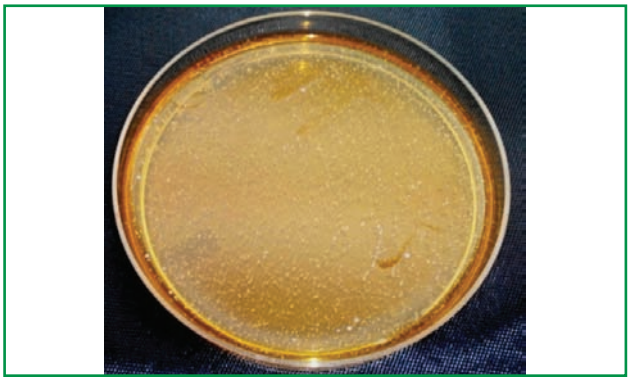
Distribution of *ace* gene (316bp) in *ctx* gene positive *V. cholera* (Lanes 3, 4, 6, ace^+ ctx^+ *V. cholerae* isolates from fish and fishery environment; Lane 7 MTCC 3904; Lane 8: 100 bp marker)



Distribution of *zot* gene (947bp) in *ctx* gene positive *V. cholera* (Lanes 2, 3, 4, 6, zot^+ ctx^+ *V. cholerae* isolates from fish and fishery environment; Lane 7 MTCC 3904; Lane 8: 100 bp marker)



Sodium alginate gel with *L. plantarum*



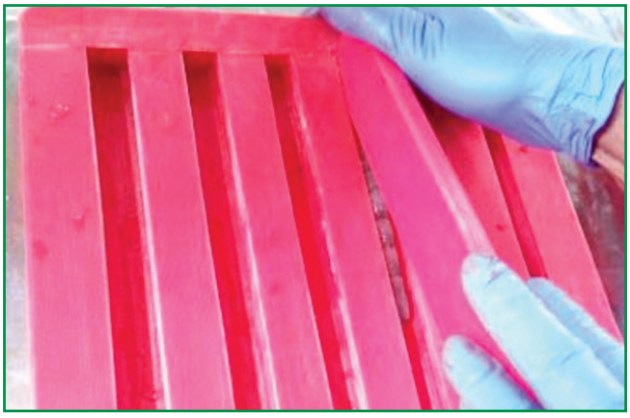
Lactic acid bacteria in microbial gel

temperature for 10 days (maximum period tested). The Lactic Acid Bacteria (LAB) count was 2.1 x 10^5 cfu/g of the gel at the end of 10 days whereas control gel had 0 cfu/g. The microbial gel may be useful as a carrier for applying LAB or other suitable microorganisms for the preparation of fermented fish products.

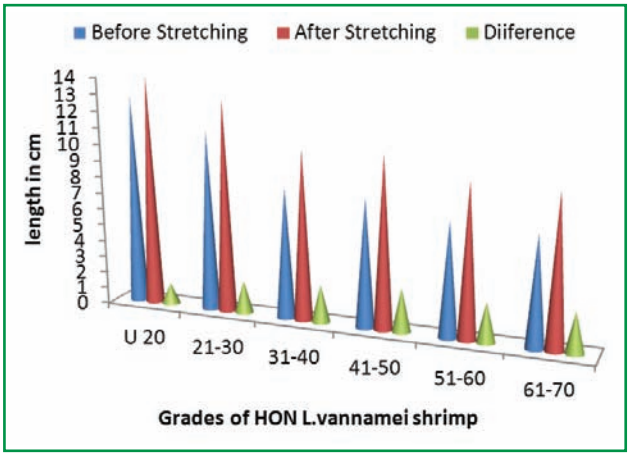
Food grade plastic mould for value Addition of shrimp as stretched shrimp

Value addition has the potential to create consumer demand and increase in profitability. The appearance of shrimp in stretched form can be a unique experience to many domestic consumers and opens new vistas for marketing. Battered and breaded stretched shrimp can be a value added product for the domestic urban market. However, a proper food grade mold is required for stretching different sizes of locally available shrimp.

Food grade plastic block of size 18'' x 12" x 2" made of low density polyethylene (LDPE) available commercially in the domestic market was used as the base for making the mold. The mould sized 30 cm x 25 cm x 5 cm was cut from the plastic block. Grooves



Food grade plastic mould with groves of six different widths for stretching shrimp of different sizes



Increase in lengths of different grades of vannamei by stretching using the food grade plastic mould

of six different widths were chiseled out of the plastic board and the inner surface of the groove was made smooth. The groves are number 1 to 6, where groove 1 corresponds to 11mm width groove and groove 6 corresponds to 21mm width groove. All the grooves had a uniform length of 21cm. Handles for pressing the shrimp were prepared from the remaining piece of plastic block. The surface of the handle is concave on the side pressing the shrimp and convex on the opposite side. The base unit with the grooves and the handles formed the components of the food grade plastic mold for stretching the shrimp. The mould with these specific groove sizes was designed so as to accommodate the commonly available sizes of shrimp.

Farmed vannamei (*Litopenaeus vannamei*) shrimps (n=50) of different grades *viz.*, under 20, 21-30, 31-40, 41-50, 51-60 and 61-70 grades were procured from a local shrimp processing plant. Grade indicates the numbers of whole shrimp per kilogram

Stretched *L. vannamei*

Battered and breaded stretched shrimp (top row); Control shrimp (bottom row) after frying

weight of shrimps. For under-20 grade vannamei 50% of the shrimp fitted in groove Number 5 and 50% in groove Number 4; for 21-30 grade vannamei 62% of the shrimp fitted in groove Number 4 and 38% in groove Number 3; for 31-40 grade vannamei 50% fitted in groove Number 4 and 50% in groove Number 3; for 41-50 grade vannamei 10% fitted in groove Number 4 and 90% in groove Number 3; for 51-60 grade vannamei 70% fitted in groove Number 3 and 30% in groove Number 2 and for 61-70 grade vannamei 50% fitted in groove Number 3 and 50% in groove Number 2.

The stretching (extension) obtained for less than 20 grade vannamei was 1.0 to 1.5 cm with a mean stretching of 1.25 cm. The stretching obtained for 21-30 grade vannamei was 1.5 to 2.5 cm with a mean stretching of 1.94 cm. The stretching obtained for 31-40 grade vannamei ranged from 1.3 to 3.0 cm with a mean stretching of 2.26 cm. The mean stretching was 2.64 cm, 2.41 and 2.46 cm for 41-50, 51-60 grades and 61-70 grades, respectively.

Veraval Research Centre

Research projects handled

- Processing and quality improvement of seafoods in Gujarat
- Risk assessment of emerging food-borne pathogens and chemical residues in aquatic systems
- Utilization of fish processing waste for the development of innovative products
- Thermal and non-thermal technologies for processing and packaging of fish products
- Management dimensions in the fisheries sector - Policies, issues and implications

Chief findings

- Biochemical, microbiological and sensory quality of fresh squid dried in solar drier was compared with sun dried squid samples. The moisture content was reduced to 24% in 36 hrs in sun dried samples and in 12 hrs in solar dried samples. Compared to open sun drying, moisture reduction was three times faster in solar drying. Values of other quality indicators such as shrinkage and rehydration ratio were also better for the solar dried squid samples.
- Shelf life of modified atmosphere packed Whiteleg shrimp in chilled storage was 10 days.
- The drying time for salted Silver croaker was 18h for solar dryer compared to 38h for sun drying to achieve a final moisture content of 30%. Moisture content was 32.7 and 38.1% for the salted and dried Silver croaker during pre-monsoon and monsoon period.
- A flavouring agent was prepared from the dried non-penaeid shrimp, *Acetes indicus* by extraction of nitrogenous compounds with 1% brine and incubated at 100 °C for 60 minutes. Shrimp flavour extract was dried using Sodium chloride as binder in a hot air oven at 50 °C for 72 hrs.
- Quality and shelf life of air and vacuum packed Malabar tongue sole in refrigerated storage was assessed. Sole can be stored in an acceptable condition for 10 days in vacuum pack in refrigerated condition compared to six days in air pack.
- Freshly caught Ribbonfishes were dried in solar drier and the quality was compared with the sun-dried Ribbonfish. Spoilage parameters and organoleptic score during storage indicated that the solar dried Ribbonfish stored at ambient temperature had a better quality compared to the sun dried Ribbonfish. A shelf-life of eight months was observed for salted and solar dried Ribbonfish compared to only five and three months for solar dried Ribbonfish without salting and sun dried fish.
- Quality of commercially important fishes like Seerfish and Cobia stored in tube ice was compared to flake ice. Seerfish stored in flake ice had a shelf life of two days compared to three days in tube ice while Cobia stored in flake ice and tube ice were sensorily acceptable till 3rd and 4th day of storage, respectively. The study reveals that tube ice is more suitable than flake ice during long term storage and transportation

of fish compared to flake ice.

- Essential oil extracted from Rosemary, Oregano, Curry leaf and Ginger was used alone (0.2%) and in combination to improve the microbiological quality and to prevent the lipid oxidation of Indian Mackerel steaks. When used alone, maximum antioxidant property was shown by Rosemary essential oil treated fish steaks and Ginger essential oil treated sample had better microbiological quality.
- A total of 18 samples consisting of Lobster harvesting cage culture water samples (n=11), Fish processing industry's effluent water (n=4) and ice samples (n=3) were analyzed for microbiological quality such as total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, Faecal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolyticus* and *Listeria monocytogenes* in April-June, 2013.
- Effect of collagen-chitosan pre-coating on the oil uptake and quality characteristics of battered and breaded fish fingers from Mahi-mahi was evaluated. There was a 2% reduction in the oil uptake when the fish finger was pre-coated with collagen-chitosan solution.
- Quantification of stress was done in fish caught from trawl and gillnet. The result shows slightly higher activity of both the enzymes in fish caught from gillnetters but the difference is not significant.
- Moisture and protein contents of the dried air bladder of Eel were 14 and 83% respectively.
- A total of 25 isolates of coagulase positive *S. aureus* isolates were isolated from 17 dry fish samples and 30 spoilage bacteria from the chilled and frozen stored fish samples in April-June, 2013. The DNA isolation was done for these isolates by pelleting the revived young culture, washed in 0.5M TE buffer twice and DNA was isolated by using DNA isolation kit (Sigma). The quality of the DNA was checked on 1% Agarose and the DNA was preserved in TE buffer for further PCR characterization.
- Different species of fish sample caught from trawl net and gillnet was collected and different stress enzymes *viz*. Super oxide dismutase (SOD) and catalase were standardized to evaluate stress associated with catching methods.
- Sampling of the fish caught in the bagnet supplied to the local fisherman of Bharuch district, Gujarat was done. During the sampling, incidence of Anchovy, Hilsa, Baracuda, Sole fish, Mudskipper, and prawns were observed both in codend and codend cover. The fish caught in codend and codend cover indicated efficient escapement of juveniles through the BRD used in the bagnet.
- Field visit made to the dry fish processing industry were drying season months start from September to May revealed that the fishes used for drying purpose are Catfish, Leather jacket, Bombay duck and shrimp.
- Chemical composition of the curry leaf essential oil was analyzed using GCMS-QP2010 Ultra (Shimadzu, Japan). Analysis revealed that alpha-pinene, beta-caryophyllene, beta-elemene, alpha-humulene, (E)-beta-ocimene, beta-phellandrene, alpha-terpinene, sabinene and beta-pinene are the main constituents of curry leaf essential oil collected from Veraval.
- The combined effect of Ginger essential oil (GEO) treatment and *sous vide* processing on the quality of Indian Mackerel steaks during refrigerated storage (2 ^{o}C) was assessed. A shelf life extension of 21 and 16 days was observed for the *sous vide* processed Mackerel with and without GEO treatment, respectively compared to eight days for control sample.
- Moisture content, TBA and TPC of sun and solar dried Mahi-mahi decreased with increased salt concentrations. Histamine content was decreased when the salt concentration increased in case of sun drying. Mahi-mahi dried by solar drier had lower concentration of histamine compared to sun drying.
- Mean values of histamine content in fresh Mackerel and frozen Mackerel were 14.33 mg/Kg and 49.14 mg/Kg sample. In fresh fish, the value ranged between 2.75 to 108 mg/Kg while it was between 4.71 to 206.5 mg/Kg in frozen

samples collected from various units. Fifty percenatage of the frozen fish samples and 80% of fresh fish sample contained less than 10 mg/Kg histamine.

- Silage powder was prepared from Dhoma for incorporating in fish feed.
- Carotenoids were extracted from non-penaeid shrimp, *Acetes indicus* using different solvent mixtures, cotton seed oil and castor oil.
- Collected information regarding the dry fish marketing channels for Catfish, Bombay duck and shrimp of Okha and Navabandar region.
- A total of 21 samples consisting of Prawn (n=3) Ribbonfish (n=1), Squid (n=1), Sole (n=2), prawn cultured water samples (n=4), dried fish (n=8) and water (n=2) were analyzed for microbiological quality such as Total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, Faecal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolytica*, *Listeria monocytogenes*, and total fungal counts in July-September, 2013.
- A total of 30 isolates of *E. coli* (confirmed on EMB & IMViC) isolates were isolated from the above samples and 20 spoilage bacteria from PIA from the chilled and frozen stored fish samples in July-September, 2013. The DNA isolation was done for these isolates by pelleting the revived young culture, washed in 0.5M TE buffer twice and DNA was isolated by using DNA isolation kit (Sigma) and were preserved in TE buffer for further PCR characterization.
- Data relating to raw material cost, drying cost, packing, transportation cost, marketing cost and margin involved and finally the price realized in the traditional methods of fish drying were collected.
- Twenty one fishing trials were conducted during the quarter ending in December 2013. The catch comprised of 30 species of finfish, three molluscan species and two crustacean species.
- Studies are in progress to compare the economics of operation of fish drying between the traditional sun drying methods and using CIFT solar dryer.
- A total of 19 samples consisting of prawn culture water samples (n=3), wild fish samples (n=8) and shellfish (n=8) were tested for Total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, Feacal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolytica* and *Listeria monocytogenes* in the quarter January-March 2014.
- A total of 25 isolates of coagulase positive *S. aureus* isolates were isolated from 17 dry fish samples in January-March 2014.

Report of the work done

Processing and quality improvement of seafoods in Gujarat

Principal Investigator: Dr. R. Badonia

Co-Investigators : Dr. G.K. Sivaraman, Dr. C.O. Mohan, Dr. A.K. Jha, Shri V. Chandrasekar, Smt. V. Renuka and Smt. S. Remya

Optimization of squid drying using solar dryer

Biochemical, microbiological and sensory quality of fresh squid dried in solar drier was compared with sun dried squid samples during winter. Fresh squid had a moisture content of 82%, protein content of 15.68%, lipid content of 0.86% and ash content of 1.1%. The moisture content was reduced to 24% in 36 hrs in sun dried samples and in 12 hrs in solar dried samples. Compared to open sun drying, moisture reduction was three times faster in solar drying. Initial bacterial count of the fresh sample was 4.7×10^2 cfu/g sample. The total bacterial count of sun and solar dried samples were 1.5×10^3 cfu/g and 3.5×10^4 cfu/g respectively. Peroxide and TVBN values of the sun

Solar and sun dried squid rings

dried samples (32 meq O_2 per kg sample and 29 mg%) were more than solar dried samples (22 meq O_2 per kg sample and 24 mg %). Sensory score of the solar dried squid was higher than the sun dried samples especially for texture and colour. Values of other quality indicators such as shrinkage, rehydration ratio etc. were also better for the solar dried squid samples.

Comparison of lipid oxidation of fish packed with natural antioxidants, vacuum pack and oxygen absorber

Effect of dried Rosemary (*Rosmarinus officianils*) leaves dip treatment on the quality of Horse mackerel (*Megalopsis cordyla*) was assessed. For this, Rosemary extract at two different levels (1 and 2%, w/v in DW) for 5 min. were used. The fish steaks (200g each) were packed in EVOH pouches and stored on ice until analysis at regular intervals. TBA values of fresh Horse mackerel (0.21 mg MA kg^{-1} fish) showed an increasing trend with storage period in all the samples. TBA value of air packed sample was 2.63 mg MA kg^{-1} fish on the day of sensory rejection (10^{th} day) compared to 1.84 and 1.46 mg MA kg^{-1} fish on 14^{th} and 17^{th} days, respectively for 1 and 2% treated samples. The browning index was least for fishes treated with 2% Rosemary extract followed by 1% extract and air packed samples. Sensorily, fishes treated with 1% Rosemary extract was rated better whereas biochemical analysis indicated that 2% Rosemary extract treatment was very effective in inhibiting the oxidation rate. A shelf life of ~15-16 days were observed for 2% Rosemary treated samples compared to ~11-12 and ~8-9 days for 1% Rosemary treated and control air packed samples, respectively.

Shelf life study of modified atmosphere packed *Litopenaeus vannamei*

Culture of Pacific white shrimp/Whiteleg shrimp (*Litopenaeus vannamei*) is on the rise globally. It accounts for 90% of the global aquaculture shrimp production. But shrimps are highly perishable leading to quality loss associated with chemical changes, microbial spoilage and melanosis. In the present work, effect of modified atmosphere packaging (MAP) on the keeping quality of *Litopenaeus vannamei* during chilled storage was studied. There was a lowered increase in the Total Plate Count (TPC), pH, H_2S-producing bacteria count, trimethylamine (TMAN), total volatile base nitrogen content (TVBN) peroxide value (PV), p-anisidine value and thiobarbituric acid reactive substances (TBARS) in the shrimp samples stored under MAP compared to the control samples stored in air. The decrease in titratable acidity (TA) was also significantly lower in shrimp stored under modified atmosphere. Shelf life of modified atmosphere packed Whiteleg shrimp was 10 days in chilled storage.

Effect of essential oil combination on fish quality

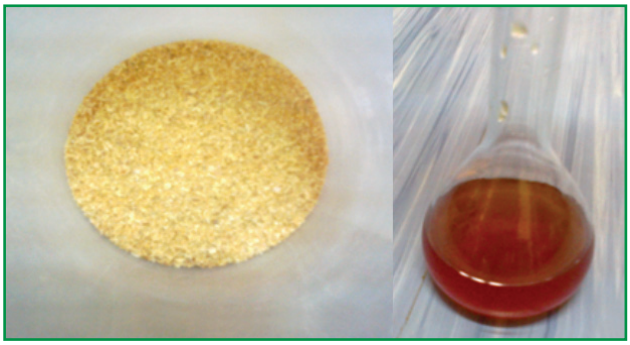
Extracted essential oil

Effect of essential oil combination on the microbiological quality and lipid oxidation of Indian Mackerel (*Rastrelliger kanagurta*) steaks during refrigerated storage was assessed. Essential oil extracted from Rosemary, Oregano (*Oregano vulgare*), Curry leaf and Ginger was used alone (0.2%) and in combination to improve the microbiological quality and to prevent the lipid oxida-tion of fish steaks. When used alone, maximum antioxidant property was shown by Rosemary essential oil treated fish steaks and Ginger essential oil treated sample had better microbiological quality.

Flavouring agent from *Acetes indicus*

A flavouring agent was prepared from the dried non-penaeid shrimp, *Acetes indicus* by extraction of nitrogenous compounds with 1% brine and incubated at 100 °C for 30 minutes. Shrimp flavour extract was dried using Sodium chloride/dextrose as binder in a hot air oven at 50 °C for 72 hrs (Sodium chloride) and 48 hrs (dextrose). The shrimp flavour powder was kept

Dried *Acetes indicus*



Acetes powder and extracted flavouring agent

at 4 °C until used.

Information on the additives used in the fish processing units of Gujarat and heavy metal content of additives

Information on the additives used in the fish processing units of Gujarat was collected. For this, the processing units were grouped based on the location like Veraval, Mangrol, Porbandar and rest of Gujarat. Sodium bicarbonate is the major additive used in cephalopod processing. The heavy metal quality of additives used were monitored. Very low levels of cadmium was present in different additives.

Optimization of fish drying process using solar dryer

Quality of sun and solar dried Silver croaker during pre-monsoon and monsoon period were compared. The drying time for salted Silver croaker was 18h for solar dryer compared to 38h for sun drying to achieve a final moisture content of 30%. Moisture content was 32.7 and 38.1% for the salted and dried Silver croaker during pre-monsoon and monsoon period.

Preparation of dried and fried Silverbelly

Dried and fried Silverbellies with spices had shelf life up to six weeks.

Chilled storage study of vacuum packed Solefish

Quality and shelf life of air and vacuum packed Malabar tongue sole in refrigerated storage was assessed. Biochemical, microbiological and sensory attributes were monitored at regular intervals. The results indicated that Sole can be stored in an acceptable condition for 10 days in vacuum pack in refrigerated condition compared to six days in air pack.

Microbial quality and safety assessment of cultured, wild fish and shellfishes of Gujarat region

A total of 19 samples consisting of prawn culture water samples (n=3), wild fish samples (n=8) and shellfish (n=8) were tested for total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, faecal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolyticus* and *Listeria mono*cytogenes. The TPC, TE, *E. coli*, *S. aur*eus and faecal Streptococci count ranged between 2.0×10^2 to 8.0×10^6, 3.0×10^2 to 2.0×10^5, 2.0×10^1 to 1.0×10^3, 1.0×10^1 to 2.0×10^2 and 1.0×10^1 to 2.0×10^2 cfu/g, respectively. About 12.5% and 7.5% of the pathogenic strains of *E. coli* (confirmed in EMB and IMVIC) and faecal Streptococci (catalase negative) were found among

Different stages of dried and fried Silverbelly preparation (fresh, salted, dried and fried samples)

these samples and there were no pathogenic strains of *Salmonella* spp., *V. cholera, V. parahaemolyticus* and *Listeria monocytogenes* among these samples.

Preparation of fish maws from Eel air bladder

Wet swim-bladder/air bladder of Eel (*Muraenesox talabonoides*) was removed and washed thoroughly with potable water to remove blood stains. Further it was dried under shade with temperature less than 15 °C. The dried material is stored in air tight containers at room temperature. Moisture and protein contents of the dried air bladder were 14 and 83% respectively. Maws of Eel had ash and fat content of 1.5 and 1.1% respectively.

Eel air bladder

Biochemical typing of Coagulase positive Staphylococci and Coagulase negative Staphylococci

The biochemical typing of isolated Coagulase negative Staphylococci (CoNS) (n= 60) were done by Grams staining, Coagulase, Trehalose, Maltose, Xylose, Arabinose, Sucrose, Mannitol, Urea, Haemolysis, Ornithine, Resistance to Novobiocin, Nitrate, Anaerobic Growth on Thioglycolate, Pigment Production SM110, Dnase Production, Galactose, Mannose, Catalase, Lysostaphin, Anaerobic Glucose fermentation, Ribose, Growth on 15% Nacl Agar, Oxidase, VP, Cellobiose, Salicin, Raffinose and Lactose. About 36% of the isolated Staphylococci were CoNS. The CoNS were preserved in liquid paraffin.

Effect of drying method on histamine formation in dried Mahi-mahi (*Coryphaena hippurus*)

Histamine, the causative agent of scombroid poisoning, is formed mainly through decarboxylation of histidine by exogenous decarboxylase released by many bacterial species. Scombroid fishes such as Tuna, Mackerel and Bonito that contain high levels of free histidine in their muscle are often implicated in scombroid poisoning incidents. However, several species of non-scombroid fishes such as Mahi-mahi, Herring, and Sardine have also often been associated with incidents of scombroid poisoning. Mahi-mahi, commonly known as Dolphin fish is a fish of high economic value. Although only *Morganella* (*Proteus*) *morganii*, *Klebsiella pneumoniae* and *Hafnia alvei* have been isolated from fishes incriminated in scombroid poisoning, a variety of other bacterial species were also identified to be histamine-formers in fishes. Many workers have isolated histamine-producing bacteria from salted and fermented fishes. The present work was carried out to study the effect of concentration of salt and drying method on histamine production in fish. Mahi-mahi, purchased from Veraval landing centre, was salted at different concentrations (0, 2, 4, 6 and 10%) after cleaning. One batch of salted fishes was dried under sun and the other lot was dried by solar drier. Microbial and bio-chemical quality of the dried fish samples was analyzed. Moisture content, TBA and TPC of the fish samples dried by both the methods decreased with increased salt concentrations. Histamine content was decreased when the salt concentration increased in case of sun drying. Mahi-mahi dried by solar drier had lower concentration of histamine compared to sun drying.

Mahi-mahi

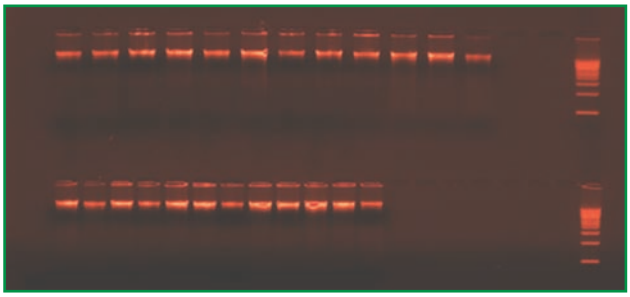
Histamine level in fresh and processed Indian mackerel

Fresh Indian mackerel (*Rastrelliger kanagurta*) collected from Veraval landing centre and frozen Indian mackerel procured from fish processing industries in Veraval region was analyzed for histamine content. A total of 50 samples were analyzsed. Mean values of histamine content in fresh Mackerel and

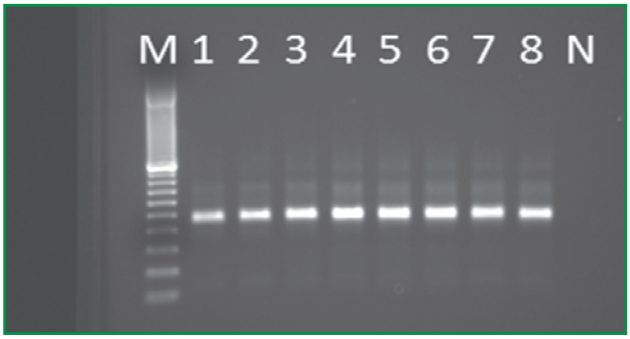
frozen Mackerel were 14.33 mg/Kg and 49.14 mg/Kg sample. In fresh fish, the value ranged between 2.75 to 108 mg/Kg while it was between 4.71 to 206.5 mg/Kg in frozen samples collected from various units. 50% of the frozen fish samples and 80% of fresh fish samples contained less than 10 mg/Kg histamine.

Molecular typing of isolated *S. aureus* isolates

A total of 25 isolates of coagulase positive *S. aureus* isolates were isolated from 17 dry fish samples. The DNA isolation was done for these CPS isolates by pelleting the revived young culture, washed in 0.5M TE buffer twice and DNA was isolated by using DNA isolation kit (Sigma). The quality of the DNA was checked on 1% Agarose and PCR characterization was done by using the Staphylococcal genus specific gene. But there was no Methicillin-resistant Staphylococci (n=25).



Quality of Staphylococcal genomic DNA on 1% Agarose



PCR amplification of *Staphylococcus aureus* specific (597bp) 165 rRNA (M= 100bp ladder, N= Negative control)

Estimation of heavy metals in commercially important fish and shellfishes

Surajbari area forms one of the important monsoon fisheries location of Little Runn of Kutch in Gujarat contributing sizeable quantity of Surajbari prawn or ginger prawn (*Metapenaeus kutchensis*). The heavy metal profiles of Zn, Cu, Mg, Co, Mn, Fe, Ni, Cd, Pb and Hg in water, sediments and different parts of Ginger prawn (Head, muscle and shell) were analyzed by atomic absorption spectrophotometer (AAS). The levels of Zn, Cu, Fe, Mg in shrimp muscle was 131, 29, 16.7 and 19.5 ppm respectively. The levels of heavy metals, cadmium and lead were observed to be very low in all the samples. Mercury was not detected in any of the samples analyzed. The heavy metals concentration in head region of shrimp was found to be Zn>Fe>Cu>Mg>Mn>Ni>Co>Cd>Pb>Hg. In muscle and shell, the order was found to be Zn>Cu>Mg>Fe>Ni>Mn>Co>Cd>Pb>Hg and Fe>Mg>Cu>Zn>Mn>Ni>Co>Cd>Pb>Hg, respectively. In water and sediment, the order was found to be Fe>Mg>Mn>Co>Zn>Ni>Pb>Cu>Cd>Hg and Fe>Mn>Mg>Ni>Co>Zn>Cu>Pb>Cd>Hg, respectively.

Trace and heavy metal content of different organs of Mahi-mahi and Leatherjacket fish were monitored. Heavy metal accumulation was higher in kidney followed by liver, gills, gonads, eyes and muscle. Among the heavy metals, the accumulation of lead was observed very high in liver followed by kidney and gills, whereas cadmium content was high in kidney followed by liver. Mercury content was below detection levels in all the organs.

Studies on solar drying of Ribbonfish

Quality of Ribbonfish (*Lepturacanthus savala*) dried by traditional sun drying and solar drying was compared. For this, freshly caught Ribbonfishes were dressed by removing head and gut. They were cut into 15-18 cm pieces and washed in potable water. It was spread on stainless steel racks and dried in solar drying maintaining a temperature of 60 ± 2 °C. Another batch of Ribbonfish was dried using traditional sun drying method. The air velocity during the drying was 12.9–14.6 km h^{-1} whereas air temperature was in the range of 33.7–33.82 °C. Drying time was 16 h in solar

Solar dried Ribbonfish

dryer compared to 30h to reduce the moisture of the sample to 22-24%. The crude protein content varied from 58.46 – 59.34% whereas fat content was in the range of 9.34–11.26%. Various biochemical, physical and microbiological quality of Ribbonfish was monitored. Volatile bases (TVBN) showed a sharp increase in the solar dried sample from an initial value of 16.29 mg% to 25.52 mg% compared to 21.42 mg% for sun dried samples. A reduction in the total mesophilic counts were observed in both samples. The initial mesophiles of the sample was $2.3x10^5$ cfu g^{-1} which reduced to 1.4 and $1.9x10^5$ cfu g^{-1} for solar and sundried samples, respectively.

Shelf life and quality characterization of dried Ribbonfish

Quality and shelf life of solar and sun dried Ribbonfishes stored at different storage temperatures were compared. For this, around 150g of dried Ribbonfish were packed in 12 µm polyester laminated with 75 µm low density polyethylene pouches and stored at 20, 28 (Room temperature) and 37 °C and various quality attributes (biochemical, microbiological, physical and sensory) were monitored at regular intervals. The formation of TVBN and lipid oxidation was higher for the sun dried samples stored at 37 °C compared to solar dried samples. A shelf life of two months were observed for sun dried samples stored at 37 °C compared to shelf life up to four and three months for samples stored at 20 °C and ambient room temperature. The solar dried samples had better quality retention with shelf life of minimum six months for all the samples. Insect infestation was observed for sun dried samples from 4th month onward for samples stored at 37 °C compared to six months for samples stored at 20 °C and ambient room temperature. No insect infestation was observed for solar dried samples.

Effect of catching method on stress of fish

Different species of fish sample caught from trawl net and gillnet was collected and different stress enzymes *viz*. Super oxide dismutase (SOD) and catalase were standardized to evaluate stress associated with catching methods. Quantification of stress was done in fish caught from trawl and gillnet. Fish sample caught from trawl net was collected from "Sagar Kripa", experimental fishing vessel of CIFT, Veraval and sample for fish caught from gillnet was procured from Jaleswar landing centre. Activity of two stress enzymes *viz*. SOD and Catalase were analyzed from the gills of fish caught from different gear system. The activity of SOD was found to be between 20.25 ± 0.04 to 22.36 ± 0.026 in fish caught from trawl system whereas SOD activity of fish caught from gillnet was between 23.01 ± 0.24 to 26.0 ± 0.42. The Catalase activity of fish caught from trawl and gillnet were 1.22 ± .26 to 1.43 ± .02 and 1.79 ± 0.2 to 1.65 ± 0.22. The result shows slightly higher activity of both the enzymes in fish caught from gill netters but the difference is not significant.

Molecular characterization of spoilage specific bacteria

About 40 number of spoilage bacteria isolated on PIA, Pseudomonas agar, STAA and MRSA were confirmed on their specific selective agar. The bacterial pellets were made on 1X TE buffer and PCR characterization will be carried out at a later stage.

Preparation of silage powder from Dhoma

Small sized Dhoma (*Johnius* spp.) was collected from the single day trawling catch of research vessel 'Sagar Kripa'. The fish was washed and chopped into small size. It was then transferred into a plastic container and Formic acid (85%) was added at 3.5% to the ground fish. BHT (100 mg/Kg of fish) was added to reduce lipid oxidation and one container of silage without BHT was kept as control. Further both the containers were sealed airtight and stored at ambient temperature for ensiling. The silage was stirred daily for aiding the ensiling process. Samples were drawn regularly (in 10 days interval) for checking the bio-chemical and microbiological parameters. During storage there was a gradual reduction in the pH, TPC,

Silage powder prepared from Dhoma for incorporating into fish feed

ash and protein content while the lipid content increased. There was a significant difference in the TBA values of silage added with and without antioxidant. After storing for 30 days, when the pH reached below 3.5, the silage was dried in a solar drier and proximate composition of the silage was analyzed. The dried silage powder was packed in polythene bags and stored for further feed preparation studies.

Preparation of fish feed

Two different iso-nitrogenous feeds were prepared using fish waste i.e. shrimp head and silage prepared from Dhoma (*Jhonius* spp.). The protein content of both the feeds were 30%. The compositions of both the feeds are depicted in the Table.

Sl. No.	Ingredients	Feed No. 1	Feed No. 2
1.	Shrimp head	500g	Nil
2.	Silage	Nil	250g
3.	Soya bean	250g	250g
4.	Corn flour	150g	150g
5.	Cellulose	Nil	250g
6.	Vegetable oil	80g	80g
7.	Vitamin mix	20g	20g
8.	BHA	1.5g	1.5g

Astaxanthin extraction from *Acetes indicus*

Carotenoids were extracted from non-penaeid shrimp, *Acetes indicus* using different solvent mixtures. Carotenoids are oil soluble pigments. Many have used vegetable oils and fish oil for extracting carotenoids from shrimp. In the present work, oil extraction of carotenoids was attempted using cotton seed oil and castor oil. The oils were selected based on local availability and also there is no report of astaxanthin extraction from shrimp using these two vegetable oils. Studies to optimize the extraction yield by changing the conditions such as temperature of heating the shrimp with oil, time of heating and the oil and shrimp ratio are in progress.

Microbiological quality of water and ice

A total of 18 samples consisting of Lobster harvesting cage culture water samples (n= 11), fish processing industry's effluent water (n= 3) and ice samples (n= 3) were analyzed for microbiological quality such as Total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, faecal Streptococci, *Salmonella* spp., *V. cholera*, *V. parahaemolyticus* and *Listeria monocytogenes*. The TPC, TE, *E. coli*, *S. aureus* and faecal Streptococci count ranged between 3.0×10^2 to 8.0×10^5, 9.0×10^1 to 1.1×10^5, 2.0×10^3 to 1.0×10^5, 1.2×10^2 to 4.0×10^2 and 5.0×10^1 to 7.0×10^3 cfu/g, respectively with 33.33% of CNFS for fish processing plant effluent water microbial load was higher. In case of ice sample the TPC, TE, *S. aureus* and faecal Streptococci ranged from 1.3×10^3 to 1.0×10^4, 7.5×10^1 to 1.2×10^2, 0.6×10^1 and 2.4×10^1 to 5.0×10^2 cfu/g respectively, with 33.33% of CNFS. But there was no pathogenic strains of *Salmonella* spp., *V. cholera*, *V. parahaemolyticus* and *Listeria monocytogenes* were found from these samples.

Collagen-chitosan pre-coating for fish fingers

Effect of collagen-chitosan pre-coating on the oil uptake and quality characteristics of battered and breaded fish fingers from Mahi-mahi (*Coryphaena hippurus*) was evaluated. Mahi-mahi, also commonly known as Dolphin fish, is a tropical pelagic fish. The boneless, skinless fish fillets were cut in the shape of fingers with 1.5 cm thickness and blanched in 1% salt solution for 2 minutes. Then fingers were battered in a solution containing maida, corn flour, bengal gram, chilly powder, turmeric powder, salt, egg and water. Further, one batch of fingers were dipped in collagen-chitosan (1:1) solution and the other batch was kept as control. All the fingers were then coated with bread

Collagen-chitosan coated fish fingers

crumbs and flash fried at 180 °C for 30 seconds. There was a 2% reduction in the oil uptake when the fish finger was pre-coated with collagen-chitosan solution. The breaded fish fingers were packaged in HIPP trays and stored at refrigerated condition for one month.

Isolation of pathogens and spoilage bacteria from fish

A total of 25 isolates of coagulase positive *S. aureus* were isolated from 17 dry fish samples and 30 spoilage bacteria from the chilled and frozen stored fish samples. The DNA isolation was done for these isolates by pelleting the revived young culture, washed in 0.5M TE buffer twice and DNA was isolated by using DNA isolation kit (Sigma). The quality of the DNA was checked on 1% Agarose and the DNA was preserved in TE buffer for further PCR characterization.

Extraction of essential oil from curry leaf

Curry leaf (*Murraya koenigii*) is a leafy spice known for its distinct aroma and preservation properties. The leaves of this plant have been used for centuries in India as a natural flavouring agent in various curries and chutneys. Essential oils are volatile aromatic compounds extracted from plant material and famous for its antimicrobial activities. Curry leaf was collected from the local markets in Veraval. Essential oil was extracted from curry leaf by hydro-distillation for 3 hrs using a Clevenger apparatus. 500 gm curry leaf was added to 1 L water. The oil yield varied between 0.5-1%. The curry leaf essential oil was stored in an airtight container in refrigerator after drying them over anhydrous Sodium sulphate. Chemical composition of the curry leaf essential oil was analyzed using GCMS-QP2010 Ultra (Shimadzu, Japan). Analysis revealed that alpha-pinene, beta-caryophyllene, beta-elemene, alpha-humulene, (E)-beta-ocimene, beta-phellandrene, alpha-terpinene, sabinene and beta-pinene are the main constituents of curry leaf essential oil collected from Veraval.

Effect of salting on the quality and shelf life of dried Ribbonfish

Effect of salting and drying on the quality and shelf life of solar and sun dried Ribbonfish was assessed. For this, dry curing was followed with salt to fish ratio of 1:5. The dressed fish, cut into 15-18 cm was applied with rock salt at the desired ratio and kept overnight and the fish was removed from the brine formed and washed with concentrated brine solution and allowed to drain. The drained fishes were dried using traditional sun drying and solar drying methods. Another batch of Ribbonfish was dried without salting to assess the effect of salting. The dried fishes (to moisture content of 26-29%) were packed in 12 µm polyester laminated with 75 µm low density polyethylene pouches and stored at ambient storage conditions. A shelf life of eight months was observed for salted and solar dried Ribbonfish compared to only five and three months for solar dried Ribbonfish without salting and sun dried fish.

Microbiological quality of fish

A total of 21 samples consisting of prawn (n=3), Ribbonfish (n=1), Squid (n=1), Sole (n=2), prawn cultured water samples (n=4), dried fish (n=8) and water (n=2) were analyzed for microbiological quality such as total plate count (TPC), Total Enterobacteria (TE), *E. coli*, *S. aureus*, faecal Streptococci, *Salmonella* spp., *V.* cholera, *V. parahaemolyticus*, *Listeria monocytogenes*, and Total fungal counts. The TPC, TE, *E. coli*, *S. aureus* and faecal Streptococci count ranged between 2.0×10^1 to 7.0×10^6, 1.0×10^1 to 2.2×10^4, 2.0×10^2 to 1.0×10^3, 1.2×10^2 to 3.1×10^2 and 2.5×10^1 to 7.0×10^1 cfu/g, respectively. But there was no pathogenic strains of *Salmonella* spp., *V. cholera*, *V. parahaemolyticus* and *Listeria monocytogenes* found from these samples. A total of 30 isolates of *E. coli* (confirmed on EMB and IMViC) isolates were isolated from the above samples and 20 spoilage bacteria from PIA from the chilled and frozen stored fish samples. The DNA isolation was done for these isolates by pelleting the revived young culture, washed in 0.5M TE buffer twice and DNA was isolated by using DNA isolation kit (Sigma) and were preserved in TE buffer for further PCR characterization.

Drying of Ribbonfish

Ribbonfish used for the salting and drying process were collected from the local fish market. The proximate composition *viz.*, moisture, total protein, total lipids and total ash were analyzed for the samples. Biochemical analysis of the samples have indicated that the spoilage indices *viz.*, Tri Methyl Amine (TMA), Total Volatile Base Nitrogen (TVBN), Free

Fatty acid (FFA), pH, Peroxide value (PV) and Thiobarbituric acid reactive substance (TBARS) were of low level indicating the freshness of the samples. Saturated brine salting was conducted. The moisture, salt content and TPC was analyzed in time interval. Salted fish was dried in solar drying and sun-drying. The texture quality was analyzed for both the samples. Solar dried fish have better quality than sun dried.

Effect of reduced oxygen packaging and curry leaf essential oil on the quality of Cobia

Effect of reduced oxygen packaging on the quality of Cobia (*Rachycentron canadum*) pre treated with curry leaf essential oil and stored at refrigerated condition (5±2 °C) was evaluated. Fresh Cobia, purchased from Veraval landing centre was brought to the laboratory in ice. The cleaned fishes were cut into 2 cm thick steaks and divided into four batches. The first batch of steaks were dipped in 1% curry leaf essential oil for 15 minutes in chilled condition prior to packing with an O_2 scavenger (Ageless® ZPT 200 EC O_2 absorber) in a multilayer film of ethylene vinyl alcohol (EVOH). The steaks of second batch were packed in EVOH pouches with O_2 scavenger and the third batch of fishes treated with curry leaf essential oil and packed in EVOH pouches. Fish steaks packed without O_2 scavenger was kept as control air sample. Further all the packs were sealed using a sealing machine and stored at 2 °C. Samples in triplicate were drawn regularly (0, 6, 12, 18, 24, 30, 35, 40 days) from each batch for bio-chemical, microbiological and sensory quality analysis. Moisture, crude protein, crude fat and crud ash contents of fresh Cobia were determined as 68.64 ± 0.02%, 16.45 ± 0.15%, 11.65 ± 0.5% and 1.12 ± 0.02 % respectively. Initial values of pH and TVBN were 5.55 and 8.6 mg N_2 per 100 g fish. During storage there was a rapid increase in the TVBN and TBA content of air packed fish compared to fishes packed with O_2 scavenger. Over the period of storage there was an increase in the total mesophilic count, pH, peroxide value, free fatty acid content, TMA, psychrophilic count, pseudomonas count etc. Oxygen absorber along with curry leaf essential oil treatment was effective in reducing the undesirable changes in the bio-chemical and microbiological quality of Cobia fish steaks. The fish steaks treated with curry leaf essential oil and packed with O_2 scavenger had an extended shelf life of 35 days while the control air pack was sensorily rejected at Day 18. Essential oil treated fish steaks and fish packed with O_2 scavenger without essential oil pre-treatment were sensorily acceptable till 24 and 30 days of storage respectively.

Combined effect of Ginger essential oil and *sous vide* processing on the quality of Indian Mackerel steaks under refrigerated storage

The combined effect of Ginger essential oil (GEO) treatment and *sous vide* processing on the quality of Indian Mackerel (*Rastrelliger kanagurta*) steaks during refrigerated storage (2 °C) was assessed. *Sous vide* cooking of Mackerel with (0.25% v/v) and without GEO treatment was continued for 60 sec. after core reached 72 ± 1 °C. Biochemical, microbiological and sensory quality were monitored at regular intervals. *Sous vide* cooking resulted in the reduction of total plate counts by 3 log cfu. The rate of increase in TMAN and TVBN for air packed samples were significantly higher ($P<0.05$) compared to treated and untreated *sous vide* packed samples. The lipid oxidation was inhibited significantly ($P<0.05$) for GEO treated *sous vide* samples. A shelf-life extension of 21 and 16 days was observed for the *sous vide* processed Mackerel with and without GEO treatment, respectively compared to eight days for control sample.

Sous vide processed Mackeral steaks

Mumbai Research Centre

Research projects handled

- Species specific technologies for the improved utilization of the fishery resources of Maharashtra region
- Species specific interventions in value addition of commercially important and emerging species of freshwater fish
- Thermal and non-thermal technologies for processing and packaging of fish products
- Utilization of fish processing waste for the development of innovative products
- Development of quality index scheme for commercially important fish species
- Use of natural gums and resins for the preservation and value addition of fishery products

Chief findings

- Bioactive hydrolysate was prepared from the gill of Mackerel using protease enzyme.
- Partial drying and quick chilling has proved to enhance the shelf life of *Pangasius* fillets.
- Ready to cook dehydrated fish roe cubes with 37% protein and 5% moisture content was prepared from the roe of Catla, with textural properties similar to that of fish meat chunks used in curry and soup preparations.
- Ready to eat fish flakes with 40% protein and less than 5% moisture was prepared from Catla roe following a simple drying process. The product showed porosity and crispness values similar to that of breakfast cereal products.
- A protocol for developing dried Catfish roe from marine Catfish was standardized.
- A fish-n-veg cocktail, after marinating with Citric acid and mixing with vegetables to reduce the muddy flavour of Rohu meat was developed. The product remained microbiologically stable for > 30 days under chilled storage, with maximum load of 4 log 10 cfu/g.
- A methodology for modifying the flavor characteristics of *Pangasius* meat using herbal extracts was developed.
- Edible coating was given to dried Bombay duck and Croaker fish. Coating imparted a glazy tint to the dried fish samples and improved surface characteristics compared to uncoated samples.
- Bombay duck intestinal microbial diversity was identified. Most of the isolates belonged to *Proteus* genus. Antibiogram analysis of the isolates revealed high resistance of most of these isolates to Cepodoxime (45%).
- Inoculations studies on *Pangasius* mince during microwave cooking were carried out. *V. cholera* and *V. parahaemolyticus* are completely destroyed after 80 seconds. *L. monocytogenes* were destroyed after 120 seconds. But, *Salmonella* species were able to survive even after 120 seconds.
- Comparison of fish scale peptone with

commercial bacteriological peptone from Oxoid, Difco and Himedia indicated no significant difference between these media.

- Higher levels of faecal indicators are detected from the water samples of fishery outlets in Vashi, Navi Mumbai.
- The concentration and dipping time of mint leaf and orange peel extract for treatment in Mackerel using response surface methodology was optimized. The optimum dipping time and concentration for orange peel extract and mint leaf extract was found to be 30 min. and 1% (w/v) and 30 min. and 0.5% (w/v), respectively.
- The protocol for preparing battered and breaded Bombay duck fillet was standardized.
- A protocol for reducing moisture content in Bombay duck mince for developing mince based products was standardized.
- Shelf life evaluation of cooked mince from Rohu during chill storage revealed 12-14 days and 14-16 days of acceptability for boiled and steamed meat, respectively.
- The effects of orange peel and mint leaf extracts on the quality attributes of gutted Mackerel during chill storage was evaluated.
- The synergistic effects of orange peel and mint leaf extracts and vacuum packaging on the quality characteristics of gutted Mackerel during chill storage was evaluated.
- A protocol for preparing a value added product based on Tilapia meat and Jawala shrimp extract was standardized.
- Heavy metal content of aquacultured shrimp and fishes collected from local markets and aquaculture farms was analyzed.

Report of the work done

Species specific technologies for the improved utilization of the fishery resources of Maharashtra region

Principal Investigator: Dr. S. Visnuvinayagam

Co-Investigators : Dr. P.K. Binsi, Smt. P. Viji, Dr. G.K. Sivaraman (At Veraval Research Centre) and Dr. V. Murugadas (At CIFT, Cochin)

Occurrence of faecal indicators in water used in retail outlets of Navi Mumbai, Maharashtra

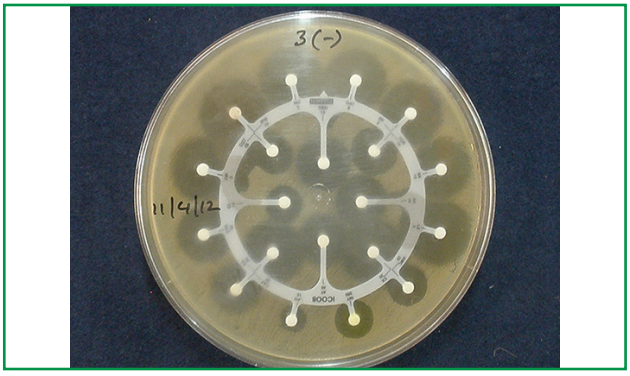
Fifty one water samples (n=51) were collected from retail fishery outlets of Vashi, Navi Mumbai and analyzed for the aerobic plate count (APC) and faecal indicators such as *E. coli*, faecal Streptococci (FS) and sulphite reducing Clostridia (SRC). In all the samples, APC level was more than the recommended limit. The mean value of the APC was 558.92 cfu/ml of water sample. The mean values of the faecal indicators in the water sample were 41. 37, 51.92 and 12.12 cfu/ml for *E. coli*, FS and SRC respectively. *E. coli* level was also higher for the all samples. As per the European Union standard, the level of faecal Streptococci should be lesser than 1/100ml. All samples contained higher level of faecal Streptococci than recommended limits. The recommended SRC count is 1/20ml. But, only eight samples showed SRC within the limit, and in remaining 43 water samples, SRC level was more than the recommended limit. Hence, presence of higher levels of faecal indicators in the samples indicated that the water sample is contaminated with the faecal materials. Positive correlation was found between the APC with *E. coli* and SRC as well as *E. coli* with faecal Streptococci and SRC. Negative correlation was found between the APC with faecal Streptococci and faecal Streptococci with SRC.

Intestinal microbial diversity of Bombay duck

Twenty numbers of gram negative bacteria were isolated from the intestine of the Bombay duck for

the identification of microbial diversity. These isolates were identified up to species level using API test strip. The isolates were identified as *Proteus penneri, P. vulgaris, P. mirabilis, Grimontia hollisae, Chryseobacterium indologenes, Pantoea* species, *Pasturella aerogenes, Rahnella aquatilis, Cedecea davisae, Morganella morganii, Plesiomonas shigelloides* and *Citrobactor braakii*.

Antibiogram was carried out for Enterobacteriaceae species isolated from Bombay duck intestine against 20 antibiotics. Among the 20 isolates, six isolates were multiple drug resistant (MDR) *i.e.*, resistant to more than one antibiotic classes. Eight number of isolates were resistance to single antibiotic; remaining six isolates were susceptible to all 20 antibiotics. The isolates were highly resistant to Cepodoxime (45%), followed by Augumentin and Imipenam (25%), Colistin (15%). Ceftazidime, Gatifloxacin, Levofloxacin, Moxifloxacin and Nitrofurantoin (5%). All 20 isolates were susceptible to the Gentamicin, Oflaxacin, Tobromycin, Amikacin, Nalidixic acid, Ciprofloxacin, Co-trimaxazole and Aztreonam.



Antibiogram of Bombay duck intestinal microflora

Microbiological changes of Golden anchovy during chill storage

The chill storage study of Golden anchovy (*Coilia dussumier*) was carried out at 0 °C and the microbiological changes were observed at equal interval during the storage. The initial mesophilic count was 5.65 log cfu/g. A lag phase was observed upto eight days on mesophilic counts. On 11th day, the mesophilic count came closer to spoilage *i.e.*, 6.9 log cfu/g. The psychrophilic counts for the first eight days were between 3.6-3.88 log cfu/g. On 11th day, the psychrophilic count rose up to 4.38 log cfu/g. The initial Enterobacteriaceae count was 3.6 log cfu/g, on the 11th day, the level went up to 4.38 log cfu/g. An initial reduction in *B. thermosphacta* count was observed from 6.83 log cfu to 3.88 log cfu and it's level slowly increased up to 5.67 log cfu/g on the 11th day. Throughout the storage study, there was no increase in *Lactobacillus* sp. and *Pseudomonas* sp. count. The values of Lactobacillus and Pseudomonas were 2.9-2.7 log cfu and 3.2-4.3 log cfu/g respectively. H_2S producing bacterial count slowly increased from 2.9 to 4.6 log cfu/g. The results revealed that Golden anchovy can be stored up to 11 days at 0 °C.

Optimization of dipping time and concentration of plant extract treatment in fish

The optimum time and dipping concentration for mint leaf extract and orange peel extract for enhancing the quality of Mackerel during chilled storage was determined by response surface methodology using Boxbehnken central composite design. Two individual experiments were conducted for mint as well as orange extract. The extracts were

Mint (*Mentha arvensis*) leaf extract

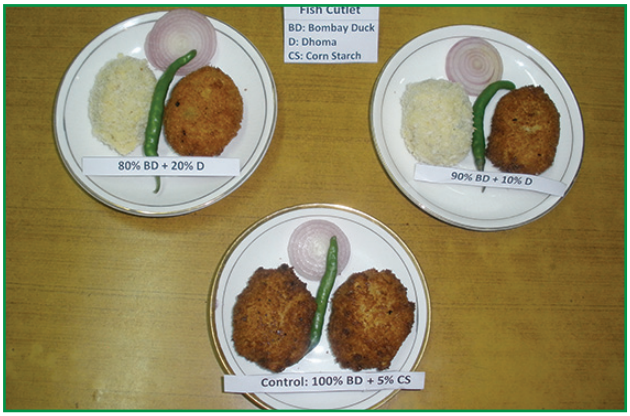
Orange (*Citrus sinensis*) peel extract

prepared using 60% ethanol as solvent. Concentration of extract (0.5, 1 and 1.5%, w/v), time of dipping (15, 45 and 45 min.) and days of sampling (3rd, 6th and 9th day) were selected as the design variables. A total of 15 sample combinations for each experiment were generated and the samples were kept under 2 ± 2 °C. The respective samples on 3rd, 6th and 9th day was analyzed for its sensory, microbiological and microbial quality. The study revealed that higher concentration of extracts reduced TVBN, TMA and TBARs and mesophilic counts in Mackerel during storage. Based on the results obtained, a dipping concentration and time of 1% and 30 min. and 0.5% and 30 min. were optimized, respectively for orange and mint extracts.

Moisture conditioning of Bombay duck for product development

Bombay duck (*Harpodon nehereus*) is an abundant marine species in North West coast of India. Traditionally the demand of fresh fish is limited and major portion of landings are converted to rope dried product. The major constraint in developing value added products from Bombay duck is its inferior meat texture with high moisture content, which forms jelly like mass on cooking. The Mumbai Research Centre has attempted to develop various value added products from Bombay duck after reducing the moisture content by treating with lemon juice. Bombay duck fillet was given dip treatment in solution containing 2% salt and 5% lemon concentrate for 15 min. to reduce the moisture content. The treatment has reduced the moisture content by 4-5% and increased the protein and ash content. The breaded and battered product from treated fillet has shown better sensory score than the control fillet.

The pH of Bombay duck mince was reduced to 5.5 by washing in a combination of filtered lemon concentrate and Sodium chloride in a pre-determined ratio based on preliminary experiments. This modification in the washing procedure reduced the moisture content of fish meat by 5% compared to raw mince. The washed mince was further evaluated for its suitability for the preparation of mince based products either by using alone or in combination with other fish mince. This was done in a series of combinations of different minces. Balls with 100% treated Bombay duck mince and cutlets containing



Mince based products from Bombay duck after moisture conditioning

90% Bombay duck mince and 10% Croaker mince showed better flavor and acceptability. An attempt has also been made to develop restructured products from Bombay duck. For this, the washed Bombay duck mince was ground with corn starch, sucrose, salt and refined vegetable oil. The ground paste was cooked in steam for 15 min. and the cooked product was cut into finger shape, battered and breaded. A trial was also done to make this value added product using combination mince (treated Bombay duck mince, 75-90% and remaining Dhoma mince). The product containing 90% Bombay duck mince and 10% Dhoma mince gave higher flavor and taste.

Ready to soak spongy fish roe cubes

Ready to cook dehydrated fish roe cubes with 37% protein and 5% moisture content was prepared from the roe of *Catla catla*. The porosity of the cubes was optimized to impart texture properties similar to that of fish meat chunks used in curry and soup preparations. The cubes showed a swelling ratio of 3.66 (to that of dried cubes by weight), when dipped

in distilled water for 10 minutes. The stability analysis of roe chunks in distilled water showed a maximum soluble loss of 11% and 20%, at room temperature and 100 °C, respectively. The chunks were subjected to texture analysis before and after soaking in water. The dried chunks showed higher hardness values indicating its physical stability during transportation. However, the hardness of roe chunks after swelling was less than the range generally observed for fish meat chunks. Further research is progressing on cross-linking the proteins before drying to improve the hardness values of roe chunks after soaking. The colour analysis of roe chunks after soaking in water showed similar L values, whereas a* and b* values were markedly different from that of fish meat chunks, especially at higher drying temperatures.

Ready to soak spongy fish roe cubes

Crispy fish roe flakes

Ready to eat fish flakes with 40% protein and less than 5% moisture was prepared from Catla roe following a simple drying process. The product showed porosity and crispness values similar to that of extruded cereal products. The flakes were prepared by a controlled drying process for a serial combination of temperature and duration. The flakes showed varying textural and sensory properties depending on the drying conditions. The crispness was higher at elevated temperatures. However, the colour and odor were inferior to that of dried at lower temperatures.

Ready to eat dried Catfish roe

The fresh roes from marine Catfish were dried to a moisture content of less than 5%, by a combination of different higher temperatures for pre-determined durations. Heating at a higher temperature of 90 °C and above imparted crispiness and porosity to the product, whereas heating at lower temperature yielded higher chewiness. Hence, two stage heating was opted to get a product with desired crispiness, porosity and stability during storage. The proximate composition of dried Catfish roe showed protein content in the range of 65-70%, fat content of 22-27% and ash content of 3-4%. The optimized products were moderately porous, non-sticky and exhibited textural properties similar to that of extruded snack products.

Ready to eat dried Catfish roe

Externally Funded Projects

1. Zonal Technology Management - Business Planning and Development Unit
2. Intellectual property management and technology transfer/commercialization
3. Green fishing systems for tropical seas
4. Development of multiplex microarray for detection of food-borne and shrimp pathogens
5. Responsible harvesting and utilization of selected small pelagics and freshwater fishes
6. Bioprospecting of genes and allele mining for abiotic stress tolerance
7. Oceanic tuna fisheries of Lakshadweep seas - A value chain approach
8. Strengthening of digital library and information management under NARS (e-Granth)
9. Studies on high pressure processing (HPP) of high value perishable commodities
10. Mobilizing mass media support for sharing agro information
11. Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies
12. Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications
13. Exploration and assessment of demersal fishery resources along the continental slope (200-1200m) of Indian EEZ and central Indian Ocean
14. Isolation and characterization of collagen and gelatin from aquatic sources and development of pharmaceutical and food grade products of commercial importance
15. Development of bioplastic based sustainable nanobiocomposite food packaging
16. Food safety interventions for women in fishery based microenterprises in coastal Kerala
17. Use of natural resins and gums for preservation and value addition of fishery products
18. Techno-economic feasibility of coconut wood canoes for the small-scale fisheries sector in the southwest coast of India and Lakshadweep
19. Retrieval of phytoplankton and associated optical constituents based on long term bio-optical studies
20. Validation of Tuna advisories off east coast
21. National surveillance programme for aquatic animal diseases
22. Studies on ecological linkages between plankton production and *Acetes* sp. along Gujarat coast
23. Nutrient profiling and evaluation of fish as a dietary component
24. Characterization of harmful algal blooms along Indian coast
25. Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala
26. Village knowledge register of Thoothoor fishing community and establishing knowledge based enterprises by pooling best innovative and traditional knowledge practices

Zonal Technology Management - Business Planning and Development Unit

(Funded by Indian Council of Agricultural Research)

Principal Investigator : Dr. C.N. Ravishankar

Co-Investigators : Dr. George Ninan, Dr. A.A. Zynudheen, Dr. B. Madhusudana Rao, Dr. L.N. Murthy and Dr. C.O. Mohan

Training programme on Food safety for food entrepreneurs: Awareness and implementation

ZTM-BPD unit, CIFT in association with M/s Synergee Systems, Cochin, conducted two day training programme on 'Food safety for food entrepreneurs: Awareness and implementation' during 13-14 February, 2014 at Business Incubation Centre, CIFT, Cochin. The training programme was attended by participants including entrepreneurs of BIC, CIFT, students and researchers. The technical sessions covered the topics such as Salient features of Food Safety and Standards Act 2006, Functions, duties and responsibilities of Food Safety Regulations, Implementation of Food Regulation under FSSAI Act, Licensing and Registration, Procedure for Registration, Documents required for registration, Fee for grant of registration and Inspection of food processing establishments by Food Safety regulators.

Training programme on Food safety for food entrepreneurs

Training programme on Finance fundamentals for entrepreneurs

ZTM-BPD unit, CIFT in association with M/s Vittree Business Solutions Pvt. Ltd., Cochin conducted a training programme on 'Finance fundamentals for entrepreneurs' at Business Incubation Centre, CIFT, Cochin during 6-7 February, 2014. The main objectives of the programme was to help the entrepreneurs to gain the relevant financial knowledge and to give them confidence and the credibility when making business decisions that impact on financial performance. The programme was attended by participants including entrepreneurs of BIC, CIFT, students and researchers. The technical session covered the following topics: Accounting and Book keeping, Financial Statement Ratios, Direct Tax and TDS, Value Added Tax, Excise Duty and Service Tax.

Training programme on Finance fundamentals for entrepreneurs

Induction programme for Industries Extension Officers

ZTM BPD unit of CIFT, Cochin organized a one day Induction programme at Business Incubation Office for the Kerala State government officials on 25 January, 2014 in association with Kerala Institute of Entrepreneurship Development (KIED). The objective of the Meet was to create awareness about the entrepreneurship development activities being carried out by BIC, CIFT and also to inform them about the various institute activities.

Symposium on Business Incubation for Start Ups

As part of raising awareness about the business

incubation and the importance of intellectual property rights and to adopt a professional approach to protect and transfer of innovations, a one day Symposium on 'Business Incubation for Start Ups' was organized at Kerala Agricultural University, Thrissur on 26 February, 2014. The Symposium was jointly organized by Agri-Business Management Division, KAU and ZTM-BPD Unit, CIFT. The Symposium featured talks on Business Incubation and Intellectual Property Rights. This programme was designed for student start ups, and other business incubation stakeholders wishing to increase their understanding and know-how of the business incubation process and to protect their valuable Intellectual Property Rights. The first session on Business Incubation was handled by Shri Nitin Singh, Business Manager, ZTM-BPDU. The second session on the 'Overview of Intellectual Property Rights' was handled by Shri K.J. Aravind, Research Associate, ZTM-BPD Unit. In the Symposium, about 80 students and faculties were exposed to different aspects of entrepreneurship, including opportunity guidance through business incubation, and services offered by CIFT's business incubation centre etc.

Technical Session during the Symposium

Appointment of consultants for supporting incubatees

ZTM-BPD Unit has appointed consultants for supporting incubatees in the areas like i) Finance and Accounts, ii) Sales and Distribution, iii) Food Safety and Standards Authority of India (FSSAI) implementation, and iv) E-commerce portal. Trainings are provided on basic Finance, Accounts & Compliance of a company and educated the business owners on all the basic aspects of it. The two day training on FSSAI helped the participants to assess the adequacy of the design, implementation and improvement of food safety management system.

Development of online marketing portal for incubatee products

ZTM-BPD has launched an online portal 'www.fishobiz.com' with specific focus on value added products from the companies being incubated at BIC. This website will act as an online platform for promotion of many of Incubatee brands such as Freedom Kitchen, Monsoon Bounty, Prawnoes, Meenootty, Fish Funda, Fish Cube, Fish Bite and many more. Fishobiz.com will provide customers with the information on the latest innovative products along with description and gives the customer a comprehensive idea about the product and if interested they can post their requirements through e-mail.

Trademark filing for incubatees

The ZTM-BPD Unit has filed the following trademarks for registered Incubatees operating at BIC.

Trade Mark 'Pescado' (Class 35 and Class 43) for Oceanographic Ventures Pvt. Ltd, an incubatee of CIFT.

Trade Mark 'Prawnoes' (Class 29 and Class 30) for Charis Food Products, an incubatee of CIFT during December 2013.

Trade Mark 'Flavour Spellz' (Class 31 and Class 43) for Quebec Biotech International Pvt., Ltd., during December 2013.

Technology promotion workshop for coconut related technologies

One day workshop on 'Coconut technologies' was held at Coimbatore on 2 July, 2013 jointly organized by CPCRI, Kasargod, Tamil Nadu Agricultural University, Nagapattinam and ZTM-BPD Unit, CIFT, Cochin. Dr. George V. Thomas, Director, CPCRI presided over the function and highlighted the salient achievements of the CPCRI along with the technologies developed in the field of coconut industry. A total of 30 coconut farmers and

entrepreneurs around Coimbatore region attended. At the end of the workshop Farmers/Entrepreneurs and Scientists interaction was conducted. Letter of Interest from two interested entrepreneurs was signed for Virgin Coconut Oil and Coconut Chips.

Promotion workshop on Coconut technologies

Technology promotion workshops for Cobia technologies

Two Workshops on 'Pond and cage culture of Cobia' and 'Preparation of value added Cobia products' was organized in association with Tamil Nadu Fisheries University, Nagapattinam at Pattukkottai and Chennai on 9 and 10 July, 2013 respectively. Two technology brochures on Pond culture of Cobia and Sea cage culture of Cobia were also released in the Workshop and distributed to the participants. A total of 71 participants including farmers, entrepreneurs, consultants, feed company representatives, hatchery operators from Tamil Nadu, and Andhra Pradesh attended. Four presentations covering Marine finfish farming in Asia (Dr. M. Sakthivel), Pond and cage culture of Cobia (Dr. N. Felix), Status of finfish breeding and seed production under controlled conditions (Dr. A.R.T. Arasu), Convenience and diversified products from Cobia and their wastes (Dr. R. Jeya Shakila) were made during this Workshop.

Technology promotion workshop at Chennai

Participation in Indian Agri-Business Incubation Conference (NIABI 2013)

ZTM-BPD unit has been actively nurturing the growth of technology-based enterprises and creating successful business ventures in the field of fisheries. The unit has become self-sustainable in the short span of time. ZTM-BPDU participated in AGRITEX 2013 during 25-27 April, 2013 featuring over 150 exhibitors. ABI-ICRISAT along with BPD Units of IARI, IVRI, JNKVV, CIRCOT, TNAU, AAU, BAU and CIFT participated in the exhibition, presented their client products and explained the incubation services provided. The footfall at the pavilion was impressive and many units got several enquiries for their technologies. NIABI 2013 had about 120 participants which included entrepreneurs, BPD staff, scientists, and experts. The conference had six sessions featuring 52 technologies on crops, horticulture, food technology, animal husbandry, cotton and jute fiber products, and fisheries sectors. Each BPD presented technologies from their sector as well as the detailed process of technology transfer along with incubator services used in ensuring that the venture succeeds. As part of the conference objectives, there were more than 85 B2B meetings between incubator team and the industrialists, agribusiness entrepreneurs for technology commercialization. Thirty technologies were commercialized from the pool of 82 shortlisted, high-impact technologies for which 51 Letter of Intents were drawn up.

Participation in Agri-Tech Investors Meet 2013

The Agri-Tech Investors Meet was organized by ICAR at New Delhi on 18 July, 2013 for facilitating constructive deal flow between agri-entrepreneurs/ investors and Agri-Technology Providers under NAIP from across the country. The two-day Meet showcased commercializable NAIP technologies from different sectors of agriculture and their business potentials. The participants got an opportunity to interact with NAIP agri-business incubators and how they can support their agri-ventures. The event featured B2B/ B2C meetings for technology commercialization and partnership engagement. Two-day agri-exhibition featured more than 80 ready-to-commercialize agri-

technologies from crops, horticulture, food processing, animal husbandry, fibres, agri-engineering, industrial processing, fisheries sector, agribusiness incubators and their services.

Innovations 4 Industry Meet in Fisheries 2013

A Business Meet 'Innovation 4 Industries for Fisheries' was organized at Vashi, by the ZTM-BPD Unit, at CIFT, Cochin, Mumbai Research Centre of CIFT along with Sea Food Exporters Association, Maharashtra Chapter on 23 November, 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 sea food industries in Maharashtra. The Chief Guest of the function was Shri Rustom Irani, President, Seafood Exporters Association, Maharashtra Chapter. 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 implement new business ideas. The scientists of CIFT, Dr. C.N. Ravishankar, Dr. T.V. Sankar, Dr. George Ninan, Dr. A.A. Zynudheen, Dr. C.O. Mohan, Dr. P.K. Binsi, and Shri P. Anil Kumar, Deputy Director, MPEDA, Mumbai, Shri Nitin Singh, Business Manager, Business Incubation Centre, CIFT gave presentations during the technical session. The session was followed by the panel discussion on the issues and problems faced by the sea food industries in Maharashtra. The industry meet witnessed participation from 35 seafood entrereneurs from Maharashtra, officials from Marine Products Export Development Authority (MPEDA), officials from Export Inspection Agency (EIA) and officials from college of Fisheries, Ratnagiri.

Shri Rustom Irani, President, Seafood Exporters Association, Maharashtra Chapter delivering the inaugural speach

Participation in 7th International Food Convention (IFCON 2013)

ZTM-BPD unit, CIFT participated in the 7th International Food Convention (IFCON 2013) organized by CSIR-CFTRI at Mysore during 18-21 December 2013 at CFTRI, Mysore. The theme of the seminar was nutritional security through sustainable development research and education for healthy foods. The conference was attended by more than 2000 national and international delegates. The conference had more than 1000 paper presentations from students, researchers and industries. About 100 industries from food and allied participated in the programme. Dr. C.N. Ravishankar, PI, ZTM-BPD was an invited speaker for the programme and presented his talk on 'Role and impact of the business incubator in promoting entrepreneurship and business innovation in fisheries sector'. An exhibition was conducted as a part of the programme wherein ZTM-BPD unit put in a stall to showcase the technologies developed by CIFT. ZTM-BPD Unit was honoured for designing the best logo for the theme of the conference.

ZTM-BPD Team members receiving the award for IFCON Logo design

Participation in 19th India International Seafood Show

ZTM-BPD Unit participated in '19th India International Seafood show' at Chennai during 10-12 January, 2014. The three day seafood show comprised of a site tour organized by MPEDA, demonstrations of fish filleting and fish packing by selected manufacturers, technical sessions about the expectation of Seafood Export Association of India with Indian government, regulatory requirements for exporting seafood products to Japan and the EU,

Delegates from CIFT at International Seafood Show

Mr. Robert Gibson, during Industry Interface Meeting

regulatory requirements for product labelling, FSSAI import requirements, global seafood markets, and much more. Major seafood exporters from countries including India, Japan, Thailand, fish feed manufacturers, fish oil and fish meal manufacturers, R&D representative (Snowman), ingredient manufacturers, certification bodies participated with the objective of meeting their respective clients and strengthening communication. There were around 265 stalls. The show saw more than 2,000 trade visitors, giving a good visibility to SGS' services in the seafood space.

Industry Meet

The Institute Technology Management Unit (ITMU), National Bureau of Agriculturally Important Insects (NBAII) and ZTM-BPD Unit, CIFT organized an Industry Interface Meet at Bangalore on 7 December, 2013. A brochure showcasing the business prospects of NBAII technologies was officially released by Dr. Abraham Varghese, Director, NBAII. The event was successful in showcasing the technologies developed at NBAII, such as *Trichogramma, Chrysoperla*, predatory mites and formulations of *Trichoderma, Pseudomonas, Bacillus, Bt*, EPN and others, to the industries, NGOs and other agri-preneurs who are engaged in production of various bio-control agents and formulations. The meeting was attended by major biofertilizers/biopesticide/agrochemical manufacturers and suppliers. The meet also gave an opportunity for the entrepreneurs to have one-on-one interaction with the inventors.

Industry Interface Meeting

The ZTM-BPD Unit has taken up business networking activities in collaboration with the Food Processing Division (FPD), Alberta Agriculture and Rural Development, Canada. As part of the collaboration Mr. Robert Gibson, Senior Operations Manager, representative of Government of Alberta, Canada, visited CIFT and interacted with Scientists and Entrepreneurs. An Industry Interface Meeting was held during 30 September and 1 October, 2013 for adopting an integrated approach and operational strategies in Business Incubation Programme.

AgrIP 2013

As part of raising awareness about the importance of intellectual property rights and to adopt professional approach to protect and transfer of innovations, Two days National Workshop entitled 'AgrIP 2013' on 'Role of Intellectual Property Rights in the Modern Era' was organized at CIFT, Cochin during 15-16 November, 2013. The Seminar was jointly organized by ZTM-BPDU, South Zone, CIFT and Kerala State Council for Science, Technology and Environment (KSCSTE), Thiruvananthapuram. The two day National Workshop featured invited talks from leading experts and speakers in the various areas of Intellectual Property Rights. The workshop endeavoured to raise the level of awareness and knowledge about IPR issues, develop a broad understanding of the need to

Dr. S. Mauria, ADG (IP&TM), ICAR, New Delhi giving the lead talk during AgrIP2013

integrate IP in their innovation strategies business planning, improve protection of IP achievements through increased registration of in the Scientific Community, improve the protection and enforcement of IPR from infringements and to enhance the capacity to fight from counterfeiting. Overall, the programme was connoted to update the knowledge and recent trends in IPR.

National Conference on VALUE FISH-2014

A two-day National Conference on 'Emerging safety and technological issues in seafood industry' entitled VALUE FISH – 2014 was organized at CIFT Research Centre, Veraval during 14-15 March, 2014 by ZTM-BPD Unit of CIFT in association with NFDB, Hyderabad and CFTRI, Mysore. Dr. K. Radhakrishna, Additional Director, Defence Food Research Laboratory (DFRL), inaugurated the conference. Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin presided over the meeting. Dr. C.K. Murthy, Executive Director, NFDB, Hyderabad, Dr. A.Y. Desai, Dean, College of Fisheries, Veraval and Shri Lakhambhai Bhensla, President, Seafood Exporters Association of India, Gujarat Chapter were present in the inaugural function. The technical sessions covered topics like advances in fish processing technology, safety and regulatory issues in seafood industry, industry reflections, role of developmental agencies and interactive session on future needs on capacity building/ EDP, infrastructure including incubation centers, regulations and Interventions from research and developmental agencies. The Conference was attended by representatives from seafood industry, officials from State Fisheries Departments, Scientists and Professors from State Agriculture Universities, different research organizations and KVKs.

Inaugural meeting of VALUEFISH 2014

Handholding new Business Planning and Development Units of ICAR

ZTM-BPD Unit 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 (NBAII), Bangalore for preparing proposals for establishing Business Incubation Centres at their campus. The new BPD staff from IIHR, CPCRI, IISR and NAARM was given orientation at CIFT campus for streamlining the business incubation activities at their respective Institutes.

Providing guidance and support to external organizations

ZTM-BPD Unit have given support and guidance to various organisations like Department of Biotechnology (DBT), Kerala Agricultural University (KAU), Tamil Nadu Fisheries University, KVK Pathanamthitta, Central Food Technological Research Institute (CFTRI), Mysore and College of Fisheries, Mangalore on various areas like technology transfer, establishment of new business incubation facilities and setting up of individual business enterprises.

Facilitating Intellectual Property and Technology Management activities of South Zone member institutes

ZTM-BPD Unit provided assistance to the member institutes under the South Zone in commercializing and protecting the intellectual assets, on a case to case basis, in formulating model licensing contracts / MoUs, business proposals, technology promotional materials, and effective IP management, technology transfer / commercialization in database management of the intellectual assets.

Success Stories of Business Incubation Programme at CIFT

- **Ready to Serve Fish Curry in Retort Pouches:** With the changing socio-economic pattern of life and the increasing number of working couples, the concept of convenience food products is fast becoming popular in Indian market. To meet the ever changing and diverse customer demands,

CIFT has developed ready-to-eat fish products in flexible retortable pouches. The superior product quality with well preserved natural colour, flavour and texture characterizes the CIFT technology. The technology was successfully adopted by two ZTM-BPD Unit Incubatees.

- **Ideal Caterers, Cochin:** Shri Hisham Kabir of Ideal Caterers belongs to the first generation of entrepreneurs to complete business incubation from the ZTM-BPD Unit, Cochin. He joined CIFT's business incubation initiative in 2011 and his products hit the market by early 2013. Three ready-to-cook gravies, Kumarakom fish curry, 'Nadan' chicken curry and Kerala chicken curry were the first to roll out from the Incubation Centre under the brand name 'Freedom Kitchen'. CIFT provided him solutions and scientific expertise related to food processing and machinery for setting up his own production unit.

- **Monsoon Bounty Foods Manufacturing Pvt. Ltd., Chennai:** Shri Sunil Ravi who was an IT professional, joined as Incubatee at CIFT during 2012, after being introduced to the Convenience Food sector by ZTM-BPD Unit. He is now successfully running his Chennai based Company, manufacturing ready-to-eat fish, meat and vegetable products. The wide product range includes curries, soups, stews, snacks etc. which were launched to the market in early 2013.

- **Fish Kure - Extruded snack food:** CIFT specializes in Extruded Snack Food Technology, a food processing technique for preparation of nutritious food. CIFT have come out with a protein-rich fish based snack food 'Fish Kure' by incorporating fish mince, cereal flours, spices and salt. CIFT prepares this snack using twin-screw extruders which are popular among the food

manufacturers for specialized food items with high versatility and quality. CIFT's technology for extruded snack food from fish was taken by a woman entrepreneur, Smt. Omana Muraleedharan, Charis Food Products, Aroor, Kerala. Before registering as an Incubatee at ZTM-BPD Unit, she was running a small scale metal industry named Amruta Metal Works. She approached CIFT with the idea to develop prawn flavored extruded snack food. A brand named 'Prawnoes' was created and registered for trademark protection by ZTM-BPD Unit. CIFT developed and standardized three varieties of Fish Kure for the Incubatee, 'Spicy Shrimp', 'Shrimp n Onion' and 'Prawn Seasoning'. The product was launched in December 2013. Prawnoes has received excellent product reviews during its test marketing period and Smt. Omana is planning to add more snack foods to her product range. CIFT gave her technical guidance in developing the product, standardization of process parameters, testing, packaging solutions, ideas for branding, assistance in trademark filing and setting up their own production unit at Aroor.

- **Ready-to-cook fish product chain 'Meenootty':** Baigai Marine Foods, a Cochin based company, incubated at ZTM-BPD Unit has hit Kerala market with an innovative concept of establishing a retail marketing network of chilled and packed fish products. The whole idea is to bring the fish to the customer's doorsteps in a ready-to-cook form. The product line 'Meenootty' attains great importance in today's daily life as the number of seafood consumers in India is showing an increasing trend. This is mainly due to the recognition of the nutritional value of fish. But as one kind of perishable and short shelf-life

goods, fishes are easy to deteriorate and the process is accelerated with increasing temperature owing to a number of factors such as microbial metabolism, oxidative reaction and enzymatic activity. Consequently, fish economic value and use value is seriously affected. Baigai Marine Foods launched 'Meenootty' by giving importance to the scientific interventions in quality assessment and packaging, and organized business model designed by ZTM-BPD Unit, CIFT. The product is processed and packed in par with the natural conditions preserving their nutritional qualities and freshness. The whole concept is to make available clean and fresh fish to every house-hold like milk products in the market.

- **Ready-to-cook fish gravy 'Swadish':** Swadish fish gravy paste is developed by ZTM-BPD Incubatee, M/s Promise Food Products using CIFT technology and is made from finest and fresh ingredients in homely style. The product was launched in January 2014 and is currently marketed through retail kiosks in Kerala.

- **Seafood Restaurant 'PESCADO' at Thevara:** A restaurant was opened by ZTM-BPD Unit Incubatee, M/s Frank Delicacies at Thevara, Cochin. The breaded and battered fish products were standardized at the ZTM-BPD Unit and are manufactured at the Pilot Plant facility of CIFT. The restaurant was opened on 24 February 2014.

Awards

ZTM-BPD Unit, CIFT won the National Award for Best Agri-Business Incubator for the year 2013: The Zonal Technology Management – Business Planning and Development (ZTM-BPD) Unit at CIFT, Cochin has won the National Award for Best Agri-Business Incubator for the year 2013. The Award was instituted by Network of Indian Agri-Business Incubators (NIABI), to recognize the achievements of the Business Planning and Development Units for their performance excellence and the incubatees for their dedication in setting up successful agribusiness ventures. NIABI is an initiative of Indian Council of Agricultural Research (ICAR) and National Agricultural Innovation Project (NAIP). The Award was presented by Shri Kanna Lakshminarayana, Minister for Agriculture, Andhra Pradesh to Dr. T.K. Srinivasa Gopal, Director, CIFT and Dr. C.N. Ravishankar, Principal Investigator, ZTM-BPD Unit during Indian Agri-Business Incubation Conference held at Hyderabad on 25 April, 2013.

Recognitions

The Government of Kerala has launched its student entrepreneurship scheme for universities, colleges and polytechnics in the state. The Business Incubation Centre, ZTM-BPD Unit, CIFT was recognized and listed among the approved incubators in Kerala.

BIC, CIFT is listed among the approved Business Incubator by Development Commissioner, Ministry of Micro Small and Medium Enterprises (DC-MSME)

The National Business Incubation Association (NBIA) is the world's leading organization advancing business incubation and entrepreneurship. BIC, ZTM-BPD Unit has taken organizational membership, which allows it to interact with members from all types of incubators throughout the world through networking and mentoring.

Intellectual property management and technology transfer/commercialization

(Funded by Indian Council of Agricultural Research)

Principal Investigator : Dr. C.N. Ravishankar

Institute Technology Management Unit

Institute Technology Management unit (ITMU) is service unit which is responsible for the Intellectual Property (IP) protection/management and technology transfer/commercialization of CIFT developed technologies as per the ICAR guidelines. Intellectual property in CIFT constitutes the research results derived by the scientists/innovators which could be protected by patents, or any other form of intellectual property rights such as copy right, trademark, design etc. Technology commercialization means the transfer of IPR enabled technologies or other know-how through licensing under the terms and conditions specified in the license agreement entered into for the purpose or through auction or sale. The unit serves as an interface between R&D, knowledge revolution and stakeholders. It acts as Secretariat for the Institute Technology Management Committee (ITMC). ITMC chaired by Director of the institute is the highest decision making body relating to all issues of IP management in the institute level.

The members of the ITMU are: Dr. C.N. Ravishankar, Principal Scientist, Head, FP Division & Officer In charge, ITMU, Shri M. Kirandas, Research Associate and Smt. K.A. Anju, Research Associate.

Patents filed during the period under report

Sl. No.	Patent Application Filing No.	Inventors	Title
1	226/CHE/2014	Dr. Femeena Hassan, Dr. P. Muhamed Ashraf, Dr. V. Geetha Lakshmi and Dr. T.V. Sankar	Chromatophore based lipstick

IPR Portfolio

IP	In process/ Maintained	Granted
No. of Patents	31	Nil
No. Trade Marks	1	1

Request for examination filed for patent applications at Chennai Patent Office

1. A process for the production of high purity glucosamine hydrochloride from shrimp shell waste - Dr. K.G. Ramachandran Nair, Dr. K.A. Martin Xavier and Dr. K. Devadasan (4274/CHE/2011 dated 8/12/2011).
2. A low cost easy method for extraction of caroteinoprotein from tropical shrimp shell waste - Dr. R. Chakrabarti (4273/CHE/2011 dated 8/12/2011).
3. Ready to eat thermal processed smoked Tuna in oil medium in indigenously developed see-through retortable pouch and a process for preparing the same - Dr. J. Bindu and Dr. T.K.

Constitution of ITMC is as follows:

Dr. T.K. Srinivasa Gopal	Director , CIFT	Chairman
Dr. T.V. Sankar	Principal Scientist & Head, QAM Division	Member
Dr. K. Ashok Kumar	Principal Scientist, QAM, Division	Member
Dr. S. Balasubramaniam	Principal Scientist & Head, EIS Division	Member
Dr. P. Pravin	Principal Scientist, FT Division	Member
Dr. Suseela Mathew	Principal Scientist & Head I/c, B&N Division	Member
Dr. A. Sheeja	Senior Scientist, IISR, Calicut	Member
Dr. C.N. Ravishankar	Principal Scientist & Head, FP Division	Member Secretary

Srinivasa Gopal (4272/CHE/2011 dated 8/12/2011).

4. Smoked masmin flakes and a process for preparing the same - Dr. T.K. Srinivasa Gopal, Dr. R. Yathavamoorthi, V.R. Mumthaz, Dr. J. Bindu and Dr. Suseela Mathew (4276/CHE/2011 dated 8/12/2011).

5. Extruded fish product utilizing low value fish and a process for preparing the same - Dr. T.K. Srinivasa Gopal, Dr. C.N. Ravishankar, C.K. Kamalakanth and Jones Varkey (4322/CHE/2011 dated 12/12/2011).

6. Collagen-chitosan - An absorbable guided tissue regeneration membrane and a process for preparing the same - Dr. Suseela Mathew, Dr. T.V. Sankar and Dr. K. Harikumar (4346/CHE/2011 dated 13/12/2011).

7. Insulation fish bags for preserving quality of iced-fish - Dr. D. Imam Khasim, Dr. B. Madhusudana Rao and A.K. Chattopadhyay (4345/CHE/2011 dated 13/12/2011)

8. Rapid test kit for identification of white spot disease and stress in shrimp and method thereof - Dr. Suseela Mathew, Dr. K. Ashok Kumar, Dr. R. Anandan, Dr. K. Devadasan and Dr. P.G. Viswanathan Nair (4344/CHE/2011 dated 13/12/2011)

9. Fish enriched noodles and a process for preparing the same - A.K. Chattopadhyay, Dr. B. Madusudana Rao and Dr. D. Imam Khasim (4322/CHE/2011 dated 12/12/2011)

10. Fish food composition and a process for preparing the same - Dr. T.K. Srinivasa Gopal, Dr. R. Yathavamoorthi, V.R. Mumthaz, Dr. J. Bindu and Dr. Suseela Mathew (4321/CHE/2011 dated 12/12/2011).

Consultancy agreement signed

Sl. No.	Consultancy	Name of the party	Date of signing	Revenue Generated
1	Validation of diesel engines manufactured by the client	Mahindra & Mahindra - Powerol Division, Mumbai - 400 101	29 May, 2013	₹ 2,22,500/- + ST
2	Technical advice and assistance relating to the extraction of Chitin and Chitosan from prawn shell waste	V.V. Biotech Private Limited, Flat No.404, Dhruva Appartment, Chavali Street, Santapet, Ongole, Andhra Pradesh - 523 001	15 June, 2013	₹ 1,00,000/- + ST
3	Technical guidance for the setting up of a Laboratory with NABL accreditation status at Products Dairy, ERCMPU, Edappally	Ernakulam Regional Milk Producers Union Ltd. (Milma), Edappally, Cochin - 682 024	24 June, 2013	₹ 1,50,000/- + ST
4	Technical assistance for the production of fish curry in retortable pouches	M/s. Monsoon Bounty Foods Manufacturing Pvt. Ltd., No. W115SB complex, Mezzanine Floor, 3 Avenue, Anna Nagar (East), Chennai - 600 040	15 July, 2013	₹ 1,50,000/- + ST
5	Technical advice and assistance related to the production of Fish-Kure, an extruded snack food from fish	M/s. Charis Food Products, Development Area, Aroor, Aroor P.O., Alappuzha	16 July, 2013	₹ 25,000/- + ST

Sl. No.	Consultancy	Name of the party	Date of signing	Revenue Generated
6	Technical advice and support for the procurement of GCMS	State Referral Institute for Water Quality, Kerala Water Authority, Nettoor P.O., Cochin - 682 040	13 December, 2013	₹ 44,500/- + ST
7	Validation and certification of diesel engines produced by M/s. Lombardini India Private Limited.	M/s. Lombardini India Private Limited, Plot No. J-2/1, MIDC Industrial Area, Chikalthana Aurangabad - 431 210	6 January, 2014	₹ 1,11,250/- + ST
8	Consultancy to arrange the drawing design, cost estimate, and technical specifications of intermediate mechanized fishing craft (Extension of agreement signed on 7 Octber, 2011)	Department of Fisheries, Andaman & Nicobar Administration, Port Blair	3 February, 2014	-
9	Technical advice assistance relating to the production of lipstick using squid chromatophore as colourant	M/s. Travancore Aquapets, IV/342 A, Kolliyil house, Kumbalam P.O., Cochin - 682 506	7 February, 2014	₹ 58,500/- + ST
10	Technical support for the purchase/procurement of a research vessel (Extension of MoA signed on 30 March, 2012)	The Regional Agricultural Research Station (RARS), Kerala Agricultural University, Kumarakom, Kottayam - 686 563	3 March, 2014	-
11	Consultancy for the designing and setting up of a food testing laboratory at the campus of St. George's College, Aruvithura	St. George's college Aruvithura, Aruvithura P.O. Kottayam - 686 122	27 March, 2014	₹ 2,75,000/- + ST

Handing over of signed MOU to MILMA

Handing over of signed MOU to St. George's College

Handing over MoU to M/s Monsoon Bounty Foods Manufacturing Pvt. Ltd.

Handing over MoU to M/s Charis Food Products

Green fishing systems for the tropical seas

(Funded by National Fund for Basic, Strategic and Frontier Application Research in Agriculture)

Principal Investigator : Dr. Leela Edwin

Co-Investigators : Dr. Saly N. Thomas, Dr. P. Pravin, Dr. M.P. Remesan, Shri M.V. Baiju and Dr. V.R. Madhu

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

The first all India baseline technical survey of marine mechanized fishing vessel and gear and energy use in the fishing sector was carried out, for the creation of a database. The study covered the fishing harbours and important landing centres along the maritime states and the islands of Andaman & Nicobar and Lakshadweep islands. Three to five fishing villages of each location were selected and a total of 160 fishing villages were covered during this survey which was carried out during October 2012 to September 2013.

Documentation of designs of fishing gear were done as per FAO (1975, 1978). Documentation of designs of fishing vessels was done as per FAO standards (Fyson, 1986). The classification of fishing vessels into different classes, was carried out using General Classification and Regression Tree Model Analysis (C&RT) based on details collected during the survey on vessel types operating along the Indian coast. The factors taken into consideration were the L_{OA} (m), breadth (m), draft (m), material used, engine power (hp), and fuel consumption (L/h) of the registered vessels.

Fishing Vessel

Representative samples of fishing vessels were selected based on the most prevalent designs of the region and the type of fishing. Lines plan and structural details of 35 most widely used fishing vessels along the Indian coast were collected during the survey. The scantling details of different parts such as hull, deck, and wheel house were measured and recorded. The classes of vessels covered during the survey were: trawler, purse seiner, ring seiner, gillnetter, dolnetter, long liner and other liners and combination fishing vessels like trawler-cum-longliner, trawler-cum-gillnetter, trawler-cum-purse seiner and gillnetter-cum-long liner.

Fishing gear system

Data on gear designs, fabrication, operation and investment details of major fishing gears from the mechanized sector like trawl nets, purse seines, ring seines, gillnets, dolnets and hook and lines were collected and digitised. The structural, operational and design differences in the common gear systems

of different coastal states *viz.*, details regarding the dimensions, materials, accessories like floats, sinkers and operational parameters of the gears were also covered during the survey.

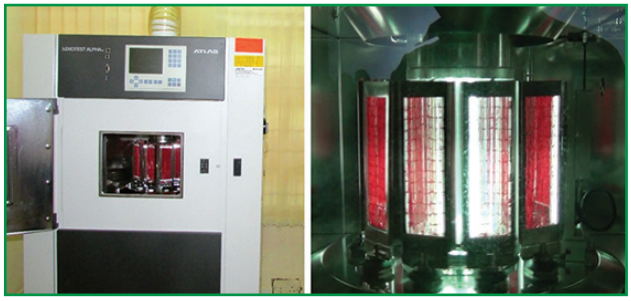
Energy efficient combination fishing vessel

As a part of the project the design and calculation of 19.80 m combination fishing vessel was carried out. Lines plan in 2D Format was developed from the offset table. 3D model of the fishing vessel was generated from the 2D lines plan and offset table. The preliminary general arrangement plan was also prepared.

The design was presented to different stake holders in the industry across the country and feedback was collected and relevant suggestions were incorporated in the final design. Powering calculation was carried out to find out the resistance and perfomance of the designed hull form in different domines. Star CCM+, a Computational Fluid Dynamics software is used to simulate the hull form to obtain the resistance values. The resultant design and parametrs were handed over to Goa Shipyard Limited for model testing.

Durability studies on ring seine fishing nets

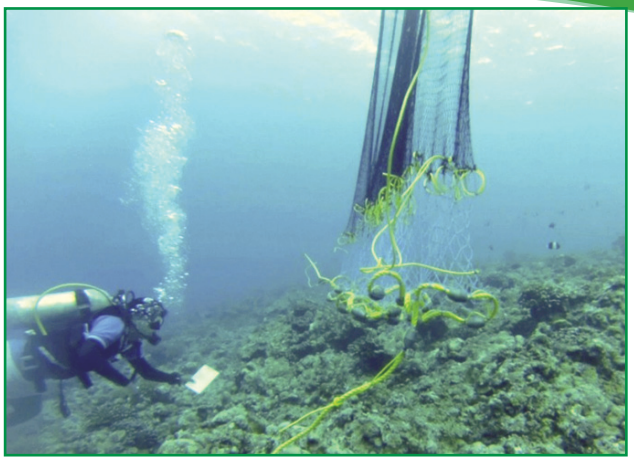
Polyamide webbing are generally used for ring seine construction. Due to the low durability of these webbings, the fishermen are forced to replace netting panels frequently. There were no reports available on the durability studies of ring seines. Weather O meter studies were conducted for analyzing the life-span of different ring seine webbings. An 18 month durability study was conducted and analysis for strength parameters was conducted for each month.



Weather O meter used in the study

Purse seine sinking speed studies in Lakshadweep waters

Studies on the sinking efficiency of purse seines



Purse seine sinking speed studies

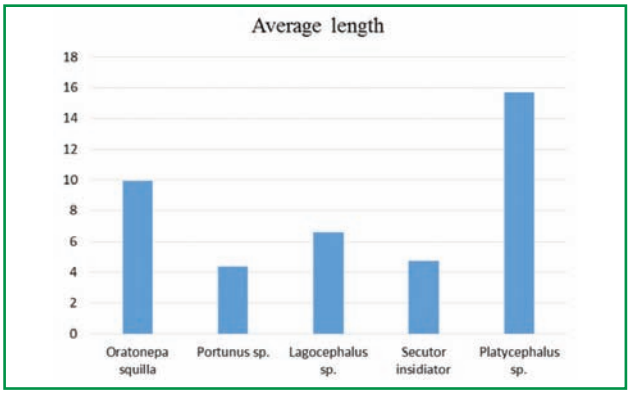
were carried out in Lakshadweep sea using three seine models with different mesh sizes. The model was set 20 times for each design under five different depths to evaluate sinking characteristics of purse seine designs. A scale model of a purse seine having 10 m length and 90 m depth (a standard Indian purse seine net panel) was experimentally operated in actual field conditions. This work helped in gaining reliable insight on sinking speed, under-water behaviour of purse seine webbing in water, sinking pattern of purse seine, etc. The purpose of this study was to compare the traditional nets with the newly introduced high durable materials and evaluate its performance in commercial conditions.

Drift gillnets for large pelagics using new generation gear materials

For the development of optimized drift gillnets for large pelagics through new generation fishing gear materials, Sapphire (7x3) and Star (No.8) were selected as materials for substituting conventional polyamide (PA) twine. Finalised the design of drift gillnets with these two new materials having dimensions identical to the commercial gear (control) made of PA multifilament of 210d x 8 x 3. The newly designed experimental nets are having 80 mm mesh depth and 150 mm mesh size. Mesh size of 150 mm (stretched) was chosen as this is commonly used by the fishermen to catch large pelagics. The nets are getting fabricated for comparative fishing trials through commercial fishermen groups. Accordingly, fishermen groups are identified who are operating gillnets in the high seas for harvesting large pelagic high value fishes.

Characterization of bycatch in commercial trawling operations

Studies on bycatch characterization revealed that bycatch constituted about 30-60% of the total catch.



Bycatch characterization

The major species which comprised the bycatch were *Oratosquilla nepa*, *Portunus* sp., *Lagocephalus* sp., *Secutor insidiator* and *Platycephalus* sp. Juveniles of commercially important species like *Nemipterus japonicus* and *Uroteuthis (Photololigo) duvauceli* were found to form about 4% by weight in the total bycatch.

Trainings

An international workshop cum training programme on "Technical measures as tool for fisheries management in the Indian scenario" was organized at CIFT, Cochin on 12 February, 2014 under the Project Green Fishing Systems for Tropical Seas. Dr. Yugraj Singh Yadava, Director, BOBP-IGO was the Moderator and Dr. Petri Suuronen, Fishery Industry Officer, FAO, Rome was the main resource person of the programme. Details are given elsewhere in the report.

Development of multiplex microarray system for detection of food-borne and shrimp pathogens

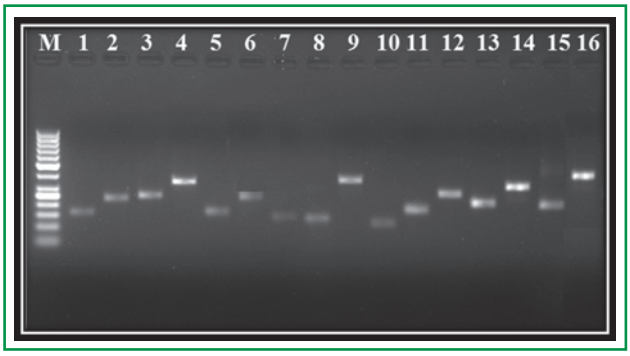
(Funded by National Fund for Basic, Strategic and Frontier Application Research in Agriculture)

Principal Investigator : Dr. Toms C. Joseph

Co-Investigators : Dr. K.V. Lalitha and Dr. G.K. Sivaraman

PCR assay for detection of shrimp viruses

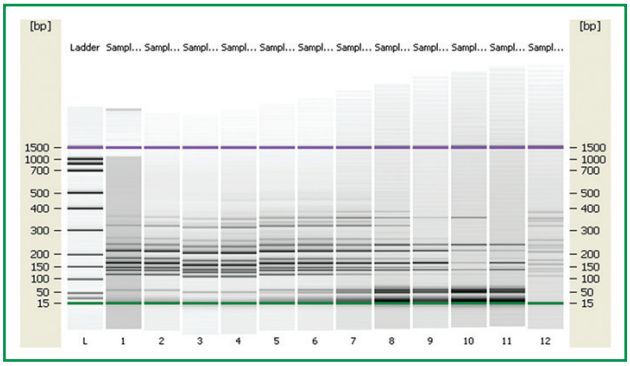
Sixteen PCR assays targeting four virulent genes each from four shrimp viruses; WSSV, MBV, HPV and IHHNV were standardized using primers designed to target different regions of each virus. The PCR products were cloned in TA cloning vector to be used as templates for development of a multiplex PCR.



PCR detection of shrimp viruses
(Lane M: 50bp Molecular weight marker,
Lane 1-4: MBV 1-4, Lane 5-8: WSV 1-4,
Lane 9-12: HPV 1-4, Lane 13-16: IHHNV 1-4)

Standardization of multiplex PCR assay for amplification of multiple targets from shrimp viruses

Multiplex PCR was standardized for detection of four different shrimp viruses; WSSV, MBV, HPV and



Determination of sensitivity of multiplex PCR for shrimp viruses, WSSV, MVV, HPV and IHHNV
(Lane L: DNA 100 molecular weight ladder,
Lane 1-11: PCR products of template mix serial dilution from10 ng/µl to 1 ag/µl, Lane 12: 10 ng/µl template mix)

IHHNV using Qiagen multiplex PCR Kit as per the manufacturer's protocol. Different annealing temperatures, PCR cycling conditions and primer concentrations were employed for finalizing the PCR protocol. The sensitivity of multiplex assay was determined by serial dilution of template mix from 10 ng/µl to 1ag/µl. The diluted template mix was subjected to multiplex PCR using standardized multiplex PCR. The assay showed a sensitivity of up to 10^2 copy of templates. Further dilutions resulted in non amplification of one or more templates.

Responsible harvesting and utilization of selected small pelagic and freshwater fishes

(Funded by National Agricultural Innovation projects)

Principal Investigator : Dr. K.V. Lalitha

Co-Investigators : Dr. S. Sanjeev, Shri M. Nasser, Dr. R. Anandan, Dr. V. Geethalakshmi and Dr. S. Ashaletha

The major achievements of the project have resulted in employment generation and income augmentation of the stakeholders in the fisheries sector.

Memorandum of Agreement signed

Under the Project the technology for the production of Omega-3 enriched poultry egg and meat was developed. The technology for incorporating Omega-3 in poultry meat through Omega-3 enriched feed was successfully tried in two locations. Consequently, M/s Kokkarakko Poultry Farm, Pattambi signed a consultancy agreement with the Project on 13 December, 2013. The consultancy services consisting of the technology and the business model will be provided by the team of scientists Dr. K.V. Lalitha, Shri M. Nasser, Dr. R. Anandan and Dr. S. Ashaletha.

Dr. T.K. Srinivasa Gopal, Director, CIFT handing over the MOA to the Managing Director of M/s Kokkarakko

"Seafresh" launch in different locations in Ernakulam district

A new business model has been developed in the Project for trading fresh fish under the brand name "Seafresh". The sale of hygienically cleaned and packed fresh fish through "signature kiosks" has been initiated at various locations in Ernakulam district. "Seafresh" was officially launched by Shri Hibi Eden, MLA, Ernakulam on 19 February, 2014 at St. Albert's College, Ernakulam. During the inaugural function, the portable kiosks were distributed by Shri Hibi Eden to 15 students of Fisheries Science Department of the College for the marketing of 'Seafresh'. The processed fresh fish packed in 500 g and 1 kg packets are being sold through kiosks placed at roadside at locations Palarivattom, Kaloor, Thevara, High court Junction and Kadavantra in Ernakulam district from 3 pm to 6 pm during working days by the Fisheries Science students including girls, after the class time.

Shri Hibi Eden, MLA inaugurating Seafresh signature kiosk

The new venture has helped in wiping off the social stigma related to fish trade and has helped to elevate the status of the occupation. It also gives an opportunity for women from coastal belt to earn a subsidiary income. At production end, the primary producers (fisherfolk) are getting an increased price for their fish when they bring it in good quality demanded by the project team. In the processing centre, the women get income for hygienically dressing and packing. The persons engaged in trading also derives a margin and customers get the value added fresh fish at almost same cost that of other fishes, as there is no middle men's share.

The Project team has trained fisherwomen in hygienically processing high quality fresh fish acquired directly from harbor, considering HACCP protocols and at present two processing units have started production at Ochanthuruth, Ernakulam and Kollam, which are being operated by fisherwomen. In the production units, the fresh fish procured from selected fishing boats under quality monitoring are dressed and packed in special LDPE sealed trays in chilled condition and make it ready for sale. The business model is a solution for the problems in fresh fish trade like unhygienic handling, spoilage due to lack of preservation, incorporation of unwanted chemicals, generation of waste at market place or at home while dressing the fish etc.

FRP boat designed and developed for inland fishing operations

A 5.77m FRP boat design for inland fishing was developed under the Project. Computer optimized structural design was adopted for ease of construction, optimal strength, high operational safety, maintenance-free use and low cost. Size and maneuverability characteristics of the boat were designed to suit the inland fishing operations. The boats were constructed in the boat-building hall of CIFT's workshop under the technical supervision of the Project. The cost of a boat is only ₹ 24,750/-. The boats will be owned by the consortium partner Chellanam SC/ST Co-operative Society, Chellanam and will be used by its fishermen members.

FRP boats being constructed for inland fishing at CIFT's Boat Yard

Fuel efficient propellers for ultra high power engines

Six fuel efficient propellers for high powered engines (300-600 Hp) presently in vogue for fishing has been developed and the trials of Prototypes were conducted onboard boats in Kollam. These propellers were found to save fuel by 18-21% leading to saving of around ₹ 4,25,000/- per annum per boat. Engine manufacturers are on the lookout for rightly matched propellers as it affects the engine performance and consequently their market. The technology developed can help to reduce fuel consumption in fishing sector as well as carbon emission. Fisheries is one of the industrial sectors in the country using large amount of diesel and cause a large carbon foot print. These designs were commercially released to two manufacturers in Kerala.

Extraction of PUFA from Srdine oil

Extraction of PUFA from Srdine oil was perfected in the newly erected reflux/distillation equipment. The yield of omega-3 concentrate ranged between 18-25% and concentrations upto 70% could be obtained. The extracted oil was encapsulated. Purification of DHA from fish oil using argentated silica gel chromatography was also standardized. Experimental studies in rats were carried out to determine the cardio-protective and anti-ageing properties of PUFA which have shown that significant amount of n-3 PUFA is getting incorporated into the muscle tissue. Hence an attempt was made to incorporate n-3 fatty acid rich PUFA concentrate prepared from Sardine oil into hens' diet. The project has been successful in extracting PUFA from Sardine oil in its purest form in a cost effective way and demonstrated that it can be incorporated in poultry feed for better growth and quality eggs. The technology has been given to a progressive poultry

farmer and he has reported encouraging results. Furthermore 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.

International training programme on SHIPFLOW

CIFT is engaged in the cutting-edge research of CFD to bring the benefits to the designers and builders of fishing vessels in the country. The ship's hydrodynamic performance can be studied and optimized at the highest level of sophistication through CFD techniques. It minimizes the implementation of model testing which is often prohibitively expensive in terms of time and budget, especially for fishing sector. The project is using SHIPFLOW for CFD optimization and has amassed considerable experience. To help uncover the immense advantages of SHIPFLOW codes and to share the research in this area, the Project, in association with Flowtech International AB, Sweden had conducted a five-day advanced training program on SHIPFLOW during 15-19 April, 2013. Shri M. Nasser, Principal Scientist (Naval Architect) was the Director of the training course and Dr. S. Ashaletha, Senior Scientist was the programme convener. Dr. Leif Broberg, and Dr. Michal Orych of Flowtech International AB and Shri M. Nasser took classes.

Inaugural session in progress

Participants and resource persons of the programme

The course was inaugurated by Prof. K.A. Simon, Director, Kunjali Marakkar School of Marine Engineering, CUSAT and was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT. Dr. K.V. Lalitha, CPI of the project proposed vote of thanks. The participants included academicians, scientists, naval architects and research students from leading organisations like Naval Science and Technological Laboratory, Indian Register of Shipping, Indian Maritime University, Indian Institutes of Technology (IITs, Kharagpur and Chennai), National Institute of Technology (NIT, Kozhikode) and leading design firms like SEDS, Navgathi, Vedam, NAPA, Teknomak Project etc.

Capacity building programme on 'Fishmaid' products

An intensive Capacity Building Programme was designed and conducted at the centralized fish value-addition facility of Kerala Coastal Area Development Corporation, "Nalapakam" at Kollam. Sixty trainees were selected from a group of 452 applicants for imparting skill to produce selected innovative Fishmaid products. The training was conducted in three batches of 20 trainees each for 70 days continuously during January-March, 2014. The trainees were evaluated at the end and certificates issued.

A practical manual for the HACCP and GMP to be followed in fish-snacks production facilities was prepared and the training was imparted based on the

Capacity building programme in progress

manual. The participants were equipped with adequate entrepreneurial skills to run small production centers using the entrepreneurial instruction module, 'FECAM' developed under the project.

Model hygienic bulk drying yards for Bombay duck

A low cost commercial Hygienic bulk drying system was designed and perfected for Bombay duck by Shri M. Nasser, Co-PI of the Projects. This is an improved version of the low cost bulk drying technology demonstrated to fishermen in Jaffarabad, Gujarat. For popularizing the business model for dried Bombay duck for domestic as well as export markets, the project in association with NETFISH (MPEDA) fabricated this commercial level drying facility in Umbergaon, South Gujarat with funding from NETFISH in January, 2014. This facility has a capacity of 2.5 tonnes and consists of 24m x 9m drying chamber, a 12m x 3m hot air solar dryer and laminating machines.

A training programme on 'Hygienic bulk drying of Bombay duck' was conducted at Umbergaon Fishermen's Sarvodya Sahakari Society during 24-26 March, 2014 to demonstrate the facility to the stakeholders. Around 70 fish processors participated in the Workshop-cum-training programme. The programme started with welcome by Ms Sindhu, a social activist at Umargam who briefed the stakeholders about the project. Shri Jitu Bhai Tandle, President of the Umbergaon Fishermen's Sarvodya Sahakari Society, explained to the stakeholders the importance of the project and appreciated the efforts put up by the project team at Umbergaon. Dr. K.V. Lalitha, CPI, NAIP-RHSSP who gave the presidential address, urged the participants the need to bring out quality improvement in Bombay duck. Shri Jignesh Visavadia, State Coordinator, NETFISH, Gujarat explained to the participants the merits of the hygienic bulk drying system set up at Umbergaon. Training on processing, drying and packing of Bombay duck using the model drying facility was imparted. The laminating machine developed under NAIP-RHSSP project which has been installed at Umbergaon was also demonstrated during the 3-day programme.

Hygienic bulk drying system for Bombay duck at Umbergaon, Vapi, Gujarat

Workshop on 'Hygienic handling and production of fresh fish'

A three day workshop was organized on 'Hygienic handling and production of fresh fish' at "Greenfish" Production Unit, Ochanthuruthu, Vypeen, Ernakulam during 20-22 December, 2013. Classes were given on handling and hygienic production of fresh fish, various aspects of 'Seafresh' business model and marketing of packed fish as well as the business economics. A total of 20 participants were trained on production of fresh fish and packing methods. All the fisherwomen who underwent the programme were employed by "Greenfish".

Workshop on Hygienic production of fresh fish in progress

Business meet organized

A Business meet of prospective "Fishmaid" entrepreneurs was conducted on 3 September, 2013 at Thiruvananthapuram jointly by Kerala State Coastal Area Development Corporation and the Project. Dr. K. Ampady, MD, KSCADC presented the franchisee programme. The business model was presented by Shri M. Nasser, Principal Scientist and the queries from the entrepreneurs were handled by Dr. S. Ashaletha, Senior Scientist. Fourty seven entrepreneurs who applied for taking up the franchisee operation was

A degustation session for entrepreneurs in progress

interviewed and the business premises were inspected. Thirty applicants were shortlisted to start the franchisee programme.

Participation in Arunachal Meen Mahotsav 2013

The Project was invited for participation in the "First Ever Arunachal Meen Mahotsav 2013" during 21-22 November, 2013 held at Itanagar, Arunachal Pradesh to show case the technologies developed. The programme was organized by Department of Fisheries, Arunachal Pradesh and supported by National Fisheries Development Board, Hyderabad and ATMA. Honourable Chief Minister of Arunachal Pradesh Shri Nabam Tuki inaugurated the exhibition on 21 December and Shri Chowna Mein, Honourable Minister for Finance, PWD & Planning, Arunachal Pradesh and Dr. H.K. Paliwal, IAS, Chief Secretary, Arunachal Pradesh delivered special address during the inauguration. The exhibition was opened for various Development agencies, State departments, leading business houses etc. About 15 exhibitors from various parts of India participated in the event. The technologies developed under the Project were displayed such as value added fish products ('Fishmaid'), hygienically packed dry fishes ('Drish'), omega-3 fatty acid enriched products, organic manure from fish ('Fertifish'), fuel efficient propellers and FRP boats for fresh water fisheries sector. During technical session a presentation on "Value chain project on pelagic and freshwater fisheries" was made by NAIP-RHSSP project team members. Several ministers, official departments and entrepreneurs from Arunachal Pradesh visited the stall. Through the event a very good awareness was created among the public and business houses about the technological contributions of the Project.

NAIP-RHSSP Exhibition stalls at Itanagar, Arunachal Pradesh

NAIP Media team visit

The members from Press Trust of India, Dainik Bhaskar and the NAIP Media consultants Goldmine Creations visited the industrial units commercialized under the Project. They interviewed the beneficiaries of the units and also the fisherfolk in order to get more understanding about the outcomes and also to find out the improvement in their livelihood. They visited the production units and marketing centers in Kollam and also the propeller manufacturing unit at Chavara, Kollam. The team has recorded a video programme on the benefits of the Project as well as published many articles throughout the country on its outcomes.

Agri Tech Investor' Meet

The Project participated in Agri-Tech Investors Meet, organized by NAIP in association with ICRISAT, at New Delhi during 18-19 July, 2013 with the objective of commercializing agro-technologies

Media team interacting with the Project team

developed under the Project. The Project was shortlisted to show case the technologies of value added fish products. In the marine products session chaired by Dr. B. Meenakumari, DDG (Fy.), ICAR, details of products developed under the Project was presented by Dr. K.V. Lalitha, CPI. Agri-exhibition and B2B meetings were also arranged for technology commercialization and partnership engagement. In the B2B meeting, M/s Aachi Masala Foods Private Limited, Chennai had expressed interest to scale up the technologies.

Distribution of gillnets for reservoir fishing

The Project organized a programme for distribution of improved gillnets suitable for reservoir fisheries to the fishermen of seven dams of Palakkad district in association with the State Department of Fisheries, Malampuzha, Palakkad, at Kollengode Block Panchayat Hall, on 22 July, 2013. Shri K. Babu, Hon. Minister for Fisheries, Ports and Excise, Kerala inaugurated the programme and distributed the gillnets to the fishermen of Meenkara and Chulliyar dams. Later, gillnets were distributed to all the active fishermen belonging to the other four dams also. The function was presided over by Shri K. Vasudevan, President, Kollengode Block Panchayat. Smt. Mallika Swaminathan, Smt. T. Pradeepa, Smt. Anu Ramesh and Smt. K.C. Vijayakumari, Members, Kollengode Gram Panchayat offered felicitations. Earlier Dr. K.V. Lalitha, Consortium PI welcommed the gathering and Shri M. Nasser, Co-PI of the project gave a detailed report on the project interventions for the reservoir fisheries in Palakkad. Shri Y. Sayed Muhammed, Deputy Director of Fisheries, Malam-puzha proposed vote of thanks. Dr. V. Geetalakshmi and Dr. S. Ashaletha, Co-PIs of the Project coordinated the programme. Altogether, 132 fishermen fishing in various dams in Palakkad namely Valayar, Mangalam, Pothundi, Kanjirapuzha, Meenkara and Chulliyar got benefited from the programme.

Hon'ble Minister distributing gillnets

Popularization of technologies

Prepared four brochures and one video film for the popularization of technologies developed under the Project and around 24 news reports were published in different news media. Nearly four exhibitions were organized for popularizing NAIP-RHSSP products and technologies. Also the impact assessment studies were taken up, which is still continuing.

Training programme on Hygienic fish drying for improve livelihood of coastal fisherwomen

The Project and M/s M.S. Swaminathan Research Foundation (MSSRF), Chennai jointly organized a four day training programme on “Hygienic fish drying for improve livelihood of coastal fisherwomen” during 16-19 July, 2013 at the “Fish for All” Research and Training Centre of MSSRF at Kaveripoompatanam, Tamil Nadu. Dr. L. Krishnan, Head of the Centre inaugurated the programme. The felicitation was given by Dr. K. Ashok Kumar Unnithan, Principal, MSSRF-IGNOU Community College for Fisherwoman, Poompuhar, and Shri T. Selvarasu, Scientist, MSSRF. Shri J. Jayakumar, Plant Manager of the Centre proposed vote of thanks.

The training programme was coordinated by Dr. S. Ashaletha, Co PI, NAIP-RHSSP. The training programme was held as two technical sessions - “Hygienic dry fish processing methods” and “Dry fish handling and packaging techniques”. A total of 108 selected fisherwomen from different fishing villages of Poompuhar attended the four days training programme which was followed by a discussion with all the trainees. The dry fish based business model was explained to the trainees by Shri M. Nasser, Pricipal Scientist and Co-PI.

Bioprospecting of genes and allel mining for abiotic stress tolerance

(Funded by National Agriculture Innovation projects)

Principal Investigator : Dr. Toms C. Joseph

Co-Investigator : Dr. K.V. Lalitha

Draft genome sequence of *Mangrovibacter* spp. MFB070 - A nitrogen-fixing bacterium isolated from an aquaculture farm

Mangrovibacter spp. is a facultatively anaerobic, nitrogen-fixing bacterium representing a novel genus and species of the family Enterobacteriaceae, associated with the rhizosphere of mangrove-associated plants. The genome of *Mangrovibacter* spp. MFB070 was sequenced to better understand the ability of *Mangrovibacter* spp. to fix nitrogen.

Sequencing was performed on the Illumina MiSeq platform with a 2 × 250 paired-end run, after library preparation with the Nextera XT sample preparation kit (Illumina); 495,258 paired sequences were generated, for a total of >203.06 Megabases and a mean length of 205 bases per read. Reads were analyzed and quality checked using FastQC and *de novo* assembled using Velvet, resulting in 53 contigs, the largest of which is 650,185 bp; N50 of 240,741 bp.

The genome sequence was annotated using NCBI Gene Bank and RAST genome annotation servers. The draft genome sequence of *Mangrovibacter* spp. is 5,361,682 dbp, with a G+C content of ~64.8% and 5297 predicted coding sequences, and 36 tRNA genes for all of the amino acids. The organism encodes for 48 genes involved in nitrogen fixation, nitrosative stress, nitrate and nitrite ammonification and ammonia assimilation. The organism also codes for mdtABCD, the multidrug resistance cluster that increase resistance to Novobiocin and Deoxycholate. The bacteria also encodes for genes for heavy metal resistance to Cobalt, Cadmium, Zinc, Arsenic and Copper based on metal resistance determinants that contain genes for RND (resistance, nodulation, and cell division protein family) protein. Several phage proteins were also identified indicating the presence of phages in the bacteria. Genes involved in iron acquisition and metabolism including siderophores were also identified in the bacteria.

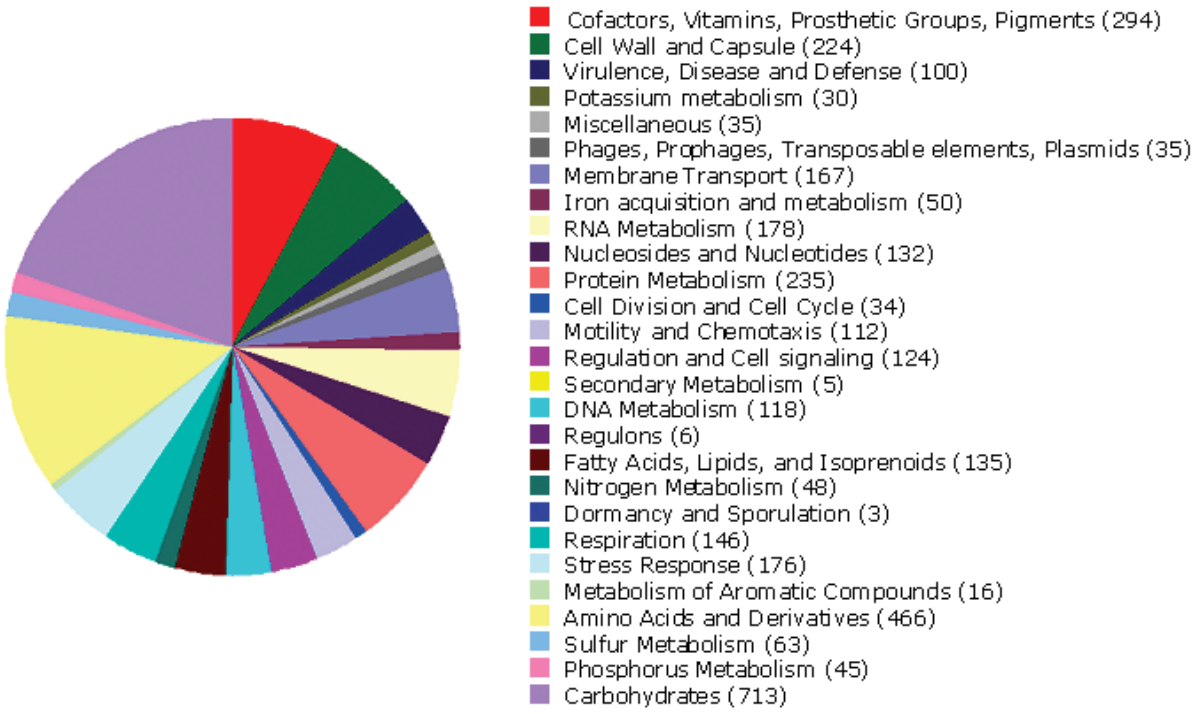
Draft genome sequence of a halophilic and highly halotolerant Gammaproteobacteria Strain MFB021

The draft genome sequence of Gammaproteobacteria Strain MFB021 was undertaken to identify the genes coding for various metabolic pathways including for halotolerance. Gammaproteobacteria Strain MFB021 was isolated from saline soil at Cochin. The organism grows optimally between 0.5-25% NaCl and in addition, it displays extraordinarily high halotolerance.

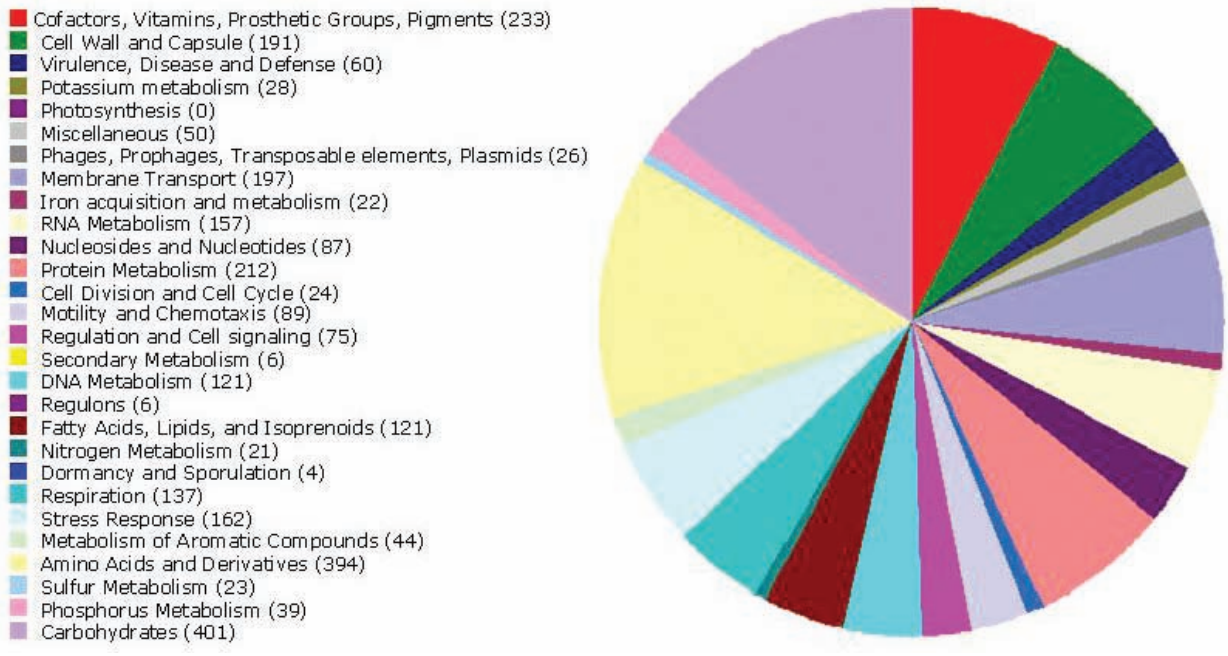
Sequencing was performed on the Illumina MiSeq platform with a 2 × 250 paired-end run, after library preparation with the Nextera XT sample preparation kit (Illumina); 522,255 paired sequences were generated, for a total of >193 Megabases and a mean length of 185 bases per read. Reads were analyzed and quality checked using FastQC. *De novo* assembly was performed using ABySS version 1.3.6. SSPACE version 2.0 was used to extend and merge the resulting scaffolds based on read-pair information and short overlaps to reduce the number of scaffolds which resulted in 142 contigs and an average coverage of 43×, for a total of 4,438,481 bp. Genome annotation was automatically performed on the RAST server using Glimmer for base calling, obtaining 4,606 protein-coding genes.

Among the CDSs, 1,886 are not in a subsystem (1020 non-hypothetical, 866 hypothetical), whereas 1,992 CDSs (1,898 non-hypothetical, 94 hypothetical) are in subsystems. RAST annotation also predicted the involvement of 162 genes in stress responses, including 30 genes involved in osmotic stress (Two in osmoregulation, 21 in choline and betaine uptake and betaine biosynthesis, three in synthesis of osmoregulated periplasmic glucans and four in ectoine biosynthesis and regulation), 75 in oxidative stress (12 in glutathione: nonredox reactions, six in redox-dependent regulation, six in Glutathione: redox cycle, six in Glutaredoxin, 24 in oxidative stress, two in glutaredoxins), eight in protection from reactive

Subsystem category distribution in *Magrovibacter* spp. MFB070



Subsystem category distribution in Gammaproteobacteria Strain MFB021



oxygen species (ROS), three in cold shock, 15 in heat shock, 29 in detoxification, and 19 in no subcategory. Also 44 genes are involved in Metabolism of Aromatic Compounds (Three in Salicylate ester degradation, four in Benzoate degradation, four in Chloroaromatic degradation pathway, 11 in Catechol branch of beta-ketoadipate pathway, five in Salicylate and gentisate catabolism, 13 in Protocatechuate branch of beta-ketoadipate pathway). The organism also has six genes involved in the synthesis of auxin, a plant hormone.

Oceanic Tuna fisheries in Lakshadweep seas - A value chain approach

(Funded by National Agricultural Innovation Projects)

Principal Investigator : Dr. T.K. Srinivasa Gopal

Co-Investigators : Dr. P. Pravin, Dr. K. Ashok Kumar, Dr. Suseela Mathew, Dr. J. Bindu, Shri M.V. Baiju and Dr. Toms C. Joseph

Tuna long line operations

Three Pablo boats one each at Kavaratti, Kalpeni and Chetlat islands of Lakshadweep were modified for Tuna long line operations. A hand operated winch was provided in the vessel that can operate 100 hooks. The main line was 2.5 mm PA monofilament and the branch line was 1.5 mm PA monofilament. The fishermen were given training in the rigging and fabrication of Tuna long lines. Field demonstrations were given to the fishermen on operation of Tuna long line monofilament gear.

Influence of smoke source characteristics on the composition of indigenous liquid smoke

Effect of smoke source in the composition of an indigenous liquid smoke (LS) produced form three sources (coconut husk, coconut fibre and coconut fibre powder) were investigated. Indigenous liquid smoke produced from coconut husk had the lowest level of PAH when compared to other two sources. LS produced from coconut husk had significantly high carbonyl content (44.20 ± 34.86 mg/ml) compared to the same produced from coconut fibre (11.56 ± 2.41mg/ml) and coconut fibre powder (12.22 ± 3.03 mg/ml) ($P < 0.05$). LS produced from coconut husk were found to be sensory-wise superior to other two samples.

Comparison of polycyclic aromatic hydrocarbons (PAH) in traditional masmin and liquid smoked masmin

Application of liquid smoke in masmin production was effective in lowering the PAH content. Bezo(a)pyrene content in traditional masmin was found to be 14.55 ppb (Exceeding the EU approved limit of 5 ppb), whereas, benzo(a)pyrene was not detected in indigenous and commercial liquid smoke (Red arrow international, SMOKEZ ENVIRO 24PB with beach wood flavour). However on analysis of indigenous and commercial liquid smoked masmin, a benzo(a)pyrene level of 0.84 ppb and 4.69 ppb was detected. PAH detected in liquid smoked masmin, other than which was present in liquid smoke might have their origin from bioaccumulation or post-harvest contamination.

Inactivation of *Escherichia coli* 0157 in Yellowfin tuna using pulsed light technology

Tuna homogenate after sterilization was stirred and transferred into petri plates. *Escherichia coli* 0157 was then transferred into the petriplate and pulsed treated for 5, 10, 15, 20, 25 sec. The corresponding energy obtained was 11.41, 21.44, 33.71, 44.27, 49.38, 64.84 J/cm^2. The samples were then analyzed for total plate count using Aerobic plate count petrifilm and incubated at 35 °C for 48 hrs. The results showed log reductions of 1.07, 1.15, 1.42, 1.97, 2.33 and 2.66 in the respective time variations when compared with the control. The D value was calculated in the above experiment and was found to be 12.38 sec. This study shows that only 1 log reduction of *E. coli* 0157 is possible in 12.38 sec. of pulsed light treatment.

Inactivation of *Staphylococcus aureus* ATCC 6538 in Yellowfin tuna homogenate using pulsed light technology

Tuna homogenate after sterilization was stirred and transferred into petriplates. *Staphylococcus aureus* ATCC 6538 was then transferred into the petriplate and pulsed treated for 5, 10, 15, 20, 25 sec. The corresponding energy obtained was 11.41, 21.44, 33.71, 44.27, 49.38, 64.84 J/cm^2. The samples were then analyzed for total plate count using Aerobic plate count petrifilm and incubated at 35 °C for 48 hrs. The results showed log reductions of 0.14, 0.26, 0.42, 0.56, 0.59 and 0.90 in the respective time variations when compared with the control. The D value was calculated in the above experiment and was found to be 35.90 sec. This study shows that on 1

log reduction of *S. aureus* ATCC 6538 is possible in 35.90 sec of pulsed light treatment.

Training programme on "Development value added products from Tuna"

A training programme was organized at CIFT during 6-7 September, 2013 under the Project at Minicoy. Five participants from Minicoy Island, Lakshadweep participated in the programme. Participants were given hands-on-training on development of various value added products from Tuna *viz*. Tuna burger, Tuna balls, Tuna pickles and Tuna spring roll etc.

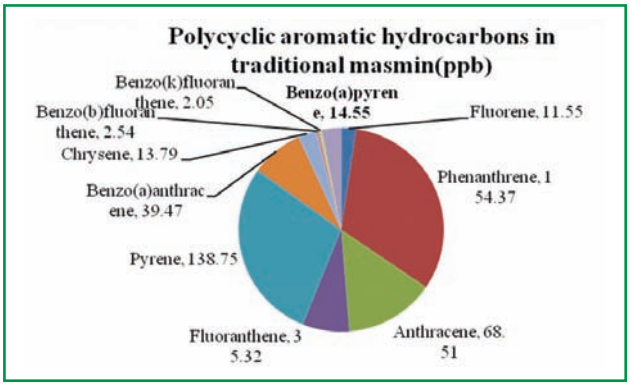
Awareness programme on "Value added products from Tuna waste"

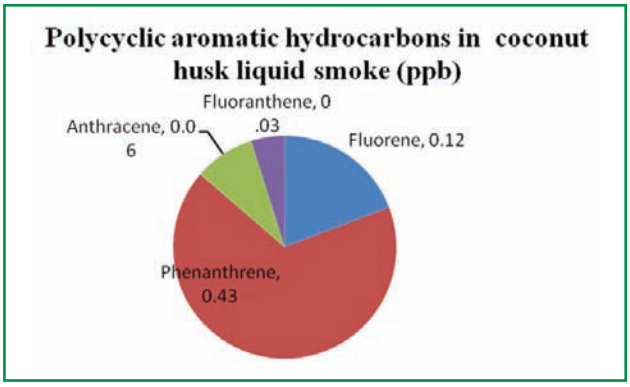
An awareness programme on "Value added products from Tuna waste" was organized by CIFT on 26 March, 2013 at the Village Dweep Panchayat, Minicoy under the Project. Fifty participants from various self help groups (SHG) in Minicoy attended the programme.

Awareness programme inauguration

Influence of smoke source characteristics on the composition of indigenous liquid smoke and comparison of polycyclic aromatic hydrocarbons (PAH) in traditional masmin and liquid smoked masmin

The aim of the study was to understand the effect of smoke source in the composition of an indigenous liquid smoke (LS) produced from three sources (coconut husk, coconut fibre and coconut fibre powder) and to compare the effectiveness of liquid smoking in reducing the polycyclic aromatic hydrocarbons in traditional masmin. Composition of indigenous liquid smoke was compared with a commercial liquid smoke (Red Arrow International,





PAHs in traditional masmin and coconut husk liquid smoke

SMOKEZ ENVIRO 24PB with beach wood flavour). Indigenous liquid smoke produced from coconut husk had the lowest level of PAH when compared to other two sources. LS produced from coconut husk had significantly high carbonyl content (44.20 ± 34.86 mg/ml) compared to the same produced from coconut fibre (11.56 ± 2.41mg/ml) and coconut fibre powder (12.22 ± 3.03 mg/ml) (P 0.05). LS produced from coconut husk were found to be superior sensory-wise to other two samples. Application of liquid smoke in masmin production was effective in lowering the PAH content. Bezo(a)pyrene content in traditional masmin was found to be 14.55 ppb (which is very high compared to the EU approved limit of 5 ppb). Whereas, benzo(a)pyrene was not detected in indigenous and commercial liquid smoke. However on analysis of indigenous and commercial liquid smoked masmin, a benzo(a)pyrene level of 0.84 ppb and 4.69 ppb was detected. PAH detected in liquid smoked masmin, other than which was present in liquid smoke might have their origin from bioaccumulation or post harvest contamination.

Strengthening of digital library and information management under NARS (e-Granth)

(Funded by National Agricultural Innovation Projects)

Principal Investigator : Dr. Suseela Mathew

Co-Investigator : Smt. T. Silaja

e-Granth project under NAIP

'Strengthening of Digital Library and Information Management under NARS (e-Granth)' - a sub-project under Component-1 of National Agricultural Innovation Project (NAIP), ICAR was operative in CIFT from June 2013 onwards in collaboration with other 38 ICAR Institutes/SAUs. *Koha* Integrated Library Management Software was adopted by the project and the library catalogue is searchable through Union Public Access Catalogue of NARS Libraries.

National Workshop on "Implementation of automated library management system using Koha Open Source Software" was conducted under the project during 12-13 December, 2013 at CIFT for the library professionals. An "User awareness programme" was also conducted on 29 March, 2014 to sensitize the users about the innovative services developed under the project.

Dr. A.K. Jain, Principal Scientist, IARI, New Delhi inagurating the Workshop

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

(Funded by National Agriculture Innovation Projects)

Principal Investigator : Dr. J. Bindu

Co-Investigators : Dr. T.K. Srinivasa Gopal, Dr. K.K. Asha, Dr. Sanjoy Das and Dr. P.S. Rao

Effect of high pressure on marinated Tuna steaks

Yellowfin tuna (*Thunnus albacares*) steaks marinated with condiments were vacuum packed in EVOH pouches and processed to 200 and 300 MPa pressure for 5 min. at 25-28 °C. Untreated Tuna steaks were kept as control and all samples were subsequently stored in chilled condition (2 ± 1 °C). Microbiologically control, 200 and 300 MPa treated samples had a shelf life of 22 days, 36 days and 41 days respectively. Sensory score also correlated with microbiological values and based on these parameters, 200 MPa treated Tuna was rated superior.

Control and high pressure treated marinated Tuna

Studies on pressure treated Tuna sausage during chilled storage

Studies on Tuna sausage subjected to high pressure treatment in the combinations of pressure (500 and 600 MPa), temperature (24-29 °C) and

holding time (15 min.) was undertaken and compared with thermal set Tuna sausage. All the sausages were chill stored at 2 ± 1 °C. The pressure treated sausage had higher gel strength but softer gel when compared to heat set sausage. The sausages were acceptable to more than two months during chilled storage.

Effect of high pressure on micro flora associated with Tuna

Aerobic plate count: Bacterial reduction pattern in high pressure processed Tuna steaks was studied at 100, 200, 400 and 600MPa with a holding time of 5 min. The aerobic plate count decreased from $1.6x10^6$ cfu/g (control) and $1.2x10^2$cfu/g (600MPa). The incremental log reduction observed for 100, 200, 400 and 600MPa treatments were 0.38, 0.49, 1.41 and 4.12 respectively.

Histamine formers: Tuna steaks were subjected to pressure treatment of 100, 200, 300, 400, 500 and 600MPa and analyzed for changes in load of histamine forming bacteria. 2.4 log reduction of histamine forming bacteria was observed after exposure to 300MPa. Histamine forming bacteria was not observed on application of pressures 400, 500 and 600 MPa.

M. morganii was inoculated to sterile Tuna meat and exposed to high pressure of 200 and 300MPa, holding time of 5 min. at 28 °C. In artificial medium i.e., BHI broth, the z(P) value of *M. morganii* culture ATCC25829 was estimated to be 66.52 MPa. *M. morganii* was inoculated to sterile Tuna meat and subjected to high pressure treatment of 200 and 300MPa and enumerated at 6, 24 and 48 hrs of interval. There was significant reduction in the load of *M. morganii* up to 6h duration. The load of *M. morganii* in all HPP treated samples remained lower than in control. The load of *M. morganii* increased to $1.01x10^9$ cfu/g in control, whereas it increased to $7.3x10^8$ cfu/g and $6.4x10^8$ cfu/g in 200 and 300MPa respectively. Histamine content in control increased from 1 ppm to 160 ppm in 48hrs and to 102 and 39.3 ppm in 200 and 300MPa respectively. At the end of 48 hrs there was comparable load of histamine forming bacteria in untreated and treated Tuna meat. This result indicated the loss of histamine forming ability of *M. morganii* with HPP treatment.

Inactivation studies with *Yersinia enterocolitis*

The threshold pressure required for inactivation of *Y. enterocolitis* in Tuna steaks was observed to be 300 MPa. There was 0.8 log reduction of *Y. enterocolitis* when exposed to 300 MPa for 5min., but a sharp reduction of this pathogen was observed beyond 300 MPa. At 250 MPa the inactivation kinetic parameters of *Y. enterocolitis* in Tuna meat was estimated to be as follows: D value 14.91 min. K is 0.15 min^{-1}. *Y. enterocolitis* being a psychrophilic pathogen, temperature assisted HP treatment was carried out. Tuna chunks were inoculated with *Y. enterocolitis* at $9.8x10^5$ cfu/g and subjecting to HP treatment at 250MPa at 60 °C for 3, 6, 9, 12 min. With 3 min. exposure at 60 °C, 2.54 log reduction of this pathogen was noticed. The pathogen was completely eliminated during 6, 9 and 12 min. holding time.

Effect of Potassium sorbate and high pressure on *Listeria monocytogenes* in Indian white prawn muscle

High pressure in combination with Potassium sorbate treatment (solution in acidic pH) was found highly effective in reducing the level of *L. monocytogenes* in Indian white prawn (*Fenneropenaeus indicus*) muscle. Ten g of muscle of Indian white prawn was artificially spiked with approximately 10^8 cfu of *L. monocytogenes* ATCC 19115 (Final concentration approximately 10^7 cfu/g). The spiked sample of prawn muscle was dipped in 30 mL of Potassium sorbate solution (0.1%) prepared in 0.02 (N) HCl for 15 min. Then the sample was vacuum-packed in EVOH pouch. This was followed by high pressure treatment with 250 and 350 MPa at around 30 ºC with 5 min. holding time. One set of sample was not treated with high pressure after vacuum packing and one set was also used as control without pressure and Potassium sorbate treatment. PALCAM agar with 5% egg yolk suspension was used for enumeration of *L. monocytogenes* population. It was observed that 250 and 350 MPa pressure treatment coupled with pressure treatment reduced the level of *L. monocytogenes* by 2.345 and 5.906 Log10 cfu /g, respectively. On the other hand, the reduction of the level of this pathogen by only Potassium sorbate treatment was found 0.986 Log10 cfu / g while compared to the control.

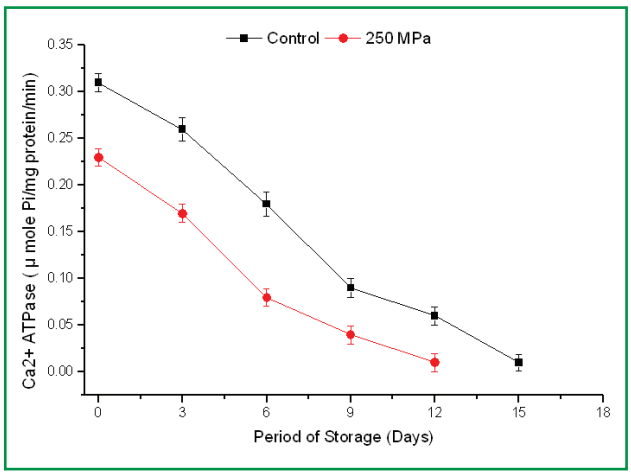
High pressure (250 and 350 MPa) in combination with Potassium sorbate treatment (0.1% for 15 min.) was found highly effective in reducing the level of *L. monocytogenes* in Indian white prawn muscle spiked with approximately 10^8 cfu *of L. monocytogenes* ATCC 19115. The levels of *L. monocytogenes* were reduced by 2.345 and 5.906 Log_{10} cfu /g at 250 and 350 MPa respectively. On the other hand, the reduction was 0.986 Log_{10} cfu / g when Potassium sorbate treatment alone was given.

Effect of high pressure on sarcoplasmic and myofibrillar protein

SDS-PAGE profiles of sarcoplasmic and myofibrillar protein after pressure treatment were examined. It was found that proteins with high molecular weight decreased in the supernatant, while proteins in the molecular weight range 35-16 kDa increased when samples were subjected to pressures over 100 MPa, due to depolymerization of the myofibrillar proteins treated at higher pressures.

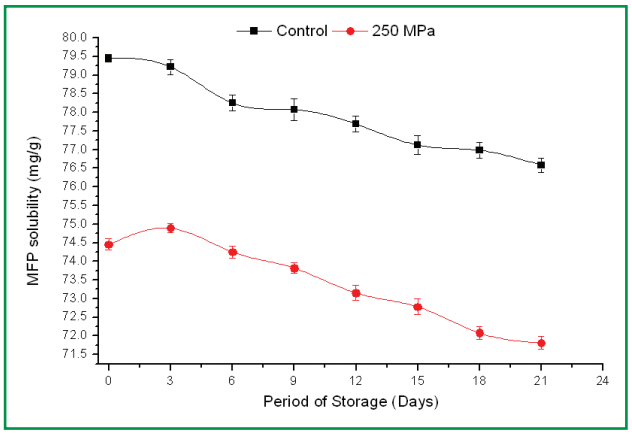
Changes in Ca^{2+}ATPase activity

Indian white prawn were treated with 250 MPa pressure for 6 mins. Reduction in Ca^{2+} ATPase activity was observed. This may be due to the pressure above 150 MPa which causes denaturation of myosin and formation of typical network structure with eventual loss of ATPase activity.



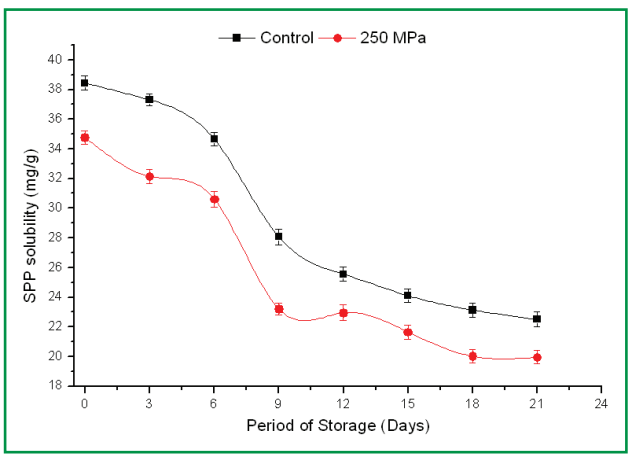
Changes in solubility of myofibrillar proteins

Solubility of myofibrillar proteins from Indian white prawn treated with high pressure (250 MPa) was reduced significantly when compared to control untreated samples. HP treatment causes the proteins to unfold, resulting in intra- and inter-molecular hydrophobic interactions. The protein becomes insoluble as it becomes less hydrated due to loss of protein bonds with water molecules.



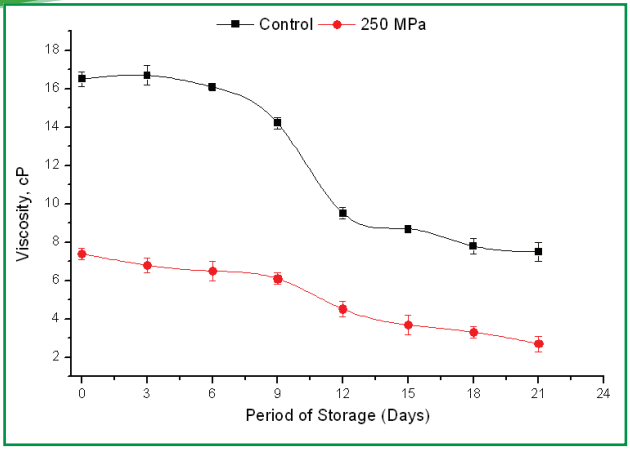
Changes in solubility of sarcoplasmic proteins

Solubility of sarcoplasmic proteins from Indian white prawn treated with high pressure (250 MPa) was reduced significantly when compared to control untreated samples. HP treatment causes the proteins to unfold, resulting in intra-and intermolecular hydrophobic interactions.



Changes in viscosity

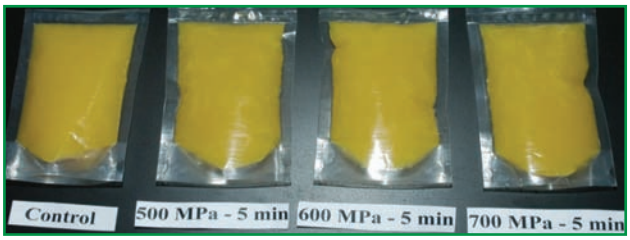
Myosin fraction of high pressure treated Indian white prawn shows decrease in viscosity when compared with untreated control samples. This is because there is an increase in surface hydrophobicity in myosin fraction with increased pressure treatment. Decrease in viscosity is known to occur with increasing hydrophobicity.



Effect of high pressure treatment on the physico-chemical and microbiological changes in mango (*Mangifera indica* L.) cv. Prior pulp and juice

A study was conducted in mango pulp and juice to understand the effect of HPP on the biochemical attributes, ascorbic acid content, instrumental colour and the indigenous microflora in the pulp and juice. Three levels of pressures (500, 600 and 700 MPa) at 600 MPa/min. for 5 min. were applied to separate lot of pulp and juice and all pouches were chill stored at 2 ± 1 °C and evaluated.

HPP was found to be effective in reducing the total indigenous microorganisms and all pressure treated samples were microbiologically safe during the whole storage period. More than 3 log cfu/g reduction was found in the case of total aerobic mesophilic, psychrophilic and total yeast and mold count. During storage the microbial load in all treated samples were below 2 log cfu/g. 600 MPa was found to be acceptable among all the pressure levels applied which preserved biochemical characteristics, instrumental colour parameters in addition to the microbial safety.



High pressure treated mango juice

Mobilizing mass media support for sharing agro information

(Funded by National Agriculture Innovative Projects)

Principal Investigator : Dr. S. Ashaletha

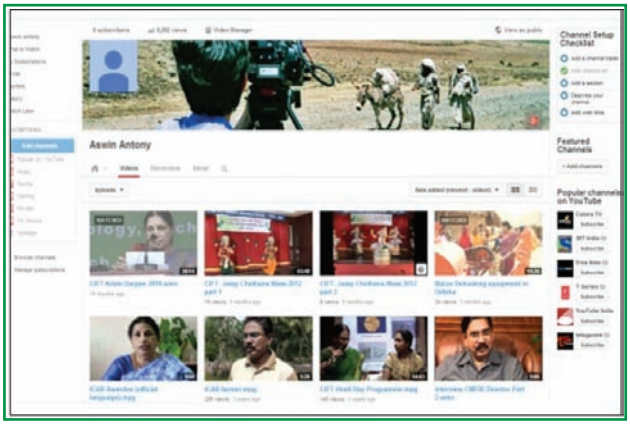
During the period under report brought out more than 30 news clippings (English Malayalam). Made 10 Success Stories published in various English/Malayalam newspapers and magazines. More than 20 postings were made on ICAR/CIFT websites and other language news portals. Two films were produced on 'SEAFRESH' and technology interventions of CIFT in boat making sector of Manipur and Assam states. Also more than 15 TV news clippings were telecasted in various Malayalam TV channels.

Website linkages

The video films and clippings on technologies and major programmes of CIFT were uploaded to YouTube as per project guidelines, which got very high viewership.

Media vists

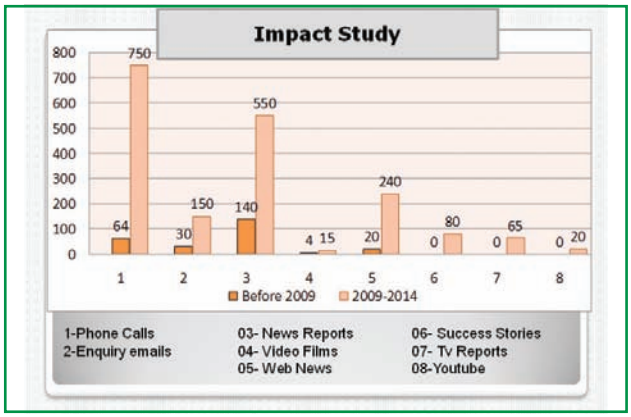
Towards the objective of strengthening media relations, two media visits were organized during the period to Sakthikulangara, Kollam and Pattambi, Palakkad. Also, arranged visit of media persons, like Mathrubhumi Reporter, Kerala Kaumudi Reporter, Amrita TV Programme Producer and Karshakan - Science Reporter.



Video clippings from CIFT in YouTube

Impact assessment study

A study was done to assess the impact of the Mass Media project with respect to the information out put conveying the technology information from CIFT. From the figure it can be observed that there was a significant improvement on the media output carrying technology information for stakeholders in general. The maximum increase was observed in the number of telephone calls from clients requesting more information and consultancies, followed by news reports in print media and web news.



Impact of the Mass Media project with respect to the information out put

Other outcomes of the project

Two success stories were published in ICAR web site. Acknowledging the works done by the Mass Media project, to strengthen the liaison of R&D institutions, primarily CIFT with media, a special report was given about the Project's activities in 'Mathrubhumi' - the leading Malayalam news paper.


മാതൃഭൂമി
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സാങ്കേതികവിദ്യ സാധാരണക്കാരിലെത്തിക്കാൻ
52.7 ലക്ഷം രൂപയുടെ സിഫ്റ്റ് പദ്ധതി

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

(Funded by Centre for Marine Living Resources & Ecology)

Principal Investigator : Dr. M.P. Remesan

Co-Investigators : Shri P.K. Vijayan, Dr. George Ninan, Dr A.A. Zynudheen, Dr. R. Anandan, Dr. Sanjoy Das, Dr. V. Murugadas, Dr. K.K. Prajith, Dr. G. Rajeswari and Dr. R. Raghu Prakash

Performance evaluation of 45 m myctophid trawl in FORV Sagar Sampada

Performance of 45 m myctophid trawl fabricated by CIFT was carried in comparison with 49.5 m Cosmos krill mid water trawl. The FORV Sagar Sampada Cruise No. 320 started on 4 October, 2013 from Cochin and ended on 16 October, 2013. 45 m myctophid trawl and 49.5 m Cosmos trawl were operated at 18 stations in combination with Thyboron trawl door (Type-7) each weighing 700kg. Depth of operation ranged from 120-2230 m. SIMRAD EK60 and EA60 eco sounders at 38 KHz and 120 KHz were used to detect the DSL. The nets were towed along the DSL using ITI sensors. The catch comprised of finfishes, cephalopods and

Catch of myctophids

Bycatch in myctophid trawls

crustaceans. Total catch of mesopelagic fishes ranged from 3 kg to 67.8 kg/haul, of which myctophids constituted 0.9 kg to 40.68 kg/haul. Eleven species of myctophids and 28 other species were landed. Major species of myctophids capture were *Benthosema pterotum, B. fibulatum, Myctophum spinosum* and *Diaphus watasei*. Out of 18 stations surveyed, major quantity of myctophids was recorded at Station 7 and 10 in the Lakshadweep sea. Bycatch included 28 species of fishes namely *Aluterus monoceros, Argyropelecus affinis, Charybdis longicollis, Cubiceps caeruleus, Nemichthys scolopaceus, Stemonosudis macrura, Zenopsis conchifer, Acanthephyra purpurea, Astronesthes indicus, Ancistrocheirus lesueurii, Chauliodus sloani, Cyttopsis roseus, Macrorhamphosodes uradoi, Neoscopelus microchir, Trichiurus auriga, Bathyclupea elongata, Astronesthes martensii, Coccorella atlantica, Aspristurus investigatoris, Caristius* sp., *Cubiceps baxteri, Laeops nigromaculatus, Mini maculata, Oplophorus typus* and *Trichiurus lepturus, Polyipnus indicus, Astronesthes boulengeri* and *Asperoteuthis acanthoderma* (First record from India).

Chilled and frozen storage studies of myctophids and product development

Studies were conducted on the species collected from Sagar Sampada cruise in October 2013. The major species available were *Diaphus watasei* and *Benthosema fibulatum*. Frozen storage studies are being carried out and some products were prepared from *B. fibulatum viz.*, marinated items, cured and dried items, fish meal and fish feed. *Benthosema fibulatum* had crude protein content of 17.99% . This species has high saturated fatty acid content (SFA). The fatty acid profile showed 46.34% SFA, 23.59% mono unsaturated fatty acid (MUFA) and 29.89% poly unsaturated fatty acid (PUFA). Fish meal was prepared from *B. fibulatum* by wet rendering method. Fish meal contained 5.5% moisture, 12.2% ash, 16.8% crude fat and 63.5% crude protein. Fish feed was formulated using Pearson's Square Method. The main ingredients were fish meal (26%), rice bran (37%) and wheat flour (37%). The dressed block frozen *Diaphus watasei* was assessed for biochemical, bacteriological and sensory quality characteristics on monthly basis. It was found to be in acceptable condition for more than five months at -20 °C. Quality evaluation of the dried products have shown that salted products were infested with fungi after two months of storage at room temperature while dried products were stable for a period of five months.

Benthosema fibulatum

Fish feed from *B. fibulatum*

Microbiological evaluation of products developed from Myctophid sp.

Microbiological quality evaluation of products (sundried, salt-cured and frozen product) developed from Myctophids revealed that these products do not harbor *Staphylococcus* sp., *E. coli*, Enterobacteriaceae, feacal Streptococci and fungi during their first two months of storage. The total plate count were found to be $<1x10^5$ cfu/g.

Extraction of fish oil from myctophid fish *Diaphus watasei* and comparison with Sardine oil

Myctophid samples were collected from the bycatch of deep sea shrimp trawlers operating off Kollam and Cochin coast and Oil sardine were bought from the nearby fish market in Cochin. Fish oil was extracted from both species by cooking method from the whole fish. Fishes were thawed, washed and then cooked in boiling water for 21 min. and allowed to cool down for some time. The top layer was collected and poured into separating funnel; remaining stick water was filtered and solids were separated by pressing. The press liquor obtained was also transferred to separating funnel. Oil was separated from the press liquor and clarified with salt and hot

water washes, stored in glass bottles in room temperature. Fatty acid methyl esters were analysed by using Perkin Elmer Autosystem XL Gas Chromatograph and Perkin Elmer Turbo Mass Spectrophotometer (Norwalk, CTO 6859, USA).

Fatty acid profile (%) of oil from Sardine and *D. watasei*

Carbon No.	Fatty acids	*Sardinella longiceps*	*Diaphus watasei*
Saturated fatty acids			
C14	Myristic acid	12.02 ± 0.01	4.00 ± 0.1
C16	Palmitic acid	25.22 ± 0.05	21.02 ± 0.02
C18	Stearic acid	4.08 ± 0.01	9.07 ± 0.01
C20	Arachidic acid	0.86 ± 0.02	3.40 ± 0.01
Total SFA		**42.17**	**37.49** ± 0
Mono unsaturated fatty acids (MUFA)			
C16:1	Palmitoleic acid	14.47 ± 0.02	2.86 ± 0.01
C18:1	Oleic acid	8.81 ± 0.03	39.51 ± 0.04
C20:1	Gadoleic acid	0.33 ± 0.02	0.12 ± 0.01
Total MUFA		**23.61**	**42.49** ± 0
Poly unsaturated fatty acids (PUFA)			
C18:2	Linoleic acid	1.24 ± 0.01	0.85 ± 0.01
C18:3n3	α-Linolenic acid	0.73 ± 0.01	0.28 ± 0.02
C18:3n6	λ-Linolenic acid	0.61 ± 0.01	0.04 ± 0
C20:2	Eicosadie-noic acid	0.15 ± 0	0.29 ± 0.01
C20:3	Eicosatrie-noic acid	0.18 ± 0.01	0.04 ± 0.01
C20:4	Arachidonic acid	1.56 ± 0.01	0.73 ± 0.01
C20:5	Eicosapen-taenoic acid	16.85 ± 0.001	2.83 ± 0.01
C22:6	Docosa-hexaenoic acid	8.67 ± 0.02	9.01 ± 0.02
Total PUFA		**30.00**	**14.07**

The total oil content was found to be more in *Sardinella 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 oil extracted from *D. watasei* but MUFA content were found higher in the later. In the present study, in *Diaphus* oil, significant proportion of PUFA was found with comparable levels to SFA and MUFA. 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. Oleic acid, Palmitic acid, Stearic acid and DHA were found as the predominant fatty acids in the *Diaphus* oil.

Proximate composition

Three species of myctophid fishes *viz.*, *Benthosema pterotum*, *B. fibulatum* and *Diaphus jenseni* were collected during October 2013 from FORV Sagar Sampada Cruise No. 320 at Kollam coast, proceeded to off Thiruvananthapuram, Lakshadweep Sea, off Mangalore. The samples were analyzed for proximate composition, amino acid profiling and fatty acid profiling.

Proximate composition of myctophid fishes

Species	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Benthosema pterotum	81.03 ± 0.1	13.94 ± 0.05	3.64 ± 0.01	3.00 ± 0.01
Benthosema fibulatum	76.67 ± 0.1	18.72 ± 0.2	3.30 ± 0.01	3.09 ± 0.01
Diaphus jenseni	76.95 ± 0.1	18.61 ± 0.02	3.43 ± 0.02	3.01 ± 0.01

Amino acid composition

Amino acid composition of both fish samples were determined after hydrolysing the samples in 10 ml 6 N Hydrochloric acid at 120 °C. Acid was removed by vacuum evaporation, made up to a known volume with 0.05 N HCl and then analyzed using Shimadzu (LC-10 AT) Amino Acid Analyser System equipped with cation exchange column (Sulphonated polyvinyl styrene column) and fluorescence detector. Tryptophan content of the samples was determined

Amino acid composition (%) of myctophid fishes

Amino Acids	*Benthosema pterotum*		*Benthosema fibulatum*		*Diaphus jenseni*	
ASP	14.53	±0.47	10.56	±0.59	4.04	±0.07
THR	5.65	±0.47	6.01	±0.45	4.45	±0.08
SER	3.47	±0.16	4.18	±0.06	4.41	±0.21
GLU	11.87	±0.12	12.29	±0.20	5.18	±0.06
PRO	0.10	±0.01	0.08	±0.01	3.56	±0.11
GLY	13.04	±0.12	12.88	±0.33	7.40	±0.34
ALA	2.96	±0.40	3.96	±0.46	4.51	±0.15
CYS	0.23	±0.02	0.75	±0.09	3.62	±0.12
VAL	8.31	±0.25	7.91	±0.41	9.51	±0.02
MET	3.64	±0.08	5.15	±0.15	2.76	±0.12
ILE	4.32	±0.46	4.69	±0.27	1.64	±0.12
LEU	8.51	±0.14	7.92	±0.30	6.13	±0.32
TYR	0.56	±0.08	0.68	±0.10	8.22	±0.19
PHE	5.27	±0.12	5.61	±0.31	4.51	±0.15
HIS	0.55	±0.09	5.77	±0.12	6.97	±0.08
LYS	12.55	±0.15	7.85	±0.28	15.35	±0.09
ARG	2.90	±0.16	1.21	±0.23	5.60	±0.18
TRP	1.55	±0.14	2.51	±0.09	2.15	±0.14

spectrometricaly after alkali hydrolysis lysine was of higher level of 15% which was found in *D. jenseni* and around 14% aspartate was found in *B. pterotum*. Glycine and glutamate were the other two amino acids which were found to be in comparable amounts in *B. pterotum* and *B. fibulatum*.

Fatty acid composition

Fatty acid methyl esters were analyzed by using Perkin Elmer Clarus 580 Gas Chromatograph (Norwalk, CTO 6859, USA). The separation was performed in an Elite 225 capillary column measuring 30m long and 0.25mm diameter with a film thickness of 0.25µm. Nitrogen was used as a carrier gas at a flow rate of 2.0 ml/min. The initial temperature was maintained at 265 °C. The oven temperature was initially held at 110 °C for four min. and was programmed to increase to 240 °C at a rate of 2.7 °C/min., held at 240 °C for five min. and then programmed to increase to 300 °C and held for five min. Flame ionization detector was used for identifying the fatty acids. The total run time was about 60 min. Peaks were identified by comparison of their retention times with FAMEs standards. Analyses were carried out as percentage

Fatty acid composition (%) of myctophid fishes

Fatty acid	*Benthosema fibulatum*	*Diaphus jenseni*	*Benthosema pterotum*
Saturated Fatty acid (SFA)			
Total	59.14±0.25	44.89±0.75	65.19±0.14
Mono unsaturated fatty acid (MUFA)			
Total	8.49±0.02	4.50±0.18	16.89±0.01
Poly unsaturated fatty acids (PUFA)			
Total	32.36±0.22	50.61±0.57	17.92±0.13

of total fatty acid methyl esters (FAME).

The fatty acid components (Saturated fatty acid - SFA, Mono unsaturated fatty acid - MUFA and Poly unsaturated fatty acid - PUFA) were extracted from three myctophid species *Benthosema fibulatum, B. pterotum* and *Diaphus jenseni*. Among these three myctophid fishes, significant proportion of PUFA was found with comparable levels to SFA and MUFA. The fatty acid composition of *B. fibulatum* consisted of SFA-59.14%, MUFA-8.49% and PUFA-32.36%. In *D. jenseni* the SFA, MUFA and PUFA were found as 44.89%, 4.50% and 50.61%, whereas in *B. pterotum* the SFA, MUFA and PUFA was 65.19%, 16.89% and 17.92%.

Among these three myctophid fishes, the PUFA (50.61%) content was high in *D. jenseni* when compared to other two fishes. EPA and DHA which plays an important role in treatment of cardiovascular diseases, infant brain and retina development and in various disorders were found to be rich in *B. fibulatum*. DHA (17.52%) is found to be the predominant fatty acid in *B. fibulatum*. A comparable amount of DHA was also present in *D. jenseni* (15.52%) and a reasonable amount of EPA and DHA in *B. pterotum*. The palmitic acid was found to be the fatty acid which is present in higher amount among all the three myctophid fishes. Stearic acid (18.01%) and oleic acid (9.59%) were found in considerable amount in *B. pterotum*. The other major fatty acids were linoleic acid (16.87%) and linolenic acid (9.19%) found in *D. jenseni*.

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

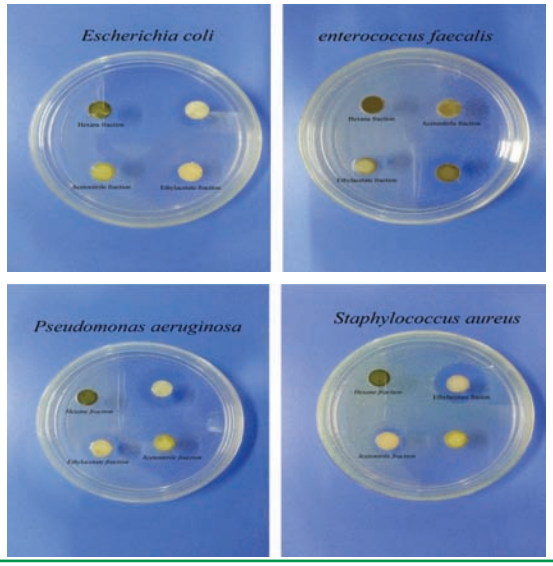
(Funded by Centre for Marine Living Resources & Ecology)

Principal Investigator : Dr. Suseela Mathew

Co-Investigators : Dr. R. Anandan, Dr. K.K. Asha and Dr. Niladri Sekhar Chatterjee

Antimicrobial and antioxidant extract from *Halymenia floresia* - An edible marine red algae from Gulf of Mannar

Edible seaweeds are traditionally known to be rich in bioactive molecules such as antioxidants and phytochemicals with novel nutraceutical properties. An edible marine red algae species (*Halymenia floresia*) was harvested from the Gulf of Mannar, Mandapam coast. Chloroform-methanol (2:1) extract of the shade dried sample was evaluated for possible antimicrobial, anti oxidant activity and total polyphenol content. The total polyphenol content (TPC) of the crude extract was determined by spectrophotometry, using Gallic acid as standard. The extract showed presence of significant amount of polyphenolic compounds (~6.72 mg/100g Gallic acid equivalent of dry extract).The antioxidant activity was evaluated using DPPH free radical scavenging, ferrous ion chelating and total reducing power assays, where 3.74 mg of the extract showed 50% DPPH radical scavenging; 0.84 mg of the extract showed 50% ferrous ion chelation and total reducing power of about 9.39 mg/100g Gallic acid equivalent of dry extract respectively. The crude extract was concentrated and diluted with saline water followed by partitioning with different solvents, *viz*. ethyl acetate, hexane and acetonitrile. Antimicrobial properties of these fractions were evaluated using disc diffusion method [CLSI (NCCLS)] against the pathogens *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeruginosa* (ATCC 27853) and *Enterococcus faecalis* (ATCC 29212). The ethyl acetate fraction exhibited good activity against all the test pathogens namely, *E. coli*, *P. aeruginosa*, *S. aureus* and *E. faecalis* with inhibition zone 15, 17, 23 and 11mm respectively. The hexane fraction did not exhibit any activity against above pathogens while the acetonitrile fraction exhibited activity only against *S. aureus* (Inhibition zone 16mm).



Antimicrobial activity of extract

Exploration and assessment of demersal fishery resources along the continental slope (200-1200m) of Indian EEZ and central Indian Ocean

(Funded by Centre for Marine Living Resources & Ecology)

Principal Investigator : Dr. U. Sreedhar

Co-Investigators : Dr. Suseela Mathew, Dr. G. Rajeswari, Dr. R. Raghu Prakash and Dr. L.N. Murthy

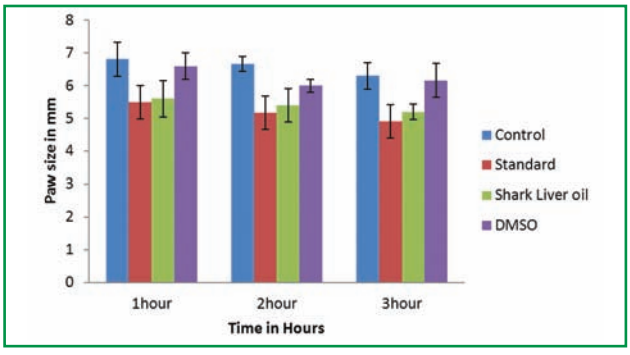
Anti-inflammatory effect of shark liver oil

Anti-inflammatory effect of shark liver oil extracted from *E. brucus* was determined by the method of Hunskaar and Hole, 1987, using the

formalin-induced rat paw edema test. The oil along with the vehicle DMSO (oil:DMSO, 4:1) was administrated orally at a dose of 1.5g/kg body weight prior to the induction of inflammation by the subcutaneous injection of 0.1ml sterile saline solution of 3.5% formalin in the right hand paw. Reference drug used was Ibuprofen at a dose of 100mg/kg. Shark oil and DMSO alone administrated and at each interval paw size was measured. Significant reduction of paw was reported in oil treated rats which was very much similar to standard drug. Oil treated sample also showed significant reduction of paw size compared to untreated rats. These results show a good anti-inflammatory effect of shark liver oil.

Anti-ulcer effect of shark liver oil

Anti-ulcer effect of shark liver oil extracted from *E. brucus* has been investigated using rat as animal model. Three groups were selected, Group 1 normal control, Group 2 oil+DMSO (vehicle) and Group 3 DMSO. Dose was orally admistrated as 1.5kg/body weight. Animals were fed with normal diet up to 14 days and ulcer was induced using Hydrochloric acid and ethanol (0.6%v/v) after one day starving. Rats were sacrificed and gastric juice was collected. 1.5ml/kg HCl/EtOH was used to induce ulcer and animals were killed four hours after the administration of ulcerogenic agent. Their stomach were excised and opened along the great curvature, washed and stretched on cork plates. The surfaces were examined for the presence of lesions and the extent of the lesions was measured. Significant anti-ulcer effect was found out in oil treated animal whereas, vehicle (DMSO) resulted in no effect.



Anti-inflammatory effect of shark liver oil

Research cruises in FORV Sagar Sampada

Participated in research cruises in Fisheries and Oceanographic Research Vessel Sagar Sampada during 6 January to 19 January, 2014 (14 days) and covered 1188 nautical miles in the voyage. Important species recorded during trawling operations of Sagar Sampada Cruise No. 322 were *Bembrops caudimacula*, *Bathypterois guentheri*, *Pterigotrygla hemisticta*, *Zenopsis congifer*, *Lophius* sp., *Gempylus surpens*, *Bassozetus*, *Nemychthys* sp., *Neopinnula orientalis*, *P. cyanea*, *Hypopleuron caninum*, *Naurcine timuli*, *Lamprogrammus fragilis*, *Glyptophidium oceanium*, *Gavialiceps* sp., *Hydrolagus africanus*, *Myctophid glyptophidium* and *Roulina squamilatira*. Total 14 stations were recorded. Out of these trawling operations were done only in 11 stations. From 11 stations, fish as well as water samples were collected for observing taxonomical, biological and residual contamination of collected deep sea fishes.

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

(Funded by Department of Biotechnology)

Principal Investigator : Dr. Suseela Mathew

Co-Investigators : Dr. T.V. Sankar and Dr. George Ninan

Shelf life studies of gelatin coated fish fillets

Fillets of white snapper (*Pristipomoides typus*) were dip treated in different concentrations of gelatin solution, vacuum packed and the shelf life was evaluated in iced conditions. Aqueous solutions of gelatin at 5%, 10% and 15% concentrations were made. The fillets were dip treated in 5% 10% and 15% gelatin solutions for 10 minutes , vacuum packed in polyester / cast polypropylene laminate pouches and kept under iced conditions. The initial TBA value of 0.28 mg of MDA/kg of fish fillets increased to 4.76 on 8th day in control samples whereas it was only 2.67 and 2.81 mg of MDA/kg of fish in 10% and 15% gelatin coated fillets respectively on 12th day. TVBN of the control

fillets increased to about 34.4 mg /100 g by 7th day in iced storage, whereas it was only 24.3 and 23.1 mg / 100 g in 10 and 15% gelatin coated fillets after 11 days of storage. TVC in fresh samples was about 3.6 log CFU/g. On 8th day, it increased to 7.1 log CFU/g for control samples, whereas it had increased only to about 6.4 and 6.0 log CFU/g at 12 days of storage for samples coated with 10% and 15% gelatin solutions, respectively. The results indicated that 10 and 15% gelatin coating could maintain the fillet quality up to 12 days under refrigeration, whereas control fillets could only maintain their freshness for about seven days when no gelatin treatment was done.

Anti arthritic study of collagen peptide

Collagen peptide was developed from Queenfish skin collagen by enzymatic treatments and its amino acid composition was determined. It is observed that the extract shows antioxidant activity. Peptide fragment showing antioxidant activity was purified by chromatographic methods. Evaluation of anti arthritic activity of collagen peptide in experimental rats (adult male Wistar rats) is under study. Arthritis was induced by Complete Freund's adjuant. After two weeks of drug administration, a reduction in paw edema was observed.

Changes of CFA induced paw edema (in mm)

Groups	First day	Seventh day	14th day	21th day	28th day
Normal Control	3.65 ± 0.51	3.65 ± 0.60	3.71 ± 0.21	3.70 ± 0.25	3.70 ± 0.25
Disease Control	8.54 ± 1.5	8.39 ± 0.90	8.78 ± 1.60	8.36 ± 0.50	8.15 ± 0.83
Standard Drug Treatment	7.93 ± 0.35	6.3 ± 0.12	5.4 ± 0.55	5.36 ± 0.37	5.06 ± 0.26
Collagen Peptide Extract	8.94 ± 0.46	7.2 ± 0.57	6.7 ± 0.55	5.8 ± 0.82	5.34 ± 0.45

Development of bioplastic based sustainable nano biocomposite food packaging

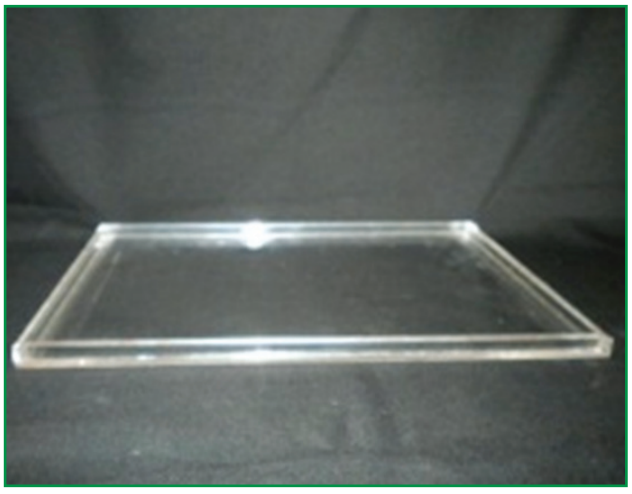
(Funded by Department of Biotechnology)

Principal Investigator : Dr. J. Bindu

Co-Investigator : Dr. S.K. Panda

Studies on poly lactic acid based films

An evaluation of the barrier properties of poly lactic acid based (PLA) films for determining the oxygen transmission rate (OTR) and the water vapour transmission rate (WVTR) was carried out. Values showed that the OTR rates were higher in PLA films when compared to conventional films. Chitosan based antimicrobial films were developed and standardized using propionic and acetic acid with glycerol as a plasticiser. Film properties like WVTR and OTR were determined. Further dried Anchovies were stored in these two films to determine the shelf life in comparison with polyester polythene laminate films at room temperature.



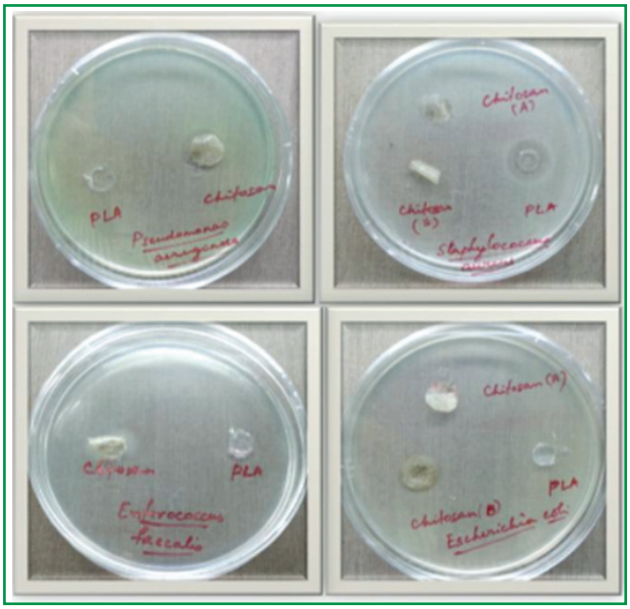
Chitosan film casting trays

Preliminary trials were undertaken for developing poly lactic acid (PLA)/chitosan films by solvent casting method. Trials were undertaken by varying the chitosan and PLA concentrations. The chitosan-PLA

PEST/LDPE Acetic acid Propionic acid

Dried Anchovy wrapped for storage studies

film developed by solvent casting method was subjected for antimicrobial activity assessment. The results showed better antimicrobial activity for chitosan-PLA films.



Antimicrobial activity of PLA/chitosan film

Food safety interventions for women in fishery based microenterprises in coastal Kerala

(Funded by Department of Science and Technology)

Principal Investigator : Dr. Femeena Hassan

Co-Investigators : Dr. P.T. Lakshmanan and Dr. S. Balasubramaniam

Studies on selected microenterprises

Under the DST project nine self help groups (SHG) from three coastal districts of Kerala *viz.*; Ernakulam, Alappuzha and Kasaragod were selected. Three SHGs from Moothakunnam fishing village in Ernakulam district, three SHGs from Aroor fishing village in Alappuzha district and three SHGs from Valiyaparampa fishing village in Kasaragod district were selected for the intervention.

A cross sectional study was conducted in these selected micro enterprises. A total of 180 samples were selected. The socio-economic parameters of the women from selected micro enterprises were surveyed. The study pointed out that majority of the respondents has good socio-economic status. Involvement of women in microenterprises might be the reason for majority to have better socio-economic status. Hence promotion of these kinds of women microenterprises through adequate trainings might improve the socio-economic status of the fisher folks.

A cross-sectional study on Knowledge and Attitude of Fisherwomen in selected microenterprises was conducted at districts *viz.*, Ernakulam, Alappuzha And Kasaragod. A total of 500 food handlers in 37 microenterprises were included in the study and

Project staff interacting with the SHG members during the survey

collected information on the understanding on health and hygiene, and awareness on environmental sanitation and cleanliness. The study also revealed that fisherwomen had poor food safety knowledge on some key concepts of food safety. Further it is understood that there is a need for appropriate awareness campaigns emphasizing the importance of cleanliness and hygiene in handling of fish.

Studies on baseline cleanliness

Baseline cleanliness of food contact surfaces were assessed using ATP-bioluminiscence and traditional microbiological methods in microenterprise units. Microbiological procedures including standard plate count and ATP-bioluminescence was measured luminometrically with Hygiena System SURE *Plus*. The study showed that swab results, measured in relative light units proportional to total recovered ATP, is not having a significant association with standard method of microbiological swab contact for adjacent sites of equal area. The efficiency and retention time of sanitizers were analyzed using the analysis of variance technique and the treatment was found to be significantly different from each other. Analysis of percentage reduction of bacterial load showed that commercially available stabilized hydrogen peroxide was found to be more effective than Sodium hypochlorite used in the food industries especially for seafood due to their high moisture and protein content ($p<0.05$).

Hygiene check of working table

Quality evaluation of Tuna loin under chilled storage

The observations on the shelf-life of Tuna (*Thunnus albacares*) loin under chilled storage (2 ± 1 °C) was found to be nine days. Chemical and microbial quality attributes were found to increase significantly

Tuna loins

($p<0.01$) with the advancement of storage period. About four log cycle increase on Aerobic Plate Count was noticed by 10th day of storage and no bacteria of public health significance were not detected. The sensory scores and physical measurements decreased significantly ($p<0.01$) with storage time and Tuna loin was judged as acceptable for consumption up to nine days of chilled storage, by the taste panel.

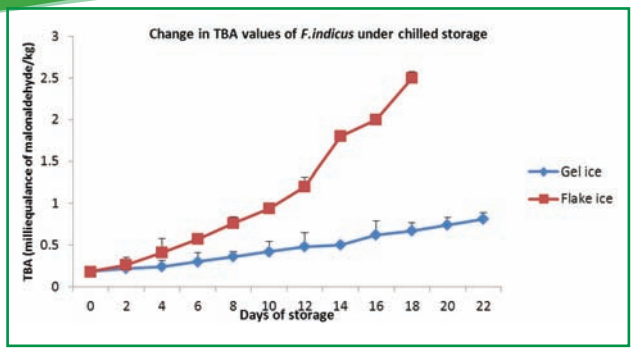
Fish freshness in the microenterprise units

Evaluation of fish freshness in the microenterprise units *viz.*, three from Ernakulam, three from Alappuzha and three from Kasaragod showed that most of the fish sold through microenterprise units were having only average quality and freshness. Fish samples collected from Ernakulam contains formalin and ammonia in ppm levels and the fish samples from Kasaragod contains more microbial load. Trace metals were found to be within the limits in all the samples.

Fish samples from a microentreprise unit

Quality characteristics of Indian white prawn and Rainbow runner

Changes in quality characteristics of Indian white prawn (*Fenneropenaeus indicus*) iced in gel ice and flake ice and kept under chilled (2 ± 1 °C) condition



were analyzed for a period of 22 days. Sensory evaluation, biochemical parameters like pH, TMA, TVBN, TBA, PV, FFA and TBA, physical parameters like colour, texture and freshness and microbial values were periodically determined. It was found that the sample kept in gel ice retained more freshness and shelf life. pH, TMA, TVBN and TBA values increased and exceeded the level of acceptance on 18th day for the samples kept in flake ice. Initial Aerobic Plate Count was 5.31 log cfu/gm, it rose to7.07logcfu/gm in gel iced and 7.02 in flake iced shrimp by 22nd and 18th day respectively. During the study period, pathogens like *Salmonella*, *V. cholerae* and *V. parahaemolyticus* could not be detected. *E. coli* and *Staphylococcus aureus* were <10cfu/gm. Enterobacteriaceae were found to be part of the spoilage microflora in *F. indicus*. H_2S producing bacteria, *B. thermophacta* and *Pseudomonas* also constituted a significant proportion of the microflora.

Quality evaluation studies of chilled *Elagatis bipinnulata* (Rainbow runner) demonstrated a shelf life of 13 days. Chemical parameters such as TMA, TVBN, TBA, PV, FFA and pH were analyzed and it was found that all these attributes were increased during the storage period with respect to the initial values. Microbiological parameters such as APC.

Elagatis bipinnulata (Rainbow runner)

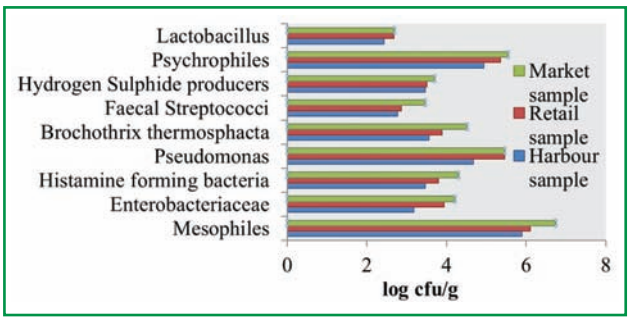
Studies on preservation of Bluefin trevally

Quality evaluation of Bluefin trevally (*Caranx melampigus*) under similar chilled (2 ± 1 °C) condition demonstrated that fish kept in gel ice retained more freshness and shelf life. With reference to pH, TMA and TVBN values it was judged as acceptable for consumption up to 18th day of storage compared to 14 days during storage in flake ice. The TPC level was correlated with sensory assessment.

Mesophilic and psychrotrophic count crossed the limit.i.e 7 $\log_{10}$cfu g^{-1} on 9th day of storage and reached 8 and 9 $\log_{10}$cfu g^{-1} by the end of the storage period. The mean log values of Pseudomonas, Hydrogen sulphide producers, *Brochothrix thermosphacta*, Histamine producing bacteria, Enterobacteriaceae, Total Coliforms and Faecal Streptococci counts increased several logs.

Microbial quality of Pink ear emperor

The microbial quality of an economically important fish *Lethrinus lentjan* (Pink ear emperor) collected from three strategic locations, harbour, retail fish stall and market were analysed as per standard procedures. Fish samples were procured from harbour (*n*=3), retail fish stall (*n*=3) and from market (*n*=3), iced and brought to the laboratory within one hour. Quantitative and qualitative bacteriological analyses were performed. During analyses pathogens *Salmonella*, *Vibrio cholerae*, *V. parahaemolyticus* and *Listeira monocytogenes* could not be detected.



Bacteriological analysis of *Lethrinus lentjan*

It is apparent that in samples examined, bacterial populations of market samples were higher than those obtained for harbour and retail fish stall samples, signifying the mishandling of fish during handling and transportation.

Awareness Programmes

Organized an awareness programme on 'Seafood Safety' to the women stakeholders at Puthanangady in in Aroor fishing village of Alappuzha district on 21

April, 2013.

Organized a training programme for women microenterprise at Chandiroor, Alappuzha on 15 July, 2013. A class on "Essentiality of baseline cleanliness for a fishery microenterprise unit" was taken by Dr. Femeena Hassan, PI of the project. The aim of the class was to create awareness on the importance of sanitation within the food processing unit and cleaning schedules of food contact surfaces. During the programme, demonstration on cleaning schedule of food contact surfaces were also carried out.

PI of the project interacting with the stakeholders

Organized a training programme on 'Food safety and hygiene for women microenterprise' at Moothakunnam fishing village (Ernakulam) on 20 July, 2013 to create awareness on implementing food safety system in a microenterprise unit.

An awareness programme on 'Contaminants in seafood' was organized at Moothakunnam in Ernakulam district on 11 October, 2013. The meeting was held under the presidentialship of Dr. P.T. Lakshmanan, Joint Director of CIFT. The programme was inaugurated by Shri Surjith, Ward Member, Vadakkekara Panchayath. The classes were handled by Smt. C.R. Sathyavathi, Joint Director of Fisheries, Shri P.H. Abdul Kalam, District Manager, Matsyafed and Plant Manager, MIFP, Cochin and Ms. Annie Shafna, Project Officer, Matsyafed.

A demonstration cum training programme on various food safety and hygiene practices was organized at Valiyaparampa fishing village, Kasaragod on 9 January, 2014. During the programme different aspects about hygiene and cleanliness practiced in fishery industry were demonstrated to the SHG members by Dr. Femeena Hassan, PI of the project. Various aspects including fishery industry in India, food safety and quality, hygiene and sanitation were exhibited through charts and demos.

A training programme was conducted on 'Challenges and opportunities in personnel hygiene' at Valiyaparamba on 8 January, 2014. The meeting was held in the presence of Shri K.H. Sherief, Project officer, Matsyafed, Shri V.V. Uthaman, President, Fishermen Welfare Society, Padanna Kadappuram, Smt. Shaiba, Project Officer, Matsyafed. Dr.Femeena Hassan, PI of the project took class on personnel hygiene. The programme was inaugurated by Shri Uthaman. Brochures related to food safety and personnel hygiene were distributed among the SHG members. The programme concluded by a group discussion among project team and stakeholders.

Organized a free medical cum awareness camp on 18 and 19 March, 2014 at Valiyaparamba panchayath office, for the stakeholders at Valiyaparamba in Kasaragod district. The main objective of the camp was to bring affordable healthcare and free health information to the beneficiaries and identifying the common health problems of the fishery women. With the increasing cost of living and especially health care, it is going to be even harder for the common people to afford effective medicine and food.

Medical team examining the stakeholders

Use of natural gums and resins for the preservation and value addition of fishery products

(Funded by Department of Biotechnology)

Principal Investigator: Dr. P.K. Binsi

Co-Investigators : Dr. S. Visnuvinayagam, Dr. C.N. Ravishankar and Dr. George Ninan

Natural gums as functional ingredient for value added fishery products

The physical properties of commercially available natural gums such as Xanthan gum, Guar gum, Tragacanth gum, Gum acacia, Gum arabica, Gum ghatti and Ester gum, were evaluated to assess their suitability for modifying the textural and functional characteristics of value added fishery products. A standard solution of 1% concentration of gums was used for analyzing the physical and functional properties such as viscosity, solubility, transparency coefficient and setting and melting parameters. Xanthan gum showed the highest viscosity followed by Guar gum and Gum gshatti. Xanthan gum, Guar gum, Gum arabica and Gum acacia were readily soluble while Tragacanth gum was partially soluble and formed sediments on settling. The 1% gum solution of Xanthan gum and Guar gum appeared to be thick, white and opaque in nature. Gum acacia appeared as a faint brown coloured clear solution while Tragacanth gum and Gum ghatti appeared as a brown solution with some undissolved particles. Gum arabica gave a clear and transparent solution. The gums were further added at a concentration of 1% to fish flavor stock solution to stabilize and retard its melting point at room temperature. Tragacanth gum, Xanthan Gum and Guar gum delayed melting of the stock gels quite significantly as compared to the control. The other gums had no effect on the melting of the stock; however they were effective in modifying the viscosity of fish stock solution.

Edible coating of natural resin on dried fish

Dried Bombay duck and Croaker fish was subjected to a dip treatment with edible lac resin at various concentrations. The coated fish samples were analyzed for moisture gain, swelling and sensory characteristics. Coating imparted a glazy tint to the dried fish samples and improved surface characteristics compared to uncoated samples. However, coating with a higher concentration of 20% and above imparted yellowish colour to the samples on extended storage. This was further rectified by using bleached lac which gave better glaziness without changing the natural colour of dried fish.

Natural resin coating for dried fish A: Control Croaker fish, B: Lac coated Croaker fish

Techno-economic feasibility of coconut wood canoes for the small scale fisheries in the south-west coast of India and Lakshadweep

(Funded by Coconut Development Board)

Principal Investigator : Dr. Leela Edwin

Co-Investigators : Dr. Nikita Gopal, Shri M.V. Baiju and Dr. V.R. Madhu

Effect of CCB treatment on the occurrence of marine wood borers and foulers in short period

Twelve panels treated with CCB and 12 contol panels were exposed at North oil Tanker Berth test site in Cochin estuary, at 1m depth using sinkers. Four panels (Two each from control and treated) were removed every week, washed in sea water and transported to the laboratory, submerged in sea water in polythene bags. The fouling organisms (barnacles, mussels etc.) were scraped off from the panels and visual examination was carried out for the presence of borer attack. No borer attacks were detected on any of the panels. All the panels showed an overgrowth of fouling organisms among which, barnacles of diameter of 1 - 2 mm were the most dominant.

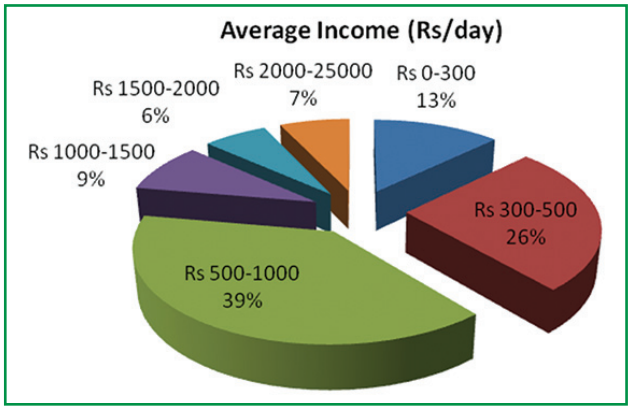
Survey among traditional fishermen using wooden canoes in the south-west coast of India

Survey was carried out among fishermen operating wooden canoes in the south-west coast of India covering all the coastal districts of the states of Kerala, Karnataka (Mangalore, Uduppi, Uttara Kannada), Goa (North Goa and South Goa) and Tamil Nadu (Kanyakumari). It was observed that 52 percentage of respondents used *Aini* (*Artocarpus hirsuta*) for canoe construction and 25.3 percent of respondents used *Mango* (*Mangifera indica*). Other species like Jack (*Artocarpus heterophyllus*), *Panjimaram* (*Bombax cebia*) and *Chillamaram* (*Albizia* sp.) are also sparsely used in different areas. The average cost of wooden canoes varies from ₹ 18,000/- for 2.74 m L_{OA} to ₹ 52,000/- for 4.57 m L_{OA} canoes. The most widely used canoes among small scale fisheries sector in the South West coast of India are in the length range of 3.04 m to 7.62 m. The average cost of L_{OA} 7.62 m canoe was approximately ₹ 50,000/- and the life span of the wooden canoes was 10 years.

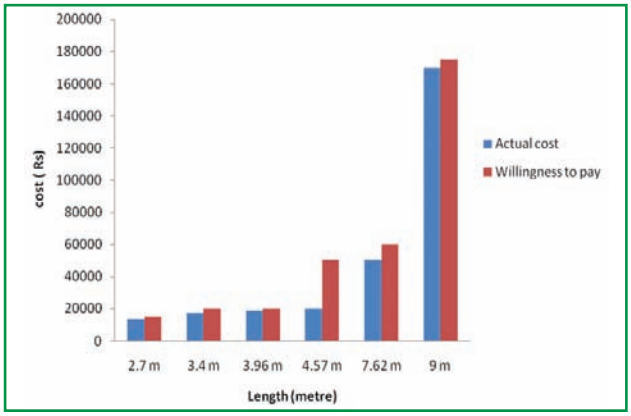
Gillnet was the most commonly used gear by fishermen using wooden canoes. It was observed that 78.8 percent of respondents in the south west coast operate gillnet. Hook and line, ring seine, shore seine and stake nets are also used by a small percentage of fishermen. About 17.6 percent of fishermen use hook and line. Twenty six percent of the fishermen get an income of ₹ 300 - 500/-. Only 39% of fishermen have an income of ₹ 500-1000/- per day. The average annual fishing days ranges from 200-250.

Assessment of extent of coconut wood availability for alternate uses and valuation of existing potential resources

In India, highly durable varieties like, *Teak*, *Aini*, etc. were traditionally used. The use of teak wood is



Average income per day of fishermen operating wooden craft along coastal states of south India



Comparison of actual prices and willingness to pay (₹) for different size class of canoes

decreasing due to its high cost. Coconut wood is another alternative, especially in the South West coast of India and Lakshadweep. Coconut wood is already used as structural and interior design material. Coconut occupies an area of 12 million hectares globally and the total production was 56 billion nuts (CPCRI, 2000). India is the third largest producer of coconut. The average cost of coconut wood canoes currently produced varies from ₹ 13,500/- for 2.7 m canoe to ₹ 50,000/- for 7.62 m L_{OA} canoes. Willingness to pay for improved coconut wood canoe was assessed and it was observed that the fishermen were willing to pay ₹ 15,000/- for 2.7 m canoe to ₹ 60,000/- for 7.62 m L_{OA} canoe.

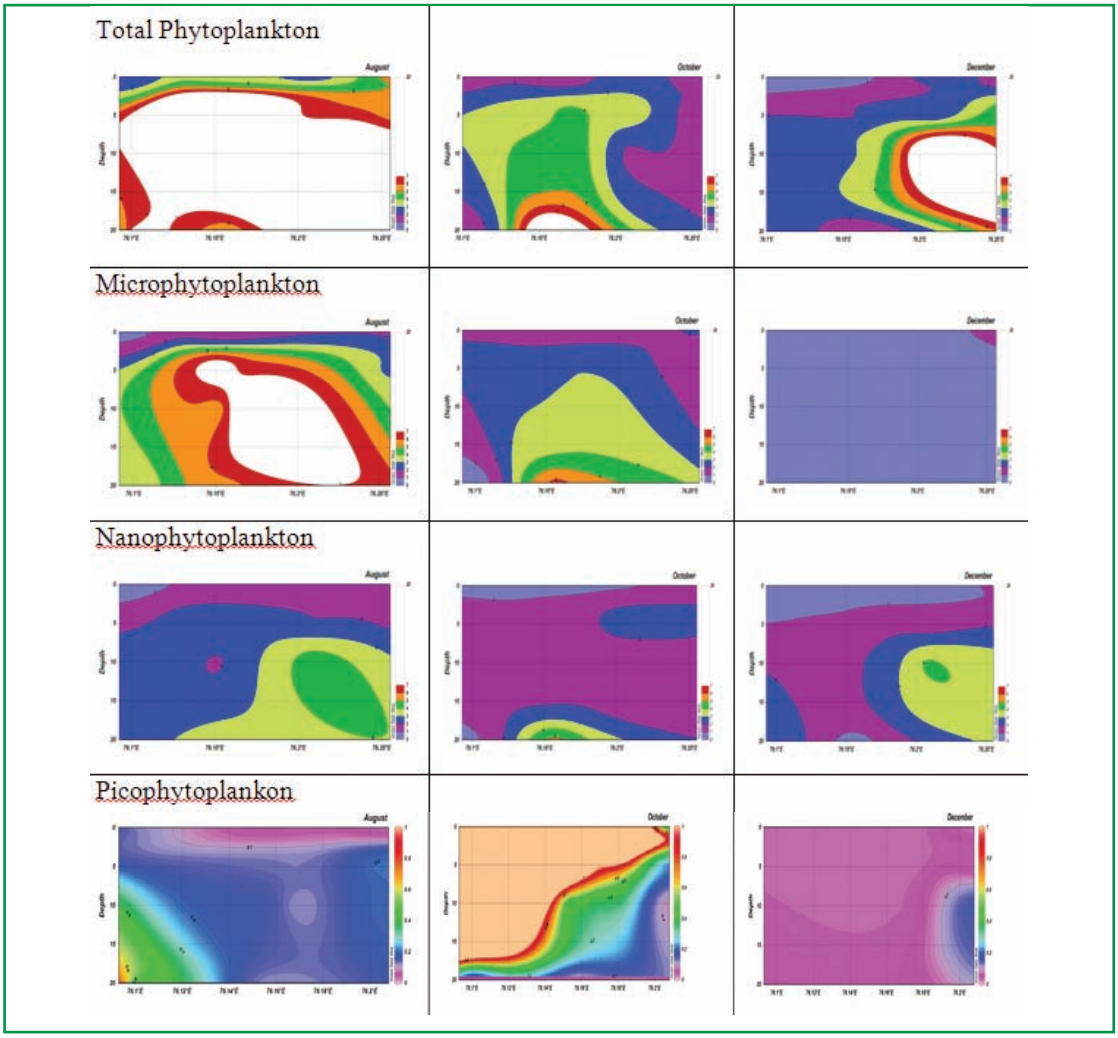
Retrieval of phytoplankton biomass and associated optical constituents based on long term bio-optical studies

(Funded by Indian National Centre for Ocean Information Services)

Principal Investigator : Dr. P. Muhamed Ashraf

Variation in the phytoplankton size classes

The size structure and species composition of phytoplankton were investigated with special attention to the phytoplankton size fractions. Monthly variations in numerical abundance of phytoplankton were quite evident from the cell counts. Total



Chlorophyll a concentration in different fractions of phytoplankton during the months where highest concentration recorded

chlorophyll concentration showed maximum in the month of August 2013 in the bottom waters as well as in surface waters. During October and December high chlorophyll concentration was exhibited in the bottom waters of depth 5-20m.

Microphytoplankton was the major contributor of chlorophyll during August 2013. During October high chlorophyll was due to the pico fraction of phytoplankton. During December, nanophytoplankton was the major contributor of chlorophyll concentration in the bottom waters. Microphyto-plankton contributed more towards 10m depth. Nanophyto-plankton was mainly concentrated in the surface to 5m depth of water column and pico fractions are more in 10-20m water column. High numerical density of phytoplankton was seen during September 2013, where 80% of the total numerical density was contributed by *Biddulphia* spp. followed by *Coscinodiscus* spp. and *Fragilaria* spp.

Variation in the specific absorption of phytoplankton

Specific absorption by phytoplankton, a*ph(λ) at 440nm and 665nm were high for nano fraction of phytoplankton. For total phytoplankton a*ph(440) were 0.0226 and 1.172 m^2 mg $Chla^{-1}$ and a*ph(665) were 0.0074 and 0.128 m^2 mg $Chla^{-1}$. High a*ph exhibited during the month of August 2013 and lowest during May 2013.

The results showed that specific absorption of phytoplankton is associated with high chlorophyll concentration in most of the stations. It was related to the southwest monsoon and associated river runoff from the adjacent estuary. Slope calculated from the absorption spectra of coloured dissolved organic matter (CDOM) showed values close to that of riverine CDOM than towards *in situ* degradation of phytoplankton and detritus matter. Hence it can also be assumed that CDOM has riverine origin in the coastal waters off Cochin. Nanophytoplankton contributed 60% of the total chlorophyll in all months. Phytoplankton community structure showed a clear variation from a dominant diatom to dinoflagellate and cyanophyte community (monsoon, post-monsoon and pre-monsoon seasons) as evident from the microscopic cell counts. High chlorophyll, absorption by phytoplankton and numerical density are related with the pre-showers and extended south west monsoon prevailed in the region and associated river runoff trough estuary.

	A*ph (440) m^2 mg $Chla^{-1}$		A*ph (665) m^2 mg $Chla^{-1}$	
	Min	Max	Min	Max
Microphyto-plankton	0.0019	0.4200	0.0005	0.1660
Nanophyto-plankton	0.0010	0.5721	0.0006	0.1860
Picophyto-plankton	0.0545	0.7000	0.0112	0.0971
Total phyto-plankton	0.0226	1.1720	0.74	1.1716

Validation of Tuna advisories off east coast

(Funded by Indian National Centre for Ocean Information)

Principal Investigator : Dr. U. Sreedhar

Studies on catches of long lining industry from Visakhapatnam coast

Oceanic resources of commercial value are generally distributed over very large oceanic areas of fishing potential. High export demand of these resources has made fishery very lucrative but the search for these resources is very energy intensive. Remote sensing techniques show great potential to support to global fishery management scenario and the exploitation of these resources as they reduce the scouting time. Visakhapatnam of-late has become the hub of Tuna fishery in India. There is a growing business activity due to industrial and export value. Nearly 3035 mini liners are operating from Visakhapatnam harbor. The fishing data used in this

study were collected and recorded in log books by the long line fleet operators from Visakhapatnam harbor. Information consisted of position, number of hooks operated, date and time of operation, number of individuals of species captured in each fishing day etc. The data set is collected from January, 2010 to February, 2014. In this study, data collected from liners operating from Visakhapatnam harbor was analyzed for seasonal variation i.e. pre-monsoon, monsoon and post-monsoon. In the study hooking rate of 3.03 kg/hook was observed for the entire period from 2010 to 2014. The analysis of season-wise catch shows a hooking rate of 0.96 kg/hook for pre-monsoon period. During the monsoon a hooking rate of 1.42 kg/hook was observed. Analysis of post-monsoon catches shows a hooking rate of 1.94 kg/hook. Highest hooking rate was reported in the year 2012, which are about 4.48 kg/hook. In monsoon highest catch were reported in the year 2013, i.e. 1.46 kg/hook. In monsoon highest hooking rate was reported in the 2013, which is about 1.46 kg/hook. In post-monsoon, highest hooking rate reported in the 2012 is about 7.80 kg/hook.

Phytoplankton biodiversity along Visakhapatnam coast

To study the biodiversity of phytoplankton along the coast of Visakhapatnam, samples were collected from surface at various depths up to a maximum of 60 m. The samples were collected every month from departmental vessel "CIFTECH" starting from July, 2013 onwards. The study is still continuing and also from the private lines operating from Visakhapatnam. Samples were collected from the stations *viz.*, Kailasagiri, Rushikonda and Bheemunipatnam.

In this study a total of 30 planktonic species belonging to three Classes namely Chlorophyceae, Bacillariophyceae and Dinophyceae were reported from the collection made from July, 2013 to March, 2014. Thirty species out of which 29 belonging to 18 Genera and 15 Families were found to be Diatoms. A total of 19 species belonging to 12 Genera and eight Families were found to be in the Order Centrales. Nine species belonging to five Genera and five Families were found in the Order of Pennales. Dinoflagellates were represented by only five Genera with single species, each belonging to five Families. The study on the sea truth data on being annotated on the Tuna advisories is in progress. A detailed study is been done on the catches from industry with the gradients observed in the satellite images.

National surveillance programme for aquatic animal diseases

(Funded by National Fisheries Development Board)

Principal Investigator : Dr. K.V. Lalitha

Co-Investigators : Dr. Toms C. Joseph and Dr. V. Murugadas

Prevalence of bacterial pathogens in aquaculture ponds

Base line data on farmed species, area of the farm, disease prevalence were collected from 21 farms including eight farms from Kottayam district, seven farms from Palakkad district and six farms from Alappuzha district in Kerala.

Catfish samples collected from two farms located at Kodungallur, Thrissur district were analyzed. Among the eight pathogenic bacteria isolated, five were identified as *Aeromonas hydrophila,* one was *A. sobria,* and one was *Chryseobacterium* spp. Antimicrobial susceptibility test for the above strains revealed that one of the *A. hydrophila* was showing multiple drug resistance.

Screening of 96 samples of fish, sediment and water samples from freshwater aquaculture farms of Kottayam and Palakkad districts for the presence of bacterial pathogens revealed the presence of *Aeromonas hydrophila*, *A. sobria* and *Enterobacter cloacae*, an opportunistic pathogen from 19, eight and 10 samples respectively.

Antimicrobial susceptibility test for the prevalence of fish viruses in aquaculture ponds

Twenty eight samples of fishes including carp, Catla, Mrugal, Tilapia and Rohu collected from

aquaculture farms in Kottayam and Palakkad districts were tested for the presence of Koi Herpes Virus and Spring Viremia of Carp Virus using *oie* protocol and none of the samples were positive for the virus.

Studies on ecological linkages between plankton production and *Acetes* sp. abundance along Gujarat coast

(Funded by Indian National Centre for Ocean Information Services)

Principal Investigator : Dr. V.R. Madhu

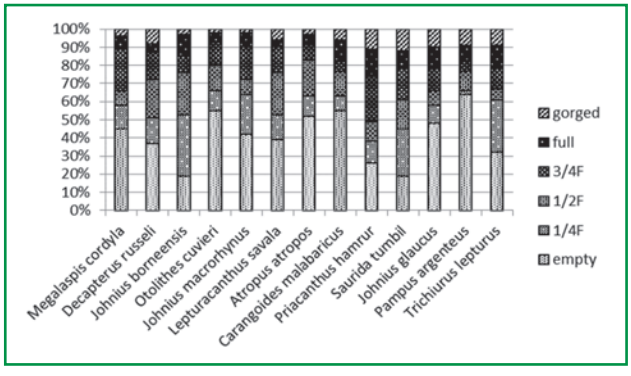
Co-Investigator : Dr. A.K. Jha

Validation of PFZ advisories along Gujarat coast

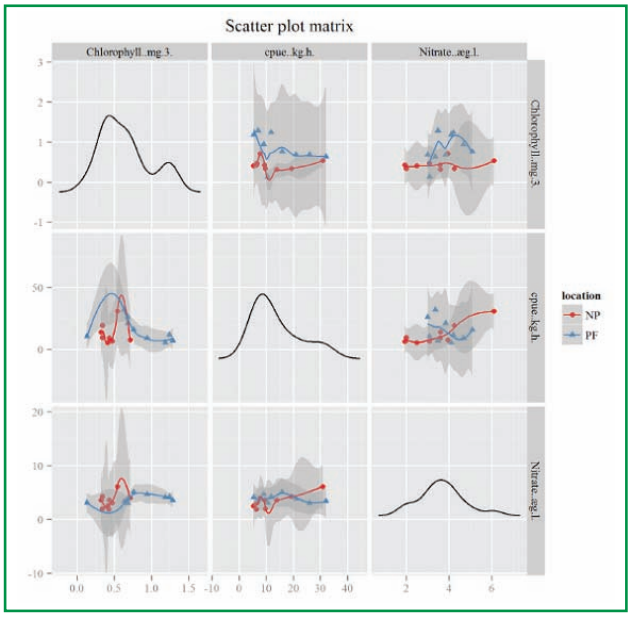
A total of nine experimental trawling validations were carried out during the period under report. The average CPUE from the PFZ region was higher (15.40 kg.h^{-1}) and the benefit/cost ratio was recorded as 1.51. The average CPUE recorded in the non-PFZ locations was 12.08 kg.h^{-1}, with a B/C ratio of 0.81.

Analysis of gut content of commercially important species

Analysis of gut of 13 different species commonly occurring along the Veraval coast was carried out. The preponderance of *Acetes* sp. was noticed in almost all the fishes occurring in the region. The percentage composition of *Acetes* sp. ranged from 48.5 to 11.0% for the different species studied. Among the species studied, 42% had empty stomach, 7% of the fishes had full stomachs and 4% of the stomachs observed were gorged in condition. Highest consumption of *Acetes* sp. were observed during the months of September-October and March. Of all the 13 species studied, crustaceans were found to be the main food consumed and thus forming the mainstay of the foodweb.



Gut content analysis of 13 species



Scatterplot matrix showing the relationship between nitrate, chlorophyll and CPUE

General Information

(1 April, 2013 to 31 March, 2014)

Training Programmes Conducted

Sl. No.	Subject	No. of beneficiaries	Venue and date
1.	Computational fluid dynamics software	12	Cochin 1-3 April 2013
2.	Modern instrumental analysis in biochemistry	1	Cochin 1-10 April 2013
3.	Identification of genes responsible for hydrocarbon degradation in aquatic bacteria	1	Cochin 1-30 April 2013
4.	Fuel efficiency in fishing boats	30	Nagapattinam 2-4 April 2013
5.	FTIR spectra of selected *Vibrio* sp.	1	Cochin 7 January - 6 April 2013
6.	Water quality analysis	10	Cochin 8-12 April 2013
7.	Hygienic handling of fish and prawn	15 fisherwomen	SIFT, Kakkinada 17 April 2013
8.	Value added fishery products	1	Cochin 17-18 April 2013
9.	Seafood quality determination	10	Cochin 22-27 April 2013
10.	Seaweeds: Distribution and resources in selected islands of Lakshadweep	1	Cochin 22 April - 4 May 2013

Analytical techniques in biochemistry - Participants and Faculty

Hands-on training at Mumbai

Sl. No.	Subject	No. of beneficiaries	Venue and date
11.	Microbiological changes in ammonia treated Indian Mackerel (*Rastrelliger kanagurta*) during chilled storage	1	Cochin 23 April - 23 June 2013
12.	Biochemical changes in ammonia treated Indian Mackerel (*Rastrelliger kanagurta*) during chilled storage	1	Cochin 23 April - 23 June 2013
13.	Nutritional evaluation of edible crab, extraction of astoxanthin and study of its bioactivity	1	Cochin 26 February - 1 May 2013
14.	Hygienic handling of fish and prawn	15 fisherwomen	SIFT, Kakkinada 2 May 2013
15.	Laboratory techniques in microbial biotechnology	2	Cochin 5 February - 4 May 2013
16.	Processing and packaging of value added fishery products	1	Cochin 14-18 May 2013
17.	Fish processing technology including analytical instrumentation, biochemical analysis and packaging	4	Cochin 14-18 May 2013
18.	Value added fish products	23	Visakhapatnam 20 May 2013
19.	Value added fish products	39 fisherwomen	Gadimoga, East Godavari, A.P. 20 May 2013
20.	Product development, quality evaluation and packaging of fishery products	2	Cochin 20 May - 20 June 2013
21.	Isolation, characterization and bioactivity of glycosaminoglycans from Cuttlefish (*Sepia pharaonics*)	1	Cochin 30 May - 6 July 2013
22.	Laboratory course on the biochemical evaluation of fish and fishery products	10	Cochin 3-15 June 2013

Skill upgradation training at Visakhapatnam

Practical session on net making in progress

Sl. No.	Subject	No. of beneficiaries	Venue and date
23.	Production of chitin and chitosan	1	Cochin 5-6 June 2013
24.	Hygienic handling and preparation of value added products	20	SIFT, Kakkinada 6 June 2013
25.	HACCP concepts	33	Cochin 17-21 June 2013
26.	Fish processing		Cochin 20-22 June 2013
27.	Processing and packaging of value added fishery products	12	Cochin 24-28 June 2013
28.	Preservation treatment of low cost timber for boat building		Cochin 25 June 2013
29.	Value added fishery products	5	Cochin 1 July - 30 September 2013
30.	Hygienic handling of dry fish and preparation of value added products	25 fisherwomen	Visakhapatnam fishing harbor 3 July 2013
31.	Value added fishery products	4	Cochin 5 July - 4 November 2013
32.	Computational fluid dynamics software	12	Cochin 9-13 July 2013
33.	Essentiality of baseline cleanliness for a fishery microenterprise unit	14	Alappuzha 15 July 2013
34.	Hygienic fish drying to improve livelihood of coastal fisherwomen	23	MSSRF, Poompuhar 16-19 July 2013
35.	Hygienic handling and preparation of value added products	27 fisherwomen	Mangamaripeta (A.P.) 18 July 2013

Participants and faculty of training programme at Visakhapatnam

Value addition and fishery waste management at Mumbai: Participants and faculty

Sl. No.	Subject	No. of beneficiaries	Venue and date
36.	Introduction of food safety and hygiene	Women micro enterprise	Moothakunnam, Ernakulam district 22 July 2013
37.	Advanced analytical techniques in biochemistry	15	Cochin 22-26 July 2013
38.	Preparation of value added fish products	20	Kuzhippilly, Ernakulam 24-25 July 2013
39.	Microbiological quality control for seafood	Food technologists	Mumbai 29 July - 3 August 2013
40.	Value added fishery products	12	Kollam 3-5 August 2013
41.	Value added fishery products	6	Cochin 5 August - 4 November 2013
42.	Biochemical and characterization of pathogenic and commensal bacteria from fish	1	Cochin 5-21 August 2013
43.	Survey of traditional fishing methods and documentary practices	7	Cochin 8 August 2013
44.	HACCP concepts	30	Cochin 12-17 August 2013
45.	Preparation of value added fish products	30 fisherwomen	Visakhapatnam 19-21 August 2013
46.	Laboratory analysis in microbial examination of foods	1	Cochin 19-23 August 2013
47.	Isolation and identification of bacteria of public health significance in food	1	Cochin 19-23 August 2013
48.	HACCP concepts	27	Cochin 19-23 August 2013

Value addition and secondary agriculture with special reference to fish and fishery products at Cochin

Preparation of value added fishery products at Mumbai

Sl. No.	Subject	No. of beneficiaries	Venue and date
49.	Seafood quality assurance	11	Cochin 26 August - 5 September 2013
50.	Fabrication of improved fishing nets and responsible fishing and Preparation of value added fish products	20	BTC, Kokrajhar, Assam 26-29 August 2013
51.	Microbiological quality of seafood	Quality managers/ technologists	Veraval 2-7 September 2013
52.	Basis of Seamanship and navigation	15	FSI, Chennai 3-5 September 2013
53.	Production of value added products from Masmin and packaging of finished products	12	Cochin 6-7 September 2013
54.	Value added fish products	32 fisherwomen	Visakhapatnam 12-13 September 2013
55.	Energy management and conservation study for fish preservation by application of conventional and non-conventional energy sources	1	Cochin 18-26 September 2013
56.	Chemical and microbiological evaluation of water	5	Cochin 18-28 September 2013
57.	Responsible fishing and fabrication of improved gillnets	60 tribal fishermen	Fraserganj, W.B. 19 September 2013
58.	Water analysis	1	Cochin 23-27 September 2013
59.	Laboratory techniques in molecular biology	6	Cochin 23-28 September 2013
60	Technical guidance for setting up of laboratory	4	Cochin 23-28 September 2013
61.	Proximate analysis of fish	5	Cochin 30 September - 5 October 2013

Preparation of Value added products

Value added fishery products

Sl. No.	Subject	No. of beneficiaries	Venue and date
62.	Modern analytical techniques in biochemistry	1	Cochin 30 September - 11 October 2013
63.	Advances in long lining	5 fishermen	Vizhinjam 1 October 2013
64.	Contaminants in seafood	20	Moothakunnam 11 October 2013
65.	HACCP concepts	42	Cochin 21-24 October 2013
66.	Value addition and secondary agriculture with special reference to fish and fishery products	13	Cochin 21-24 October 2013
67.	Optimization of chitinase enzyme production from *Paenibacillus* spp.	1	Cochin 21 October - 20 December 2013
68.	Proximate analysis of fish	3	Cochin 31 October - 7 November 2013
69.	Purification and characterization of chitinase enzyme from *Paenibacillus* spp.	1	Cochin 1 November 2013 - 31 January 2014
70.	ISO 22000 and HACCP for seafood industry	1	Cochin 4-18 November 2013
71.	Value added products	30	Kottapalem and Lankevanidibba, Guntur Dt. 5-6 November 2013
72.	Fish processing methods, post harvest technology, value added products and fishery byproducts	12	Cochin 6 November 2013
73.	Fishing technology and fish processing	30 international delegates	Cochin 13 November 2013

Training on Value added fish products

Training on Value added fish products

Sl. No.	Subject	No. of beneficiaries	Venue and date
74.	Laboratory techniques in microbiological examination of seafoods	1	Cochin 19 November - 1 December 2013
75.	Value addition and fishery waste management	Seafood processors	Mumbai 20-22 November 2013
76.	Entrepreneurial opportunities for women based fish value addition	20	Thrikkakara, Cochin 20 November 2013
77.	Harvest and post harvest technology	113 fishers	Vizianagaram 21 November 2013
78.	Value added product preparation and Demonstraion of coracles	145 fishers	Vengalraya Sagar 22-23 November 2013
79.	Value added fishery products	28	Cochin 26-30 November 2013
80.	Fishing technology and fish processing	15 international delegates	Cochin 27 November 2013
81.	Laboratory techniques for microbiological examination of seafoods	13	Visakhapatnam 2-12 December 2013
82.	Fisheries byproducts, prawn shell powder, chitin, chitosan and glucosamine hydrochloride	2	Cochin 2-28 December 2013
83.	Isolation and characterization of *tdh* positive isolates of *Vibrio parahaemolyticus* from seafood	1	Cochin 9 December 2013 - 7 February 2014
84.	Cloning and sequencing of ecotine biosynthesis genes from *Haererehalobacter* spp.	1	Cochin 9 December 2013 - 7 February 2014
85.	Preparation of value added fishery products	Tribal fishermen	Mumbai 11-13 December 2013
86.	Culture, processing and development of value added products from trout	12	Kullu, Manali 11-13 December 2013

Seafood quality assurance (Cochin)

HACCP concepts (Cochin)

Sl. No.	Subject	No. of beneficiaries	Venue and date
87.	Harvest and post harvest technology	130 fishers	Ranchi, Jharkhand 16-18 December 2013
88.	Cloning and sequencing of chitinase gene from *Paenibacillus elgii*	1	Cochin 16 December 2013 - 15 March 2014
89.	Molecular characterization of *Vibrio parahaemolyticus* isolates from aquatic environment	1	Cochin 18 December 2013 - 17 March 2014
90.	Improved fishing nets and responsible fishing techniques	55 fisherfolk	Frasergang, W.B. 18 December 2013
91.	Molecular characterization of *Vibrio parahaemolyticus* isolates from aquatic environment	1	Cochin 18 December 2013 - 17 March 2014
92.	Improved fishing nets, responsible fishing techniques and fabrication of improved gillnets	50 fisherfolk	Nimpit, W.B. 19 December 2013
93.	Ecotine production from halotolerant bacteria	1	Cochin 21 December 2013 - 20 March 2014
94.	Responsible fishing	10 fisheries inspectors	Cochin 4 January 2014
95.	Canning of fish and shellfish	1	Cochin 4-13 January 2014
96.	Preparation of value added fisheries products	Tribal fishermen	Mumbai 6-8 January 2014
97.	Microbiological analysis of water and handling of reference cultures	1	Cochin 7-9 January 2014
98.	'Seafresh' business model and marketing	15	St. Alberts College, Ernakulam 8 January 2014

Preparation of value added fisheries products (Mumbai)

Products development and quality evaluation of fishery products (Cochin)

Sl. No.	Subject	No. of beneficiaries	Venue and date
99.	Challenges and opportunities in personal hygiene	12	Valiyaparampa, Kasaragod 9 January 2014
100.	Various food safety and hygiene practices	12	Valiyaparampa, Kasaragod 10 January 2014
101.	Fish processing technology	13	Cochin 15-20 January 2014
102.	Testing of packaging materials	2	Cochin 20-25 January 2014
103.	Microbiology	1 student	Visakhapatnam 21 January - 11 February 2014
104.	Heavy metal analysis in freshwater and marine fishes	1 student	Visakhapatnam 25 January - 25 February 2014
105.	Seafood quality assurance	12	Cochin 27 January - 7 February 2014
106.	Preparation of fish and prawn pickle	5	Cochin 28-29 January 2014
107.	Products development and quality evaluation of fishery products	1	Cochin 1-28 February 2014
108.	HACCP concepts	44	Cochin 10-14 February 2014
109.	Tribal Sub Plan Programme	30	Venkatapuram, Visakhapatnam 18 February 2014
110.	Modern analytical techniques in biochemistry	4	Cochin 21 February - 5 March 2014

Demonstration on value added fish products


Trainees from Tamil Nadu on-board CIFNET training vessel M.V. Prashikshani

Sl. No.	Subject	No. of beneficiaries	Venue and date
111.	Fish based products	60 entrepreneurs	Kollam 24 February - 21 March 2014
112.	Hygienic handling of dry fish	25	Fishing harbor, Visakhapatnam 25 February 2014
113.	Hygienic fish handling and production of value added fishery products	12	Thaikkal, Alappuzha 25-26 February 2014
114.	Hygienic handling of fish	25 women dry fish vendors	PCR Lab, Kotturu, Visakhapatam 1 March 2014
115.	Production of chitin and chitosan and quality analysis	1	Cochin 3-5 March 2014
116.	Tribal sub plan programme	50 tribal fishermen	Jagadalpur, Chattisgarh 4-6 March 2014
117.	Tribal sub plan programme	20 ST fishermen	Jeenabadu fishing village 13 March 2014
118.	Tribal sub plan programme	43 ST fishermen	Konam fishing village 13 March 2014
119.	Preparation of chitin, chitosan and glucosamine	1	Cochin 19-21 March 2014
120.	Hygienic handling of fish and preparation of value added fish products	30 women fishers	PCR Lab, Mangamaripetta 21-22 March 2014
121.	Monofilament long lining	9 fishermen and 1 official from Dept. of Fisheries	Cochin 24-28 March 2014
122.	Responsible fishing methods	40 SC/ST fishermen	Meenkara, Palakkad 27 March 2014
123.	Hygienic fish handling and value added fishery products	40 SC/ST fishermen	Meenkara, Palakkad 28-29 March 2014

Indicates Outstation Training Programmes

Training on fish based products

Demonstration session on hygienic handling of fish during the training

Technologies Assessed and Transferred

- Designs of wooden fishing vessels in the size range of 7.6 m - 15.2 m
- Designs of steel fishing vessels of size 15.5 M L_{OA}, 20 M L_{OA} and fuel efficient vessel of 18 M L_{OA}
- Design of Aluminum craft for inshore waters and FRP pole and line fishing vessels for Lakshadweep
- Substitution of wooden boats by FRP canoes and treated rubber wood canoes for use in backwaters and near-shore waters
- Dual preservative treatment for low valued species of timbers for boat construction
- Painting schedules for Aluminum-Magnesium alloy and FRP sheathing for under-water hulls of fishing vessels
- Antifouling and anticorrosive paints for protection of fishing craft
- Mercury free anodes for cathodic protection of fishing craft
- Protective coating for cast iron propeller
- Specifications for different types of synthetic materials for fabrication of different types of fishing gear
- Designs of different types of fishing gear such as trawls for demersal, pelagic and semi-pelagic applications, 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 and 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 investigations etc.
- Improved methods for freezing, freeze drying, canning, drying and curing of different types of fish and shellfish
- An improved method for production of dried prawns
- Methods for production of quality dried fish products with attractive appearance and long storage life
- Hygienic drying of Anchoviella
- Method for economic utilization of low grade fish and conversion of fish wastes into useful byproducts
- Methods for production of value added products such as wafers, pickles and soup powder from fish/shellfish
- Ready-to-use isinglass from fish maws
- Methods for extraction of chitin/chitosan from prawn shell waste and their application in textile and poultry industry and in the medical field
- Pilot plant for production of chitosan
- Method for extraction of shark fin rays and processing shark cartilage
- High gel strength agar from sea weeds
- Method for isolation of squalene from shark liver

oil for use in cosmetics

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

Outreach Programmes Conducted

Outreach training programmes

During the period (April 2013 to March 2014) a total of 41 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:

- Tamil Nadu Fish Festival at Chennai during 9-12 May, 2013.
- Exhibition organized as part of the International Symposium on 'Greening Fisheries' held at Cochin during 21-23 May, 2013.
- Exhibition held in connection with International conference on Tropical roots and tubers for sustainable livelihood under changing agro-climate, CTCRI, Thiruvananthapuram during 9-12 July, 2013.
- Exhibition held in connection with Expert consultation on Fish genomics research in India: A way forward, NBFGR, Lucknow on 2 August, 2013.
- 17th National exhibition on the theme 'India advancing towards a world power', Santiniketan, West Bengal during 21-25 September, 2013.
- Exhibition held in connection with the 8th National conference of Krishi Vigyan Kendras, UAS, Bangalore during 23-25 October, 2013.
- Exhibition held in connection with the National seminar on Taxonomy for managing biodiversity: Present scenario and future challenges, Dr. V.S. Krishna Govt. College, Visakhapatnam during 25-26 October, 2013.
- 11th Rural Technology Mela held at Rural Technology Park, NIRD, Hyderabad during 8-13

Tamil Nadu Fish Festival

International Symposium exhibition - Dignitaries at CIFT stall


Exhibition at NBFGR, Lucknow

Shri A.K. Panigrahi, Sr. Tech. Officer receiving memento at the exhibition at Santiniketan


Exhibition at Bangalore


Visit of Arunachal Chief Minister Shri Nabam Tuki at CIFT stall at Itanagar

Dr. U. Sreedhar, Senior Scientist, CIFT explaining at IITF


Global Konkan Festival at Navi Mumbai

Dr. D. Rameshwar Singh, Project Director, DKMA, ICAR and Dr. S.D. Singh, ADG (I. Fy.), ICAR visiting CIFT stall in IITF

Exhibition at Gondia

12th Rural Technology & Crafts Exhibition at NIRD, Hyderabad

"ShellCon 2014", Cochin

Smt. I.R. Sangma, Director of Fisheries, Govt. of Meghalaya at CIFT stall, Agarthala

Receiving participation certificate at '57th Kisan Mela', Anakapalle, A.P.

Kerala Science Congress, Wayanad

International Aquashow, Cochin

November, 2013.

- India International Trade Fare, Pragathi Maidan, New Delhi during 14-27 November, 2013.
- Exhibition held in connection with 'Arunachal Meen Mahotsav - 2013' at Itanagar, Arunachal Pradesh during 21-22 November, 2013.
- Exhibition held in connection with the National seminar SYMSAC-II at IISR Research Centre, Madikeri, Karnataka during 27-29 November, 2013.
- Exhibition held in connection with Whale Shark Day Campaign, Ahmedabad on 2 December, 2013.
- 'Global Konkan Festival' at Navi Mumbai during 14-17 December, 2013
- Exhibition held in connection with 7th International Food Convention at CFTRI, Mysore during 18-21 December, 2013.
- 'Karshika Mela - 2014', Thodupuzha during 26 December 2013 to 4 January, 2014.
- Exhibition organized by Department of Fisheries at Gondia, Maharashtra on 27 December, 2013.
- Exhibition held in connection with 'Technology Week Celebrations', KVK, Amdalavalasa, Srikakulam on 23 January, 2014.
- Exhibition organized in connection with the India International Aquashow, 2014 at Cochin during 24-28 January, 2014.
- Exhibition organized in connection with the 26th Kerala Science Congress Expo ('Sasthra Jalakam, 2014') at Wayanad during 28-31 January, 2014.
- Exhibition held in connection with the Consultation workshop on Self-sufficient and sustainable aquaculture in north eastern region, Agarthala on 5 February, 2013.
- 12th Rural Technology and Crafts Exhibition at NIRD, Hyderabad during 14-19 February, 2014.
- Exhibition held in connection with 'Spandana-Girijanotysavamulu-2014' at Parvatipuram, Vizianagaram district, Andhra Pradesh on 23 February, 2014.
- 57th Kisan Mela at ANGR Agril. University, Anakapalle during 14-15 March, 2014.
- Exhibition held in connection with "ShellCon-2014" at CMFRI, Cochin during 22-23 March, 2014.

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.

Radio talks

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

- Dr. P.T. Lakshmanan, Head, Biochemistry and Nutrition Division - Protective effect of selenium against tumour/cancer through fish (In Malayalam), AIR, Kochi (26 April, 2013)
- Dr. George Ninan, Senior Scientist - Value addition in fisheries (In Malayalam), AIR, Kochi (2 May, 2013)
- Shri V. Radhakrishnan Nair, Scientist - Role of GIS in development of fisheries sector (In Malayalam), AIR, Kochi (3 May, 2013)
- Dr. B. Madhusudana Rao, Senior Scientist - Nutritional significance of Godavari Hilsa (In Telugu), AIR, Visakhapatnam (20 June, 2013)
- Dr. M.S. Kumar, Chief Tech. Officer - Synthetic fishing gear material - Protection from weathering conditions (In Telugu), AIR, Visakhapatnam (26 June, 2013)
- Dr. M.M Prasad, SIC, Visakhapatnam - Wealth from waste - Fishing industry: A case scenario, (In Telugu), AIR, Visakhapatnam (7 July, 2013)
- Dr. G. Rajeswari, Principal Scientist - Modern methods in trawling (In Telugu), AIR, Visakhapatnam (14 July, 2013)
- Dr. K.K. Asha, Scientist - Fish spoilage - Causes, indices and prevention (In Malayalam), AIR, Kochi (15 July, 2013).

- Dr. M.S. Kumar, Chief Tech. Officer - Conservation of endangered marine turtle's, (In Telugu), AIR, Visakhapatnam (15 September, 2013)
- Dr. M.M. Prasad, SIC, Visakhapatnam - Role of marine protected areas in conservation of fishery resources, AIR, Visakhapatnam (20 February, 2014)
- Dr. M.S. Kumar, Chief Tech. Officer - Bio diversity and conservation of marine resources, AIR, Visakhapatnam (20 March, 2014)

Agricultural Technology Information Centre

At ATIC, 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. Various technical queries received regarding training and other extension activities were replied.

Awards and Recognitions

National Award for Best Agri-Business Incubator

The Zonal Technology Management - Business Planning and Development (ZTM-BPD) Unit at CIFT, Cochin has won the National Award for "Best Agri-Business Incubator" for the year 2013. The Award was instituted by Network of Indian Agri-Business Incubators (NIABI), to recognize the achievements of the Business Planning and Development Units for their performance excellence and the incubatees for their dedication in setting up successful agribusiness ventures. NIABI is an initiative of Indian Council of Agricultural Research (ICAR) and National Agricultural Innovation Project (NAIP). The award was presented by Shri Kanna Lakshminarayana, Minister for Agriculture, Andhra Pradesh to Dr. T.K. Srinivasa Gopal, Director, CIFT and Dr. C.N. Ravishankar, Principal Investigator, ZTM-BPD Unit during AgriTex 2013 held at Hyderabad on 25 April, 2013.

Dr. C.N. Ravishankar and Dr. T.K. Srinivasa Gopal receiving the award

CIFT team wins National Award for Technology Innovation

A team of researchers from CIFT, Cochin has been selected for the 4th National Award for Technology Innovation (Runner Up) in the field of Polymer Science & Technology for their work on "Upgradation of Treated Rubber Wood Using FRP Sheathing for Fishing Boat Construction". Dr. Leela Edwin, Principal Scientist and Head of Fishing Technology Division was the team leader. The other members of the team are Dr. P. Muhamed Ashraf, Dr. Nikita Gopal, Dr. M. Ajith Peter, Dr. A. Sreeja, Dr. Saly N. Thomas and Dr. B. Meenakumari.

Recognition to Dr. Nikita Gopal

Dr. Nikita Gopal, Senior Scientist, CIFT, Cochin received the Asian Fisheries Society Merit Award for

Dr. Nikita Gopal receiving the award from Dr. Meryl Williams, Former Director General, World Fish Centre

her work on Gender in Fisheries. The Award was presented on 30 April, 2013 during the inaugural function of the 10th Asian Fisheries and Aquaculture Forum held at Yeosu in South Korea. The Forum was held from April 30 to May 4, 2013. Dr. Nikita has also participated in the 4th Global Symposium on Gender in Aquaculture and Fisheries (GAF4) which was held as part of the Forum and was the Chair of the Programme Committee of the GAF4 in which 25 papers were presented and delegates from 16 countries participated. As part of GAF4, four special International Workshops were also held.

Indira Gandhi Sadbhavana Award to Dr. A.R.S. Menon

Dr. A.R.S. Menon, Chief Technical Officer, CIFT, Cochin received the Indira Gandhi Sadbhavana Award instituted by National Integration and Economic Council, New Delhi. The award is given for the category 'Science Popularization'. The award was presented to Dr. Menon during the National Symposium on 'Life and works of Late Smt. Indira Gandhi' held at Teen Murthi Bhavan, New Delhi to mark the 96th Birth Anniversary of Late Smt. Indira Gandhi on 21 November, 2013. His Excellency Dr. S.C. Jamir, Hon'ble Governor of Odisha gave away the award.

Dr. S.C. Jamir presenting the award to Dr. A.R.S. Menon. Also seen is Ch. Randhir Singh

Dr. Santosh Alex felicitated

Dr. Santosh Alex, Sr. Tech. Officer, Visakhapatnam Research Centre of CIFT who has been chosen to be featured in the Seventh Edition of 'Asian Admirable Achievers' an International Publication that features 500 achievers from different fields across Asia every year, for his contributions to Indian Literature for his translation works in five languages, was felicitated in the Town Official Language Implementation Committee Meeting by Shri Anil Kumar, DRM and Chairman, TOLIC, on 30 October, 2013.

Dr. Santhosh Alex after the felicitations

CIFT staff bags laurels

Shri K.R. Rajasaravanan, SSS, CIFT, Cochin became the Winner of 29th S. Ramaswamy Memorial Kerala State Carom Championship held at Thiruvananthapuram during 8-10 February, 2014. Shri K.D. Santhosh, Technical Assistant won the third position in Veterans (Singles) in the championship.

Shri Santhosh and Shri Rajasaravanan receiving the trophies

Recognition to Shri M. Prasanna Kumar

Shri M. Prasanna Kumar, Technical Assistant, Visakhaptanam Research Centre of CIFT participated in the Hindi Essay and Debate competition organized by the Town Official Language Implementation Committee (TOLIC) of Visakhapatnam. Shri Prasanna Kumar received the first prize in the competition.

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 materials etc. Type testing of marine diesel engines was also carried out and performance certificates were issued to the concerned manufacturers in addition to calibration of mercury, alcohol and digital thermometers received from different fish processing plants and the industry. Samples were tested in the different laboratories at Headquarters of CIFT and test reports were sent to the concerened.

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, Thiruvan-anthapuram
- Kerala University of Fisheries and Ocean Studies, Cochin
- Agency for Development of Aquaculture

National Institutes and Agricultural Universities

- Agricultural Universities
- Ministry of Agriculture
- Ministry of Food Processing Industries
- Department of Ocean Development
- Department of Biotechnology
- Department of Science and Technology
- Department of Electronics
- Indian Institute of Technology, Chennai/ Kharagpur
- State Fisheries Departments
- Union Territory of Lakshadweep
- Kerala Water Authority
- Science and Technology Entrepreneurship Development project (STED)
- Bureau of Indian Standards
- Industries Department, Andaman & Nicobar Administration
- Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
- College of Fisheries, Mangalore
- National Research Centre on Plant Biotechnology, Thiruvananthapuram
- Institute of Microbial Technology, Chandigarh
- Central Marine Fisheries Research Institute, Cochin
- Central Institute of Fisheries Education, Mumbai
- National Institute of Cholera and Enteric Diseases (NICED), Kolkata

- Marine Biotechnology MIRCEN (UNESCO), Department of Fishery Microbiology, College of Fisheries, Mangalore
- National Bureau of Fish Genetic Resources, Cochin

Private Sector

- M/s Garware Wall Ropes Ltd., Pune
- M/s DSM India Ltd., Mumbai

International Institutions

- Food and Agriculture Organization (FAO), Rome
- Bay of Bengal Programme (BOBP)
- Asia Pacific Fisheries Commission (APFC)
- INFOFISH
- Australian National Quality Assurance Programme (ANQAP), Australia

Extension and Development Agencies

- Central Social Welfare Board
- South Indian Federation of Fishermen Societies (SIFFS), Thiruvananthapuram
- AFPRD, Hyderabad
- Kanyakumari District Fishermen Sangam's Federation
- Bharat Sevak Samaj, Thiruvananthapuram
- Small Industries Development Bank of India (SIDBI)
- Matsya Mahila Vedi, Chellanam
- Alleppey Diocesan Charitable and Social Welfare Society, Alappuzha
- Vanitha Matsya Thozilali Bank, Neendakara
- Kerala Industrial and Technical Consultancy Organisation (KITCO)
- Avani Agro Society, North Paravur, Ernakulam
- Kerala State Women's Development Corporation Ltd., Thiruvananthapuram
- Chellanam Panchayat SC/ST Co-operative Society Ltd., Cochin
- Development Action through Self Help Network (DARSHN)
- Agency for Development of Aquaculture in Kerala (ADAK)
- Kudumbasree Community Development Society, 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, Bangaluru
- Triptisagar Society for Fishermen Ltd., Jafarabad, Gujarat
- Gandhi Smaraka Seva Kendram, Alappuzha
- Kottappuram Integrated Development Society (KIDS), Kodungalloor
- MS Swaminathan Research Foundation, Chennai

Technical Guidance/Consultancy

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

1. With M/s. Mahindra & Mahindra, Powerol Division, Mumbai - 400 101 for validation of diesel engine for fishing vessel application (Consultancy fee - ₹ 2,22, 500/-).
2. With M/s. V.V. Biotech Pvt. Ltd., Flat No. 404, Dhruva Apartment, Chavali Street, Ongole - 523 001, Andhra Pradesh for technical assistance and

guidance on extraction of chitin and chitosan from prawn shell waste (Consultancy fee - ₹ 1,00,000/-).

3. With M/s Lombardini India Pvt. Ltd., Aurangabad for providing the validation service and certification of the diesel engines manufactured by the party. (Consultation fee - ₹ 1,11,250/-).
4. With M/s Travancore Aquapets, Kumbalam P.O., Cochin for providing the technical guidance and assistance relating to the production of Lipstick using squid chromatophore as colorant. (Consultation fee - ₹ 65,731/-).
5. With St. George College, Aruvithura P.O., Kottayam for providing technical advice and assistance relating to setting up of a food testing laboratory with NABL accreditation status (Consultation fee - ₹ 2,75,000/-).
6. With M/s Ernakulam Regional Co-operative Milk Producers Union Ltd. (MILMA), Edappally, Cochin - 682 024 for technical guidance and setting up of a laboratory with NABL accreditation status at Products Dairy, Edappally (Consultancy fee - ₹ 1,50,000/-).

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-II-3
6. Shri P. Mani, UDC
7. Shri M.T. Mani, Cook
8. Shri V. Deepak Vin, SSG-II

Nominated Member Secretary

Asst. Admn. Officer, CIFT

Research Advisory Committee

Chairman: Dr. V. Prakash, Former Directior, CFTRI, Mysore

Members

1. Dr. Rintu Baerjee, Professor, Dept. of Agriculture & Food Engineering, IIT, Kharagpur
2. Dr. D.S. Shesappa, Former Dean, College of Fisheries, Mangalore
3. Dr. K.C. Dora, Dean, College of Fisheries, West Bengal University of Animal & Fisheries Sciences, Chakagaria, Kolkata
4. Dr. S. Jeevan, Chief Executive Officer, Samudra Shipyard (P.) Ltd., Aroor
5. Dr., Madan Mohan, Asst. Director General (M. Fy.), ICAR, New Delhi
6. Dr. T.K. Srinivasa Gopal, Director, CIFT

Member Secretary: Dr. Leela Edwin, HOD, FT, CIFT

Management Committee

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

Members

1. Dr. C. Mohanakumaran Nair, Pro VC, KUFOS, Panangad P.O., Cochin - 682 506
2. Shri K.G. Prakasan, Jt. Director (Central Zone), Department of Fisheries, Govt. of Kerala
3. Dr. V. Kripa, HOD, FEMD, CMFRI, Cochin
4. Smt. Chaya D. Jadhav, At Post Lanja, 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 - 700 120
7. Dr. C.S. Purushothaman, Principal Scientist, CIFE, Mumbai
8. Dr. P.K. Mukhopadhyay, Principal Scientist, Regional Centre, CIFA, Rahara, West Bengal - 700 118

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

Member Secretary : Shri P.J. Davis, Senior Administrative Officer, CIFT

Institute Joint Staff Council

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

Members (Official side)

1. Dr. C.N. Ravishankar, Principal Scientist & HOD, FP
2. Dr. M.P. Remesan, Principal Scientist
3. Dr. Suseela Mathew, Principal Scientist & HOD I/c, B&N
4. Shri R. Anil Kumar, Administrative Officer
5. Shri K. Sreekumaran, Assistant Finance & Accounts Officer

Secretary (Official Side)

Shri P.J. Davis, Senior Administrative Officer

Members (Staff Side)

1. Shri G. Vinod, Technician
2. Shri K.B. Subukuttan, Assistant
4. Shri P.K. Somasekharan Nair, Assistant
5. Shri K.K. Karthikeyan, Skilled Support Staff
6. Shri P.N. Nikhil Das, Skilled Support Staff

Secretary (Staff Side)

Shri P.S. Nobi, Tech. Officer

Dr. V. Prakash, Chairman, RAC and Dr. Madan Mohan, ADG (M.Fy.) ICAR conducting the proceedings

RAC meeting in progress

Management Committee Meeting in progress

RAC members meeting research students

Participation in Training Programmes

Sl. No.	Name(S) of Participants (S)	Training attended	Venue and Date
1.	Dr. U. Sreedhar	Training on Coastal and marine biodiversity conservation	Kakkinada 6 April 2013
2.	Shri Ankur Nagori	Training on Design optimization of ships using SHIPFLOW	Cochin 15-18 April 2013
3.	Dr. V. Murugadas	Training programme on Laboratory quality management system and internal audit as per IS/ISO/IEC 17025	NITS, Noida 7-10 May 2013
4.	Smt. T. Silaja Shri K.D. Jos	Training programme on Competency enhancement for Technical Officers	NAARM, Hyderabad 13-23 May 2013
5.	Dr. A.R.S. Menon	Workshop on Right to Information Act - 2005 for PIO's	ISTM, New Delhi 27-28 May 2013
6.	Dr. C.N. Ravishankar	World bank Global Food safety Partnership training programme on Good aquaculture practices	Suralaya, Indonesia 17-22 June 2013
7.	Dr. M.M. Prasad	Training programme on Fish post harvesting training to the active fisherwomen	Pudimadaka 20 June 2013
8.	Dr. A. Jeyakumari	Short course on Thermal processing of ready to eat (RTE) meat products	NRC on Meat, Hyderabad 9-18 July 2013
9.	Dr. M.M. Prasad	Training on Hygienic handling and preparation of value added products	Mangamaripeta, Visakhapatnam 18 July 2013
10.	Dr. Leela Edwin Dr. P. Pravin	Trainers training programme on Moving towards sustainability	FSI, Cochin 6-8 August 2013
11.	Dr. K.K. Asha	Training on Bio remediation	Brookhaven National Laboratory, USA 19 September - 17 December 2013
12.	Dr. K.K. Prajith	Short course on Taxonomy and identification of commercially important crustaceans of India	CMFRI, Cochin 20-24 August 2013
13.	Dr. M.M. Prasad Dr. G. Rajeswari	Training on Post harvest technologies	YMCA, Visakhapatnam 30 August 2013
14.	Dr. P. Pravin	Trainers training programme on Moving towards sustainability	FSI, Mangalore 3-5 September 2013
15.	Smt. Arathy Ashok	Skill upgradation programme on Value added fish products	Pudimadaka 12-13 September 2013

Sl. No.	Name(S) of Participants (S)	Training attended	Venue and Date
16.	Dr. K. Ashok Kumar Dr. S.K. Panda	Workshop on Good wild caught practice and seafood HACCP inspection - Train the trainer programme	Goa 16-20 September 2013
17.	Dr. K.V. Lalitha	Orientation training programme of the project on National surveillance programme for aquatic animal diseases	NBFGR, Lucknow 17-20 September 2013
18.	Dr. R. Raghu Prakash	4th Training programme of Fishery Survey of India	Goa 24-26 September 2013
19.	Dr. S. Balasubramaniam Dr. V. Geethalakshmi Dr. Nikita Gopal Shri V. Radhakrishnan Nair Shri V. Chandrasekar Smt. P. Jeyanthi Smt. Arathy Ashok	Short course on Marketing research for value chain in fisheries	CIFT, Cochin 1-10 October 2013
20.	Shri P.J. Davis	Training course on Knowledge management	ISTM, New Delhi 7-9 October 2013
21.	Dr. U. Sreedhar	Training programme on Creating awareness on generation of satellite tuna advisories	INCOIS, Hyderabad 7-10 October 2013
22.	Dr. K.K. Prajith Smt. S.J. Laly	Workshop on Scientific paper writing	Cochin 14-17 October 2013
23.	Dr. V. Murugadas	Short course on Metagenomics - Role of next generation sequencing and bioinformatics	AAU, Anand 15-24 October 2013
24.	Dr. U. Sreedhar	Vessel navigation and engineering	CIFNET, Visakhapatnam 17 October 2013
25.	Dr. P. Pravin Dr. K. Ashok Kumar	Workshop on Enhancing research collaborations through National Knowledge Network	Bangalore 17-19 October 2013
26.	Shri Ankur Nagori Dr. A. Jeyakumari Smt. S. Remya Kum. Jesmi Debbarma Smt U. Parvathy	National training course on Application of high pressure and pulsed light technology for food processing	CIFT, Cochin 18-31 October 2013
27.	Dr. G.K. Sivaraman	Training programme on Bioinformatics (Fisheries) by using Bio Numerics mathematical model system	North Carolina State University, USA 21 October, 2013 - 20 January, 2014
28.	Kum. V.P. Souda	Winter school on Climate change and variability, marine ecosystems and coastal zone management	Cochin 2-7 November 2013

Sl. No.	Name(S) of Participants (S)	Training attended	Venue and Date
29.	Dr. Leela Edwin Dr. M.P. Remesan Dr. S. Ashaletha Shri V. Chandrasekar	Winter school on ICT-oriented strategic extension for responsible fishing management	CMFRI, Cochin 5-25 November 2013
30.	Dr. K.K. Prajith Smt. S.J. Laly	Workshop on Scientific presentations	Cochin 18-21 November 2013
31.	Dr. V. Ronda Smt. P.K. Shyma	Training programme on Laboratory quality management system and internal audit	BIS, Chennai 18-21 November 2013
32.	Shri C. Subhash Chandran Nair	Workshop on HD Video	Cochin 19 November 2013
33.	Shri T. Viswanathan	Workshop on Noting and drafting	ISTM, New Delhi 21-22 November 2013
34.	Shri P. Krishnakumar	Workshop on Income tax (WiTax)	ISTM, New Delhi 25-26 November 2013
35.	Dr. Leela Edwin Dr. T.V. Sankar Dr. C.N. Ravishankar	Management development programme on Leadership management	NAARM, Hyderabad 25 November - 7 December 2013
36.	Shri P.J. Davis	Orientation course on Record management	NAI, Puducherry 2-6 December 2013
37.	Smt. G. Surya Kum. Nilina Elais Smt. N.R. Akhila	Special training programme for the newly recruited Assistants of ICAR	NIFM, Faridabad 2-13 December 2013
38.	Dr. T.K. Srinivasa Gopal Shri P.J. Davis Shri R. Anil Kumar Shri K.S. Sreekumaran	Interactive workshop on Administrative and financial matters for the ICAR Institutes	NAARM, Hyderabad 9-10 December 2013
39.	Smt. P. Jeyanthi	Training programme on Data analysis using SAS	IISS, Bhopal 9-13 December 2013
40.	Smt. Asha Gopalan	Special training programme for the newly recruited Assistants of ICAR	NIFM, Faridabad 9-20 December 2013
41.	Shri K.S. Sreekumaran	Customized programme on Financial issues for the officers of ICAR	NIFM, Faridabad 16-20 December 2013
42.	Dr. C.O. Mohan	Training on Sensor based application including bio indicators	University of Wisconsin Madison, USA 22 December, 2013 - 21 March, 2014
43.	Dr. U. Sreedhar	Training for Andhra Pradesh State Disaster Response Force	Visakhapatnam 29 January 2014
44.	Shri M. Nasser Dr. Femeena Hassan Dr. S. Ashaletha	Training programme on Data analysis using SAS	CIFT, Cochin 1-7 February 2014

Sl. No.	Name(S) of Participants (S)	Training attended	Venue and Date
	Shri V. Radhakrishnan Nair Smt. P. Jeyanthi Shri Ankur Nagori Dr. V. Murugadas Smt. Arathy Ashok Dr. A. Jeyakumari Smt. Priyanka Vichare		
45.	Dr. P.K. Binsi	Training on Smart packaging (Fisheries)	Rutgers State University, New Jersy, USA 1 February - 31 March 2014
46.	Dr. V. Visnuvinayagam Shri G. Kamei	Training programme on Development and nano sizing of biotechnology products from fisheries and aquaculture	CIFE, Mumbai 5-25 February 2014
47.	Dr. George Ninan	Refresher course on Food science and technology	DFRL, Mysore 20 February 2014
48.	Shri P.P. Anil Kumar	Workshop on Analysis of financial statements	ISTM, New Delhi 20-21 February 2013
49.	Dr. G. Usha Rani Smt. P.A. Jaya	Short term training programme on Insights in to the analysis of pesticide residues	CFTRI, Mysore 24-28 February 2014
50.	Dr. P. Muhamed Ashraf	Training on Detection of HABs in southeast Asia by remote sensing: Operational warming and regional monitoring protocols	Univ. of Philippines, Philippines 24 February - 15 March 2014
51.	Smt. T. Silaja Shri P. Bhaskaran Shri Eldho George Shri Shaiph Mustafa	Koha professional training	TNAU, Coimbatore 27 February - 1 March 2014
52.	Dr. B. Madhusudana Rao	Training programme on Hygienic handling of fish	Kotturu, Visakhapatnam 1 March 2014
53.	Dr. U. Sreedhar Dr. K.K. Prajith Kum. V.P. Souda	Training programme on *in situ* sampling protocols for satellite coastal oceanographic research (SATCORE) and marine fisheries advisory services (MFAS)	Andhra University, Visakhapatnam 2-5 March 2014
54.	Dr. Toms C. Joseph	Training programme on Next generation sequencing: Data analysis and notation	IISR, Calicut 17-20 March 2014
55.	Dr. M.M. Prasad Dr. B. Madhusudana Rao Smt. Arathy Ashok Kum. Jesmi Debbarma	Hygienic handling of fish and preparation of value added fish products	Mangamaripeta, Visakhapatnam 21-22 March 2014
56.	Kum. V.P. Souda	Short course on remote sensing of potential fishing zones and ocean state forecast	ITC Ocean, Hyderabad 24-29 March 2014

Visits Abroad

Dr. T.K. Srinivasa Gopal, Director, **Dr. Nikita Gopal** and **Dr. Femeena Hassan**, Senior Scientists were deputed to South Korea to attend the 10th Asian Fisheries and Aquaculture Forum held at Yeosu, South Korea during 30 April to 4 May, 2013. Dr. Srinivasa Gopal and Dr. Femeena Hassan also attended the 4th International symposium on Cage aquaculture. Dr. Srinivasa Gopal also chaired the Session on Fisheries Processing on 2 May, 2013. After attending the session on Fishing Gear and Technology Dr. Srinivasa Gopal also visited Chungnam National University. Dr. Nikita Gopal has also participated in the 4th Global Symposium on Gender in aquaculture and fisheries.

Photo 1- Dr. T.K. Srinivasa Gopal and Dr. Nikita Gopal with Prof. Sungchul C. Bai, President, KOSFAS and Prof. Jeong-Yeol Lee, Chair, Local Organization Committee, 10th AFAF

Photo 2- Dr. Femeena Hassan making her presentation

Dr. Leela Edwin, Head, Fishing Technology, **Shri M.V. Baiju** and **Dr. V.R. Madhu**, Senior Scientists participated in the 2013 ICES FAO Working Group on Fish Technology and Fish Behaviour (WGFTFB) Meeting at Bangkok, Thailand during 6-9 May, 2013. Dr. Leela Edwin presented an invited paper on "CIFT's Initiatives towards Green Fishing Systems" at the Symposium on Impact of fishing on the environment.

Dr. Leela Edwin, Shri M.V. Baiju and Dr. V.R. Madhu with Mr. Mike Pol, Co-Chair, FAO-WGFTFB at SEAFDEC, Thailand.

Dr. C.N. Ravishankar, Head, Fish Processing served as Resource Expert in Fish Processing Technology in World bank Global Food safety Partnership (GFSP) training programme on Good Aquaculture Practices at Suralaya, Indonesia during 17-22 June, 2013.

Participants and resource persons of the programme (Sitting at extreme left is Dr. Ravishankar)

Dr. K.K. Asha, Senior Scientist was deputed to Biosciences Department of Brookhaven National Laboratory, Department of Energy, Upton, USA to undergo a training programme on Bioremediation during 19 September to 17 December, 2013.

Dr. K.K. Asha at the Brookhaven National Laboratory

Dr. R. Anandan, Senior Scientist was deputed to undergo training in the area of Nutraceuticals (Fisheries Sciences) in the Department of Medicine (Cardiology), Biochemistry and Molecular Biology, Gazes Cardiac Research Institute, Medical University of South Carolina, USA during 21 October, 2013 to 17 January, 2014.

Dr. Anandan undergoing training

Dr. G.K. Sivaraman, Senior Scientist has undergone training on Bioinformatics (Fisheries) by using BioNumerics mathematical model system to type the seafood-borne bacterial pathogens by Pulse Field Gel Electrophoresis (PFGE) and Multi-Locus Sequence Typing (MLST) at Department of Population Health and Pathobiology, College of Veterinary Medicine, North Carolina State University, USA during 21 October, 2013 to 20 January, 2014.


Dr. G.K. Sivaraman

Dr. P. Muhamed Ashraf, Senior Scientist was deputed to attend the training programme on Detection of HABs in southeast Asia by remote sensing: Operational warming and regional monitoring protocols at Bolinao Marine Laboratory, Marine Science Institute, University of Philippines, Philippines during 24 February to 15 March, 2014.

Dr. P. Muhamed Ashraf in front of Marine Science Laboratory

Dr. C.O. Mohan, Scientist was deputed by ICAR, New Delhi for undergoing 90 days International Training to undertake a short term project work in the field of "Sensor based applications including Bio-indicators". He carried out the work under the guidance of Prof. Sundaram Gunasekaran, Biological Systems Engineering Department, University of Wisconsin-Madison, USA during 22 December, 2013 to 21 March, 2014.


Dr. C.O. Mohan (extreme right) with Prof. Sundaram Gunasekaran and other colleagues

Dr. P.K. Binsi, Scientist was deputed to USA to undergo advanced training on 'Smart packaging' at Rutgers-The State University of New Jersey under the financial assistance of NAIP. The training programme was carried out under the guidance of Dr. Kit L. Yam, Professor and Undergraduate Programme Director, Department of Food Science, Rutgers University for a period of two months during 1 February to 31 March, 2014.


Prof. Kit L. Yam and Dr. P.K. Binsi

Participation in Symposia/Seminars/Workshops etc.

Sl. No.	Name(s) of Participant(s)	Symposia/Seminars/ Workshops etc. attended	Venue and Date
1.	Dr. C.N. Ravishankar	Review meeting for evaluating proposals for establishing Business Planning and Development Unit	ICAR, New Delhi 1 April 2013
2.	Dr. George Ninan	International seminar cum workshop on Mud crab aquaculture and fisheries management	RGCA, Sirkazhi 10-12 April 2013
3.	Dr. M.M. Prasad	21st Meeting of the ICAR Regional Committee No. III	AAU, Jorhat, Assam 15-16 April 2013
4.	Dr. P.T. Lakshmanan	Brain storming session to evolve Research Policies	KUFOS, Cochin 23 April 2013
5.	Dr. George Ninan	Technical programme discussion meeting pertaining to the radiation and environment subcommittee	BARC, Mumbai 25 April 2013
6.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar	Indian Agribusiness Incubation Conference	Hyderabad 26 April 2013
7.	Dr. S. Ashaletha Dr. J. Charles Jeeva	Brain storming session on Improving research in agricultural extension: Issues and way forward	TNAU, Coimbatore 26 April 2013
8.	Shri P.K. Vijayan	Executive committee meeting of NIFAM	Thiruvananthapuram 27 April 2013
9.	Dr. P. Pravin Dr. K. Ashok Kumar	Workshop on Development of digital knowledge repository for fisheries	Cochin 29-30 April 2013
10.	Dr. T.K. Srinivasa Gopal Dr. Nikita Gopal Dr. Femeena Hassan	10th Asian Fisheries and Aquaculture Forum	Yeosu, South Korea 30 April - 4 May 2013
11.	Shri M.V. Baiju	Meeting of Expert Committee for Fish wealth and scientific study, Govt. of Kerala	Thiruvananthapuram 2 May 2013
12.	Dr. A.R.S. Menon	Inter Media Publicity Coordination Committee meeting	Doordarshan Kendra, Thiruvananthapuram 3 May 2013
13.	Dr. M.S. Kumar	Farm and home rural unit programme sub committee meeting	AIR, Visakhapatnam 6 May 2013
14.	Dr. Leela Edwin Shri M.V. Baiju Dr. V.R. Madhu	ICES-FAO Working Group on Fish Technology and Fish Behaviour (WGFTFB) Meeting	SEAFDEC, Bangkok, Thailand 6-10 May 2013
15.	Dr. P. Muhamed Ashraf	Meeting of the PI's of Southern ocean projects	NCAOR, Goa 8 May 2013
16.	Dr. Leela Edwin	Academic Council Meeting	KUFOS, Cochin 13 May 2013
17.	Dr. M.M. Prasad	Meeting of AQUADIRECT.ORG	Visakhapatnam 15 May 2013

Sl. No.	Name(s) of Participant(s)	Symposia/Seminars/ Workshops etc. attended	Venue and Date
18.	Dr. C.N. Ravishankar Smt. A. Razia Mohamed	STEM Annual Summit	Chennai 15-17 May 2013
19.	Dr. M.M. Prasad Dr. G. Rajeswari Dr. R. Raghu Prakash Kum. Jesmi Debbarma	Scientific Committee on Oceanic Research (SCOR) Meeting at Center for Studies on Bay of Bengal	Visakhapatnam 17 May 2013
20.	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. S. Visnuvinayagam Shri P.K. Vijayan 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. G. Rajeswari Dr. V. Geethalakshmi Dr. Nikita Gopal Dr. S. Ashaletha Dr. R. Raghu Prakash Dr. U. Sreedhar Dr. G.K. Sivaraman Dr. Femeena Hassan Dr. Sanjoy Das Dr. R. Anandan Dr. George Ninan Dr. A.A. Zynudheen Dr. J. Bindu Dr. P. Muhamed Ashraf Shri M.V. Baiju Dr. Toms C. Joseph Dr. B. Madhusudana Rao Dr. J. Charles Jeeva Dr. S.K. Panda Dr. V.R. Madhu Dr. L.N. Murthy	International symposium on Greening fisheries - Towards green technologies in fisheries	Cochin 21-23 May 2013

Sl. No.	Name(s) of Participant(s)	Symposia/Seminars/ Workshops etc. attended	Venue and Date
	Dr. K.K. Asha Shri V. Radhakrishnan Nair Dr. C.O. Mohan Shri V. Chandrasekar Shri Ankur Nagori Dr. A.K. Jha Smt. Arathy Ashok Dr. V. Murugadas Shri C.G. Joshy Smt. S.J. Laly Dr. A. Jeyakumari Dr. P.K. Binsi Kum. Jesmi Debbarma Smt. V. Renuka Smt. S. Remya Smt. P. Viji Dr. K.K. Prajith Dr. Niladri Sekhar Chatterjee Smt. U. Parvathy Dr. A.R.S. Menon Shri C.R. Gokulan Smt. K. Beena Shri B.K. Pradhan Smt. P.K. Shyma Dr. G. Usha Rani Dr. M. Baiju Dr. B. Ganesan Shri P.S. Babu Shri T.V. Bhaskaran Smt. K.K. Kala Smt. G. Remani Shri P.A. Aneesh Shri Nitin Singh Shri K.K. Santhosh Shri P. Vineeth Kumar Shri M. Kiran Das Smt. K.A. Anju Smt. A. Razia Mohamed Kum. K.B. Biji Shri V.C. Jijomon Shri T. Jose Fernandez Shri P.H. Dhiju Das Shri P.M. Vipin Shri P.S. Muhammed Sherif Shri P.T. Sreejith		

Sl. No.	Name(s) of Participant(s)	Symposia/Seminars/ Workshops etc. attended	Venue and Date
	Shri C.K. Kamalakanth Smt. K.A. Sayana Shri Renju Ravi Shri V.R. Kiran Shri Paresh S. Khanolkar Kum. E.S. Sumi Shri F. Daniel Raj Shri Rithin Joseph Shri P. Shameer Shri V.G. Jinoy Shri K.A. Roshan Shri Shiran Kalappurakkal Kum. P. Sruthi Smt. S. Soma Kum. Jolsna Jeevan Shri R. Navaneethan Shri K.K. Ajeeshkumar Shri K.V. Vishnu Shri B.P. Bijula Shri Jomey George Kum. N.B. Jayasree Smt. K. Shyni Smt. G.S. Hema Kum. K.R. Remya Kumari Shri C.T. Nithin Shri T.R. Ananthanarayanan Shri U. Sumith Kum. P. Minu Kum. V.P. Souda Shri Rahul Ravindran Shri M.M. Lijin Nambiar Kum. Nimisha V. Satheesh Shri Jinu Krishnan Kum. E.R. Priya Shri K.R. Midhun		
21.	Dr. C.N. Ravishankar	Launch workshop of the BPD	CPCRI, Kasaragod 7 June 2013
22.	Dr. A.A. Zynudheen	National symposium on Chitosan	IHBT, Palampur 8-9 June 2013
23.	Dr. P.T. Lakshmanan	Technical sub committee meeting of Council for Food Research and Development (CFRD)	Cochin 10 June 2013
24.	Dr. P. Pravin Shri M.V. Baiju	Meeting of Expert Committee for Fish wealth and scientific study, Govt. of Kerala,	Thiruvananthapuram 11 June 2013

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25.	Dr. George Ninan	National seminar on Promotion of fisheries and upliftment of fishers	Cochin 14 June 2013
26.	Dr. P. Pravin	Meeting regarding Tuna long line training programme for Tamil Nadu fishermen	CIFNET, Cochin 17 June 2013
27.	Dr. Suseela Mathew	Fisheries expert's brain storming session	FCRI, Thoothukudi 19 June 2013
28.	Dr. George Ninan	NAIP training programme for the CPI and CoPI's of the new BPD units	TNAU, Coimbatore 19 June 2013
29.	Dr. Saly N. Thomas	First sitting of the Expert Committee constituted by Matsyafed for the implementation of new fish net factory	Thiruvananthapuram 20 June 2013
30.	Shri M.V. Baiju	Meeting of Expert Committee for Fish wealth and scientific study, Govt. of Kerala	Thiruvananthapuram 22 June 2013
31.	Dr. T.K. Srinivasa Gopal Dr. T.V. Sankar Dr. K. Ashok Kumar Dr. Nikita Gopal Dr. S.K. Panda	Brainstorming session on SPS (Sanitary and Phytosanitary) measures	NAAS, New Delhi 27 June 2013
32.	Dr. Santhosh Alex	Hindi workshop	MPEDA, Visakhapatnam 27-28 June 2013
33.	Dr. P. Pravin	Meeting on issues related to security/ fisheries	Bangalore 1-3 July 2013
34.	Dr. C.N. Ravishankar	FSSAI meeting on fish and fishery products	New Delhi 2 July 2013
35.	Dr. Suseela Mathew	National workshop on Strategies for strengthening NARS Libraries under e-granth	IARI, New Delhi 5-6 July 2013
36.	Dr. G. Rajeswari Dr. U. Sreedhar	Workshop on Fishing technology	CIFNET, Visakhapatnam 9 July 2013
37.	Dr. George Ninan	Annual review meeting of KVKs of Zone III	KVK, Pathanamthitta 9 July 2013
38.	Dr. A.A. Zynudheen	International conference on Tropical roots and tubers for sustainable livelihood under changing agro climate	CTCRI, Thiruvananthapuram 9-13 July 2013
39.	Dr. T.K. Srinivasa Gopal Dr. Leela Edwin Dr. S. Balasubramaniam Dr. C.N. Ravishankar Dr. M.M. Prasad Dr. J. Charles Jeeva	Workshop on technology transfer programmes in NEH states	NRC on Pig, Guwahati 10 July 2013

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40.	Dr. J. Bindu	Workshop on Husbandry of Pearl spot	KSCADC, Thiruvananthapuram 10 July 2013
41.	Dr. Leela Edwin	First meeting of the Technical Committee constituted by the Ministry of Agriculture for assessing the impact of fishing ban and to review its duration	CMFRI, Cochin 12 July 2013
42.	Dr. S. Ashaletha	Sustainable agri-village programme	Cochin 12 July 2013
43.	Dr. Leela Edwin	National strategic consultation and conference on Green technology for carbon free fishing	Nagercoil 13 July 2013
44.	Dr. T.K. Srinivasa Gopal	Director's conference and ICAR Foundation Day Celebrations	ICAR, New Delhi 16 July 2013
45.	Dr. T.K. Srinivasa Gopal Shri C.G. Joshy	Performance indicator meeting of KVK, institutes and Deemed Universities	NCAP, New Delhi 17 July 2013
46.	Dr. T.K. Srinivasa Gopal Dr. K.V. Lalitha Dr. C.N. Ravishankar Dr. J. Bindu Shri Nitin Singh	Agri Tech Investors and Interaction Meeting	New Delhi 17-18 July 2013
47.	Dr. Saly N. Thomas	Meeting before the officials of State Fisheries Department of Maharashtra	Mumbai 22 July 2013
48.	Dr. Leela Edwin Shri M.V. Baiju	Third annual review meeting workshop of the NFBSFAR	New Delhi 22-23 July 2013
49.	Dr. G. Rajeswari	Annual Board of study meeting of Marine Living Resource Division	Andhra University, Visakhapatnam 25 July 2013
50.	Dr. S. Ashaletha	Review meeting of NAIP on Mobilizing mass media support for sharing agro-information	Chetali, Coorge 26-27 July 2013
51.	Smt. A. Razia Mohamed Smt. K.A. Anju	Conference and exposition on Building and managing an IP ecosystem for business excellence	Hyderabad 26-27 July 2013
52.	Dr. P.K. Binsi Smt. P. Viji	Workshop on Towards sustainable fishing	Navi Mumbai 31 July 2013
53.	Dr. T.V. Sankar	National symposium on Prospects and advances in biotechnology and bioprocess engineering	Sri Budha College of Engineering, Pattor 1 August 2013
54.	Dr. S.K. Panda	Workshop on Codex: Principles and procedures	FSSAI, New Delhi 2 August 2013
55.	Dr. V. Murugadas	Expert consultation on Fish genomics research in India: A way forward	NBFGR, Lucknow 2 August 2013

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56.	Dr. Leela Edwin	Meeting of Vigilance Study Circle, Kerala Chapter	SBT, Thiruvanantapuram 7 August 2013
57.	Smt. T. Silaja	Workshop on Information literacy in the digital Era	IISR, Kozhikode 12 August 2013
58.	Dr. M.M. Prasad Dr. U. Sreedhar Smt. Arathy Ashok	State level workshop on Towards sustainable fishing	CIFNET, Visakhapatnam 20 August 2013
59.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Dr. P. Pravin	National workshop on Repeat study on assessment of post harvest losses of major horticultural crops, animal and fishery products of India	ICAR, New Delhi 29 August 2013
60.	Dr. R. Anandan	National conference on Current approaches and challenges in nanomaterials and nano medicine	R.S. Government College, Thanjavur 29-30 August 2013
61.	Shri P. Bhaskaran Shri Shaiph Mustafa	Workshop on KOHA integrated library systems	CPCRI, Kasaragod 29-30 August 2013
62.	Dr. T.V. Sankar	Eight meeting of Scientific panel for Biological hazards	FDA, New Delhi 30 August 2013
63.	Smt. P. Viji	National conference on Bulk packaging of hazardous goods for exports and the importance of UN certificate	Mumbai 30 August 2013
64.	Dr. P.K. Binsi	Expert committee meeting to present the research proposal entitled, "Use of natural resins and gums for preservation and value addition of fishery products"	IIT, Delhi 30 August 2013
65.	Dr. S. Ashaletha	Business meet of FISHMAID entrepreneurs	Thiruvananthapuram 3 September 2013
66.	Dr. K.K. Asha Dr. Niladri Sekhar Chatterjee	Workshop on Mass spectrometry and International conference on Frontiers of mass spectrometry	MG. University, Kottayam 6-9 September 2013
67.	Dr. S. Ashaletha	Extension Meet	College of Agriculture, Thiruvananthapuram 10 September 2013
68.	Kum. Nimisha V. Satheesh	National symposium on 'Foodxplore '13 - Process, preserve and prosper'	TNAU, Coimbatore 20-21 September 2013
69.	Dr. S. Visnuvinayagam Dr. P.K. Binsi	Seventh edition of 'Food World India' - The global convention for food business and industry	FICCI, Mumbai 23-24 September 2013

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70.	Dr. Leela Edwin Dr. Saly N. Thomas	Review of Indian oil sardine fishery improvement project organized by WWF-India and Marine Stewardship Council	Cochin 24 September 2013
71.	Dr. T.V. Sankar Dr. K. Ashok Kumar	FAD12 meeting of BIS	NIFPHATT, Cochin 24 September 2013
72.	Dr. P.K. Binsi Smt. P. Viji	International symposium on Ready to eat foods: Innovations in ready-to-eat products: Drivers, trends and emerging technologies	Mumbai 25-26 September 2013
73.	Dr. Leela Edwin	First meeting of Expert committee for Comprehensive review of deep sea fishing and policy guidelines	New Delhi 26 September 2013
74.	Dr. Leela Edwin Dr. Saly N. Thomas Dr. J. Bindu Dr. P. Muhamed Ashraf Shri G. Omanakuttan Nair	National seminar on Biopolymers and green composites - Emerging science and technology	KSPC, Cochin 27 September 2013
75.	Dr. M.M. Prasad Dr. R. Raghu Prakash	Workshop on Fish conservation methods	Visakhapatnam 27 September 2013
76.	Dr. T.K. Srinivasa Gopal	Meeting to discuss about the development action plan for livelihood options	Bali Island, Sundarbans 1 October 2013
77.	Dr. T.K. Srinivasa Gopal	Review meeting of NFBSFARA funded project on Stock characterization, captive breeding seed production and culture of Hilsa	Godhkail 2 October 2013
78.	Dr. T.V. Sankar	Workshop on Codex Alimentarius Commission: Principles and procedures	Cochin 2 October 2013
79.	Dr. T.V. Sankar	National seminar on Food safety and phytosanitory measures in fisheries	St. Terasa's College, Ernakulam 4 October 2013
80.	Dr. S. Ashaletha	Workshop on Healthy women, healthy society	Vypeen, Ernakulam 4 October 2013
81.	Dr. A.R.S. Menon	Inter Media Publicity Coordination Committee Meeting	AIR, Thiruvananthapuram 4 October 2013
82.	Dr. T.K. Srinivasa Gopal Dr. Leela Edwin	ICAR-GWRL interface meeting	Wai, Maharashtra 6 October 2013
83.	Dr. Saly N. Thomas	2nd State wide Guidance Council meeting of the Matsya Samrudhy Programme of Kerala State Fisheries Department	Thiruvananthapuram 8 October 2013
84.	Dr. S.K. Panda	2nd Scientific panel meeting of Fish and fishery products of FSSAI	New Delhi 15 October 2013

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85.	Dr. P. Pravin	National Knowledge Network Workshop	Bangalore 16-19 October 2013
86.	Dr. K. Ashok Kumar Dr. S.K. Panda	Meeting of the National committee on sanitary import permit for fish and fishery products	NIFPHATT, Cochin 17 October 2013
87.	Dr. C.N. Ravishankar Shri Nitin Singh	First Foundation Day celebrations of AgrInnovate India Ltd.	ICAR, New Delhi 19 October 2013
88.	Dr. S. Ashaletha	National conference on Krishi Vigyan Kendras	UAS, Bangalore 23-25 October 2013
89.	Dr. P. Pravin	Workshop on Presentation skills	Cochin 25-26 October 2013
90.	Dr. U. Sreedhar	National seminar on Taxonomy for managing biodiversity: Present scenario and future challenges	Dr. V.S. Krishna Govt. College, Visakhapatnam 25-26 October 2013
91.	Shri Eldo George	Workshop on KOHA Library Management Software	ANGRAU, Hyderabad 25-26 October 2013
92.	Dr. T.V. Shankar Dr. K. Ashok Kumar Dr. S.K. Panda	7th Meeting of ISO/TC 234 and associated Working group and advisory group meeting	Cochin 27-29 October 2013
93.	Dr. P. Pravin Dr. V.R. Madhu	Regional symposium on Ecosystem approaches to the management and conservation of fisheries and marine biodiversity in the Asia region	Cochin 27-30 October 2013
94.	Dr. M.M. Prasad Dr. Santhosh Alex	Half yearly meeting of Town Official Language Implementation Committee	Visakhapatnam 30 October
95.	Dr. Leela Edwin	Second meeting of the Expert committee for comprehensive review of deep sea fishing policy guidelines	CIBA, Chennai 31 October 2013
96.	Dr. A.R.S. Menon	Inter Media Publicity Coordination Committee Meeting	AIR, Thiruvananthapuram 1 November 2013
97.	Dr. V.R. Madhu	Project proposal meeting of Chief Conservator of Forests	Mumbai 6 November 2013
98.	Dr. P. Muhamed Ashraf	National workshop on Characterization of advanced materials	Mar Ivanios College, Thiruvananthapuram 6-8 November 2013
99.	Dr. Saly N. Thomas	Strategic workshop on Communication needs of marine fishermen	Chennai 9-10 November 2013
100.	Dr. Santhosh Alex	Hindi workshop	HPCL, Visakhapatnam 11 November 2013

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101.	Dr. Santhosh Alex	Hindi workshop	MPEDA, Visakhapatnam 11-12 November 2013
102.	Dr. Femeena Hassan	Group monitoring workshop	DST, Jaipur 12 November 2013
103.	Dr. Suseela Mathew	Final report presentation meeting of the project, 'Isolation and characterization of collagen and gelatin from aquatic sources and conversion of them in to pharmaceutical and food grade products'	DBT, New Delhi 12 November 2013
104.	Dr. C.N. Ravishankar Shri M. Nasser Dr. Niladri Sekhar Chatterjee Dr. K.K. Prajith Shri C.R. Gokulan Smt. P.K. Shyma	National workshop on Role of IPR in modern era -'Agrip 2013'	CIFT, Cochin 15-16 November 2013
105.	Dr. M.M. Prasad	Interactive session with aqua culturists of Andhra Pradesh	CIFE RC, Kakinada 16 November 2013
106.	Dr. M.M. Prasad	ICAR Interface meeting of line departments in agriculture, allied sectors, universities and ICAR institutes in Andhra Pradesh	Bapatla 17 November 2013
107.	Dr. Santhosh Alex	Hindi workshop	CIFNET, Visakhapatnam 19-20 December 2013
108.	Dr. Leela Edwin	Third meeting of the Expert committee for comprehensive review of deep sea fishing policy guidelines	ICAR, New Delhi 21 November 2013
109.	Dr. Leela Edwin Dr. M.M. Prasad	Consultative meeting of fisheries development in West Bengal: Research, extension and developmental support by the ICAR fisheries institutes	CIFE RC, Kolkatta 22 November 2013
110.	Dr. G. Rajeswari	National seminar on Recent trends in aquaculture for sustainable environment	St. Theresa's College, Eluru 22-23 November 2013
111.	Dr. Suseela Mathew	Seminar and workshop on Biological techniques	MA College, Kothamangalam 27 November 2013
112.	Dr. R. Raghu Prakash	3rd International fisheries symposium on Shaping fisheries and aquaculture today for a healthier tomorrow	Jomtien, Thailand 28-30 November 2013
113.	Dr. P. Muhamed Ashraf	6th India Nano International conference	Bangalore 4-6 December 2013

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114.	Dr. A. Jeyakumari Shri Jomey George	National seminar on Therapeutics of marine bioactive compounds	GRI, Gandhigram 9-10 December 2013
115.	Dr. M.M. Prasad	Workshop on Conservation of Olive Ridley turtle: Protection measures in east coast of Andhra Pradesh	Visakhapatnam 10 December 2013
116.	Dr. R. Raghu Prakash	International conference on Small scale fisheries governance development for well being and sustainability	CESS, Hyderabad 10-13 December 2013
117.	Shri V. Radhakrishnan Nair	14th ESRI India user Conference 2013 on GIS-Transforming our world	New Delhi 11-12 December 2013
118.	Shri K.K. Ajeesh Kumar	National seminar on New frontiers in molecular biology	MA College, Kothamangalam 12-13 December 2013
119.	Dr. S.K. Panda Shri Rahul Ravindran Shri M.M. Lijin Nambiar	National workshop on Seafood safety and trade	CUSAT, Cochin 17-19 December 2013
120.	Dr. Leela Edwin	Regional workshop on Fisheries management for member countries of Indian Ocean Rim Association for Regional Co-operation (IORARC)	Cochin 18 December 2013
121.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Smt. S. Remya Shri Nitin Singh Shri P. Vineeth Kumar Smt. K.B. Biji Smt. K.A. Anju Shri C.K. Kamalakanth Shri T.R. Ananthanarayanan Shri C.T. Nithin Kum. Nimisha V. Satheesh	7th International food convention	CFTRI, Mysore 18-21 December 2013
122.	Dr. Leela Edwin	Workshop on Draft science and technology policy, 2013, Govt. of Kerala	Cochin 19 December 2013
123.	Dr. G. Rajeswari Dr. B. Madhusudana Rao	Workshop on Biological science 'Bio-Essence'	Visakha Govt. Degree College for Women, Visakhapatnam 19 December 2013
124.	Dr. T.K. Srinivasa Gopal	Sectional committee meeting of FADC-BIS	New Delhi 23 December 2013
125.	Dr. T.K. Srinivasa Gopal	Shadow CODEX Committee meeting	FDA, New Delhi 24 December 2013
126.	Dr. C.N. Ravishankar	Workshop on technology valuation and pricing	ICAR, New Delhi 25-26 December 2013

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127.	Dr. A.R.S. Menon	Inter Media Publicity Coordination Committee Meeting	AIR, Thiruvananthapuram 3 January 2014
128.	Dr. J. Bindu	National symposium on Sustainable polymers	IIT, Guwahati 6-11 January 2014
129.	Dr. T.K. Srinivasa Gopal Dr. C.N. Ravishankar Shri Nitin Singh Shri K.K. Santhosh Shri P. Vineeth Kumar Shri V.C. Jijomon	19th India International Seafood Show-2014	Chennai 9-12 January 2014
130.	Dr. T.V. Sankar	Faculty improvement programme	Academic Staff College, University of Kerala, Thiruvananthapuram 16 January 2014
131.	Dr. T.K. Srinivasa Gopal	Annual conference of Vice Chancellors of Agricultural Universities and Directors of ICAR Institutes	Baramati, Maharashtra 18-20 January 2014
132.	Dr. Saly N. Thomas	Meeting of the committee set up for 'Implementation of fish net factory at Trivandrum'	Cochin 21 January 2014
133.	Dr. M.S. Kumar	'Technology Week Celebrations' of KVK, Amdalavalasa	Srikakulam 23 January 2014
134.	Dr. T.V. Sankar Dr. K. Ashok Kumar Dr. S.K. Panda	Meeting of the Scientific panel of Food Safety Standards Authority of India	CIFT, Cochin 23-24 January 2014
135.	Dr. M.M. Prasad	Mid term review meeting of ICAR Regional Committee No. II	CIFRI, Barrackpore 24 January 2014
136.	Dr. U. Sreedhar	Meeting of Andhra Pradesh State Disaster Response Force (APSDRF)	Visakhapatnam 29 January 2014
137.	Dr. Santhosh Alex	Hindi workshop	HPCL, Visakhapatnam 29 January 2014
138.	Dr. T.K. Srinivasa Gopal Dr. Nikita Gopal Shri P.J. Davis	XII plan meeting	ICAR, New Delhi 30 January 2014
139.	Dr. T.V. Sankar	43rd meeting of Institute Management Committee	CIBA, Chennai 31 January 2014
140.	Smt. P. Viji	Seminar held in connection with 'Fish Maha Festival'	Goa 31 January - 2 February 2014

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141.	Dr. T.K. Srinivasa Gopal	Lab Research Council Meeting	DFRL, Mysore 1 February 2014
142.	Dr. M.M. Prasad Kum. Jesmi Debbarma	Consultation workshop on Self-sufficient and sustainable aquaculture in north eastern region	Agarthala 5 February 2014
143.	Dr. George Ninan	National student conference on Food technology	IICPT, Thanjavur 7-8 February 2014
144.	Dr. A.R.S. Menon	Inter Media Publicity Coordination Committee Meeting	AIR, Thiruvananthapuram 7 February 2014
145.	Dr. Leela Edwin Dr. Saly N. Thomas Dr. P. Pravin Dr. M.P. Remesan Dr. P. Muhamed Ashraf Shri M.V. Baiju Dr. M. Baiju	Workshop on Technical measures as tools for fisheries management in the Indian scenario	CIFT, Cochin 12 February 2014
146.	Dr. George Ninan	Clinic on Agro Marine food processing	DIC, Alappuzha 13 February 2014
147.	Dr. M.S. Kumar	Interface Coordination Committee Meeting of industrial and ICAR institutes, SAUs and Veterinary Universities	SMILDA, Hyderabad 14 February 2014
148.	Smt. G. Remani Shri P. Suresh	Seminar on Optimize your lab performance	Cochin 18 February 2014
149.	Dr. T.K. Srinivasa Gopal	Technical programme discussion meeting for review of the research projects pertaining to TSC-4, NRFCC, BRANS	BARC, Mumbai 19 February 2014
150.	Dr. M.M. Prasad Dr. G. Rajeswari	Workshop on Fish conservation	Visakhapatnam 24 February 2014
151.	Dr. U. Sreedhar	Fourth INCOIS User Interaction Workshop 2014	Hyderabad 25 February 2014
152.	Shri C.G. Joshy	Workshop on Internet Protocol Version 6	New Delhi 27 February - 1 March 2014
153.	Smt. P. Viji	Industry day meet	CIFE, Mumbai 28 February 2014
154.	Dr. L.N. Murthy	Workshop on Post harvest fisheries and fish byproducts	SYNM College, Narsapur 1 March 2014
155.	Dr. M.M. Prasad	National conference on Mitigation and adaptation strategies in wetlands: A community leadership perspective	CIFRI, Barrackpore 1-2 March 2014

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156.	Dr. Saly N. Thomas	International conference on Advanced technology for ballast water and biofouling	Chennai 4-7 March 2014
157.	Dr. P. Pravin	Meeting to review the Action Taken report on the recommendations of the XXIII meeting of ICAR Regional Committee No. VIII	CTCRI, Thiruvananthapuram 7 March 2014
158.	Smt. P. Viji Kum. K.R. Remya Kumari	High pressure processing for food preservatives	CIFT, Cochin 7 March 2014
159.	Dr. C.N. Ravishankar	Annual review workshop of ITMU, ZTMC and Business Incubation centres	ICAR, New Delhi 6-8 March 2014
160.	Kum. P. Minu	INCOIS project review meeting	Andhra University, Visakhapatnam 7 March 2014
161.	Shri Saiph Mustafa Shri Eldho George	National workshop on Developing institutional repositories using DSpace	IISR, Calicut 12-13 March 2014
162.	Dr. Leela Edwin	Fourth meeting of Expert committee for comprehensive review of deep-sea fishing policy and guidelines	ICAR, New Delhi 13 March 2014
163.	Dr. T.K. Srinivasa Gopal Dr. R. Badonia Dr. C.N. Ravishankar Dr. G.K. Sivaraman Dr. A.A. Zynudheen Dr. L.N. Murthy Dr. A.K. Jha Dr. K.K. Prajith Smt. S. Remya Smt. V. Renuka	National conference on Emerging safety and technological issues in seafood industry	Veraval 14-15 March 2014
164.	Dr. Saly N. Thomas	Meeting of the Expert committee to study 'Farming of variety fishes in Kerala'	KUFOS, Cochin 15 March 2014
165.	Kum. P. Minu	INCOIS project review workshop	Andhra University Visakhapatnam 17 March 2014
166.	Dr. U. Sreedhar Dr. V.R. Madhu	Review committee meeting of INCOIS projects	INCOIS, Hyderabad 19 March 2014
167.	Dr. C.N. Ravishankar	Workshop on Challenges and opportunities in intellectual property management and commercialization of technologies in fisheries and agriculture sectors	NBFGR, Lucknow 20 March 2014
168.	Dr. J. Bindu	Terminal workshop of the Component-4 of NAIP projects	IARI, New Delhi 20 March 2014
169.	Dr. Niladri Sekhar Chatterjee	Research project proposal development workshop	NAARM, Hyderabad 20-22 March 2014

Sl. No.	Name(s) of Participant(s)	Symposia/Seminars/ Workshops etc. attended	Venue and Date
170.	Dr. S. Ashaletha	Workshop on Opportunities and challenges of women in agriculture of Kerala	College of Forestry, Thrissur 21-22 March 2014
171.	Dr. J. Bindu	Round table conference held in connection with 'Shellcon - 2014"	CMFRI, Cochin 23 March 2014
172.	Dr. Santhosh Alex	Hindi workshop	MPEDA, Visakhapatnam 24 March 2014
173.	Dr. M.M. Prasad	State level workshop on Fishers - Impact on their livelihoods	Visakhapatnam 27 March 2014
174.	Dr. A.A. Zynudheen Dr. C.O. Mohan Dr. V. Ronda Shri C.R. Gokulan Shri Nitin Singh	Made in Kerala - Conference and exposition on Opportunities in value added agriculture and food processing	Cochin 29 March 2014
175.	Dr. B. Madhusudana Rao	National workshop on Aquatic animal health and biodiversity	Andhra university, Visakhapatnam 29 March 2014

Special Days and Events

Workshops and Seminars

International Symposium on Greening Fisheries: His Excellency Shri Nikhil Kumar, Governor of Kerala inaugurated the International Symposium on Greening Fisheries and presented the SOFTI Biennial Award at Cochin on 22 May, 2013. The three days symposium was organized in connection with the Golden Jubilee Celebrations of Society of Fisheries Technologists India. The Honourable Governor also gave away the Biennial SOFTI award for the outstanding fisheries scientist of the country for the year 2011 to Dr. S.A.H. Abidi, former Member, ASRB, New Delhi. Dr. B. Meenakumari, DDG (Fisheries), ICAR, New Delhi was the Guest of Honour. Felicitations were offered by Dr. Ambekar E. Eknath, Director General, NACA and Shri A.J. Tharakan, Chairman, Amalgam Foods, Cochin. Dr. T.K. Srinivasa Gopal, Director, CIFT presided over the meeting.

Hon'ble Governor Shri Nikhil Kumar inaugurating the International Symposium. Also seen are Dr. A. Ramachandran, Dr. T.K. Srinivasa Gopal, Dr. S.A.H. Abidi and Dr. B. Meenakumari

Hon'ble Governor Shri Nikhil Kumar presenting the SOFTI award to Dr. S.A.H. Abidi. Also seen are Dr. Ambekar E. Eknath, Dr. A. Ramachandran, Dr. T.K. Srinivasa Gopal, Dr. B. Meenakumari and Shri A.J. Tharakan

Brainstorming Session on 'Sanitary and Phytosanitary (SPS) Measures in Fisheries': A one-day brainstorming session on 'Sanitary and Phytosanitary (SPS) Measures in Fisheries' was organized by National Academy of Agricultural Sciences, New Delhi on 27 June, 2013 at New Delhi. Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin was the Convener and Dr. J.K. Jena, Director, NBFGR, Lucknow and Dr. T.V. Sankar, Head, QAM Division, CIFT were the Co-Conveners. The Session was chaired by Dr. Anwar Alam, Secretary, NAAS and Former DDG (Engineering), ICAR and Dr. B. Meenakumari, DDG (Fisheries), ICAR was the Co-Chair. Twenty six invited participants from ICAR institutes, Universities, Department of Animal Husbandry, Dairying and Fisheries, EIC, MPEDA, NIPHATT and the seafood industry attended the Session.

In the Technical Session that followed, Dr. T.V. Sankar presented an overview of the SPS measures. Shri Vishnu Bhatt, Fisheries Development Commissioner, DAHD&F, Ministry of Agriculture presented the major challenges for India with respect to SPS issues in fisheries. Dr. A.G. Ponnaiah, Director, CIBA, Chennai spoke on the quarantine measures for import of live aquatic organisms stressing the need for capacity building on risk assessment and diagnostics and harmonization with international standards. Dr. S.K. Panda, Senior Scientist, CIFT presented SPS standards and cases of discrepancies in the regulations. Dr. K. Ashok Kumar, Principal Scientist, CIFT presented the industry perspectives of SPS measures while Dr. C.S. Shinekumar, Deputy Director, MPEDA, Cochin made a presentation on trade perspectives. The Technical Session was followed by a good discussion among the participants.

Brainstorming session in progress. Seen are: Dr. B. Meenakumari, Dr. Anwar Alam and Dr. T.K. Srinivasa Gopal

Hindi Workshop: A one day Hindi Workshop on "Computer application in Hindi" was conducted at the Visakhapatnam Research Centre of CIFT on 28 June, 2013 for the benefit of staff members. The Workshop was inaugurated by Dr. M.M Prasad, SIC of the Centre. Shri Y. Srinivas, Assistant Director (OL), Income Tax Department was the resource person.

Hindi workshop (L to R: Shri Y. Srinivas, Dr. M.M Prasad and Dr. Santhosh Alex)

Workshop cum Training on Survey of Traditional Fishing Methods and Documenting Practices: A Workshop cum training on "Survey of traditional fishing methods and documenting practices" was organized under the National Innovation Foundation funded project "Village knowledge register of Thoothoor fishing community and Establishing knowledge based enterprises by pooling best innovative and traditional knowledge practices" on 8 August, 2013 at CIFT, Cochin. CIFT and Innovation India, a non-profit organization are partnering institutions with National Innovation Foundation in which this project is carried out with help of Association of Deep Sea Going Artisanal Fishermen (ADSGAF).

The workshop was conducted to the benefit of seven trainees for getting first hand information on the documentation procedure for a better output while compiling data and to ensure the local representation of the technologies. The session started with training class on 'Community resource analysis through PRA' by Shri Allwin Thomas, Community Development Supervisor, Jalanidhi, Govt. of Kerala. Dr. J. Charles Jeeva, Senior Scientist, CIFT, Cochin delivered a lecture on the topic 'Tools and techniques for social survey and documentation'. A practical session for data collection was also organized

during the training. Dr. P. Pravin explained the questionnaire and cleared the doubts of trainees in the interactive session. After the session, a field visit to Thoppumpady harbour and Fort Cochin was also arranged.

Shri J. Vincent Jain, CEO giving remarks. On the dais are Dr. Leela Edwin and Dr. P. Pravin

Hindi Work Shop for Administrative Staff: A one day Hindi Workshop was conducted on 22 August, 2013 for the Administrative staff of the Visakhapatnam Research Centre of CIFT. Smt. A. Aruna, Hindi Pradhyapak, Hindi Teaching Scheme, Visakhapatnam was the Resource person for the workshop. She conducted classes on noting and drafting. She also spoke on the importance of Official Language policy by the Department of Official Language. The doubts of the participants were also cleared during the workshop.

Hindi workshop in progress

Hindi Workshop for Scientists and Technical Officers: Hindi Workshop was conducted for the benefit of Scientists and Technical Officers of the Visakhapatnam Research Centre on 12 December, 2013. Dr. Veerotama Patar, Asst. Director, Hindi Teaching Scheme, Visakhapatnam was the Resource Person for the workshop. She conducted classes on Official Language Policy and Sentence Construction. The staff members took part with great interest and their queries were answered.

International Workshop cum Training Programme on Fisheries Management: CIFT-FAO International Workshop cum Training Programme on "Technical measures as tools for Fisheries Management in the Indian Scenario" was organized at CIFT, Cochin on 12 February, 2014. The programme was organized under the project "Green Fishing Systems for Tropical Seas" funded by National Fund for Basic, Strategic and Frontier Application Research in Agriculture of ICAR. Seventy stakeholders including scientists, researchers, academicians, policy makers, fishers and international experts participated in the programme to make a roadmap for developing strategies for adoption of technical measures for effective management of marine fisheries in India. Chief Guest and Moderator, Dr. Y.S. Yadava, Director, Bay of Bengal Programme Inter-Governmental Organization (BOBP-IGO) inaugurated the workshop. Dr. Petri Suuronen, Fishery Industry Officer (Fishing Technology), FAO, Rome, the main resource person addressed the gathering and specified the need for combining fishing technology with governance. Dr. T.K. Srinivasa Gopal, Director, CIFT presided over the meeting. Dr. Leela Edwin, Convener and Principal Investigator of the project gave a brief of the workshop.

Dr. Y.S. Yadava inaugurating the Workshop

Participants with resource persons

A book on "Mechanized Marine Fishing Systems: India" authored by Leela Edwin, P. Pravin, V.R. Madhu, Saly N. Thomas, M.P. Ramesan, M.V. Baiju, Renju Ravi, P.H. Dhiju Das, M.R. Boopendranath and B. Meenakumari was released on the occasion. The technical session started with an introductory presentation by Dr. Y.S. Yadava. Dr. P. Pravin, Co-PI (GFSTS), Principal Scientist, CIFT delivered a talk on ''Responsible Fishing Interventions - Indian Scenario''. Dr. Petri Suuronen delivered talk on "LIFE (Low Impact Fuel Efficient) Fishing - Challenges and opportunities".

Food Safety Technology Seminar: CIFT, Cochin in collaboration with M/s Shimadzu Analytical (India) Ltd., Mumbai organized a 'Food Safety Technology Seminar" on 7 January, 2014. In the Seminar Dr. T.V. Sankar, HOD, QAM delivered a lecture on "Food risk challenges in developing countries" while Dr. K. Ashok Kumar, Principal Scientist delivered a lecture on "Challenges in food testing".

Dr. T.K. Srinivasa Gopal inaugurating the Workshop

Food Safety Management Certification Seminar: CIFT, Cochin in association with Bureau of Indian Standards organized one day Seminar on 'Food safety management system certification" at CIFT, Cochin on 28 March, 2014.

Trainings and awareness programme

Training-cum-Demonstration on Preservative Treatment of Low Cost Timber for Boat Building: A Training-cum-Demonstration Programme on 'Preservative treatment of low cost timber for boat building' was organized at CIFT, Cochin on 25 June, 2013. The main objective of the programme was creating awareness on the importance of using low cost timber for boat construction and demonstrating the newly installed Pilot Level Wood Preservation Facility for Boat Building for the benefit of fisheries extension officers from government sector and co-operative sector, local boat builders, fishermen, research scholars working in the field etc.

The inaugural remarks were given by Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin who presided over the meeting. Dr. T.K. Dhamodaran, Scientist F and Head, Department of Wood Science and Technology, Kerala Forest Research Institute, Peechi, offered felicitations. The Technical Session started with a talk by Dr. T.K. Dhamodaran on 'Upgradation of low cost timber'. Dr. Leela Edwin gave a talk on 'Use of low value timber for aquatic purposes'. The technology for upgradation of rubberwood for construction of canoes developed by CIFT was explained in the session. Types of preservatives used, method of treatment and exposure of treated rubber wood in different environmental conditions were discussed in detail. The results of the experiments showed that the treated rubber wood was ideal for canoe construction. One of the participants shared his successful experience in using the rubber wood canoe given by CIFT.

Dr. T.K. Srinivasa Gopal giving the inaugural remarks. On the dais are (L to R) Dr. P. Muhamed Ashraf, Dr. Leela Edwin and Dr. T.K. Dhamodaran, Scientist F, Kerala Forest Research Institute, Peechi

Participants being explained about the wood preservation methods

The practical session conducted in the afternoon started with a class lead by Smt. K.G. Sasikala, Tech. Officer, CIFT, on the 'Experiments undertaken on wood preservation by CIFT'. Chemical preservatives, different species of wood borers, and experimental aquarium were exhibited and explained in the Session. Technical staff and research scholars of the Division demonstrated the functioning of Pilot Level Wood Preservation Facility installed in the Division. Scantlings for boat building were treated with Chromated Copper Borate using Vacuum Pressure Impregnation Facility. The training programme concluded with the distribution of certificates to the participants.

Training Programme on Essentiality of Baseline Cleanliness: One day training programme on "Essentiality of baseline cleanliness for a fishery micro enterprise unit" was conducted for women microenterprise units *viz.*, Grihajyothi, Pavithram and Snehadeepam, in Chandiroor, Alappuzha on 15 July, 2013. The programme was organized as part of the DST project entitled "Food safety interventions for women in fish based microenterprises in coastal Kerala". Dr. Femeena Hassan, Senior Scientist and PI of the Project took a class on "Essentiality of baseline cleanliness for a fishery microenterprise unit". The Research Fellows of the Project gave a demonstration on how to clean food contact surfaces where the main works are carried out. The participants were informed about a cleaning schedule, water and chlorine treatment and about the uses of detergents, how the cleanliness of floor and food contact surfaces can be maintained and the necessity of doing these.

Project staff interacting with stakeholders

MoES-NOAA Training Workshop: Under the Ministry of Earth Sciences (MoES) – National Oceanic and Atmospheric Administration (NOAA), USA collaboration on research and development, a training workshop on "Algal blooms and fishery prediction system" was organized at CIFT, Cochin in association with CMLRE and NOAA, during 23-27 September, 2013. The CIFT being a leading agency under the National HAB programme of MoES, actively cooperated with CMLRE in conducting the workshop. NOAA-NMFS, INCOIS, CMFRI, and NIO are the other associated partners of the National HAB and Fishery Predictions Project of Ministry of Earth Science.

Dr. Vera L. Trainer, Programme Manager, Harmful Algal Blooms Programme, at the Northwest Fisheries Science Centre was the resource person. Dr. T.V. Sankar, Head, QAM Division and Dr. K. Ashok Kumar were the Faculty of the Workshop. Two research fellows Kum. R. Rajisha and Ms. Rose Mary Mathew from QAM Division participated in the Workshop. They also participated in the one-day FORV Sagar sampada cruise field trip on 24 September, 2013 organized for understanding the sampling protocols and Data/ sample analysis including practical sessions on data analysis. A hands-on training on toxin detection was conducted on 24 September, 2013 at the QAM Division of CIFT. Dr. Vera L. Trainer (NOAA), Dr. Bill Peterson (NOAA), Dr. T.V. Sankar and Dr. K. Ashok Kumar headed the training session.

Participants of the HAB Group with Dr. Vera L. Trainer

International Training Conducted: An international training was organized under TCS Colombo Plan

Ms Samila with the faculty of the training programme

Training on 'ISO 22000 and HACCP for seafood industry' during 4-18 November, 2013 for Ms Samila Sulani Abeysinghe, Development Officer, Department of Fisheries and Aquatic Resources, Colombo, Sri Lanka.

Another international training programme on "Fisheries by products, prawn shell powder, chitin, chitosan and glucosamine hydrocloride' under TCS Colombo Plan was conducted during 2-28 December, 2013. Ms Mar Lar Soe, Assistant Fishery Officer and ms New Ni Aung, Deputy Assistant Fishery Officer, Yangon, Republic of Myanmar were the beneficiaries.

Trainees with the faculty of the programme

Short Course on Marketing Research for Value Chain in Fisheries: An ICAR Short Course on "Marketing Research for Value Chain in Fisheries", was organized by CIFT, Cochin during 1-10 October, 2013. Dr. Nikita Gopal, Senior Scientist, EIS Division was the Course Director and Dr. S. Balasubramaniam, Head, EIS Division was the Co-Director. The Course had both theory and hands on sessions. Lectures covered the basic concepts of marketing research and value chain, gave an exposure to export and domestic marketing scenario and research in the area, introduced the concept of supply chain management, had theoretical and practical statistical applications relevant to marketing research and presented business models in fisheries etc. Field visits to fisheries related Institutes in Cochin like MPEDA, NIFPHATT and CMFRI; and seafood factory and fish landing centres were organized. Participants were exposed to quantitative tools using SPSS and SAS software. On the last day, participants made brief presentations on topics of their interest related to marketing research.

The course was inaugurated by Shri N. Ramesh, ITS, Director (Marketing), Marine Products Export Development Authority, Cochin on 1 October, 2013 and the Guest of Honour was Dr. R. Narayanakumar, Head, Socio-Economic Evaluation and Technology Transfer Division, CMFRI, Cochin. Dr. T.K. Srinivasa Gopal, Director, CIFT presided over the valedictory function and handed over the certificates to the participants. Twenty five participants from different parts of the country had participated in the Course.

National Training on Non-thermal and Non Chemical Processing Technology: CIFT, Cochin conducted a National Training on "Non-thermal and Non Chemical Processing Technologies: Application of High Pressure and Pulsed Light Technology for Food Processing" during 18-31 October, 2013. The programme was inaugurated by Dr. S. Girija, Director, NIFPHATT, Cochin. The function was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT and Dr. Mukund V. Karwe, Professor and Chair, Rutgers University, USA was the Guest of Honour. Dr. Karwe released the training manual. Dr. J. Bindu, Senior Scientist was the Corse Director.

The list of external faculty included Dr. Mukund V. Karwe, Professor and Chair, Rutgers University, USA, Dr. P.S. Rao, Associate Professor, IIT, Kharagpur, Dr. Ashish Kumar Singh, Senior Scientist, NDRI, Karnal,

Inauguration of the ICAR Short Course by Shri N. Ramesh, ITS, Director (Marketing), MPEDA, Cochin

Dr. S. Girija, Director, NIFPHAAT, Cochin inaugurating the training programme

Participants and faculty

Participants of the training with faculty

Dr. K.P. Sudheer, Associate Professor, KCAET, Tavanur and Dr. Navin Rastogii, Principal Scientist, CFTRI, Mysore. In the hands on training, microbial inactivation kinetics and practical demonstration of high pressure processing of fish, yogurt, fruits etc. and pulsed light was undertaken. Apart from this, field visits to fish processing plants and landing centres were also organized. On completion of the classes CIFT laboratories were visited by the trainees. The events concluded on the 31 October, 2013 with a formal valedictory function in which evaluation and feedback from participants were sought followed by distribution of certificates to trainees.

Training on Data Analysis Using SAS: At CIFT, Cochin a training on 'Data analysis using SAS' was organized under the NAIP on 'Strengthening statistical computing for NARS' during 1-7 February, 2014. The inaugural function of the training programme was held on 1 February, 2014. Dr. V. Geethalakshmi, Principal Scientist and Course Director of the training welcomed the participants and Dr. Gopinath Rao, Professor, Department of Agricultural Statistics, UAS, Bangalore ad Zonal Coordinator of the NAIP project gave a brief introduction on the project. Dr. Leela Edwin, HOD, FT and Director I/c, CIFT presided over the function. There were a total of 23 registered participants for the training programme who were scientists, teachers and academicians from varied fields of research in agriculture, veterinary and fishery sciences in ICAR institutes and agricultural universities.

The various topics covered were basic statistical tools, SAS data sets, logistic regression, multivariate statistical analysis, design and analysis of experiments, time series analysis, SAS genomics, SAS for genetics and breeding experiments, conjoint analysis using SAS, response surface models using SAS, SAS Enterprise Guide, SAS for statistical modelling and SAS for quantitative fishery science. The training sessions were handled by experts in the field of agricultural statistics from various ICAR institutes. The valedictory function of the training was held on 7 February, 2014. Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin presided over the function and handed over the certificates to the participants. The training report was read by Dr. Gopinath.

National Workshop cum Training on High Pressure Processing for Food Preservation: A National Workshop cum Training on "High pressure processing for food preservation" was organized on 7 March, 2014 at CIFT, Cochin. Dr. J. Bindu, Senior Scientist and CPI of the project welcomed the gathering and gave an introduction to the Workshop. Dr. T.K. Srinivasa Gopal, Director, CIFT inaugurated the Workshop Dr. P. Srinivasa Rao, Associate Professor and Consortium Partner of the project, IIT Kharagpur also spoke on

Dr. Gopinath Rao inaugurating the programme

Dr. T.K. Srinivasa Gopal inaugurating the programme

Demonstration in progress

Trainees from Tamil Nadu along with Director, CIFNET and faculty from CIFT and CIFNET

the occasion.

Various technical sessions related to this emerging technology were handled by national experts. Dr. J. Bindu, in the first lecture introduced the topic to the trainees and presented the activities undertaken in the project with respect to seafoods. Dr. P. Srinivasa Rao spoke on High pressure processing of perishable fruits and on the engineering aspects of the process. The effect of high pressure on biological systems was handled by Dr. Venkateswarlu Ronda, Scientist, CIFT and Dr. S.K. Panda, Senior Scientist, CIFT spoke on the effect of high pressure on microorganisms. Dr. K.K. Asha, Senior Scientist, CIFT and Associate of the project spoke on the biochemical aspects of high pressure. In the afternoon session the working principle of high pressure processing machine was explained and practical demonstration of the processing of seafoods was done. In the concluding session certificates were distributed by Dr. Srinivasa Gopal to the participants. The feedback from the participants about the training was positive and they mentioned that the programme was really beneficial to them in understanding a new emerging non thermal technology. Dr. K.K. Asha proposed vote of thanks.

National Trainers' Training Programme on Monofilament Long Lining: Recognizing the importance of the emerging oceanic Tuna fisheries in Indian economy, CIFT, Cochin and CIFNET, Cochin jointly organized a National Trainers' Training Programme on Monofilament Long Lining for ten stakeholders sponsored by the Department of Fisheries, Tamil Nadu, Govt. of Tamil Nadu during 24-28 March, 2014. The training programme was inaugurated by Shri R.C. Sinha, Director, CIFNET, Cochin on 24 March, 2014 and the function was presided by Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin.

The programme was attended by nine fishermen from Tamil Nadu and an official from the State Fisheries Department, Tamil Nadu. A fishing voyage on monofilament long lining was also organized for three days on board CIFNET training vessel M.V. Prashikshani. Fishing operations on were carried out at 09° 52.7 'N 075° 25.425'E in depth of 1700 m. The participants were familiarized with handling, shooting and hauling of the monofilament long lines. A total of 270 hooks were operated.

Theory classes on Sea safety, Seamanship and Navigation was held at CIFNET Cochin, The Valedictory function was held at CIFNET on 28 March, 2014. Dr. Jomon Joseph, Chief Instructor & Head, Fishing Technology Division, CIFNET, Cochin welcomed the gathering. Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin was chief guest of the function and he distributed the certificates to the trainees. Shri R.C. Sinha, Director, CIFNET, Cochin also addressed the gathering. Trainee representative gave the feedback of the training programme and requested for arranging marketing links for export of sashimi grade Tuna. Shri M.V. Baiju, Senior Scientist & Naval Architect, CIFT Cochin proposed the vote of thanks.

Technology transfer programmes in NEH Region

North-East regional Workshop on Technology Transfer Programmes in NEH States: A Regional Workshop on 'Technology Transfer Programmes in NEH States' was organized by CIFT, Cochin at National Research Centre on Pig (NRCP), Rani, Guwahati on 10 July, 2013. The Workshop was organized to facilitate face-to-face interaction between researchers, policy makers, Fisheries Department Officials and

Inagural session in progress

Inauguration of the training

Interactive session in progress

Participants with faculty

stakeholders in fisheries so as to plan technology transfer programmes for the year 2012-14 in NEH states. The Workshop also facilitated the understanding of the technological needs in harvest and post harvest fisheries from stakeholders using various aquatic resources that includes beels, lakes, rivers and reservoirs in all NEH states, and on the researchable issues in fisheries technology. Dr. S.V. Ngachan, Director, ICAR Research Complex for NEH Region, Umiam, Meghalaya inaugurated the Workshop. Dr. Dilip Kumar Sarma, Director, NRCP, Guwahati and Shri Mukesh Sandesh Sahoo, IAS, Principal Secretary, Bodoland Territorial Council offered felicitations on the occasion. In the technical session, HODs from CIFT made presentations and answered the technical queries of the stakeholders. About 80 officials and stakeholders representing State Departments of Fisheries, KVKs, NGOs, Bodoland Territorial Council, and fishermen/ fisherwomen associations from Assam, Manipur, Arunachal Pradesh, Tripura and Nagaland participated in the programme with very good interaction and feedback in technical sessions.

Technology Transfer Programmes at Kokrajhar, Assam: CIFT, Cochin organized two training programmes on Fabrication of improved fishing nets and responsible fishing and Preparation of value added fish products at Bodoland Territorial Council, Kokrajhar, Assam during 26-28 August, 2013. On 26 August, 2013, the training was inaugurated by Hon'ble Chief Sjt. Hagrama Mohilary which was attended by 150 fish farmers/fishermen. A training on Fabrication of improved fishing nets and responsible fishing was conducted for two days on 27 and 28 August, 2013. A training on Post harvest handling, processing, value addition and packaging was conducted during 29-31 August, 2013 at Kokrajhar.

Capacity Building Programme for ATMA Women Farmers: A one day capacity building programme on "Entrepreneurship development based on fish value addition" was conducted on 21 November, 2013 by

Participants and faculty

NAIP value chain sub project on "Responsible harvesting and utilization of selected small pelagics and freshwater fishes" in association with Krishi Bhavan, Department of Agriculture, Govt. of Kerala at CIFT, Cochin for a group of women farmers of ATMA from Thrikkakkara Grama Panchayath. The main objective of this training was to open the entrepreneurial opportunities for women farmers through the production and marketing of fish based value added products from small pelagics and freshwater fishes. Twenty one women farmers attended the training programme. The theory session was followed by a practical session. Product demonstration and training was imparted by Senior Research Fellows of the Project. The participants were trained on production of certain selected fish based value added products and an introduction to business planning in this sector was also given.

Farmers Training on Culture, Processing and Value Added Products of Trout: A farmers training on "Culture, processing and value added products of trout" was jointly organized by the DCFR, Bhimtal, CIFT, Cochin and KVK, Bajoura, Kullu, at the KVK, Kullu during 11-13 December, 2013. Dr. A. Barat, Director, DCFR inaugurated the programme. Dr. C.N. Ravishankar, Head, FP Division and Dr. Chandrakantha, KVK In Charge offered felicitations. Dr. J. Bindu, Senior Scientist, Dr. C.O. Mohan, Scientist, Shri V.T. Sadanandan and Shri N. Sunil, Tech. Assts. demonstrated the various processing activities. Forty trout farmers of Himachal Pradesh participated in the training.

Training was mainly imparted on practical aspects which included hygienic handling of trout, filleting (double skin and skinless), preparation of steaks and different types of cuts. Value added products demonstrated included battered and breaded products like balls, fingers and cutlets using mince of trout, condiment incorporated steaks and trout pickle. The use of pouches and thermoformed trays for packaging different value added fish products and trout pickle were taught to the trainees. Also demonstrated method of preparation of trout silage and feed using trout silage. Procedure for smoked trout in oil in TFS cans was explained in detail since the participants highly appreciated the smoked trout products.

Faculty of DCFR, CIFT and KVK

Tribal Sub Plan Programmes

Training Programme under TSP held at Fraserganj, West Bengal: CIFT, Cochin organized one day training programme on "Responsible fishing" for the benefit of the members of Fraserganj Tribal Fishermen Cooperative Society, West Bengal on 19 September, 2013 under the Tribal Sub Plan (TSP) programme. Smt. Samuli Das, Fraserganj Panchayat Pradhan inaugurated the programme which was presided over by Shri Sabapathi Sahadev Mondal, President, Fraserganj Tribal Fishermen Cooperative Society. Dr. M.P. Remesan, Principal Scientist, CIFT, Cochin gave the Key Note address. Felicitations were offered by Shri L.Z. Padani, Member, Fraserganj Panchayat, Shri Vidut Giri and Shri Arunab Mitra, Technical Officers, CIFRI, Kolkata. About 60 men and women participated in the programme.

The concept and need for responsible fishing in the light of Code of Conduct on Responsible Fishing (CCRF) was discussed with particular reference to Hilsa fishing and related issues. The existing non-selective fishing gears and indiscriminate fishing methods prevalent in the traditional Hilsa fishing grounds in India and the nature of fish landings, quantity of discards and the consequences on the fishery resources were highlighted in the presentations made by Dr. M.P. Remesan. The importance of selective fishing gears like gillnet and fabrication and rigging of simple gillnet with recommended mesh size for Hilsa and other fishes in

Participants and resource persons of the training programme

the region was presented by Dr. V.R. Madhu, Senior Scientist, CIFT, Cochin. Fabrication and rigging of selective surface drift gillnet (*Chandi jaal*) with large mesh for Hilsa was demonstrated to the fishermen during the practical session. Shri H.V. Pungera, Technical Officer, Veraval RC of CIFT conducted the practical session. CIFT has already initiated steps for procuring about 1000 kg gillnets with mesh size ranging from 100 mm to 280 mm and other accessories for distribution among the tribal fishermen at Fraserganj and Bali island.

Tribal Sub Plan Programmes at Ranchi, Jharkhand

A Training-cum-Demonstration Programme for the benefit of Scheduled Tribe Fisher Folk for three days under Tribal Sub Plan programme was conducted by, Visakhapatnam Research Centre of CIFT at Ranchi, Jharkhand during 16-18 December, 2013. One hundred and thirty tribal fishers associated with different Cooperative Societies have participated and were benefited by the programme. Training was organized at training Hall, Director Fisheries Office, Ranchi and demonstrations on fishing gears were conducted at Hatia Reservoir, Ranchi and Chandil Reservoir, Saraikela district. Chandil Reservoir is the biggest reservoir in Jharkhand with a catchment area of 18,900 hectares. Cage culture of fast growing fish like *Pangasius sutchi* is being actively followed in the reservoir with the help State Fisheries Department.

On 16 December, 2013 the training programme was inaugurated by Shri Rajiv Kumar, Director Fisheries, Ranchi and Dr. M.M. Prasad, Principal Scientist and SIC of the Centre explained about the purpose of the training programme in his presidential address. After the inaugural session Dr. Prasad explained to the trainees regarding the importance of fish in nutritional security followed by the technical sessions on 'The latest trends in harvest technologies for inland waters' by Dr. U. Sreedhar, Senior Scientist and 'Utilization of inland fishery resources for value addition' by Dr. L.N. Murthy, Senior Scientist. In the afternoon session, practical demonstrations were held on use of foldable fish traps, employment of eco-friendly fishing gears *viz*., BRDs, TED etc. by Dr. Sreedhar. Various technologies developed by CIFT were also showcased in the programme. Foldable fish traps and other inputs were handed over to fishers on gratis. Interactive sessions were held simultaneo-

Shri Mannan Mallick, Hon'ble Minister of Animal Husbandry and Fishery, Jharkhand visiting the venue

usly while TCDs was in progress. Shri Aditya Swaroop, IAS, Principal Secretary Animal Husbandry & Fisheries, Government of Jharkhand visited the training centre and appreciated the efforts made by CIFT in TSP front. He also emphasized to make maximum use of the technologies developed at CIFT for the development of fisheries in Jharkhand and visited the stall in which technologies developed at CIFT were exhibited.

Shri Mannan Mallick, Hon'ble Minister of Animal Husbandry and Fishery, Govt. of Jharkhand visited the venue and he urged the youth to engage in fishing activities to earn livelihood. Technical demonstrations on hygienic handling of fish and preparation of value added fish products were conducted by Dr. Murthy with the assistance of Shri M. Prasanna Kumar, Tech. Asst., CIFT. Value added product preparation included fish pickle, minced meat preparation using meat mincers, fish pakoda, fish cutlet, fish fingers and fish wafers.

Field demonstrations on different harvest technologies were conducted in Hatia Reservoir, Ranchi. In the afternoon beneficiary feedback was collected and they expressed that training gave them an opportunity to learn many new things related to fisheries. Visit was also made to Chandil Reservoir in order to explore the potential for fisheries harvest and post harvest interventions in future.

Tribal Sub Plan Programme at Vengalaraya Sagar, Andhra Pradesh: Training-cum-Demonstration Programme for the benefit of Scheduled Tribe Fisher Folk for three days under Tribal Sub Plan programme was conducted by CIFT, Cochin at Vengalaraya Sagar, Salur Mandal, Vizianagaram dist., Andhra Pradesh

Resource persons from CIFT with officials of the Department of Fisheries

Demonstration of use of coracle

during 21-23 November, 2013. The tribal fishers affiliated to the Girijana Swadeshi Matsya Parisramika Cooperative Society, China Cheepuravalasa, Salur (Mandal), Vizianagaram participated in the training-cum-demonstration programme. Girijana Swadeshi Matsya Parisramika Cooperative Society has 270 tribal fishers as members in the Society from 13 villages. These tribal fishers fish in the Vengalaraya Sagar reservoir.

The programme included Demonstration of fishing gear and traps, Demonstration of coracles in the Vengalaraya Sagar reservoir, Training on value added product preparation *viz.*, fish pickle, fish pakoda, fish cutlet, fish fingers, fish wafers, minced meat preparation using meat mincers and Training on Hygienic handling of fish for the benefit of 145 tribal fishers.

Training Programmes for ST Fisherfolk at Frasergunj West Bengal: CIFT, Cochin has organized a training cum demonstration programme on "Improved fishing nets and responsible fishing techniques" at Frasergunj, West Bengal for the benefit of the members of Frasergaunj Tribal Fishermen Cooperative Society on 18 December, 2013. The inaugural function was presided over by Shri Sahadeb Mondal, President, Frasergunj Tribal Fishermen Association. Dr. S. Balasubramaniam, HOD, EIS, CIFT welcomed the participants and explained about the tribal plan programmes for the benefit of fisherfolk organized by CIFT under the TSP. The Frasergunj Panchayat Pradhan Smt. Samuli Das inaugurated the programme and the Officer-in-charge, Coastal Police, Frasergunj delivered the keynote address. Dr. V.R. Madhu, Senior Scientist, Fishing Technology Division, CIFT and Shri H.V. Pungera, Technical Officer, Veraval Research Centre of CIFT conducted the demonstration on 'Improved fishing nets' fabrication and rigging'. The code of conduct on responsible fishing has been narrated with particular reference to Hilsa fishing. The importance of selective fishing gears like gillnet and fabrication and rigging of simple gillnets were explained. About 55 participants (men and women) participated in the programme. During the programme, fishing net materials such as nylon monofilament nets (110 mm, 120 mm, 150 mm mesh sizes) and nylon monofilament nets (180 mm and 200 mm) and PP ropes of 8 mm and 10 mm were distributed among the participants. Each fishermen received materials of about 4 kg nets and 2 kg ropes during the programme. Data on the socio-economic conditions of tribal fisherfolk were collected from the participants.

Participants and faculty

The second training-cum-net distribution programme was conducted at Ramkrishna Ashram Krishi Vigyan Kendra (RAKVK), Nimpith, South 24 Parganas dist., West Bengal on 19 December, 2013. A total of 50 participants attended the training on "Improved fishing nets and responsible fishing techniques". Dr. Nilenderjyoti Maitra, Programme Coordinator, RAKVK, Nimpith presided over the

Participants and faculty of the programme

Handing over of FRP coracles to the tribal fisher-folk

inaugural. Dr. S. Balasubramaniam, HOD, EIS, CIFT delivered the key note address, and explained about the extension methodologies used for promoting technology adoption and about the tribal plan programmes for the benefit of fisherfolk organized by CIFT under the TSP. Dr. V.R. Madhu, Senior Scientist, Fishing Technology Division, CIFT presented a power point presentation on 'Improved fishing nets and responsible fishing techniques'. Shri H.V. Pungera, Technical Officer, Veraval Research Centre of CIFT conducted the demonstration on 'Improved fishing nets fabrication and rigging'. During the programme, fishing net materials such as nylon monofilament nets (110 mm, 120 mm, 150 mm mesh sizes) and nylon monofilament nets (180 mm and 200 mm) and PP ropes of 8 mm and 10 mm were distributed among the participants. Each fishermen received materials of about 4 kg nets and 2 kg ropes during the programme. Further, data on the socio-economic conditions of tribal fisherfolk were also collected from the participants.

Tribal Sub Plan Programmes at Venkatapuram, Andhra Pradesh: A Tribal Sub Plan Programme was organized by Visakhapatnam Research Centre of CIFT at Venkatapuram, a remote fishing hamlet adjoining Tandava Reservoir, Visakhapatnam district on 18 February, 2014.

During the Tribal sub plan programme, FRP coracles, foldable fish traps and gillnets were distributed to selected beneficiaries. Dr. M.M. Prasad, Principal Scientist & SIC of the Centre addressed the gathering regarding the activities of CIFT for welfare of fishers and the purpose of the tribal sub plan programmes implemented by Government of India. Dr. G. Rajeswari, Principal Scientist and Dr. R. Raghu Prakash, Senior Scientist explained about the FRP coracles and foldable fish traps in reservoir fisheries and they urged the fishermen for proper use of the given resources. Smt. Arathy Ashok, Scientist collected data from the fishermen regarding their socio-economic condition. Shri John Prabhu Dasu, Assistant Director, Department of Fisheries, Narasipatnam and Smt. Nirmala Kumari, FDO, State Fisheries Department were also present during the programme. After the programme demonstrations were conducted in the reservoir on the use of FRP coracles. Fishermen were very comfortable in using the FRP coracles. Finally Shri Prabu Dasu proposed vote of thanks.

Field visit into the reservoir revealed that there is vast potential for development of cage culture as is practiced in Chandil of Jharkhand. Implementation of Chandil kind cage culture can make significant difference in the lives of fishers in this region.

Tribal Sub Plan Programme at Shahapur, Thane district, Maharashtra: As a part of implementation of Tribal Sub Plan (TSP) of CIFT for the betterment of tribal communities in Maharashtra state, a programme was organized at Shahapur, an inland fishing village in Thane district on 21 February, 2014. The four tribal fishermen societies selected are Kothare Fishermen Co-operative Society (213 members), Shirvanje Fishermen Co-operative Society (39 members), Vasai Fishermen Co-operative Society (79 members) and Usgaon Fishermen Co-operative Society (109 members).

The programme started with the welcome speech by Dr. S. Visnuvinayagam, Scientist & SIC, MRC of CIFT. Dr. S. Balasubramaniam, HOD, EIS Division & Nodal Officer (TSP), CIFT, Cochin detailed the various technology transfer programmes undertaken by CIFT under the TSP component in his presidential address.

Dr. S. Balasubramaniam addressing the fisherfolk

Dr. S. Visnuvinayagam handing over of fishing gear materials

Shri Anil Kumar, Administrative Officer, CIFT, Cochin explained the purpose of TSP activities of Govt. of India and its benefits. During the programme, monofilament and multifilament nylon gillnets of different mesh sizes and dimensions, nylon twine, ropes, floats, sinkers and weighing balances were distributed to selected beneficiaries. Shri Vaydha, Assistant Commissioner of Fisheries, Department of Fisheries, Maharashtra also addressed the gathering and he urged the fishermen for proper and effective use of the resources.

After the inaugural programme, Shri Arvind S. Kalangutkar, Tech. Officer, CIFT, Cochin gave a training on mending of the gillnets. Smt. P. Viji, Scientist detailed the different value added products that could be prepared from the fishes harvested from the reservoir. However, the fishermen raised concern about the marketing of value added products like cutlets, balls, burgers etc. as they have to travel long distances to sell out the products. The products like dried fish, masala dried fish, pickle etc. were found suitable for the convenience of marketing and training on the preparation of such products were offered as per their interest.

Tribal Sub Plan Programmes at Jagadalpur, Chattisgarh: Visakhapatnam Research Centre of CIFT conducted a three day Training cum Demonstration Programme under Tribal Sub Plan, Government of India at Jagadalpur in Chattisgarh during 4-6 March 2014. During the programme, training cum demonstration sessions were conducted on use of coracles, foldable fish traps, gillnets and preparation of value added products from fishes. Fifty tribal beneficiaries belonging to different Cooperative Societies attended the programme. Beneficiaries included members of two Fishermen Cooperative Societies associated with fishing in Kosateda reservoir in Bastar district, Chattisgarh and members of tribal Women Cooperative Society 'Pradhamic Aadivasi Machvaar Mahila Sahakari Samiti Maryadit Kurandi'. The programme was arranged in collaboration with the Department of Fisheries, Government of Chattisgarh.

The programme was conducted at Balenga Fish Farm, Jagadalpur. Training on harvest technology included lectures on responsible and selective fishing practices for reservoir and inland water bodies. Practical demonstrations were given on operation of gillnets, foldable fish traps and coracles. Many of the technologies were new for the tribal fisherfolks and they have expressed high satisfaction during the feedback session. The State Department officials Shri Nag (Deputy Director Fisheries, Raipur) and Shri Sanjay Padhi (Assistant Fisheries Officer, Jagadalpur) showed their interest in future collaboration with CIFT in conducting different programmes for the welfare of tribal fisherfolk in Chattisgarh.

Distribution of assets to beneficaries

Tribal Sub Plan programmes at Jeenabadu and Konam Villages of Visakhapatnam district, Andhra Pradesh: As part of the Tribal Sub Plan training programme, FRP coracles were distributed to

scheduled tribe fishermen. The schedule tribe fisher villages were identified with the help of State Fisheries Department, Andhra Pradesh. Dr. M.M. Prasad, SIC, Dr. R. Raghu Prakash and Dr. B. Madhusudana Rao, Senior Scientists, Visakhapatnam Research Centre of CIFT conducted the programme. Shri Prabhu Das, Assistant Director, State Fisheries Department, Andhra Pradesh coordinated the programme.

At Jeenabadu Fishing Village, Raiwada Reservoir, Visakhapatnam district, Andhra Pradesh: Two FRP coracles were distributed to the fishermen society of Jeenabadu fishing village. All the members of the society were tribal fishers whose livelihood depended entirely on the Raiwada Reservoir. Training cum demonstration programme was conducted on 13 March, 2014 wherein the fishermen of the Society were trained in using the coracles in the Raiwada Reservoir and the fishers ventured into the reservoir using the coracles. The fishermen were satisfied with the performance of the FRP coracles. Earlier the fishermen were using bamboo traps for catching prawns. The advantages of foldable traps developed by CIFT when compared to bamboo traps (mainly durability and ability to carry more traps by single fishermen) was explained to the fishers. Foldable traps would be given to the fishermen for user trials. The role of hygienic handling and value added products for income was emphasized during the post harvest session.

Resource persons with ST fishers at Jeenabadu village, Rewada Reservoir

At Konam Village, Sri Vechalapu Palavelli Reservoir, Visakhapatnam district, Andhra Pradesh: Two FRP coracles were distributed to the fishermen of Konam village. The fishermen catch fish from the Sri Vechalapu Palavelli Reservoir. A programme was conducted on 13 March, 2014 to demonstrate the use of coracles. The fishermen actively participated in the programme and had ventured in to the reservoir using the coracles. The fishermen were satisfied with the performance of the FRP coracles. The fishermen of this reservoir area were not using traps. The fishermen expressed their desire for more FRP coracles and FRP boats. Forty three fishermen participated in the programme.

Resource persons with ST fishers at Konam village, Sri Vechalapu Palavelli Reservoir

Tribal Sub Plan Programme at Meenkara, Palakkad: In collaboration with Meenkara SC/ST Reservoir Fishermen Cooperative Society, technology transfer programmes were conducted during 27-29 March, 2014. The inaugural programme was presided by Shri C. Kunju, President, SC/ST Reservoir Fishermen Cooperative Society, Meenkara. The programme was inaugurated by Dr. S. Balasubramaniam, HOD, EIS, CIFT, Cochin and Nodal Officer, TSP. Shri S. Mahesh, Deputy Director, Department of Fisheries, Malampuzha delivered the Key Note address. Dr. M.P. Remesan, Principal Scientist, CIFT, Cochin, Shri Saji M. Rajesh, ADF, Malampuzha, Shri P.S. Shenoob, Ex-Officio Secretary & SI (Fisheries), Meenkara SC/ST

Training on 'Value added fishery products'

Cooperative Society and Shri K. Kanakadas, Ex-President, SC/ST Cooperative Society were the dignitaries who addressed the participants during the function.

The training on 'Responsible fishing methods' was conducted on 27 March, 2014 by Dr. M.P. Remesan and Shri Aravind S. Kalangutkar, Tech. Officer, CIFT, Cochin. Forty trainees attended the training. Besides the training, 125 kg fishing net materials were provided to the participants so as to improve their daily fish catch, and income under TSP component. The training on 'Hygienic fish handling and value added fishery products' was organized during 28-29 March, 2014. Dr. J. Bindu, Senior Scientist, Dr. A. Jeyakumari, Scientist, Shri K. Dinesh Prabhu and Shri V.T. Sadanandan, Jr. Lab Assts., CIFT, Cochin conducted the training for the 40 trainees. During the training, the preparation of fish pickles, fish fingers, fish balls, fish cutlets, prawn chutney powder and dried fish was explained and demonstrated to the participants.

Celebrations

Grand Finale of Golden Jubilee Celebrations of SOFTI: Dr. V. Prakash, distinguished CSIR Scientist and Shanthi Swarup Bhatnagar Award winner delivered the Golden Jubilee Lecture at the Grand Finale function of the Golden Jubilee celebrations of Society of Fisheries Technologists India (SOFTI) on 21 May, 2013.

The SOFTI Golden Jubilee celebrations ended with the International Symposium on "Greening fisheries – Towards green technologies in fisheries". Dr. T.K. Srinivasa Gopal, Director, CIFT presided over the function. Felicitations were offered by Dr. S.K. Tripathi, former Director, CIFE, Mumbai, Dr. G. Syda Rao, Director, CMFRI, Cochin and Shri Nobert Karikkassery, President, SEAI, Cochin. The past executive committee members of SOFTI were honoured during the function. Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR inaugurated the exhibition held in connection with the Symposium.

Foundation Day Celebrations: The Institute celebrated its 56th Foundation Day on 29 April, 2013. The day was also celebrated as Agricultural Education Day. To commemorate the day, the Institute organized an "Open House" in the forenoon. The Institute remained open for the public to get acquainted with the activities and achievements of the Premier Institute. The expert scientists and technicians of the organization facilitated the visit of large number of students from the Kendriya Vidyalaya in an around Cochin.

Students being explained in 'Open House'

Shri Hibi Eden, MLA, Ernakulam Constituency was the Chief Guest of the Foundation Day Celebrations. Dr. Krishna Rao, retired Principal Scientist, Shri N.S. Prabhu and Smt. Annamma Vargheese, retired Asst. Administrative Officers of CIFT were honoured during the function. Dr. Krishna Rao and Smt. Annamma Varghese offered felicitations Cash Awards to meritorious wards of CIFT employees were also be distributed during the function. The meeting was presided over by Dr. P.T. Lakshmanan, Head,

Dr. V. Prakash delivering the Golden Jubilee lecture

Shri Hibi Eden delivering the inaugural address

Biochemistry & Nutrition Division & Director Incharge, CIFT. The function was followed by a variety entertainment programme.

'Onam': 'Onam' – the national festival of Kerala was celebrated at CIFT, Cochin on 11 September, 2013 with pomp and gaiety. Traditional floral carpet competition was held in the morning followed by traditional 'Sadya'. Capt. R.S. Sunder, Director, Operations, Cochin Shipyard Ltd. was the Chief Guest of the afternoon function. A cultural programme also followed.

World Fisheries Day Observations: CIFT Visakhapatnam Research Centre observed World Fisheries Day with the theme "Safety of Fishers" on 21 November, 2013 at Vizianagaram. In the morning session host of dignitaries from Vizianagarm district delivered talks on various initiatives undertaken for the development of fisheries by different governmental agencies. Dr. S. Balasubrmaniam, Principal Scientist & HOD, EIS, CIFT, Cochin delivered Key Note Address and explained the activities of CIFT, Dr. M.M. Prasad, Principal Scientist & SIC, CIFT Visakhapatnam RC delivered a talk on Development of fisheries in Andhra Pradesh and role of CIFT in the same specially harvest and post harvest aspect of fisheries in Andhra Pradesh region. Dr. G. Rajeswari, Principal Scientist delivered a talk on Conservation of the fisheries resources for sustainable.

Release of Souvenir

Dr. L.N. Murthy demonstrating fish wafer preparation

Training cum demonstrations were held in use of foldable fish traps, employment of eco-friendly fishing gears *viz.*, BRDs, TED, development of value added fish products. An exhibition was also held on various technologies developed at CIFT. FRP coracles, fish traps and other inputs were handed over to fishers on gratis. Interactive sessions were held simultaneously while TCDs was in progress. The programme was widely covered by both print and electronic media.

Vigilance Awareness Week: Vigilance Awareness Week was observed at CIFT, Cochin during 28 October to 2 November, 2013. The Celebrations started on the morning of 28th October with the Director and Staff of the Institute assembling together and taking the Vigilance Awareness Pledge.

In the meeting held in the afternoon, Shri P.C. Cyriac, IAS (Retd.) and Former Chief Secretary, Govt. of Tamil Nadu delivered a talk on "Promoting good governance: Positive contribution of vigilance". The meeting was presided over by Dr. T.K. Srinivasa Gopal, Director, CIFT. Dr. Leela Edwin, Head, Fishing Technology and Vigilance Officer introduced the Guest and welcomed the gathering.

Shri P.C. Cyriac delivering the talk. On the dias are Shri R. Anil Kumar, Dr. T.K. Srinivasa Gopal and Dr. Leela Edwin

National Science Day Celebrated: Prof. Ram Rajasekharan, Director, CFTRI (CSIR), Mysore inaugurated the National Science Day celebrations at CIFT, Cochin on 28 February, 2014 and gave a lead talk on "Applaud-Aquatic Biofunctionals". He spoke on the importance of healthy oils containing omega-3 fatty acids.

Inagural session in progress: On the dias are Dr. Suseela Mathew, Dr. T.K. Srinivasa Gopal and Prof. Ram Rajasekharan

Meetings

Meeting on Livelihood of Tribal Fishermen: A meeting was held in the Mumbai Research Centre of CIFT on 6 October, 2013 for the betterment of the tribal fisherman livelihood utilizing TSP fund. The meeting was attended by members of the four Fisherman Society in Thane district of Maharashtra. The meeting was presided by Dr. T.K. Srinivasa Gopal, Director, CIFT. Dr. Leela Edwin, Head, Fishing Technology Division, CIFT gave a presentation on the various technology options in fish harvesting. Dr. P.K. Binsi, Scientist of MRC delivered a talk on 'Value addition in fish processing'.

Meeting in progress

ISO meeting on Fisheries and Aquaculture: The 7th plenary meeting of International Organization for Standardization for ISO/TC 234 'Fisheries and Aquaculture Technical Committee', associated Working Group and Advisory Group meetings were held at Cochin during 28-29 October, 2013. Delegations from Thailand, Iceland, France, Norway, India and other countries participated. The Indian delegation was led by Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi. India being the leader of the Working Group 07, four set of traceability standards, earlier circulated as committee draft were presented. In the meeting all the inputs received from various participating nations were deliberated upon and consensus was arrived. The draft standards on traceability were discussed in detail and recommen-ded for notification as Final Draft International Standard (FDIS).

Meeting of FSSAI: The 23rd Meeting of Fish and Fishery Products of FSSAI, New Delhi was held at CIFT, Cochin during 23-24 January, 2014.

Dr. S. Ayyappan, DG, ICAR conducting the meeting

Other Important Activities

Union Minister visits CIFT, Cochin: Honourable Minister of State for Agriculture & Food Processing, Government of India Shri Tariq Anwar visited CIFT, Cochin on 27 May, 2013. The Honourable Minister visited the different Divisions of the Institute and showed keen interest on the technologies developed at CIFT. The visit to the Divisions was followed by a meeting of the Honorable Minister with the scientists and staff of CIFT. Dr. T.K. Srinivasa Gopal, Director, CIFT delivered the presidential address and briefed the guest on the Institute activities. He also welcomed Shri P. Gopinath, Member, Institute Management

Honourable Minister addressing the scientists and staff

Committee of CIFT who accompanied the Honoruable Minister.

Union Minister and Rajya Sabha Member visits Visakhapatnam Research Centre of CIFT: Honourable Minister of State for Agriculture & Food Processing, Govt. of India Shri Tariq Anwar was on an official visit to the Regional Centres of CIFT and CMFRI, Visakhapatnam on 11 May, 2013. Shri Tariq Anwar was accompanied by Hon'ble Member of Rajya Sabha Shri T. Subba Rami Reddy. The dignitaries visited the laboratories of both CMFRI and CIFT. The visit to the laboratories was followed by a meeting with Scientists and staff of both CMFRI and CIFT, formers Scientists of the Institutes, Officials from state departments of Government of Andhra Pradesh and representatives from fishermen community and industry. The Chief Guest, Shri Tariq Anwar then addressed the gathering.

Shri Tariq Anwar addressing the scientists and staff of the Centres

Release of Technical Brochures: Mumbai Research Centre of CIFT has released nine technical brochures on the occasion of 'Innovations 4 Industry meet in fisheries' held on 23 November, 2013 at Royal Orchid Hotel, Vashi, Navi Mumbai. The brochures detailing the technical features of some of the technologies developed by CIFT including chitosan and its derivatives, collagen peptide, chitosan sponge, seafood analogues, fish silage, fish oil for food fortification, instant fish gravy mix, fish sausage and fish de-scaling machine were released by the Chief Guest of the function Shri Rustom Irani, President, Seafood Exporters Association, Maharashtra Chapter in the presence of Director, CIFT. The function was witnessed by 35 entrepreneurs from seafood Industry.

Release of the brochures (L to R: Dr. T.V. Sankar, HOD, QAM, CIFT, Shri Rustom Irani, President, Seafood Exporters Association, Maharashtra Chapter, Dr. T.K. Srinivasa Gopal, Director, CIFT, Dr. C.N. Ravishankar, HOD, FP, CIFT and Dr. S. Visnuvinayagam, SIC, Mumbai Research Centre of CIFT

Secretary to the Govt. of India visits CIFT, Cochin: Shri Anup Kumar Thakur, Secretary to the Govt. of India, Ministry of Agriculture, Department of Animal Husbandary, Dairying and Fisheries, New Delhi visited CIFT, Cochin on 7 November, 2013 as part of his official tour to Cochin during 5-7 November, 2013. The Secretary was welcomed by Dr. T.K. Srinivasa Gopal, Director, CIFT and there was an interaction meeting with the various HODs on the activities and achievements of the Institute. The Secretary visited the various laboratories, BPD unit, Pilot plant and ATIC of the Institute and had interactions with the scientists.

Shri Anup Kumar Thakur having discussions with the Director and HOD's

Foreign Delegation Visits CIFT, Cochin: India and the U.S.A. have announced a new agriculture partnership to address global food security, during the visit of President Obama to India during November, 2010. As a part of this initiative, to address the food security challenges in Africa, MANAGE (Ministry of Agriculture, GOI), Hyderabad has been assigned with the responsibility of organizing the U.S.-India-Africa Triangular International training programme on "New Dimensions in Agricultural Extension Management for Extension Functionaries" from Liberia, Kenya and Malawi. As part of the above programme, 30

Interaction with international delegates

Dr. K. Gopakumar laying the keel of energy efficient combination fishing vessel

International delegates from Liberia, Kenya and Malawi visited CIFT, Cochin on 13 November, 2013 along with Dr. S. Sentil Vinayagam, Director (AE), MANAGE.

Dr. P.T. Lakshmanan, Head, Biochemistry & Nutrition Division and Director-in-charge, CIFT presided over the meeting at the Conference Hall. Dr. S. Balasubramaniam, Head, Extension, Information and Statistics Division in his welcome address explained about the technology transfer activities carried out at this Institute. Dr. S. Sentil Vinayagam, Director (AE), MANAGE narrated about the whole training programme in agriculture and allied sectors conducted at MANAGE, Hyderabad. The trainees had interactions with the Head of Divisions who had attended the meeting and answered the queries raised by the trainees. They were also taken around the Pilot Plant Complex by Dr. C.N. Ravisankhar, Head, Fish Processing Division and the team left the Institute by the afternoon.

Training was imparted to another batch od 15 International trainees from Maldives as a part of their training at CMFRI, Cochin on 27 November, 2013.

Keel laid for Energy Efficient Combination Fishing Vessel: The Keel laying ceremony for the 19.8 m energy efficient combination fishing vessel, jointly designed by CIFT, Cochin and Goa Shipyard Ltd., was held at Vasco, on 13 January, 2014. The vessel is being constructed by GSL under the project 'Green Fishing Systems for Tropical Seas' funded by National Fund for Basic, Strategic and Frontier Application Research in Agriculture. The vessel is being designed by analyzing the hull form using computational fluid dynamics software and model testing in a towing tank. The novel features are bulbous bow, refrigerated sea water tank, solar panels, hydraulic long line winch, split trawl winch, hydraulic gillnet hauler, efficient propulsion and bilge keel make it remarkable from the conventional vessels.

Dr. K. Gopakumar, former Deputy Director General (Fisheries), ICAR and the Chief Guest of the day laid the keel in the presence of Shri Sanjeev Sharma, Chairman & Managing Director in charge, GSL. Dr. T.K. Srinivasa Gopal, Director, CIFT, Dr. K.A. Simon, Director, Kunjali Marakkar School of Marine Engineering, CUSAT, Cochin, Shri Raghuveer Singh, General Manager (GES & SR), GSL, Senior officials of GSL, Dr. A.K. Bhargava, Zonal Director, Fishery Survey of India, Scientists from ICAR Research Complex, Goa, Dr. P. Pravin, Dr. Saly N. Thomas, Dr. M.P. Remesan, Shri M.V. Baiju and Dr. V.R. Madhu, Scientists and Co-Principal Investigators of the Project, CIFT, representatives from Fishermen and Boat Owners Association were also present on the occasion. Dr. Leela Edwin, Head & Principal Investigator of the project, Fishing Technology Division, CIFT thanked the officials for the support extended for the different activities of the project.

CIFT Sun Boat Launched by Hon'ble Fisheries Minister: At a function organized by CIFT, Cochin, Shri K. Babu, Hon'ble Minister for Fisheries, Ports and Excise, Govt. of Kerala launched the CIFT Sun Boat, a solar powered boat on 23 February, 2014 at Matsyafed Njarakkal Fish Farm in presence of Dr. T.K. Srinivasa Gopal, Director CIFT. The boat with a length of 3.6 m is twin hulled and is solely propelled by solar power. It can be put to use in aqua farms for aquacultural purposes and for gillnetting, line fishing, transportation and aqua tourism. It's main advantages are that it does not burn fuel, there is no atmospheric or sound

Shri K. Babu launching the boat

pollution, has more deck space with clean FRP surface for fish handling and is suitable for shallow waters. The CIFT Sun Boat is costlier than the conventional boat but the additional cost is compensated by the fuel saved. Shri K.S. Sajeevan, Manager, Aqua Division, Matsyafed offered felicitation. Dr. S. Girija, Director, NIFPHATT, Cochin and Shri R.C. Sinha, Director, CIFNET, Cochin graced the occasion. Representatives of inland fishermen organizations attended the meeting.

CIFT participates in *Spandana - Girijanotsavamulu*, 2014: The Visakhapatnam Research Centre of CIFT has participated in the *Spandana -Girijanotsavamulu* 2014 at Parvatipuram, Vizianagaram district, Andhra Pradesh on 23 February, 2014. The programme was organized by ITDA, Parvatipuram in collaboration with agriculture and other line departments in Vizianagaram district. Shri V. Kishore Chandra Deo, Hon'ble Union Cabinet Minister of Tribal Affairs and Panchayatiraj, Govt. of India and Shri Kantilal Dande, IAS, District Collector, Vizianagaram were present in the programme.

An exhibition stall was also put up by CIFT, Visakhapatnam showcasing different technologies developed which are useful for setting up of a small scale industry. More than 50,000 people visited the stalls. Visitors have shown keen interest to know in detail about different technologies developed by the Institute for the welfare of fishers. As a part of TSP inputs were distributed for selected beneficiaries belonging to scheduled tribe category. The assets were handed over to the tribal fishers by Hon'ble Minister Shri V. Kishore Chandra Deo. Shri Kantilal Dande, handed over the FRP coracles to the selected beneficiaries. In this context, the District Collector has appreciated the role of CIFT, Visakhapatnam in developing of new technologies and implementation of the same at grassroots level for the benefit of fishers in general and ST fishes in particular.

Shri Kantilal Dande distributing the CIFT TSP inputs to the beneficiaries

Administration

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

During the period under report, the following Committees met for purposes as follows: Departmental Promotion Committee : 7 times, Departmental Selection Committee : NIL, Assessment Committee : 3 times, Career Advancement Committee : NIL, MACP Committee : Twice, Selection test : Once.

Cases considered by the Departmental Promotion Committee

Category	Promotion	Declaration of probation & Confirmation	Granting MACP
Scientific	-	1	-
Technical	11	10	-
Administrative	8	15	7
Supporting	-	-	2
Auxiliary	-	-	-

Technical Section

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

Submission of monthly, quarterly and half yearly reports

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

Quarterly and six monthly reports on the targets and achievements of the Institute comprising both research and financial aspects were regularly furnished to the Council. Six monthly targets and achievements of all individual Scientists were furnished to DG, ICAR, twice in the year under report.

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 six times for screening 30 papers.

Institute Research Council

The Institute Research Council meeting was convened during 27-29 May, 2013 to review the progress achieved in the ongoing research projects of the Institute during 2012-13 and to discuss the research project proposals for the year 2013-14. The Institute Research Project Document for the year 2013-14 was compiled and brought out for discussion at the Meeting. The House discussed in detail the 13 ongoing research projects, besides five completed projects and five new projects apart from the various ad hoc projects.

Updating Project files

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

PERMISnet, IRS and PIMS-ICAR

The Technical Section helps in maintaining the Personal Management Information System network (PEERMISnet-II) of ICAR up-to-date. Further, also furnishes quarterly inputs to the Intelligent Reporting System (IRS-II) being maintained by ICAR. Through 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 2012-13 and Research Highlights 2012-13 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 14 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 six times to discuss 109 cases. As recommended by the HRD Committee the scientists and officers of the Institute participated in 56 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

The 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.

The library acquired 69 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 has supplied copies of 443 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 Chetana Mas 2013

Chetana Mas 2013 was celebrated at the Institute during 26 August - 27 September, 2013. During the Chetana Mas various competitions in Hindi were conducted for the staff members of the Institute, such as Technical Quiz, Administrative Quiz, Cross Word, 'Matsya Lok', Street Play, ICAR Song, Administrative Terminology and Scientific Terminology.

Concluding function of Chetana Mas was held on 27 September, 2013. Chief Guest of the function was Dr. A. Gopalakrishnan, Director, CMFRI, Cochin. The function was presided over by Dr. P.T. Lakshmanan, Director Incharge, CIFT. Welcome address was delivered by Shri P.J. Davis, Senior Administrative Officer. Felicitations were offered by Shri Vijayakumar, Officer Incharge, Southern Regional Hindi Implementation Centre and Shri K.K. Ramachandran, Secretary, Kochi Tolic. Dr. C. Jessy Joseph, Deputy Director (OL) proposed the vote of thanks. Chief Guest distributed the prizes to the winners of the competitions. The 'Rajbhasha Pratibha Puraskar 2013' was awarded to Kum T. Deepa who scored the maximum points, and Best Division prize was given to the Administration Division.

A very colourful cultural programme was presented during the function. Shri Rakesh Kamath, an invited artist presented 'Sopana Sangeetham'. The administrative staff of the Institute presented a "Street Play" and Dr. K.K. Prajith, Scientist presented 'Ardhanareeswara Dance'. A group of artists from Noopur Arts Academy, Bangalore presented one hour Kathak Dance (Lucknow style) performance which was sponsoed by the ICCR, Thiruvananthapuram.

Technical Talk

Dr. Jagdeep Saxena, Editor, DKMA, ICAR, New Delhi delivered a Technical Talk in Hindi on "Writing for the Media" on 7 October, 2013 for the benefit of Scientific and Technical staff.

Dr. Jagdeep Saxena delivering the talk

TOLIC Awards

For the Best implementation of Official Language and for the best Hindi Journal CIFT has bagged the TOLIC awards and the same was received by Dr. C.

Dr. P.T. Lakshmanan, Director Incharge delivering the Presidential address

Receiving the Best implementation of official language

Kum. T. Deepa receiving the Rajbhasha Pratibha Puraskar 2013

Receiving the best Hindi journal award

Jessy Joseph, DD (OL) on 18 July, 2013 from Shri D.K. Das Sharma, Chairman, TOLIC and Chief Commissioner of Income Tax, and from Shri Vijayakumar, Dy. Director, Regional Implementation Centre, Kochi respectively.

Parliamentary Committee's Visit

Parliamentary Committee's Visit and Inspection of the Veraval Research Centre at India International Centre, Delhi was held on 18 April, 2013. Dr. T.K. Srinivasa Gopal, Director, CIFT, Cochin. Dr. R. Badonia, SIC, Veraval Research Centre of CIFT, Dr. Madan Mohan, ADG (M.Fy.), ICAR, New Delhi, Dr. C. Jessy Joseph, D.D. (OL), CIFT, Shri Anil Kumar, A.O., CIFT and Shri Joshi, Technical Officer, ICAR Head Quarters attended the meeting. The Inspection Committee consisted of the following members: 1. Shri Satyavrat Chaturvedi, 2. Dr.(Mrs.) Botcha Jhansi Lakshmi, and 3. Shri Raghunandan Sharma. Along with the Parliamentary Members, Dr. S.P. Sukla, Under Secretary for the committee and the other officers were also present. A small exhibition of the Official Language activities of the Institute and Official Language publication was also held at the venue of the Parliamentary Committee meeting at Delhi. The Committee expressed their happiness in the Official Language implementation activities of the Veraval Research Centre and that of Head Quarters at Cochin.

Hindi Week Celebrations were conducted at the Visakhapatnam Centre during 17-24 September, 2013. During the week, various competitions were held for the staff members of the Centre. The valedictory function was held on 25 September, 2013. The programme began with the welcome speech by Dr. Santosh Alex, Sr. Tech. Officer, CIFT. The meeting was presided by Dr. M.M. Prasad, SIC & PS. Shri M.R. Ghoke, Pay & Accounts officer, Customs and Central Excise Department, Visakhapatnam was the Chief Guest for the occasion. He urged the staff members to use simple Hindi in the day to day correspondence. Later he distributed prizes for the winners of the competitions. Smt. Arathy Ashok, Scientist, CIFT, proposed vote of thanks.

Hindi week was celebrated during 24-28 September, 2013 at the Mumbai Research Centre and competitions on various themes were conducted. Prize distribution for the winners was carried out on 30 September, 2013.

Parliamentary Committee Chairman Shri Satyavrat Chaturvedi inspecting the exhibition

Meeting in progress

Parliamentary Committee members with the Institute Officers

PME Cell

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

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

Dr. Nikita Gopal, Senior Scientist : Member

Shri C.G. Joshy, Scientist : Member

Dr. A.R.S. Menon,
Chief Technical Officer : Member

Smt. P.K. Shyma,
Sr. Technical Officer : Member

Smt. N.C. Shyla, Sr. Tech. Asst. : Member

The 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.

Post Graduate Studies

Shri Ashish Kumar Jha, Scientist, Veraval Research Centre of CIFT has obtained his Ph.D. from Central Institute of Fisheries Education, Mumbai (Deamed University). He worked under the guidance of Dr. A.K. Pal, Scientist, CIFE, Mumbai. The topic of his Doctoral research was "Biochemical, molecular and cellular responses of *Labeo rohita* fingerlings to hypoxia".

Invited Talks

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

- Shri Srinivas Joshi, Business Development Manager, Waters India Pvt. Ltd. - Regulatory requirements and technologies involved in analysis of contaminants in food chain (2 August, 2013)
- Dr. Hans-Joachim Hubschmann, Technical Director, Thermo Fisher Scientific - Pesticide residue and dioxin analysis in food using GCMS/HR MS System (13 August, 2013)
- Mr. Robert Gibson, Senior Operations Manager, Food and Bioprocessing Division, Agri-value Processing Incubator, Alberta Agriculture and Rural Development, Canada - Innovations and commercialization of agri-value processing incubator at Leudec, Alberta, Canada (30 September, 2013)
- Dr. Jagdeep Saxena, DKM, ICAR, New Delhi - Writing for the media (In Hindi) (7 October, 2013)
- Prof. Ram Rajasekharan, Director, CFTRI, Mysore - Applaud-Aquatic Biofunctionals (28 February, 2014)

Prof. Ram Rajasekharan 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, College of Fisheries, Panangad and College of Fisheries, Tuticorin
- Institute Management Committee, NRC Meat, Hyderabad

Dr. Leela Edwin, Head, Fishing Technology Division

As Member

- 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
- Scientific panel for Biological hazards, Food Safety Standards Authority of India, New Delhi

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

As Member

- Expert for the evaluation of a research projet proposal of DST, New Delhi
- Examiner, Ph.D. thesis, TNAU, Coimbatore
- Examiner, M.F.Sc. students, TNFU, Nagapattinam
- Exmainer, M.F.Sc. students, KUFOPS, Cochin
- Committee for syllabus revision for Fisheries Extension Discipline, CIFE, Mumbai

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

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 drafting curriculam 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
- Consultant, NACA, Bangkok, Thailand
- National Business Incubation Association, USA
- Agrinnovate India Pvt. Ltd. for technology valuation and pricing of ICAR technologies

Dr. Suseela Mathew, Head I/c, Biochemistry & Nutrition Division

As Member

- Reviewer of journals, Fishery technology, Journal of Food Science & Technology, Indian Journal of Fisheries, Journal of Medicinal Food and Fishing Chimes

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

As Member

- Committee of AQUDIRECT.ORG
- Assessment panel of experts of Export Inspection Council

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
- 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 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 constituted by Matsyafed, Kerala for the implementation of fish net factory at Thiruvananthapuram
- Expert committee to study farming of variety fishes under the Matsya Samrudhy Programme of Kerala State Fisheries Department
- Chief Editor of the journal, Fishery Technology published by SOFT(I), Cochin
- Exmanienr in Fishing Technology for PG courses of KAU, Thrissur,CUSAT, Cochin and MG University, Kottayam

Dr. P. Pravin, Principal Scientist

As Member

- Expert committee on Fish wealth and scientific

study, of Govt. of Kerala

- Expert team from CIFT for developmental plans for fisheries in Andaman and Nicobar islands

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
- Consultative committee for construction and modernization of fish markets with the financial assistance of NFDB, Hyderabad
- Expert group of Ministry of Agriculture for review of standard conditions for sanitary import of various fish/fishery products

Dr. M.P. Remesan, Principal Scientist

As Member

- Committee for the selection of Group A & B posts of MPEDA, Cochin

Dr. G. Rajeswari, Principal Scientist

As Member

- External examiner for M.Sc. students, Department of Marine Living Resources, Andhra University, Visakhapatnam
- External examiner for vessel navigation course of CIFNET, Visakhapatnam
- Advisory committee for the Centre for women's Studies, Andhra University, Visakhapatnam

Dr. V. Geethalakshmi, Principal Scientist

As Member

- Examiner for Ph.D. course thesis evaluation in Biostatistics of NIMHANS, Bangalore

Dr. Nikita Gopal, Principal Scientist

As Member

- Programme Chair, 4th Global Symposium on Gender in aquaculture and fisheries, held as part of the 10th Asian Fisheries and Aquaculture Forum, Yeosu, Korea, 30 April- 5 May, 2013.
- Executive committee, Agricultural Economics Research Association, New Delhi
- Executive committee, Society of Fisheries Technologists (India), Cochin

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. 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
- MPEDA subsidy committee on setting up of chilled fish unit
- 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

- Registered guide of the Cochin University of Science and Technology, Cochin

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
- Research Guide, Faculty of Marine sciences, CUSAT, Cochin

Dr. S. Ashaleta, Senior Scientist

As Member

- Purchase committee for purchase of equipment for the 'Fishmaid' outlets of KSCADC in the state

Shri M.V. Baiju, Senior Scientist

As Member

- Committee to evaluate fish wealth/impact of trawl ban along Kerala coast, Govt. of Kerala
- Committee constituted to examine proceedures for registration of boat building yards, regulation of fishing power and issues related to registration of fishing vessels, Govt. of Kerala
- Committee constituted by Department of Animal Husbandry, Dairying and Fisheries to develop fisheries in Lakshadweep islands
- Committee constituted by the Lieutenant Governor of Andaman and Nicobar Administration to develop fisheris in Andaman and Nicobar islands
- Committee for the construction of 19.7 m L_{OA} Fisheries Research Vessel under Indian register of Shipping classification
- Committee for the construction of 11 m L_{OA} Fisheries Research Vessel of CMFRI, Cochin
- Committee to finalize the specification and construction of a Research Vessel for the Department of Industrial Fisheries, CUSAT, Cochin

Dr. B. Madhusudana Rao, Senior Scientist

As Member

- Assessment panel of experts of Export Inspection Council

Dr. L.N. Murthy, Senior Scientist

As Member

- Assessment panel of experts of Export Inspection Council

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 Vetrinary and Animal Sciences, KAU, Thrissur
- Examiner and question paper setter for B.F.Sc. course, KUFOS, Cochin and TNVASU, Chennai

Dr. S.K. Panda, Senior Scientist

As Chairman

- E-working group WG_VS8_FFP2 on Semi-preserved fish and fish products, including molluscs, Crustaceans and echinoderms fish paste constituted by FSSAI
- E-working group WG_HS9_MC1 on Microbial contaminants (except mycotoxins) constituted by FSSAI

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. K.K. Asha, Senior Scientist

As Member

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

Dr. V.R. Madhu, Senior Scientist

As Member

- Committee for introduction of marine ambulance service along the coastal districts of Kerala

Dr. C.O. Mohan, Scientist

As Member

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

Shri Ankur Nagor, Scientist

As Member

- Expert committee on Tuna long line and fish hold subsidy scheme of MPEDA
- Panel for Apprentice trainees in the discipline B. Tech. (Mechanical and Electrical & 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
- Research Advisory Committee of CIFE, Mumbai for Masters and Ph.D. programme

Dr. A.R.S. Menon, Chief Technical Officer

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

Shri C.R. Gokulan, Asst. Chief Technical Officer

As Member

- Committee constituted for selection of Mechanic (Group-C) at FSI, Marine Engineering Division
- Committee constituted for selection of Electrician of NIPHATT, Cochin
- Committee constituted for selection of Electrical Suprervisor (Group-C) at CIFNET, Cochin
- Panel for Apprentice trainees in the discipline B. Tech. (Mechanical and Electrical & Electronics)

Visitors

The following were some of the dignitaries who visited the Institute during the period:

- Dr. K. Devadasan, former Director, CIFT, Cochin; Dr. A.K. Upadhyay, Professor and Head, Fish Processing Technology, GB Pant University of Agriculture & Technology, Pantagar, Uttarakhand; Dr. C. Hridayanathan, former Director, School of Industrial Fisheries, CUSAT, Cochin; Dr. V. Venugopal, former Scientific Officer, BARC, Mumbai; Dr. C.K. Mukherjee, Professor, Dept. of aquaculture, IIT, Kharagpur and Dr. Madan Mohan, Asst. Director General (M. Fy.), ICAR, New Delhi (CIFT, Cochin on 27 April, 2013)
- Shri Hibi Eden, MLA, Ernakulam (CIFT, Cochin on 29 April, 2013)
- Shri Tariq Anwar, Honourable Minister of State for Agriculture & Food Processing, Govt. of India and Shri T. Subba Rami Reddy, Honourable Member, Rajya Sabha (Visakhapatnam RC of CIFT on 11 May, 2013)
- Shri Tariq Anwar, Honourable Minister of State for Agriculture & Food Processing, Govt. of India (CIFT, Cochin on 27 May, 2013)
- Dr. T.K. Dhamodaran, Head, Dept. of Wood Science and Technology, KFRI, Peechi (CIFT, Cochin on 25 June, 2013)
- Dr. V. Prakash, former Director, CFTRI, Mysore; Dr. Rintu Banerjee, Professor, Dept. of Agriculture and Food Engineering, IIT, Kharagpur; Dr. D.S. Sheshappa, former Dean, College of Fisheries, Mangalore; Dr. K.C. Dora, Dean, College of Fisheries, WB University of Animal & Fisheries Science, Kolkatta (CIFT, Cochin on 22 August, 2013)
- Dr. A. Gopalakrishnan, Director, CMFRI, Cochin (CIFT, Cochin on 27 September, 2013)
- Shri N. Ramesh, Director (Marketing), MPEDA, Cochin (CIFT, Cochin on 1 October, 2013)
- Dr. Jagdeep Saxena, DKMA, ICAR, New Delhi (CIFT, Cochin on 7 October, 2013)
- Dr. S. Girija, Director, NIFPHATT, Cochin; Dr.

Mukund V. Karwe, Professor and Chair, Rutgers University, USA (CIFT, Cochin on 18 October, 2013)

- Shjri P.C. Syriac, IAS (Retd.), former Chief Secretary, Govt. of Tamil Nadu (CIFT, Cochin on 28 October, 2013)
- Shri Anup Kumar Thakkur, Secretary to the Govt. of India, DAHDF, New Delhi (CIFT, Cochin on 7 November, 2013)
- Dr. S. Senthil Vinayagam, Director (AE), MANAGE, Hyderabad (CIFT, Cochin on 13 November, 2913)
- Dr. A.K. Jain, Principal Scientist, Agriculture Physics Division, IARI, New Delhi (CIFT, Cochin on 13 December, 2013)
- Dr. S. Ayyappan, DG, ICAR and Secretary, DARE, New Delhi (CIFT, Cochin on 22 January, 2014)
- Dr. Gopinatha Rao, Professor, Dept. of Agriculture Statistics, University of Agriculture Science, Bangalore (CIFT, Cochin on 1 February, 2014)
- Dr. Y.S. Yadava, Director, BOBP-IGO; Dr. Petri Suuronen, Fishery Industry Officer, FAO, Rome (CIFT, Cochin on 12 January, 2014)
- Prof. Ram Rajasekharan, Director, CFTRI, Mysore (CIFT, Cochin on 28 February, 2014)

On-going Research Projects

Institute Projects

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
1.	Responsible fishing systems for the marine sector	Dr. P. Pravin	Cochin & Veraval	Cochin Veraval	Dr. Saly N. Thomas Dr. M.P. Remesan Shri M.V. Baiju Dr. V.R. Madhu Dr. K.K. Prajith Shri G. Kamei Dr. A.K. Jha
2.	Development of appropriate fishing systems for rivers	Dr. M.P. Remesan	Cochin, Visakha-patnam & Veraval	Cochin Visakha-patnam Veraval	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 Dr. A.K. Jha Dr. R.K. Manna (CIFRI, Barrackpore) Dr. A.K. Sahoo (CIFRI, Barrackpore)
3.	Species specific interventions in value addition of commercially important and emerging species of freshwater fish	Dr. George Ninan	Cochin & Mumbai	Cochin	Dr. K.V. Lalitha Shri P.K. Vijayan Dr. A.A. Zynudheen Dr. J. Bindu Shri C.G. Joshy Shri Ankur Nagori

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
				Mumbai	Dr. V. Ronda Dr. A. Jeyakumari Smt. S.J. Laly Smt. U. Parvathy Dr. S. Visnuvinayagam Dr. P.K. Binsi Smt. P. Viji
4.	Utilization of fish processing waste for the development of innovative products	Dr. A.A. Zynudheen	Cochin, Mumbai & Veraval	Cochin Mumbai Veraval	Dr. George Ninan Dr. R. Anandan Dr. S.K. Panda Dr. V. Murugadas Shri C.G. Joshy Smt. U. Parvathy Dr. S. Visnuvinayagam Dr. P.K. Binsi Smt. V. Renuka
5.	Processing and quality improvement of seafoods in Gujarat	Dr. R. Badonia	Veraval	Veraval	Dr. G.K. Sivaraman Dr. C.O. Mohan Dr. A.K. Jha Shri V. Chandrasekar Smt. V. Renuka Smt. S. Remya
6.	Development of a Quality Index Scheme for commercially important Indian fishes	Dr. T.V. Sankar	Cochin, Veraval, Visakhapatnam & Mumbai	Cochin Veraval Visakhapatnam Mumbai	Dr. S. Sanjeev Dr. K. Ashok Kumar Dr. Femeena Hassan Dr. S.K. Panda Dr. V. Ronda Shri C.G. Joshy Smt. S.J. Laly Dr. A. Jeyakumari Dr. C.O. Mohan Dr. M.M. Prasad Smt. P. Viji
7.	Diversity of seafood-borne pathogenic and commensal bacteria and bioscreening for novel genes and biocatalysts	Dr. K.V. Lalitha	Cochin & Visakhapatnam	Cochin Visakhapatnam	Dr. Sanjoy Das Dr. Toms C. Joseph Dr. V. Murugadas Dr. B. Madhusudana Rao
8.	Bio-monitoring and bio-evaluation of marine resources and formulation of nutraceuticals in human nutrition and health	Dr. P.T. Lakshmanan/ Dr. Suseela Mathew	Cochin & Visakhapatnam	Cochin Visakhapatnam	Dr. R. Anandan Dr. K.K. Asha Dr. N.S. Chatterjee Dr. B. Madhusudana Rao

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
					Dr. L.N. Murthy Kum. Jesmi Debbarma
9.	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. N.S. Chatterjee
10.	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
11.	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
12.	Evaluation of technology transfer models in fisheries sector	Dr. S. Balasubrama-niam	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. S. Ashaletha Dr. George Ninan Dr. J. Charles Jeeva Smt. P. Jeyanthi Smt. Arathy Ashok
13.	Management dimensions in the fisheries sectors - policies, issues and implications	Dr. Nikita Gopal	Cochin, Visakha-patnam & Vetraval	Cochin Visakha-patnam Veraval	Dr. V. Geethalakshmi Dr. J. Charles Jeeva Shri V. Radhakrishnan Nair Smt. P. Jeyanthi Smt. Arathy Ashok Shri V. Chandrasekar
14.	Nano technological intervention to mitigate fishing craft and gear material degradation	Dr. P. Muhamed Ashraf	Cochin	Cochin	Dr. Leela Edwin Dr. Saly N. Thomas
15.	Reduction of environmental impact from trawling systems through bycatch reduction technologies and development of region specific sustainable fishing systems for east coast of India	Dr. R. Raghu Prakash	Visakha-patnam	Visakha-patnam	Dr. G. Rajeswari Dr. U. Sreedhar Smt. Arathy Ashok
16.	Thermal and non-thermal technologies for processing and packaging of fish products	Dr. J. Bindu	Cochin, Visakha-patnam,	Cochin	Dr. C.N. Ravishankar Dr. S.K. Panda Dr. V. Ronda

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
			Veraval & Mumbai	Visakha-patnam Veraval Mumbai	Shri Ankur Nagori Dr. L.N. Murthy Kum. Jesmi Debbarma Dr. C.O. Mohan Smt. S. Remya Smt. P. Viji
17.	Risk assessment of emerging food-borne pathogens and chemical residues in aquatic systems	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 Smt. S.J. Laly Dr. C.O. Mohan Dr. G.K. Sivaraman
18.	Species specific technologies for the improved utilization of the fishery resources of Maharashtra region	Dr. S. Visnuvinayagam	Mumbai, Veraval & Cochin	Mumbai Veraval Cochin	Dr. P.K. Binsi Smt. P. Viji Dr. G.K. Sivaraman Dr. V. Murugadas
	Indian Council of Agricultural Research (ICAR) projects				
19.	Zonal Technology Management - Business Planning and Development Unit	Dr. C.N. Ravishankar	Cochin & Visakha-patnam	Cochin Visakha-patnam	Dr. George Ninan Dr. A.A. Zynudheen Dr. C.O. Mohan Shri Nitin Singh (Business Manager) Shri K.K. Santhosh (Pilot Plant Engineer) Shri Rejin Jose (Office Assistant) Smt. A. Razia Mohamed* Shri V.C. Jijomon* Smt. K.B. Biji* Shri K.J. Aravind* Dr. B. Madhusudana Rao Dr. L.N. Murthy
20.	Intellectual property management and technology transfer/commercialization	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. Suseela Mathew Dr. R. Anandan Dr. K.K. Asha Dr. N.S. Chatterjee

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
					Shri P.A. Aneesh* Shri Jones Varkey*
National Fund for Basic, Strategic and Frontier Application Research in Agriculture					
22.	Green fishing systems for tropical seas	Dr. Leela Edwin	Cochin, Goa, Pune & Mumbai	Cochin Goa Pune Mumbai	Dr. Saly N. Thomas Dr. P. Pravin Dr. M.P. Remesan Shri M.V. Baiju Dr. V.R. Madhu 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.M. Vipin* Shri P. Shameer* Shri V.R. Kiran* Shri Jinu Krishnan* Shri B.K. Upadhyay Shri M.D. Bhat Shri R.N. Savasere Shri Kishore Darda Kum. Margot Wunnik-van
23.	Development of multiplex microarray for detection of food-borne and shrimp pathogens	Dr. Toms C. Joseph	Cochin & Veraval	Cochin Veraval	Dr. K.V. Lalitha Shri Thobias P. Antony* Dr. G.K. Sivaraman
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. V. Geethalakshmi Dr. R. Anandan Dr. S. Ashaletha Shri T.N. Nishil* Shri Muhammed Azharuddin* Shri Ratheesh Mathew* Shri C.G. Rakesh* Kum. Rohan Maria Peter* Kum. E.S. Sumi* Kum. K. Rajeswari*

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
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 & Laksha-dweep	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* Shri T.R. Ananthanarayanan* Shri C.T. Nithin*
27.	Strengthening of digital library and information management under NARS (e-Granth)	Dr. Suseela Mathew	Cochin	Cochin	Smt. T. Silaja Shri Shaiph Mustafa* Shri Eldho George*
28.	Studies on high pressure processing (HPP) on high value perishable commodities	Dr. J. Bindu	Cochin & Kharagpur	Cochin Kharagpur	Dr. T.K. Srinivasa Gopal Dr. K.K. Asha Dr. Sanjoy Das Shri Ginson Joseph* Shri C.K. Kamalakanth* Dr. P.S. Rao
29.	Mobilizing mass media support for sharing agro information	Dr. S. Ashaletha	Cochin	Cochin	Shri Aswin Antony*
	Centre for Marine Living Resources & Ecology (CMLRE) Projects				
30.	Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies	Dr. M.P. Remesan	Cochin & Visakha-patnam	Cochin	Shri P.K. Vijayan Dr. George Ninan Dr. A.A. Zynudheen Dr. R. Anandan Dr. Sanjoy Das Dr. V. Murugadas Dr. K.K. Prajith Shri T. Jose Fernandez* Shri V.G. Jinoy* Shri F. Daniel Raj* Shri R. Navaneethan*

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
				Visakha-patnam	Shri M.M. Lijin Nambiar* Shri Rahul Ravindran* Dr. G. Rajeswari Dr. R. Raghu Prakash
31.	Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications	Dr. Suseela Mathew	Cochin	Cochin	Dr. R. Anandan Dr. K.K. Asha Dr. N.S. Chatterjee Shri B.P. Bijulal* Shri Jomey George* Kum. K.R. Remyakumari* Kum. N.B. Jayasree*
32.	Characterization of harmful algal bloom along Indian coast	Dr. K. Ashok Kumar	Cochin	Cochin	Dr. T.V. Sankar Dr. R. Anandan Dr. S.K. Panda Kum. R. Rajisha* Kum. Rose Mary Mathew*
33.	Exploration and assessment of demersal fishery resources along the continental slope (200-1200m) of Indian EEZ and central Indian Ocean	Dr. U. Sreedhar	Visakha-patnam &	Visakha-patnam Cochin	Dr. G. Rajeswari Dr. R. Raghu Prakash Dr. L.N. Murthy Dr. Suseela 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. T.V. Sankar Dr. George Ninan Kum. K. Shiny* Kum. G.S. Hema*
35.	Development of bioplastic based sustainable nanobiocomposites food packaging	Dr. J. Bindu	Cochin	Cochin	Dr. S.K. Panda Smt. Vimala Devi*
	Department of Science and Technology (DST) Projects				
36.	Location specific livelihood interventions in fisheries sector for the empowerment of fisherwomen in Kerala	Dr. Femeena Hassan	Cochin	Cochin	Dr. Saleena Mathew (CUSAT, Cochin)
37.	Food safety interventions for women in fishery based	Dr. Femeena Hassan	Cochin	Cochin	Dr. P.T. Lakshmanan Dr. S. Balasubramaniam

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
	microenterprises in coastal Kerala				Kum. P.A. Asja Parveen* Kum. Milu Mathews*
38.	Use of natural resins and gums for preservation and value addition of fishery products	Dr. P.K. Binsi	Mumbai & Cochin	Mumbai Cochin	Dr. S. Visnuvinayagam Dr. C.N. Ravishankar Dr. George Ninan
39.	Village knowledge register of Thoothoor fishing community and establishing knowledge based enterprises by pooling best innovative and traditional knowledge practices	Dr. Leela Edwin	Cochin	Cochin	
	Coconut Development Board (CDB) Project				
40.	Techno-economic feasibility of coconut wood canoes for the small-scale fisheries sector in the southwest 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 Centre for Ocean Information (INCOIS) Projects				
41.	Retrieval of phytoplankton and associated optical constituents based on long term bio-optical studies	Dr. P. Muhamed Ashraf	Cochin	Cochin	Kum. P. Minu* Kum. V.P. Souda* Kum. U. Smitha*
42.	Validation of tuna advisories off east Coast	Dr. U. Sreedhar	Visakha-patnam	Visakha-patnam	
43.	Studies on ecological linkages between plankton production and *Acetes* sp. Along Gujarat coast	Dr. V.R. Madhu	Veraval	Veraval	Dr. K.K. Prajith
	National Fisheries	**Development**	**Board**	**Project**	
44	National surveillance programme for aquatic animal diseases	Dr. K.V. Lalitha	Cochin	Cochin	Dr. Toms C. Joseph Dr. V. Murugadas Shri Akhil Nath* Shri Saheer*

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- M.P. Remesan, P. Pravin, V.R. Madhu and K.K. Prajith (2014) - Brochure on Myctophids

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(As on 31st March, 2014)

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Microbiology, Fermentation & Biotechnology	:	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
Biochemistry & Nutrition Division I/C	:	Dr. Suseela Mathew, Principal Scientist
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Visakhapatnam Research Centre	:	Dr. M.M. Prasad, Principal Scientist
Veraval Research Centre	:	Dr. R. Badonia, Principal Scientist
Mumbai Research Centre	:	Dr. S. Visnuvinayagam, Scientist

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10. Dr. Niladri Sekhar Chatterjee
11. Smt. U. Parvathy
12. Shri Gaihimngam Kamei

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