“ Research is creating new knowledge ”

- Neil Armstrong

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From the Director's desk

Dr. Ravishankar C.N.

> **"The year that went by has, as always been an amalgam of accomplishments, recognitions as well as indicators on areas where we need to re-focus"**

The process of preparation of the Annual Report is a time for introspection, a time to look at our achievements and to assess shortfalls. It is also a time to set ourselves new goals and to take on new challenges. 2014-15, the year that went by has, as always been an amalgam of accomplishments, recognitions as well as indicators on areas where we need to re-focus in the coming years.

Research being the major mandate, the Institute has several contributions to the nation in the past year. The Institute has standardized the design and operational parameters of semi-pelagic trawl systems, apart from designing and fabricating radial escapement device and juvenile and trash excluder device, in an effort towards greening our fisheries. Alternative boat building material, coconut wood, was used and canoes constructed to benefit artisanal fishermen.

In processing technologies, edible coating of chitosan-collagen film has been useful in extending shelf life of fish based products. A bio-ceramic natural hydroxyapatite-chitosan composite cement has been developed and characterized which can be used in dentistry. Fish calcium capsules have been produced at a pilot scale level and it has been test marketed.

Consumers are becoming increasingly aware and conscious of the quality and safety of food products. A quality index scheme for pearlspot with limit ofacceptability of 16 days against the storage period of 22 days for 124 quality descriptors has been developed. Also an LCMS MS method for the detection of 225 pesticides was standardized using fish matrix.

V. cholera O139 serogroup pathogenic to shrimp from post-larvae of *Panaeus monodon* has been isolated and reported for the first time in India. This strain has been causing high mortality in farmed shrimp. Isolation of Methicillin-resistant *Staphylococcus* aureus raises serious concerns as pathogens are becoming resistant to drugs. *Lysinibacillus fusiformis* and *Bacillus thuringiensis* were identified as high density polyethylene degrading bacteria. Further research on this aspect may lead to a solution for menace of plastic pollution of the environment.

A novel delivery system of thiamine and pyridoxine by microencapsulating the vitamins with an antioxidant chitosan derivative was developed. Further the encapsulation efficiency and oxidative stability of fish oil microencapsulates was enhanced by blending with essential oils.

Prototypes of solar chiller and a hand held fish de-scaling machine have been developed. In Social Sciences, indicators for assessing Fishermen Co-operative Societies have been developed and various technology transfer programmes were conducted throughout the country.

Communicating research to reach a wider audience is very important for increasing its reach and effectiveness. The Institute organized 126 training and awareness programmes during the year. Several targeted programmes were conducted under the NEH and the Tribal Sub Plan programmes which has benefitted large number of fishermen and women in the North Eastern states and tribal areas of the country.

Recognizing our work the Ministry of Chemicals and Petrochemicals, Government of India awarded a team of our scientists with the 4th National Awards for Technology Innovation in Petrochemicals and Downstream Plastics Processing Industry (Runner Up) in the field of Polymer Science and Technology. The Institute also was awarded the ISO 9001:2008 Certificate.

The Institute has continued building specific purpose infrastructure like the Pilot level wood preservation facility for wood preservation treatments which is also made available to fishermen. The digital repository developed using Dspace open source software is an important step under-taken to provide world wide access to Institute's research output. Taking a cue from the national movement, the Institute also organized campaigns under the 'Swachh Bharat Mission'.

The Institute has traversed 57 glorious years and the scientists and staff rededicate themselves to carry forward the work that will be useful for the fisheries sector and to the common fishers of this country.

Kochi
20th June 2015

(Ravishankar C.N.)

निदेशक की ओर से

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वार्षिक रिपोर्ट को तैयार करना एक प्रकार का आत्मविश्लेषण है, जहां हम उपलब्धियों को पहचानते हैं और कमियों का मूल्यांकन करते हैं। यह वह भी समय है जब हम नए लक्ष्य निर्धारित करते हैं और नई चुनौतियों को स्वीकारते हैं। हर साल की तरह इस साल में भी उपलब्धियों व सम्मान प्राप्त हुए और सूचक भी थे जहां हमें आनेवालों सालों में पुनः ध्यान देना है।

संस्था का प्रमुख अधिदेश शोध है। संस्था की राष्ट्रीय स्तर पर कई उपलब्धियाँ है। संस्था ने अर्ध वेलापवर्ति ट्राल पद्धतियों की अभिकल्पना एवं प्रचालनात्मक प्राचलों को स्तरीयकृत की हैं, यही नहीं रेडियल एस्केपलेंट उपकरण, जुवेनाइल और ट्रेश एक्सक्लूडर उपकरण की अभिकल्पना और संविरचन किया ताकि मात्स्यिकी क्षेत्र संपन्न हों। बोट के निर्माण के लिए नारियल के पेड की लकड़ी का उपयोग किया गया और कारीगारी मछुवारों के लिए डोंगियाँ निर्मित की गई।

संसाधन प्रौद्योगिकियों में, मत्स्य आधारित उत्पादों के कवच आयु को बढ़ाने में कैटोसन कोलैजन फिल्म का खाद्य आवरण उपयोगी रहा। जैव सेरामिक प्राकृतिक हाइड्रोविस्पाटाइट कैटोसन कंपोजिट सीमेंट विकसित कर लक्षणीकृत किया गया जिसे दंत चिकित्सा में उपयोग किया जा सकता है। पाइलेट स्तर पर मत्स्य केलशियम कैपसूलों का उत्पादन कर इसे बाजार के अनुरूप जांचा गया है।

उपभोक्ता खाद्य उत्पादों के गुण और सुरक्षा पर जागरूक है। पर्ल स्पाट का 16 दिनों के बजाय 22 दिनों के संचय अवधि के लिए 124 क्वालिटी डिस्क्रिटर्स को विकसित किया गया।

{ÉÒxÉºÉ ¨ÉÉxÉÉbÉxÉ के पश्च लारवे से *Ê´ÉÊ¥ÉªÉÉå EòÉ±É®úÉ* 0139 को अलग किया गया और भारत में इसे पहली बार रिपोर्ट किया गया। इस स्टेन से खेतीकृत झींगों में उच्च मृत्यु दर प्राप्त हुआ। मीथैसिलिन प्रतिरोध के *º]ÉÊ¡ò±ÉÉäEòÉäEòºÉ +ÉÊ®úªÉºÉ* का पृथक्कीकरण काफी चिंताजनक है चूंकि पाथोजन का ड्रगस से प्रतिरोध होता है। *लैसिनबासिलस पृरमिस* +É® *बासिलस iÉÉ®úVÉÉÊxÉºÉºÉ* को उच्च सांद्र पालीथीलिन डिग्रेडिंग बैक्टिरिया के रूप में पहचाना गया। इस पहलू में आगे का शोध, पर्यावरण में प्लास्टिक प्रदूषण के खतरे के लिए हल होगा।

विटमिन को माइक्रोएनकेपसकेट कर गैर आक्सीकरण कैटोसन डेरिवेटिव निर्मित किया गया। यह थियामिन और पैरिडोक्सिन के नए डेलिवरी पद्धति के रूप में काम करता है।

सोलार चिल्लर और हाथ से संचालित मत्स्य डीस्केलिंग मशीन के प्रोटोटाइप को विकसित किया गया। सोशियल साईन्स में, मछुवारों के सहकारिता समितियों को निर्धारित करने के लिए सूचक विकसित किए गए और देश भर में भिन्न प्रौद्योगिकी हस्तांतरण कार्यक्रम आयोजित किया गया।

शोध को ज्यादा लोगों तक पहुँचाने की जरूरत है। साल में सस्था ने 126 प्रशिक्षण एवं जागरूकता कार्यक्रम आयोजित की। पूर्वोतर एवं ट्राइबाल उप योजना के तहद कई लक्षित कार्यक्रम चलाए गए जिससे पूर्वेत्तर एवं ट्राइबल इलाकों के मछुवारों को फायदा हुआ।

हमारे काम को पहचानकर, भारत सरकार के रसायन एवं पेट्रोकमिकल मंत्रालय ने हमारे वैज्ञानिकों को पॉलिमर साईन्स एवं प्रौद्योगिकी में टेक्नोलोसी इनोवेशन इन पेट्रोके केमिकल और एंड डाउनस्ट्रीम प्लास्टिक प्रोसेसिंग इंडस्ट्री पर राष्ट्रीय पुरस्कार (दूसरा स्थान) दिया। संस्था को ISO 9001:2008 प्रमाणपत्र भी प्राप्त हुआ।

संस्था खास संरचना के तहद काष्ठ परिरक्षण उपचार के लिए पाइलेट स्तर पर काठ परिरक्षण की सुविधा उपलब्ध करा रही है जो मछुवारों के लिए भी है। संस्था के शोध कार्य को ज्यादा लोगों तक पहुँचाने के लिए डी स्पेस ओपन सोफटवेर द्वारा डिजिटिल रिपोजेटोरी विकसित किया गया जो संस्थान का महत्वपूर्ण कदम है। राष्ट्रीय स्तर के कार्यक्रम से प्रेरित होकर संस्था ने स्वच्छ भारत मिशन के तहद काम की।

संस्था ने 57 साल पूरे किए और वैज्ञानिक और सदस्य कर्मचारी पुनः अपने को समर्पित करते हैं ताकि हमारी काम मात्स्यिकी क्षेत्र के लिए और देश के आम मछुवारों के लिए फायदेमंद हों।

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निदेशक

Executive Summary

- Composite based on polyethylene glycol-NN diethylenediamine-lead oxide detected formaldehyde in the concentration range 0.1 to 200 ppm which can be used for detection of formaldehyde adulteration.
- The design and operational parameters of semi-pelagic trawl system was standardized in collaboration with commercial vessels of Kochi, Manglore, Veraval, Devgud and Visakhapatnam.
- Incidence of juveniles of hilsa was more in surface set bagnet than bottom set bagnet operated in Hoogly river.
- A radial escapement device was designed and fabricated which showed a total escapement percentage of 17% comprising 80-90% of juveniles.
- A juvenile and trash excluder device (JTED) was designed and fabricated which was found to be efficient in excluding 11 species of juvenile fishes out of 20 species retained in the codend during the trial studies.
- *In situ* bio-optical data of Kochi region were collected and evaluated with six empirical algorithms showing that OC3M and OC4 performed better. Based on the variability in spectral remote sensing reflectance (Rrs), three water types were identified with Type 1 waters having peak Rrs in blue band having low Chlorophyll a concentration (0.25 ±0.17 mg m^{-3}), Type 2 and 3 waters with Chlorophyll a concentration 7.4 ± 4.8 mg m^{-3} and 11.5 ± 6.8 mg m^{-3}.
- Canonical correlation analysis (CCA) showed the abundance of *Acetes* sp. and total catch was most correlated to the chlorophyll content in the water and temperature.
- A total of 39 planktonic species belonging to two Divisions namely Bacillariophyta and Pyrrophyta were identified in the tuna advisory areas. Out of 39 species, 23 species belonging to 17 genera and 16 families were found to be Diatoms. Remaining 16 species belonging to six genera and four families were found to be Dinoflagellates.
- Constructed a coconut wood canoe for coastal/inland fishing of L_{OA} 9m, breadth 1.52m and depth 0.7m.
- LCA database was created for individual fishing systems (craft and gear) for the first time and critical environmental impact factors assessed. Among different categories of gear such as trawls, purse seine, ring seines and gillnets, trawls contributed maximum to the impact factors.

- The average escapement from 90 hauls using square mesh codend was found to be approximately 2 kg/haul.
- Different processing and preservation methods like cook chilling, *sous vide*, essential oil treatment, chitosan film wrapping, oxygen scavenger, vacuum packaging and MAP improved the shelf life of various fishes.
- A shelf life extension of 20 and 10 days was observed for the *sous vide* processed Indian mackerel steaks with and without curry leaf essential oil treatment, respectively, compared to control air sample, during storage at 2 °C.
- Steaks of barracuda fish were wrapped with the chitosan (CH) films incorporated with ginger essential oil (GEO) at 0.3% of the film forming solution and stored at 2 °C for 20 days. Addition of ginger essential oil (GEO) (0.5, 1, 1.5, and 2% v/v of the film forming solution) caused a significant decrease in the strength properties. Antimicrobial and barrier properties were significantly improved upon GEO addition.
- Salt concentration of 1:1 was better than 1:2 on different drying methods for solefish, croaker, Bombay duck and catfish.
- Low sodium dried fish products were prepared by partial replacement of sodium chloride (30, 40 and 50%) by six different formulations of alternative no-sodium salt and spice mixtures. There were no significant ($p \leq 0.05$) changes in the sensory quality of catfish dried in both the methods pre-salted with a mixture of no-sodium salts by replacing sodium chloride upto 50% level.
- A rapid extraction protocol for the extraction of gelatin from fish scale using microwave assisted heating was standardized.
- Shelf life prediction model was developed for chilled stored pangasius.
- Pilot scale production of fish calcium capsules were carried out and test marketing of the same was conducted by M/s Perma Health Care, New Delhi.
- Polylactic Acid (PLA) and PEG at 5% level is appropriate for biodegradable films formation.
- Incorporation of seaweed improved the total fibre content in fish jerky.
- Incorporation of seaweed in tuna based curry improved the retention of EPA and DHA in thermal processed products.
- A bio-ceramic natural hydroxyapatite-chitosan composite cement was developed and characterized based on structural and mechanical properties
- The thermal properties of gelatin extracted from fish scale was improved by blending with natural gums/plant polyphenols.
- Quality index scheme for pearlspot was established with limit of acceptability of 16 days against the storage period of 22 days for 14 quality descriptors.
- Hazard profiling of samples from market were acceptable in general, but certain samples were found to have contaminated with formaldehyde which is banned for human consumption.
- The dry fish samples were generally free from any chemical and microbiological hazards, though some of the samples were found to be contaminated with *Staphylococcus aureus*.
- In tuna loins, high pressure treatments over 400MPa eliminated histamine formers completely.
- Microbial safety studies on Bluefin trevally showed contamination with *Brochothrix thermosphacta*, an organism normally found associated with meat and meat products.
- Quality assessment of monosex tilapia showed a shelf life of 21 days for gutted fishes against the whole fish which had a shelf life of 24 days.

- Quality assessment of whole marine crab *Charybdis cruciata* in chilled condition revealed acceptability up to 13th day. The biogenic amines putrescine, cadaverine and histamine were showing an increasing pattern during the storage.
- An LCMS MS method for the detection of 225 pesticides was standardized using fish matrix.
- Lactic acid was found to be an effective antimicrobial additive against *E. coli* and *S. aureus* in a study involving fish sausages.
- A RSM based optimization of salt concentration and lactic acid concentration (4.25% NaCl and 0.2% lactic acid level) for inhibition of *Salmonella enterica* indicated effective reduction of pathogen by 6.6 log in marlin fillets.
- Efficacy of commercial preparation of bacteriophages for control of *Salmonella paratyphi* and *S. typhimurium* was demonstrated in fish matrix.
- The aqueous extracts of *Garcinia cambogia, Tamarindus indica , Camellia sinensis* and *Citrus aurantifolia* at 5% and 10% levels demonstrated efficacy against pathogenic bacteria namely *Aeromonas hydrophila, Bacillus subtilis, Enterococcus faecalis, Salmonella enteritidis, Staphylococcus aureus, Vibrio cholera* and *V. parahaemolyticus*
- The incidence of *Brochothrix thermosphacta* was an important finding which indicated the contamination in retailing of *Caranx melampygus.*
- Developed a protocol for melanosis inhibition using alternatives of metabisulphites. The combinations containing sodium citrate and EDTA have significantly controlled black spot formation in *Litopenaeus vannamei.*
- Trends in the veterinary medicinal products in shrimp exported from India to the European Union (EU) during 2003 and 2014 showed that Nitrofuran (metabolite), Furazolidone (AOZ) (44%) and Nitrofurazone (SEM) (37%) were the major causes of notifications followed by Chloramphenicol (6%) and Oxytetracycline (2%). The reported level of SEM in shrimp ranged between 1.1 and 170 ppb and AOZ ranged from 1.1 to 150 ppb.
- An experiment was conducted to assess the median lethal concentration (LC_{50}) of Cadmium in tilapia. The result of the study indicates that the LC_{50} of $CdCl_2$ for tilapia (3.1 ± 0.2 g) is 136.62 ppm.
- Proximate composition of different conventional and non-conventional feed ingredient was analyzed. The protein percentage of Spirulina and Ground Nut Oil Cake was found satisfactory for making aquafeed for finfishes but still it is a matter of investigation in case of lobster.
- *V. cholerae* O139 serogroup pathogenic to shrimp was isolated from post-larvae of *P. monodon* from a shrimp farm which reported mass mortality. This is the first report of *V. cholera* O139 strain causing high mortalities in shrimp.
- Methicillin-resistant *Staphylococcus aureus* was detected in 9.5% of 63 samples from different retail markets and aquaculture farms of Kerala and MRSA isolates belonged to SPA ridom types t002, t657, t334, t311.
- Multi-locus sequence typing of MRSA isolates revealed that the isolate which was t657 ridom spa type belonged to ST772 which is commonly called as Bengal Bay clone reported in many parts of India as community-associated MRSA in clinical infections.
- Molecular characterization of *Edwardsiella tarda,* an emerging gastroenteritis pathogen, isolated from the lesions of farmed *Pangasianodon hypophthalmus* revealed presence of T3SS gene *esaV* which is a potential virulence marker.
- Antibacterial activity against MRSA was detected in Actinobacteria belonging to Genera *Brachybacterium.*
- Two chitinase genes 19A and 18B were identified in *Paenibacillus elgii* with potent antifungal activity and a 70KDa chitnase gene was cloned in pET28 plasmid and expressed in *E. coli.*

- *Lysinibacillus fusiformis* and *Bacillus thuringiensis* were identified as high density polyethylene (HDPE)-degrading bacteria.
- Yellow Head Virus was detected in imported processed shrimp. This is the first report on the presence of YHV in imported samples.
- RNA-seq based transcriptome analysis of *Mangrovibacter* sps. during aerobic to anoxic transition revealed that the number of genes up-regulated under aerobic condition was significantly lower than that during transition and anoxic stage.
- Two draft genome sequences of halophilic, highly halotolerant Gammaproteobacteria Strain MFB021 and bacteria associated with mangrove belonging to the Genus Mangrovibacter, have been published in NCBI.
- A novel delivery system of thiamine and pyridoxine was developed by microencapsulating the vitamins with an antioxidant chitosan derivative (Ferulic acid- grafted chitosan). The microparticles were characterized with Scanning Electron Microscope (SEM) revealing spherical particles with no apparent cracks and pores. The particles showed thermal stability and slow release.
- A novel delivery system of β-carotene was developed by microencapsulating with vanillic acid-grafted chitosan. The particles showed slow release of β-carotene and provided stability against oxidation and light. A fish soup powder was developed incorporating microencapsulated β-carotene. *In vivo* studies in rat model showed enrichment of β-carotene in blood plasma.
- A solvent-free two stage enzymatic extraction protocol was developed for extraction of seaweed bioactives (peptide, phenolics, sulphated polysaccharides). These extracts showed better antioxidant potential than solvent and hot water extracts. Two functional food products such as a nutraceuticals drink and fish soup powder were developed by enriching with these extracts.
- A collagen peptide hydrolysate was prepared by a combination of enzyme digestion from fish skin collagen. The peptide hydrolysate showed promising results in collagen protein expression in mouse embryonic fibroblast cells indicating its potential application as food supplement for treatment of arthritis.
- The encapsulation efficiency and oxidative stability of fish oil microencapsulates was enhanced by blending with sage/oregano essential oils.
- In a study on engine characteristics and quality performance of fishing vessel, the engine validation procedure was refined to test the engine endurance by subjecting it to a judicious variation of maximum power and torque at specified rpm levels in 15 cycles of 16 hours with 8 hours cooling time in between the cycles.
- Designed and developed a prototype solar chiller of 5 kg capacity.
- Developed a hand held de-scaling machine of 5 kg capacity.
- Technology transfer programmes on responsible fishing and production of value added products were conducted in three fishing villages *viz.*, Thanga and Sarik Konjin fishing village, Manipur and Pulicat in Tamil Nadu. The awareness on improved practices and products was found to have increased after the training.
- Performance indicators were developed for assessing fishermen Co-operative Societies in Kerala and the study showed that legal status, financial management, co-operative planning and administrative procedures, membership strategies and market linkages were the five major indicators determining the performance.
- The annual ice requirement of the fishing industry in Kerala was estimated as 8.5 lakh tonnes.

Central Institute of Fisheries Technology

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

Vision

To facilitate sustainable harvesting and total utilization of fishery resources through innovations in harvest and post-harvest technologies

Mission

Ensure responsible harvesting of fishery resources through eco-friendly, energy efficient and economical means; ensure total utilization of the harvested fish through appropriate processing, value addition, packaging and waste utilization; ensure food safety and nutritional security to the consumer and minimize carbon & water footprint per unit volume; and to ensure equitable benefits to the stakeholders, across the value chain.

Overview

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.

Budget

For the year 2014-2015
All values in INR in lakhs

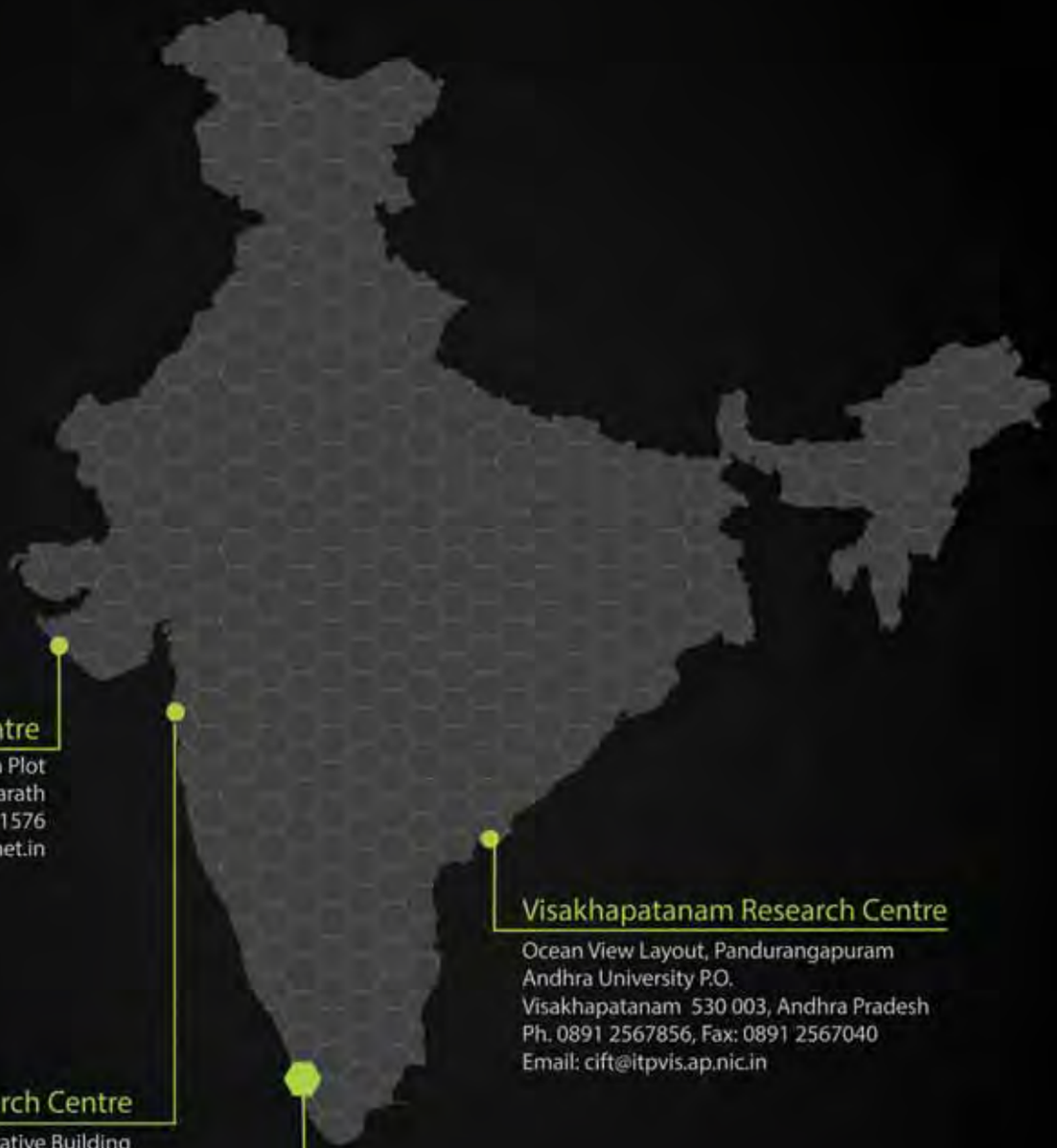
Particulars	Non-Plan		Plan	
Budget Head	Allocation	Expenditure	Allocation	Expenditure
Establishment charges	200.00	1992.94	-	-
Overtime allowances	0.50	0.38		
Traveling allowances	20.00	20.00	35.00	35.00
Works (Original)	-	-	70.00	70.00
Works (Maintenance)	-	-	-	
Other charges (Equipments)	30.00	29.92	98.00	97.93
Other charges (Contingency)	341.25	341.25	429.00	429.00
Furniture and Fixtures	2.00	1.99	-	-
Library books	4.00	3.99	25.00	25.00
Other items	-	-	-	-
HRD	-	-	-	-
Information Technology	-		15.00	14.94
NEH programme	-	-	27.00	26.95
Tribal sub plan	-	-	16.00	15.93
Total	**2397.73**	**2390.47**	**715.00**	**714.75**

Staff Position

As on 31 March 2015

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY

www.cift.res.in



Veraval Research Centre

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Email: ciftvrc_ad1@sancharnet.in

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Ph: 0484-2412300; Fax: 091-484-2668212
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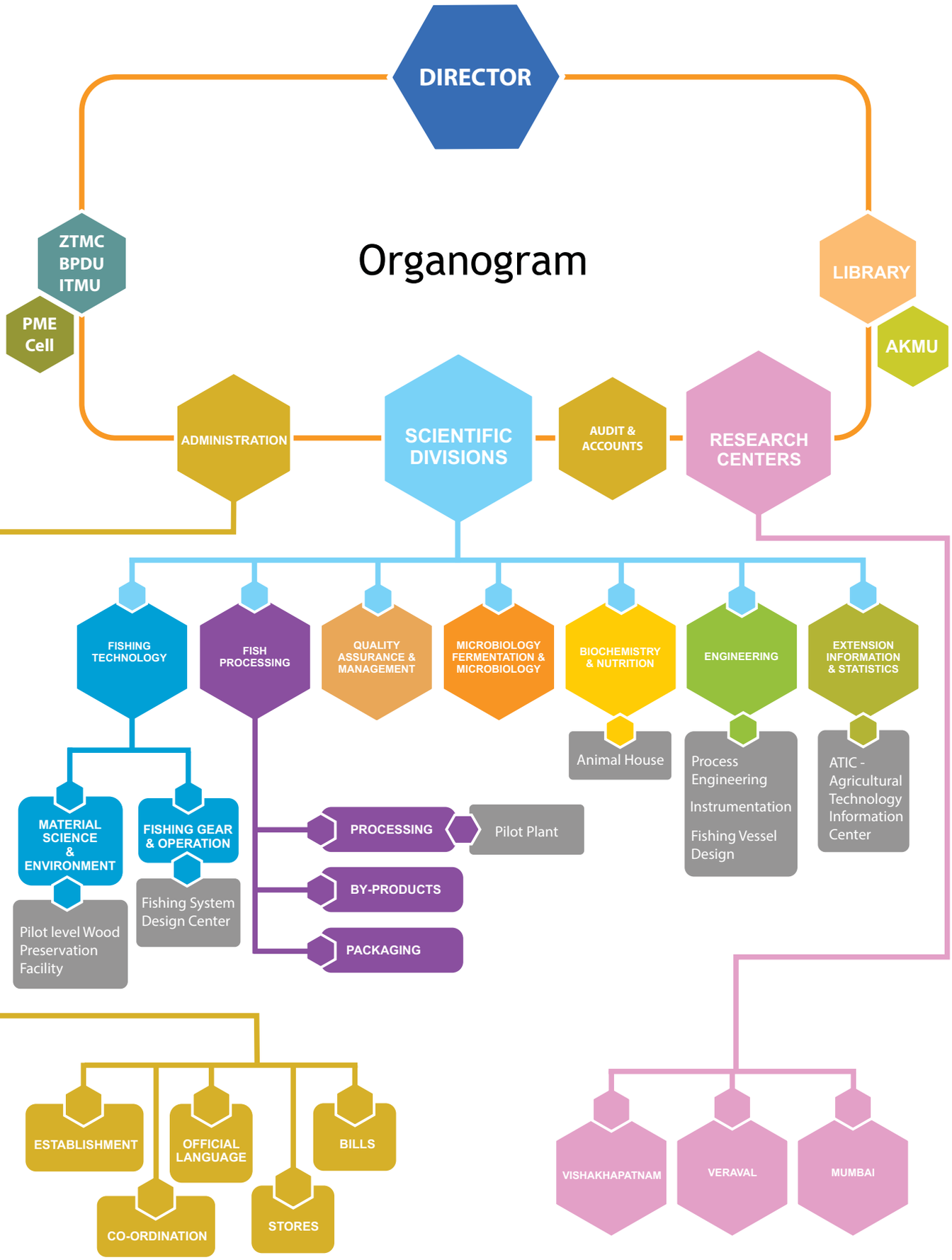
Organogram


DIRECTOR
ZTMC
BPDU
ITMU
PME Cell
LIBRARY
AKMU
ADMINISTRATION
SCIENTIFIC DIVISIONS
AUDIT & ACCOUNTS
RESEARCH CENTERS
FISHING TECHNOLOGY
FISH PROCESSING
QUALITY ASSURANCE & MANAGEMENT
MICROBIOLOGY FERMENTATION & MICROBIOLOGY
BIOCHEMISTRY & NUTRITION
ENGINEERING
EXTENSION INFORMATION & STATISTICS
Animal House
Process Engineering
Instrumentation
Fishing Vessel Design
ATIC - Agricultural Technology Information Center
MATERIAL SCIENCE & ENVIRONMENT
FISHING GEAR & OPERATION
Pilot level Wood Preservation Facility
Fishing System Design Center
PROCESSING
Pilot Plant
BY-PRODUCTS
PACKAGING
ESTABLISHMENT
OFFICIAL LANGUAGE
BILLS
CO-ORDINATION
STORES
VISHAKHAPATNAM
VERAVAL
MUMBAI

RESEARCH
ACHIEVEMENTS

FISHING TECHNOLOGY

Research projects handled

Institute projects

- Nano technological interventions to mitigate fishing craft and gear material degradation
- Responsible fishing for marine sector
- Development of appropriate fishing systems for rivers
- Reduction of environmental impact from trawling systems through bycatch reduction technologies and development of region specific sustainable fishing systems for east coast of India

Externally funded projects

- Retrieval of phytoplankton biomass and associated optical constituents based on long term bio-optical studies
- Studies on the ecological linkages between plankton production and *Acetes* sp. abundance along Gujarat coast
- Validation of tuna advisories off east coast
- Exploration and assessment of demersal fishery resources along the continental slope (200-1200 m) of Indian EEZ and central Indian Ocean
- Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- Techno-economic feasibility of coconut wood canoes for small scale fisheries sector in the south west coast of India and Lakshadweep
- Green fishing systems for tropical seas
- Demonstration and field testing of bycatch reduction devices, juvenile fish excluder devices and promotion of square mesh codend in Sindhudurg district of Maharashtra

Most significant achievements

- Composite based on polyethylene glycol-NN diethylenediamine-lead oxide detected formaldehyde in the concentration range 0.1 to 200 ppm which can be used for detection of formaldehyde adulteration.
- The design and operational parameters of semi-pelagic trawl system was standardized in collaboration with commercial vessels of Kochi, Manglore, Veraval, Devgad and Visakhapatnam.
- Incidence of juveniles of hilsa was more in surface set bagnet than bottom set bagnet operated in Hoogly river.
- A radial escapement device was designed and fabricated which showed a total escapement percentage of 17% comprising 80-90% of juveniles.
- A juvenile and trash excluder device (JTED) was designed and fabricated which was found to be efficient in excluding 11 species of juvenile fishes out of 20 species retained in the codend during the trial studies.
- *In situ* bio-optical data of Kochi region were collected and evaluated with six empirical algorithms showing that OC3M and OC4 performed better. Based on the variability in spectral remote sensing reflectance (Rrs), three water types were identified with Type 1 waters having peak Rrs in blue band having low Chlorophyll a concentration (0.25(±0.17) mg m^{-3}), Type 2 and 3 waters with Chlorophyll a concentration 7.4 ± 4.8 mg m^{-3} and 11.5 ± 6.8 mg m^{-3}, respectively.

- Canonical Correlation Analysis (CCA) showed the abundance of *Acetes* sp. and total catch was most correlated to the chlorophyll content in the water and temperature.
- A total of 39 planktonic species belonging to two Divisions namely Bacillariophyta and Pyrrophyta were identified in the tuna advisory areas. Out of 39 species, 23 belonging to 17 genera and 16 families were found to be Diatoms. Remaining 16 species belonging to six genera and four families were found to be Dinoflagellates.
- Constructed a coconut wood canoe of L_{OA} 9m, breadth 1.52m and depth 0.7m for coastal/inland fishing.
- LCA database was created for individual fishing systems (craft and gear) for the first time and critical environmental impact factors assessed. Among different categories of gear such as trawls, purse seine, ring seines and gillnets, trawls contributed maximum to the impact factors.
- The average escapement from 90 hauls using square mesh codend was found to be approximately 2 kg/haul.

Chief findings

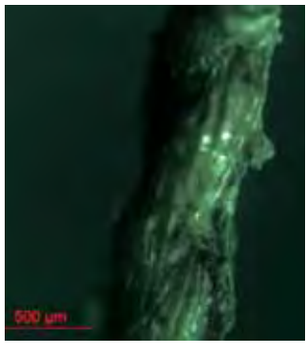
Institute projects

Nano technological interventions to mitigate fishing craft and gear material degradation

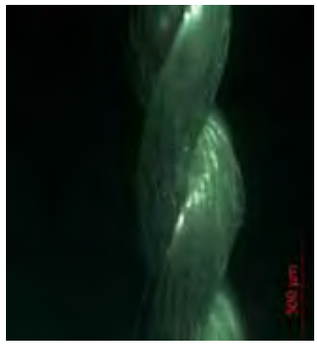
Nano material based antifouling strategies for synthetic netting

Nano Copper oxide-incorporated polyethylene glycol hydrogel: 0.002% nano Copper oxide incorporated hydrogel exhibited excellent fouling inhibition upto 30 days of exposure.

Polyamide netting was treated with mixtures of nano-sized Copper oxide and Titanium oxide in three combinations and exposed to the estuarine waters along with control. After 35 days exposure, samples with A3 treatment had maximum reduction in fouling biomass (70%) while A2 treatment had 62.2% and A1 treatment 16.1% reduction compared to untreated control.



Polyamide netting - Control after 30 days

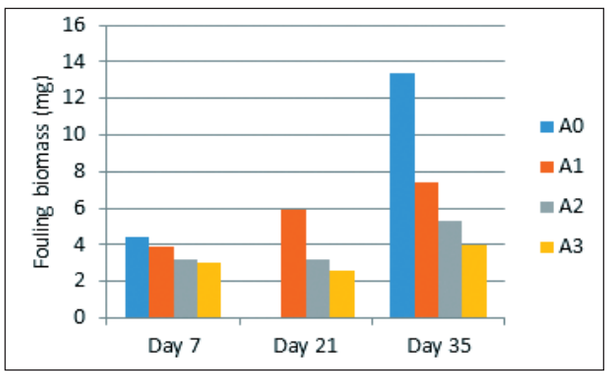


Hydrogel with 0.002% nano Copper oxide after 30 days

Bio-fouling resistance of natural fibres treated with nano biocides

Jute and Manila rope of 14mm diameter treated by immersion treatment with 0.01%, 0.03% and 0.05% TiO_2 were exposed to sea water for 30 days to assess the fouling resistance. Bio-fouling was significantly less in the treated sample with 0.03% and 0.05% TiO_2 compared to 0.01% and control sample.

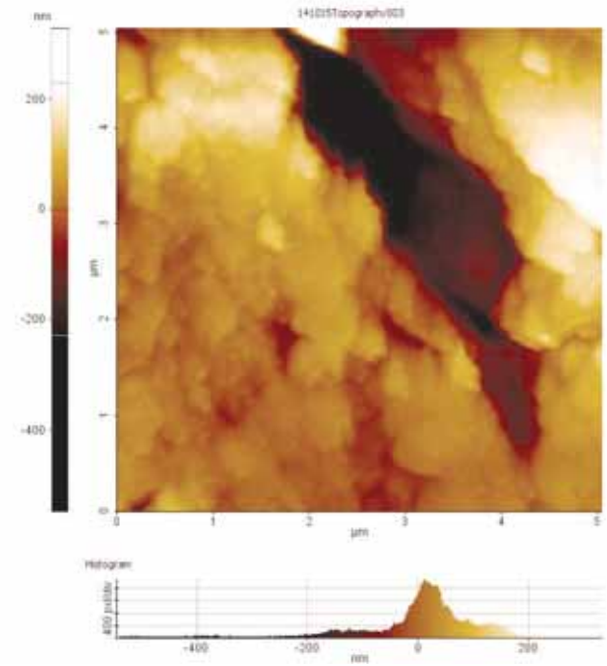
Manila rope exposed to marine environment for 30 days



Fouling biomass on Manila ropes

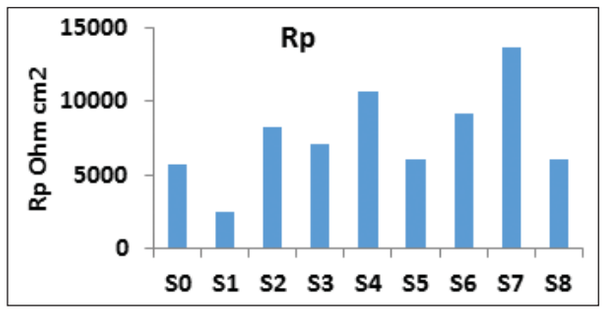
Surface modification of boat building steel using nano-sized Iron oxide and nano Cerium oxide for corrosion resistance

Boat building steel IS 2062 was treated with mixture of nano Cerium oxide and Iron oxide in different concentrations (0.001 to 0.004%) to prepare corrosion resistant nano coating over steel. The surface characterization of the treated steel panels using AFM showed uniform distribution of nano particles.



0.002% nano Iron and 0.004 Cerium oxide

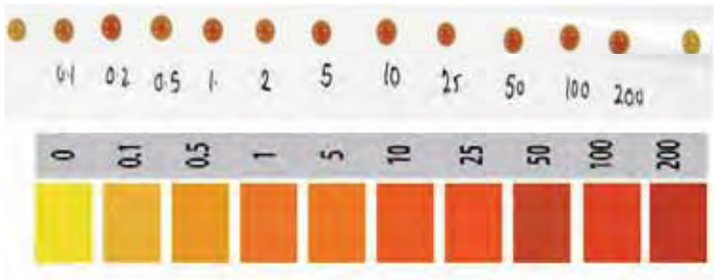
Linear sweep voltammetric evaluation of the treated steel showed that the corrosion potential, corrosion current density and polarization resistance varied from -0.704 to -0.897 V, 1.68 x 10^{-6} to 5.84 x 10^{-5} A cm^{-2} and 2500 to13650 Ohm cm respectively. Treatment S7 with 0.004% nano Cerium oxide and 0.002% nano Iron oxide showed excellent corrosion resistance when compared to other treatments.



Average polarization resistance of nano Cerium oxide and nano Iron oxide treated boat building steel measured using Linear sweep voltammetry

Development of formaldehyde sensor for environmental applications

Synthesized a polyethylene-N,N-ethylene diamine and lead oxide composite. The composite responded excellently in varying concentrations of formaldehyde. Composite prepared using polyethylene glycol, N,N-ethylene diamine and lead oxide through microwave synthesis responded to 0.1 to 200 ppm formaldehyde.



Colour pattern exhibited by varying concentrations of formaldehyde

Responsible fishing for marine sector

Development of improved semi pelagic trawls and demonstration for commercialization

Two improved versions of SPTS net with large meshes (400 and 1000 mm mesh size) in the wings were developed and field tested at Cochin. Significant reduction in shrimps was observed and the catch of fish was not affected by increasing the mesh size from 200 to 400 and 1000 mm in the wings with the codend mesh size of 30mm. The average CPUE in the 400 mm wing SPTS net was 6.98±2.48 (S.E.) kg^{-1} and in the 18m SPT (200 mm wing) the CPUE was 10.5±3.38 (S.E.) kg^{-1}.

Field demonstration of CIFT-SPTS was carried out onboard a private fishing trawler at Veraval, Gujarat. Depth of opera-

tion was 26 m and the warp released was 170 m, while the towing speed was 2.5 knots.

Catch from the SPTS

Performance of Ultra High Molecular Weight Polyethylene Rope (UHMWPE)

UHMWPE rope installed onboard Matsyakumari II was used for fishing operations for one year. An elongation of 6 and 5.4 m respectively was recorded on the starboard and port side. The UHMWPE rope was found to have many advantages over steel wire rope such as no greasing or lubricating required, safety, hygienic deck, light weight and ease of handling, installation, removal etc.

UHWMPE rope

Development of appropriate fishing systems for rivers (CIFT - CIFRI Collaborative Project)

Bycatch Reduction Device (BRD) in bagnets

Two square mesh and two bigeye BRDs were fixed in selected bagnets at Diamond harbour, in association with Hilsa Conservation and Research Centre (HCRC), Department of Fisheries, West Bengal. Length of the excluded hilsa ranged from 35 to 55 mm.w Square mesh window was found better than bigeye BRD.

Field trials were carried out with bagnets fitted with square mesh window and fish eye BRD at Odalarevu. The catches at Odalarevu was dominated by small prawns (45.7%) followed by Leognathids (18.0%), Hilsa spp. (11.0%), ribbonfish (9.0%), Cynoglossus (8.0%) and Squilla (8.0%). The fishes escaped were dominated by prawns (35.1%) followed by *Stolephorus* sp. (32.4%), Leognathids (16.2%) and crabs (16.2%). The species diversity indices of the escaped catch from bagnet attached with square mesh window were calculated.

BRD in bagnets

Multi purpose solar powered FRP boat

The multi purpose solar powered FRP boat of 3.6m L_{OA} with (0.5kw solar panel) twin hull, and two propellers each with 0.6kw was handed over to the Inland Fishermen Society at Kumbalam for fishery trials and design improvements.

Multi purpose solar powered FRP boat in operation

Wooden crafts at Gondia

Studies on craft and gear of reservoirs

Craft and gear study of Gondia and Bhandara districts of Vidharbha region of Maharashtra has been carried out to improve the craft and selectivity of fishing gears.

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

Fishing gear selectivity studies

Selectivity experiments were carried out onboard vessel CIFTECH off Visakhapatnam coast, using a 30 m demersal trawl fitted with 40 mm square mesh codend. A total of 14 species were retained in the trawl with 40 mm square mesh codend. Three species escaped. The total percentage of escapement was 15.2%. Goatfish, anchovies and silverbellies showed an escapement of 19.3%, 99.0% and 4.74%, respectively. Biodiversity parameters of the retained and escaped species were calculated.

Demersal trawl with square mesh trawl codend in operation

Development of region specific BRDs

Excluded catch from JTED

Operation of RED on-board CIFTECH1

In field trials with JTED with 1 cm spacing, it was observed that 20 species were retained in the codend and 11species had escaped into the cover codend. Three species showed escapement between 20 to 50%, three species showed escapement over 50% and three species showed between 5-20% and the rest showed 100% retention.

Radial escapement device and rigid sorting grid BRDs were designed, fabricated and field studies were conducted. Radial Escapement Device (RED) was field tested. A total of 12 species were retained while three species escaped. The total percentage of escapement was about 17% in which 80 to 90% constituted of juveniles.

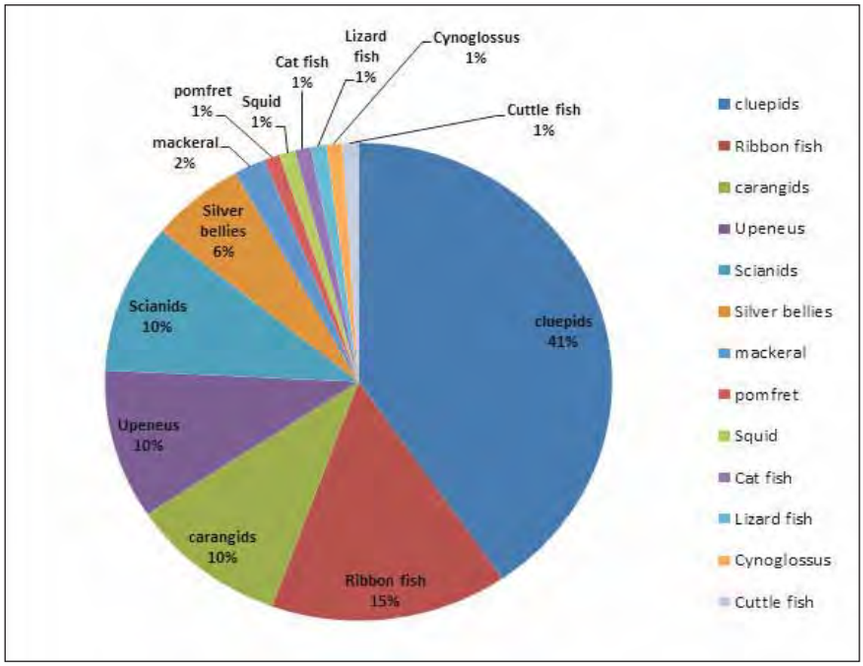
CIFT TED trials in Chennai and Visakhapatnam

CIFT-TED trials were conducted off Chennai using a fish trawl fitted with CIFT-TED. The exclusion rate during trials at Chennai and Visakhapatnam was 4.33% and 3% respectively. 100% exclusion of sea turtles was seen at both places.

CIFT-TED being deployed off Chennai

Catch with excluded turtle during TED operation

Estimation of bycatch from fishing systems



Percentage of juvenile bycatch from trawl landings

Data on bycatch were collected from long liners operating hook No. 12 targeting tuna from Visakhapatnam. The bycatch which constituted about 5% of the total catch was represented by Red snappers (40%), catfish (20%), *Pomadasys* sp. (20%), *Epenephelus* sp. (10%), *Muraenesox* sp. (10%) and *Anguilla* sp. (5%) of the total catch. Bycatch samples were collected from the landings of small trawlers based at Visakhapatnam and Kakinada. Fishes were identified using standard identification keys. A total of 264 species belonging to 61 families were identified which included juveniles of commercially important fishes.

FISH PROCESSING

Research projects handled

Institute projects

- Development of standard processes and protocols for innovative products from aquatic resources, shelf life modeling and assessment of energy use
- Development of high value byproducts from fish and shellfish processing discards
- Thermal and non-thermal technologies for processing and packaging of fish products
- Processing and quality improvement of seafoods in Gujarat
- Species specific technologies for the improved utilization of the fishery resources of Maharashtra region
- Innovative product development for value addition, nutrient fortification and shelf life extension of farmed and wild freshwater and marine fish

Externally funded projects

- Development of bioplastic based sustainable nano bio-composite food packaging - Sustain Nanopack
- Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies
- Use of natural resins and gums for preservation and value addition of fishery products

Most significant achievements

- A shelf life extension of 20 and 10 days was observed for the *sous vide* processed Indian mackerel steaks with and without curry leaf essential oil treatment, respectively, compared to control air sample, during storage at 2 °C.
- Steaks of barracuda fish were wrapped with the chitosan (CH) films incorporated with ginger essential oil (GEO) solution and stored at 2 °C for 20 days. Addition of ginger essential oil (GEO) (0.5, 1, 1.5 and 2% v/v of the film forming solution) caused a significant decrease in the strength properties. Antimicrobial properties based on fish shelf life enhanced more than eight days compared to the control sample.
- Salt concentration of 1:1 was better than 1:2 on different drying methods for solefish, croaker, Bombay duck and catfish.
- Low sodium dried fish products were prepared by partial replacement of Sodium chloride (30, 40 and 50%) and no significant change was observed upto 5% level.
- A rapid extraction protocol for the extraction of gelatin from fish scale using microwave assisted heating was standardized.
- Shelf life prediction model was developed for chilled stored pangasius.
- Pilot scale production of fish calcium capsules were carried out and test marketing of the same was conducted by M/s Perma Health Care, New Delhi.
- Polylactic Acid (PLA) and PEG at 5% level is appropriate for biodegradable film formation.
- Incorporation of seaweed improved total fiber content in fish jerky.

- Incorporation of seaweed in tuna based curry improved the retention of EPA and DHA in thermal processed products.
- A bio-ceramic natural hydroxyapatite-chitosan composite cement was developed and characterized based on structural and mechanical properties.
- The thermal properties of gelatin extracted from fish scale was improved by blending with natural gums/plant polyphenols.

Chief findings

Institute projects

Development of standard processes and protocols for innovative products from aquatic resources, shelf life modeling and assessment of energy use

Restructured fish products with functional ingredients and its quality evaluation

Restructured products were prepared from pinkperch mince with added chitosan and starch. Control samples showed higher oxidation rate than the chitosan treated one. In case of control sample, a gradual increase was observed for APC which reached 5 $\log_{10}$ on 12th day. The chitosan treated cooked sample was microbiologically stable up to 22 days. Sensory evaluation showed that combination of 0.5% chitosan and 0.25% mint had higher score for overall acceptability.

Edible coating on storage life of value added fishery products

Drum stick gum and chitosan nanoparticles

Composite edible coatings were prepared using chitosan nanoparticles (CNP) and drum stick gum (DG). Steaks of Indian mackerel treated with the composite edible coating of CNP and DG had significantly lower bacterial counts compared to control in chilled storage conditions. Edible coatings of CNP and DG alone or in combination reduced the volatile bases formation and delayed lipid oxidation in chill stored fish steaks.

Development of ready-to-serve functional fish sausage

Quality of tilapia fish sausage incorporated with Glucosamine hydrochloride (GAH) (1% and 2%) was compared with control sausage stored at 1±1 °C. Addition of GAH did not affect the gel strength and texture of sausage. Both the control samples and 1% GAH added samples were acceptable up to 30 days sensorily compared to only 15 days for 2% GAH added samples.

Microwave texturisation of Pangasius surimi

The surimi prepared from Pangasius catfish, was subjected to microwave assisted texturisation, for different heating durations. Microwave heating for 105 sec. yielded comparable texturing effect as that of conventionally heated gels, in terms of hardness, expressible moisture and solubility values. Heating for higher duration resulted in excessive bulging and distorted shape to the gel. Microbiologically, heating for 105 sec. yielded 3 log reduction in total plate count.

Functional meat gel incorporated with gelatin and collagen peptide

Effect of incorporation of gelatin and collagen peptide at various levels on textural parameters were analyzed as a function of storage period in *Nemipterus japonicus*. The results indicated that addition of collagen peptide imparted some fluidity to the heat induced-gel on first day of sampling, with higher hardness values for control gels. However, during storage, collagen peptide incorporated at 0.5% level showed significantly higher hardness values, indicating the possibility of interaction between myofibrillar proteins and collagen peptide. Addition of polyphenol extracts from green tea, oregano, sage, rosemary and turmeric improved the gel strength of meat gel.

Models for assessing shelf life of chill stored fish

A study was undertaken to predict the shelf life of *Pangasius hypophthalmus* stored in chilled condition by evaluating the sensory, chemical and microbiological quality. The shelf life prediction was made on the basis of an index developed from organoleptic, microbiological, physical and chemical aspects of the fish during the storage period using principal component analysis. A functional form for Storage Days/ Shelf Life = f (PC1, PC2) + e was formulated to predict the shelf life of *P. hypophthalmus.*

Fresh pangasius

Pangasius on the day of rejection

Rohu meat hydrolysate

Spray dried powder of rohu meat hydrolysate was prepared, which indicated a solubility value of >95% in distilled water at room temperature. Stable emulsion could be formed with 4% concentration of spray dried powder. SDS-PAGE profile of hydrolysate indicated a reduction of 205 KDa and emergence of more low molecular weight peptides below 20 KDa. The hydrolysates showed good antioxidant properties in terms of DPPH scavenging activity, metal chelating and metal reducing activities.

Assessment of energy use pattern in post harvest fishery operations

The energy use pattern of a commercial seafood export unit located at Cochin was studied. The main source of energy used by the seafood industry is electricity, supplemented by diesel operated generator. From the industry, the monthly energy consumption for the fishery production was collected in terms of units used and value of the usage for 25 months. The energy consumption highly correlated with the production.

Development of high value byproducts from fish and shellfish processing discards

Preparation and quality evaluation of water soluble chitosan and film from CMC

Water soluble chitosan was prepared by carboxymethylation of chitosan with monochloroacetic acid. The final product was completely soluble in water. Formation of carboxymethyl chitosan (CMCh) decreased the viscosity of chitosan from 80 cP to 8.6 cP. Films made of PVOH alone had very good oxygen barrier property while CMCh films were having very high oxygen transmission property. Replacing PVOH upto 33% (PVOH:CMCh 2:1) did not alter the barrier property of PVOH film while increasing the ratio of CMCh to 50% has drastically increased the OTR of the films.

Preparation and quality evaluation of sea weed-incorporated products

Seaweed was incorporated in different proportions (0, 3 and 5%) in jerky batter formulation. Addition of seaweed resulted in increase of total fiber content from 0.91 to 2.49%. The control jerky without seaweed required significantly more force to fracture than the seaweed-incorporated jerky.

Tuna jerky with seaweed

Tuna jerky without seaweed

Functional properties of protein hydrolysate from fish processing waste

The antioxidant activity of protein hydrolysates prepared from *Acetes* sp. was determined by using DPPH free radical-scavenging activity. The antimicrobial activity was analyzed against both gram negative bacteria *E. coli* as well as gram positive bacteria *Staphylococcus* in disc diffusion method. The hydrolysate exhibited good antimicrobial activity against both gram positive and gram negative bacteria.

Preparation and quality evaluation of farm site feed

Feed for immediate use (At farm site) was developed using sardine head waste and other ingredients with soya powder as additional protein source. Wheat flour and rice bran was used as carbohydrate source. The sample which was prepared by initial cooking of fish waste for 15 min. with equal water and mixing with other ingredients was found to be stable for three days.

Preparation and quality evaluation of squid silage and feed based on squid silage

Squid silage-based feeds were prepared and a comparison between the quality of silage-based feeds and fish meal-based feeds individually and in combination were carried out. Quality parameters and mineral profiling of the products were carried out and found to contain calcium, sodium and phosphorus *inter alia* other elements.

Squid silage and fish meal based feeds in different combinations

Tuna protein hydrolysate (TPH) was prepared using 0.5% (w/w) bromelain enzyme. A yield of about 3.9% spray dried hydrolysate powder was obtained from tuna waste. Antioxidant properties like DPPH activity were found to be 56.79% per mg TPH and Total Phenolic Content in the sample was observed to be 31.85 ± 2.31 GAE/g.

Preparation and quality evaluation of spray dried shrimp extract

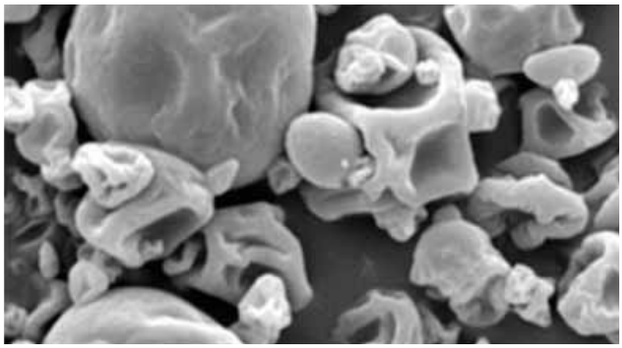
The shrimp extract prepared from prawn shell was spray dried and was compared with shrimp meat powder for different functional and organoleptic properties. It was observed that form formation and form stability of the shell extract powder was better while water holding capacity and fat binding capacity was poor for the shell extract powder when compared to the meat powder. Organoleptic evaluation of the noodle samples added with the extract has indicated that the shell extract powder has less flavour and required addition of 5% (w/w) powder when compared to meat powder.

Production of fish calcium capsules and its marketing

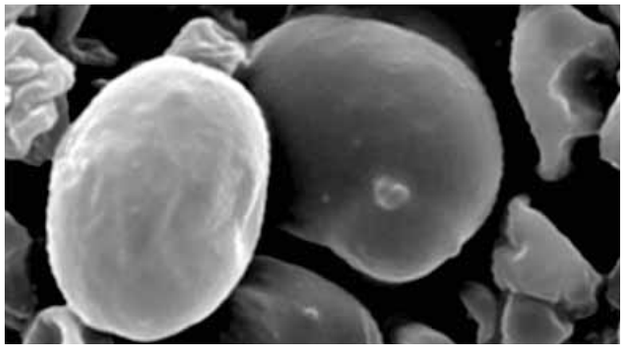
Pilot scale production of fish calcium capsules were carried out and test marketing of the same was conducted by M/s Perma Health Care, New Delhi.

Fish oil encapsulates

Fish oil encapsulates were prepared by using spray drier and freeze drier and their quality characteristics were analyzed. Encapsulation efficiency was found to be higher for the encapsulates prepared by spray drying (79.30%). In case of freeze dried sample it varied from 39.17-61.53%, depending on the emulsion composition. Lightness colour was better for spray dried samples. Fish oil encapsulation incorporating oregano essential oil improved oxidation stability.



Fish oil control



Sage/fish oil encapsulates

Extraction and characterization of acid-soluble collagen from fish scale

Native acid-soluble collagen was extracted from rohu scales and characterized based on compositional, molecular weight and solubility parameters. Gel filtration chromatography of native collagen showed a single distinct peak, which indicated the homogeneity and purity of the isolated collagen. SDS-PAGE analysis of extracted collagen indicated the presence of distinct α1, α2 and β bands. The yield of collagen from fresh carp scale was found to be around 11-15%.

Microwave assisted extraction of gelatin from fish scale

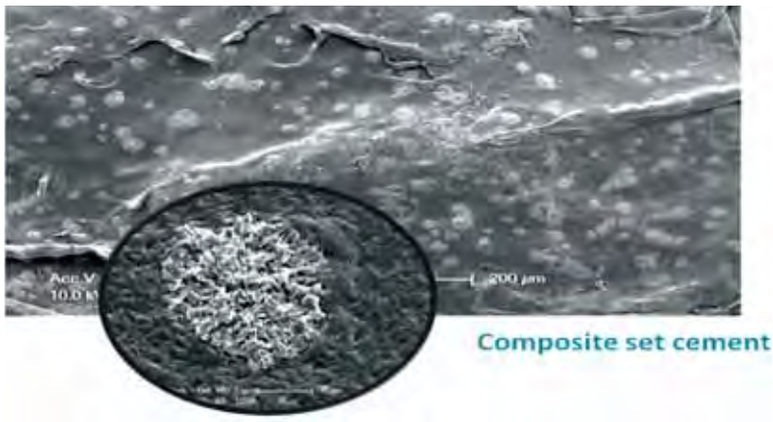
Microwave assisted protocol was attempted for the extraction of gelatin (MWG) from the scale of Indian oil sardine (*Sardinella longiceps*). Microwave heating considerably increased the recovery yield of gelatin from fish scale. The texture profile analysis of MWG indicated higher bloom strength and gumminess values compared to conventional gelatin (CG). The reconstituted solutions of MWG were less transparent than that of CG.

Crystallin protein from fish eye lense

Characterization of crystallin proteins isolated from oil sardine eyeball

Then optical proteins crystallins were isolated and characterized from the lens of oil sardine. The results indicated that oil sardine crystallins possess some structural homology with human crystallins with distinctly different thermal properties.

Development and characterization of bio-ceramic natural hydroxyapatite composite cement from fish scale



Composite set cement

Novel hydroxyapatite (HAP) /collagen polymer composites with high porosity and well-controlled pore structure were prepared from fish scale. The natural hydroxyapatite with a stoichiometric Ca/P ratio 1.67 was prepared by heat incineration method. The biological properties of the ceramic composites were further enhanced by blending with chitosan, which also improved the adhesive properties of the composite cement. The SEM image of set cement indicated the deposition of HAp crystals in a 'cauliflower like pattern' in a tightly arranged network of chitosan matrix, whereas in the absence HAp chitosan formed a porous spongy mass. A high porosity of >90% was achieved by changing the process parameters.

Nutritional profiling of seaweed

Different types of seaweed samples were collected from Mandapam, Tamil Nadu and were analyzed for proximate composition, dietary fibre, fatty acid profiling, fat soluble vitamin and carbohydrate content. Green algae such as *Ulva reticulate* and *U. lactuca* has carbohydrate content of 13.73% and 20.83% (dry wt. basis) and red algae such as *Gracilaria corticata* and *Portieria hornemanii* had carbohydrate content of 27.12% and 25.32% (dry wt. basis). Lipid content of seaweeds ranged from 1.6 to 23.8mg/g, *Caulerpa peltata* has the highest lipid content of 23.8 mg/g followed by *P. hornemanii* (20.2mg/g) and C16:0 is the dominant fatty acid present in seaweeds such as *Gracilaria edulis, G. grassa* and *Sargassum tenerrimum*.

Ulva lactuca

Sargassum tenerrimum

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

Development and characterization of an LDPE/chitosan antimicrobial blown film composite

An antimicrobial food packaging material was developed by uniformly embedding chitosan in a low density polyethylene (LDPE) matrix. The LDPE/chitosan (LDPE/CS) film showed better barrier properties against oxygen and water vapour permeability compared to virgin LDPE film. The compositional analysis carried out by Fourier Transform Infrared microscopy revealed that chitosan and LDPE bonded with each other. The migration analysis showed a better release of chitosan adduct from the LDPE matrix which enhanced the antibacterial properties of the composite film.

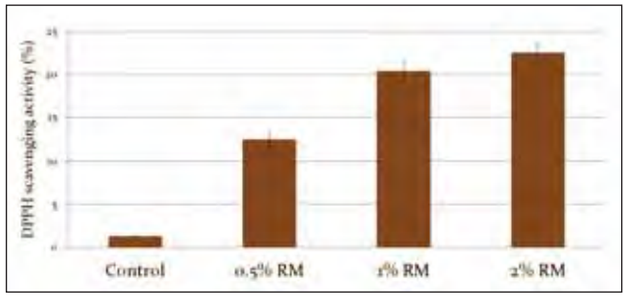
Shelf life evaluation of iced tilapia steaks in different LDPE/chitosan films

Shelf life of iced tilapia fish (*Oreochromis mossambicus*) steaks packed in chitosan (1, 3 and 5%) incorporated LDPE pouches were compared with control LDPE pouches. Overall quality parameters of the tilapia steaks remained acceptable up to 30 days of storage in 3 % LDPE/CS films, whereas it was acceptable only upto 15th day for the 1% film. The study revealed that 3% LDPE/CS films has good mechanical, barrier and antimicrobial properties in enhancing the keeping quality of perishable products like fish in chilled condition.

Tilapia steaks

Development of a natural antioxidant chitosan film incorporated with rosemary extracts

Addition of rosemary (*Rosmarinus officinalis*) extract affected the colour of the chitosan based films. The lightness showed a decreasing trend with the increase in rosemary extract level in the films whereas yellowness index showed an increasing trend with the increase in rosemary extract levels in the films. Both DPPH activity and total phenol contents increased with the increase in rosemary extracts level in the films.



DPPH scavenging activity of chitosan films with rosemary extract

Preparation and characterization of carboxymethyl chitosan and polyvinyl alcohol blended films

Carboxymethyl chitosan was prepared and blended at different ratios to obtain cast films. Increase in the proportion of CMC in the films increased the thickness of the films. Also transparency of films decreased with increase in the content of CMC. Microscopic observation revealed the formation of micro-particles due to blending of PVOH and CMC solutions. Films made of PVOH alone were having very good oxygen barrier property compared to CMC films. Replacing PVOH upto 33% (PVOH: CMC 2:1) did not alter the barrier property of PVOH film while increasing the ratio of CMC to 50% drastically increased the OTR of the films. All types of films were showing strong antimicrobial activity against *Staphylococcus aureus* while blended film with PVOH: CMC in the ratio of 2:1 was showing very good antimicrobial activity against majority of the cultures.

Karikkadi shrimp

Effect of active chitosan films on the quality of whole Karikkadi shrimp

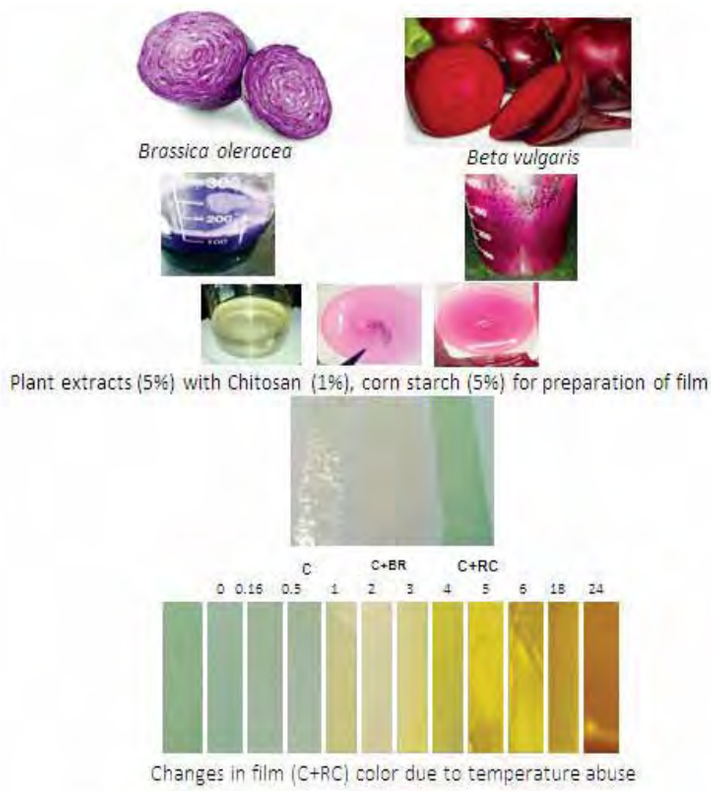
Two different types of chitosan based active films containing curcumin and ginger essential oil (0.3 % w/w) prepared to evaluate the effect on the quality of the *Parapenaeopsis stylifera* (Karikkadi) shrimp during chilled storage (2 °C) was evaluated. The initial total mesophilic and psychrophilic counts of the shrimps were 4.4 and 4.3 logcfu/g, respectively. The total psychrophilic count decreased significantly ($p < 0.05$) by wrapping in active chitosan films during the entire period of storage. Compared to control, the shrimp samples packed with active chitosan films had lower values of pH, TBA and TVBN. Based on the microbiological and sensory quality, packing with active chitosan film containing curcumin extended the storage life of shrimp by six days compared to control samples.

Effect of degree of deacetylation and viscosity on physical properties of chitosan films

Variation in the viscosity (50, 75 and 246 cps) and degree of deacetylation (DDA) (80, 86 and 90%) of chitosan on the physical properties and antioxidant properties of chitosan films incorporated with rosemary (*Rosmarinus officinalis*) extract was analyzed. Total phenolic content of film ranged between 7.3–7.7 mg gallic acid/g film for rosemary extract-incorporated films whereas it was ranging between 0.14-0.18 mg gallic acid/g film for control films. DPPH activity ranged between 0.80–1.52% for control samples whereas it was 16.4–21.3% for rosemary-incorporated films. Oxygen transmission rate was better for the film with 90% DDA chitosan.

Development of temperature abuse indicating films

Chitosan based biodegradable films incorporating red cabbage (*Brassica oleracea* var. *capitata* f. *rubra*) and beet root (*Beta vulgaris* L.) extract was prepared and characterized for indicating the temperature abused conditions during frozen storage. Addition of beet root extract and red cabbage resulted in 11.9 and 3.8 times reduction in oxygen transmission rate. Temperature abuse from frozen condition (-18 °C) to 37 °C resulted in change in the colour value for red cabbage-incorporated films. Lightness (L*) increased from an initial 17.19 to 28.67 upon exposure to 37 °C for 24 h whereas b* increased from negative values (-1.52) to positive value (11.23) indicating a shift from slight blue to yellow colour, which can be used as an indication of temperature abuse. Such colour change was not observed for control and beet root - incorporated films.



Changes in film (C+RC) color due to temperature abuse

Development of bio-nanocomposite films for fishery products

Optimized the conditions for the preparation of Polylactic Acid (PLA)-based biodegradable films. 5% (w/v) PLA solution in chloroform solvent with PEG 400 concentration of 5% (w/w) was the appropriate condition for film formation.

Bio-nanocomposite film

The prepared films had very good transparency and physical properties like Thickness of film (0.007 cm), Tensile strength (369 kg/cm^2), Elongation at break (42.6%) Oxygen Transmission Rate (OTR) (43 ml/m^2/24h), Water Vapour Transmission Rate (WVTR) (15.1 g/m^2/24h) and Heat seal strength (126 kg/cm^2).

Dual action active packaging system for fish preservation

The study compared the efficacy of new generation active packaging systems with plastic packaging (PP) in extending the shelf life of fresh cobia (*Rachycentron canadum*) fish steaks. The packaging systems used were O_2 scavenger containing plastic pack (PPOS), plastic pack with an antimicrobial film as primary wrap for fish steak (PPAM) and plastic pack with O_2 scavenger and an antimicrobial film (PPOSAM). Sensorily, the cobia steaks with PPOSAM were acceptable up to 30 days when compared to 25, 20 and 15 days for samples in PPOS, PPAM and PP, respectively.

Cobia steaks

Shelf life of vacuum packed Full beaks and Half beaks

The pelagic fishes, Full beak (*Tylosurus crocodilus*) and Half beak *(Hemiramphus brasiliensis*) caught by gillnets were cut into steaks of 2.5 cm. The steaks were packed in 75 µ PEST/PE film pouches under vacuum and stored at 4±1 °C. The microbiological quality of fresh fish was very good as indicated by the low initial count of bacteria. There was a significant difference ($p<0.05$) in the quality of fish steaks stored under vacuum packaging which gave an extension of four days in both fishes when compared to control, stored under air.

Full beak

Evaluation of antibacterial activity of plant extracts

Antibacterial activity of mint leaf (*Mentha arvensis*) and orange peel (*Citrus aurantium*) extract were evaluated against 17 ATCC bacterial strains including food-borne pathogenic and spoilage bacteria. The extracts exhibited very good antibacterial activities. In general, the inhibition zone of extracts (20% in DMSO) ranged from 15-22 mm. Growth of *Pseudomonas aeruginosa, Staphylococcus aureus, Listeria monocytogenes* and *Morganella morganii* were inhibited at 4.16 and 16.66, 8.33 and16.66, 24.77 and 4.16 and 4.16 and 33.33 mg/ml, respectively by mint and orange extracts.

Quality evaluation of sun and solar dried small size *L. vannamei*

Small size fresh *L. vannamei* of 15.84 g weight and 13.4 cm length were procured from local markets and dried using sun and solar drying with and without STPP (3%). Solar dried prawn treated with 3% STPP scored excellent in appear-

ance, texture, taste, odour and flavour. Solar dried prawn treated with 3% STPP showed highest rehydration capacity (95.58%) followed by sun dried treated with 3% STPP (83.14%).

Studies on the effect of spice on quality of vacuum packed Pangasius steaks during chilled storage

Combined effect of spices (turmeric and red chilly power) and vacuum packing to extend shelf life of Pangasius steaks during chilled storage was studied. Sensory evaluation indicated that control samples were rejected on 18th day and treated samples were rejected on 36th day indicating16-17 days for control samples and 33 days for treated samples.

Inhibition of biogenic amine development and associated microflora changes in high pressure treated Yellowfin tuna

The effect of high pressure processing in formation of biogenic amines and succession of spoilage microflora in Yellowfin tuna (*Thunnus albacares*) during chilled storage (4 °C) was evaluated. Highest build-up of histamine, cadaverine and putrescine was observed in 100 MPa treated samples, reaching up to 703.5, 506.5 and 49.3 ppm respectively after 33 days of chilled storage. Biogenic amine formation was retarded in samples treated with 400 MPa. The study recommends application of more than 200 MPa pressure for Yellowfin tuna, which can effectively retard development of biogenic amines and proliferation of spoilage flora during chilled storage.

Antioxidant extracts from Pomegranate peel

Total phenolic content and flavonoid content of the extract were 358.9 mg gallic acid eqwt/g and 158.2 mg quercetin eqwt/g. The *in vivo* antioxidant activities of pomegranate extracts were tested in fish mince (*Catla catla*) model system. Lipid oxidation was faster in control sample and it was minimum in BHA added sample.

Pomegranate extract

Effect of time and temperature abuse on growth of *Salmonella, Vibrio cholerae* and *Listeria monocytogenes* in *sous vide* tuna

Yellowfin tuna chunks were spiked separately with pathogenic bacteria namely *Salmonella, Vibrio cholerae* and *Listeria monocytogenes* at the rate of 10^6 cfu/g. The total Vibrio counts and total plate counts reduced by 5 log counts. T1 and T2 tuna chunks showed complete reduction in *V. cholerae* and *L. monocytogenes* but *Salmonella* survived the heat treatment at 90 °C for 5 min.

Development of fish ham by applying high pressure

Fish ham was prepared using minced meat of croaker and prawn and other ingredients and subjected to different pressure treatment at 400 MPa, 500 MPa and 600 MPa, at temperature 27-32 °C. Heat processed samples (90 °C for 105 min.) were kept as control. The processed samples were then sliced to 3 mm thickness and further packed in LDPE pouches and stored in chilled condition (2±1 °C) for evaluation. Control crossed the limit of 10^7 CFU/g after 21 days of storage whereas pressure treated samples after 28 days of storage had $2.98x10^6$, $2.98x10^6$

and 1.38x10^6 cfu/g for 400, 500 and 600 MPa treated samples. Control samples showed a maximum shelf life of 21 days whereas the 600 MPa treated samples had 28 days shelf life.

Development of ready to eat fish products with functional food ingredients and its quality evaluation

Extruded snacks were prepared with addition of shrimp powder and hydrolysate and their quality characteristics were analyzed. By using a mixture of Response Surface Design, 15 different formulations were made. Colour analysis of extruded snacks revealed that L* values decreased with increase in SH addition. Sensory evaluation of products revealed that formulation containing 5% SH and 5% shrimp powder had higher score than others. Further it was observed that addition of shrimp hydrolysate at more than 5% reduced the expansion.

Extruded snacks

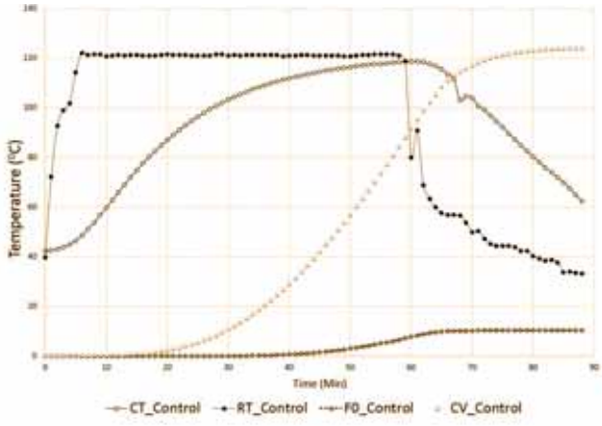
Fish chutney powder

Development of chutney powder using dried *Acetes* prawn

The chutney powder prepared using *Acetes* prawns was packed in LDPE and stored at room temperature. The protein content was very high in fish chutney powder (26.8%) than raw sample (8.0%).The moisture content of chutney powder was 4.36%. During the storage period, the TBA value and the mesophilic count increased gradually.

Application of water soluble chitosan as an emulsion stabilization agent for canned tuna

Carboxymethyl chitosan (CMC) prepared was completely soluble in water with a viscosity of 9.8 Cp and pH of 7.2. To study the effect of CMC, a 5% aqueous solution of CMCh was added at 2.5, 5 and 10 percent level to mayonnaise and blended. Tuna-in-mayonnaise was prepared and packed in tin-free-steel cans and processed in a retort at 121 °C to an Fo value of 10 min. The product was stored at room temperature. Oil drip varied with the level of CMCh.



Heating and cooling behaviour of control tuna-in-mayonnaise

Development of ready to eat fish noodles

Different flour and starch combinations were tested for optimization of ingredient level for fish noodles. It was observed that ingredients like maida and wheat flour in equal proportion were sensorily more acceptable compared to wheat or maida alone. Other than the main ingredients like maida and wheat flour, other starches like corn and potato were incorporated and potato starch gained more sensory preference than corn starch. Incorporation of fish meat to a level of 45% increased the protein content to 19.13% compared to 13.67% protein in the case of control (without fish meat).

Fish noodles

Development of ready to eat fish noodles with functional food ingredients and its quality evaluation

Ready to cook noodles were prepared with addition of fish oil encapsulates and their quality characteristics were evaluated. Noodles had 5.25-6.65% moisture, 13.25% protein, 2.50-2.80% fat and 2.46% ash. Oxidative stability studies showed that noodles prepared by steam cooking and drying had higher thiobarbituric acid value than directly dried at the end of fourth month. Colour analysis showed that noodles prepared by steam cooking and drying had less L* value than the noodles prepared by direct drying.

Fish oil fortified surimi from freshwater fish

Surimi from freshwater fish *Catla catla* was fortified with omega 3 fatty acids from cod liver oil (1%). Catla surimi yielded A grade gels irrespective of fish oil fortification. No significant difference was observed between L, a and b values of control and fortified samples. Breaking force and hardness values of fortified gels were slightly lower to that of control gels.

Fish oil fortified surimi seafood

Salting and sun drying kinetics of ribbonfish

Dry salting (1:4; salt to fish) and wet salting in 21% brine solution of ribbonfish were carried out at room temperature. After 24 h of salting, fish were taken from the brine solution and dry salted for sun drying at average temperature of 35 ^{o}C and 60% RH. Salt content of fresh fish was 0.72±0.02 % and at 24 h salting, salt content increased to 11.17±0.16% for brining method, and to 11.10±0.01% for dry salting. After 72 h of drying, moisture content decreased to 27.48±0.46% for brining method, and to 29.65±0.98% for dry salting.

Antibacterial effect of natural oils

Thirteen varieties of natural oils were tested for their antibacterial activity against *Salmonella*, *V. cholerae* and *E. coli* isolated from fish and shellfish. Only, clove oil and cinnamon oils inhibited *Salmonella*, *V. cholera* and *E. coli* and can be used as potential organic alternatives for use as antimicrobial agents in controlling pathogenic bacteria.

Antibacterial effect of clove oil on fish and shellfish

Long tail tuna fish steaks and PUD vannamei shrimp were divided into four batches and dipped in chilled water containing 0% (control), 0.125% (T1), 0.25% (T2) and 0.5% (T3) clove oil and kept in chilled condition for 30 min. The results show that dipping fish steaks and shrimp in clove oil solutions had reduced the total bacterial load. The reduction in TPC increased with increase in concentration of clove oil in the dip. Dipping in 0.5% clove oil reduced the bacterial load in fish steaks from 33,400 cfu/g to 7,850 cfu/g and in shrimp from 1,54,090 cfu/g to 5,500 cfu/g.

Preparation of alginate gel incorporated with clove oil

Solution containing sodium alginate (1.5%) and glycerol (10%) formed a gel instantaneously upon adding calcium chloride (2%). The sodium alginate to $CaCl_2$ ratio of 2:1 yielded better gels. Incorporation of clove oil at 10µl or 200µl to 15 ml of final volume of alginate-calcium chloride did not affect the gel formation. The result suggests that clove oil can be loaded as antibacterial compounds in alginate-based edible-films.

Alginate gel incorporated with clove oil (1% v/v)

Chilled storage studies of fish coated with alginate gel containing clove oil

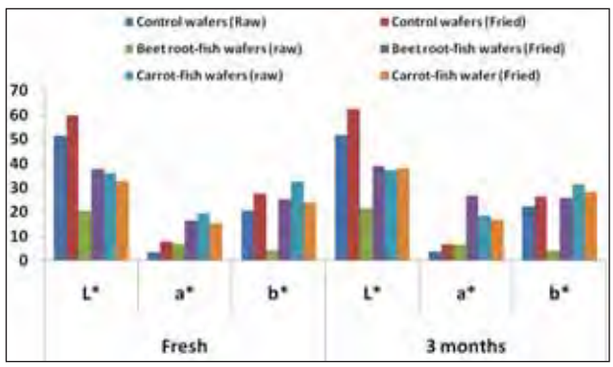
Dressed mackerel fish were coated with alginate gel incorporated with 1% clove oil (T1), packed in polyethylene bags, sealed, and stored in chilled condition at <4°C for 12 days. Alginate gels loaded with clove oil showed better antibacterial activity and anti-oxidative effects on fish during chilled storage.

Colouring bread crumbs with natural pigments

Natural pigments were extracted from beet root (*Beta vulgaris*) and carrot (*Daucus carota*). The yield of pigment laden liquid for beet root and carrot was 58.3% and 53.3%, respectively. The extracted pigment (liquid) is mixed with dried bread powder at 1:1 and 2:3 ratios (v/w) and dried at 50 °C. The colour of beet root fortified bread powder varied from light pink to dark pink and did not change on drying. The L, a*, b* values of beet root pigment fortified bread powder at 1:1 (v/w) were 40.66, 15.97 and 11.4, respectively. The L, a*, b* values of carrot pigment fortified bread powder were 74.34, 7.46 and 39.17, respectively.

Fish wafers coloured with natural pigments

Fish wafers were prepared using croaker (*Nibea maculata*) fish meat. Coloured wafers were prepared by mixing the ingredients in natural pigments laden liquid extracted from beet root and carrot. The L, a*, b* values of raw and fried wafers were measured immediately after preparation and after three months of storage at ambient temperature. The L value of raw wafers was control-fish wafer > carrot-fish wafer > beetroot-fish wafer; a* value was carrot-fish wafer > beet root-fish wafer > control-fish wafer; b* value was carrot-fish wafer > control-fish wafer > beet root-fish wafer. Frying increased the L, a*, b* values of control fish wafers and beet root-fish wafers, However,



Colour values of fish wafers with natural pigments

Wafers (Raw)

Wafers (Fried)

the increase in the L, a*, b* values was relatively higher in beet root-fish wafers; L value increased from 20.7 to 37.8; a* increased from 6.9 to 16.6 and b* value increased from 4.3 to 25.2. During storage, there was a slight change in the L, a* and b* values but the trend remained similar.

Processing and quality improvement of seafoods in Gujarat (Veraval Research Centre)

Fish protein hydrolysate from Jawla

Protein hydrolysate was prepared from non-paneid prawn *Acetes* sp. by enzymatic method. The *Acetes* protein hydrolysate exhibited antimicrobial activity against both gram positive as well as gram negative bacteria. Compared to the raw minced meat the hydrolysate exhibited higher antioxidant activity. The higher DPPH antioxidant activity (56.53%) was found at 30 min. enzymatic hydrolysis.

Surimi protein hydrolysate from surimi waste water

A comparative study was conducted with the three stages of water washing from different variety of surimi. The surimi waste water from pinkperch and ribbonfish surimi were collected from surimi processing plants at Veraval. The protein content and antioxidant activity were analyzed for all the samples. Ribbonfish surimi waste water hydrolysate exhibited higher antioxidant activity than pinkperch surimi waste water hydrolysate. The first washing of both the surimi water hydrolysate exhibited higher protein content than the subsequent washed water hydrolysate.

Ready to use Jawla minced meat for fishery products

The minced meat was prepared from Jawala shrimp (*Acetes* sp.) and refrigerated storage stability were investigated. The protein content increased from 8.0% (Wet wt basis) to 15.1% after flash cooking. The moisture content reduced to 10% during cooking. On 16th day of storage the Enterobactericeae and Pseudomonas counts increased to 2 log CFU/g and 3 log CFU/g respectively.

On 25th day the total bacterial count increased 3-fold in refrigerated storage study. The pH reduced from 8.8 to 5.7 on 25th day. The TBA increased gradually during refrigerated storage period. The samples had a shelf life of 16 days in refrigerated storage.

Studies on effect of additives in brining with different drying methods

The objectives of the work were to study the brining of Croaker with the introduction of additives and its effect on different drying methods. The initial salt content of fish was 0.59% (d.b) and the final salt content of all the samples were 19±1% (d.b). Increase in drying time, increased the salt uptake and water exudation was observed. The uniform salt uptakes were observed at 4-6 hrs of sample analysis that is 19±1% (d.b) of solar dried sample irrespective of control and additives. After 6 hrs of sampling the rehydration percentage was 15.9% and recovery percentage was 81.3% for solar additives sample. The uniform uptakes of salt content of muscle and moisture loss were observed in the solar dried fishes irrespective of treatment. The final phosphorous content of the samples were 0.4 mg P_2O_5/kg. The appearances of the treated solar dried samples were good compared to controls.

Quality of chitosan-collagen coated barracuda steaks

Chitosan coated barracuda steaks

The effect of edible coating of chitosan in combination with collagen on the shelf life extension of barracuda steaks (*Sphyraena jello*) in refrigerated storage was studied. The biochemical parameters the collagen chitosan (CCO), chitosan coating followed by collagen coating showed good quality than the control. The pH reduced from 6.1 to 5.4 (on average) on 10th day of storage for all the samples. The TBARS values of barracuda showed increasing trends with storage period in all the samples. The TBA value of control was 4.6 mg MDA /kg fat on the day of sensory rejection (7th day). The lipid oxidation (TBARS) was more in chitosan coating followed by collagen coating and chitosan collagen coating on 12th day. The TMA and TVBN were high in CC than CO on 12th day. The collagen chitosan samples showed good sensory stability upto12th days of storage against seven days in control samples.

Studies on drying of Bombay duck

Salting performance and quality characteristic of Bombay duck (*Harpadon nehereus*) were studied. The moisture content was found to be reduced and the salt content increased in 4 hr duration of sample analysis. The initial salt content of fish was 0.31% (d.b) and the final salt content was 16.4% (d.b). The microbial load decreased during brining.

Studies on drying aspects of fish in different salt ratio with sun and solar drying

Studies on drying aspects of different species like solefish, croaker, Bombay duck and catfish by both sun and solar were carried out. The moisture content was found to be reduced and the salt content increased in 4 hr duration of sample analysis. The storage stability, microbial quality, biochemical quality and sensory analysis were higher for 1:1 salting than 1:2 salted solar dried fish.

Solar and sun dried salted fish

Effect of different packaging atmosphere on the quality of Karikkadi shrimp stored at chilled condition

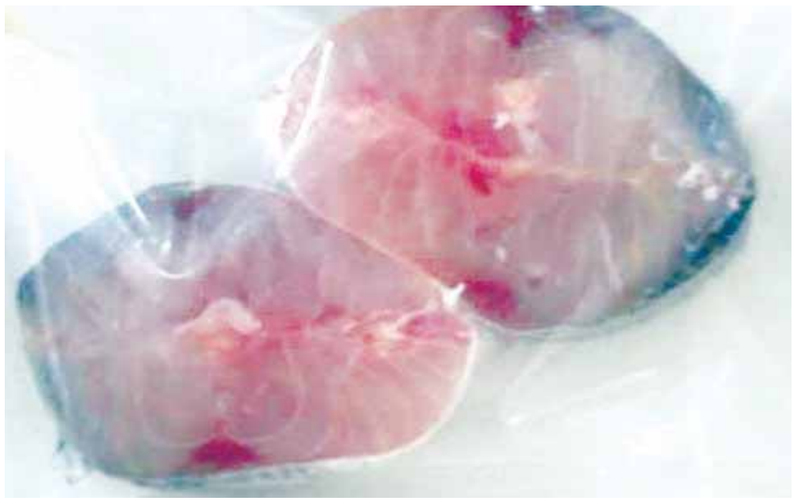
Packing studies on Karikkadi shrimp

The effect of different packaging atmosphere (Air, vacuum, and oxygen scavenger) on the keeping quality of whole Karikkadi shrimp (*Parapenaopsis stylifera)*, during chilled storage (2 °C) was assessed. Fresh shrimp had a moisture and protein contents of 77% and 20%, respectively. During storage, there was a significant difference ($p<0.05$) in the indole content of all the three samples and shrimp packed with oxygen scavenger had lower values compared to vacuum and air packed samples. The reduced oxygen packed (Vacuum, and oxyen scavenger) samples had lower total mesophilic and psychrophilic counts than the control, throughout the storage. Sensorily, the oxygen scavenger packed shrimps were acceptable up to 18 days whereas it was only nine and 15 days for air and vacuum packed sample, respectively.

Characterization of active chitosan film added with essential oil

Effect of addition of ginger (*Zingiber officinale*) essential oil (GEO) (0.5, 1, 1.5 and 2 % v/v of the film forming solution) on the antimicrobial, barrier, physical and mechanical properties of the chitosan film was evaluated. There was a significant decrease ($p<0.05$) in the strength properties, when GEO was added at higher concentration. Water Vapor Transmission Rate (WVTR) of pure chitosan film was 48 g/m^2/day, which was improved upon adding GEO. Chitosan film added with 2% GEO had a WVTR of 31.11 g/m^2/day. Antimicrobial efficiency of the films has been tested against the common fish spoilers and fish pathogens. Maximum antibacterial efficiency was shown by the chitosan films incorporated with 2% GEO against *Vibrio parahaemolyticus* ATCC 17802 (29.75±1.06 mm) and the film has expressed least antibacterial activity against *Salmonella enterica* sub sp. *enterica* serovar *enteritidis* ATCC 13076 (11.75±0.35 mm).

Effect of chitosan based active packaging film on shelf life extension of fish


Barracuda steaks packed in chitosan film

Steaks of barracuda fish (*Sphyraena jello*) were wrapped with the chitosan (CH) films incorporated with ginger (*Zingiber officinale*) essential oil (GEO) (0.3%) and stored at 2 °C. Throughout the storage period, the total mesophilic count and total volatile basic nitrogen values of fish steak samples wrapped with CH film containing GEO was significantly lower ($p<0.05$) than the unwrapped control fish steak. Wrapping the fish steak with CH-GEO film resulted in significant ($p<0.05$) reduction in the counts of specific spoilage bacteria (H2S producing bacteria including *Shewanella putrefaciens* and *Pseudomonas* spp.) Based on sensory evaluation, the CH-GEO film wrapped fish had a shelf life extension of more than eight days compared to the control sample.

Low sodium dried fish

Preparation of low sodium dried fish products

Low sodium dried fish products were prepared by partial replacement of Sodium chloride (30, 40 and 50 %). It was observed that there were no significant changes ($p \leq 0.05$) in the sensory quality of catfish dried in both sun and solar drying methods pre-salted with a mixture of no-sodium salts by replacing Sodium chloride upto 50 % level.

Effect of *sous vide* treatment on the quality of Indian Mackerel pre-treated with curry leaf essential oil

The effect of *sous vide* processing at different time and temperature combinations on the quality of Indian Mackerel (*Rastrelliger kanagurta*) steaks pre-treated with curry leaf essential oil and stored at 2 °C was assessed. 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. *Sous vide* cooking resulted in the reduction of total plate counts and delayed the formation of lipid oxidation products. A shelf life extension of 20 and 10 days was observed for the *sous vide* processed mackerel with and without essential oil treatment, respectively compared to control air sample.

Chilled storage of cage cultured spiny lobster

Open sea cage farmed spiny lobster (*Panulirus polyphagus*) in different forms (Raw and cooked) was stored in ice for assessing the changes in the keeping quality. The initial total mesophilic count of the lobster was 3.8 log cfu g^{-1}. Cooking resulted in a significant reduction ($p \leq 0.05$) in the total mesophilic count of the lobster sample. Shelf life of lobster enhanced more than two times by cook chilling method.

Chilled storage of spiny lobster (Raw)

Chilled storage of spiny lobster (Cooked)

Species specific technologies for the improved utilization of the fishery resources of Maharashtra region (Mumbai Research Centre)

Comparative studies of fish quality under conventional ice and slurry ice

Quality changes in Dhoma (*Johnius dussumieri*) were evaluated under conventional ice and slurry ice up to 15 days. The result revealed that the slurry ice is superior to normal ice. The mesophilic count of the slurry ice treated sample was around 0.3 $\log_{10}$ lesser than the control ice. Likewise 0.7 $\log_{10}$, 0.5 $\log_{10}$, 0.2 $\log_{10}$ and 0.5 $\log_{10}$ reduction were observed in psychrophilic, *S. aureus*, *E. coli* and *Brochothrix thermosphacta* counts compared to the normal ice treated samples. Thiobarbituric acid value showed an increasing trend (0.81- 1.38 mg malonaldehyde/kg) during storage. Similar trend was also observed for FFA and PV values.

Fish stored in slurry ice

Effect of plant extracts on the quality of frozen mackerel

Whole mackerel after washing was dipped in solutions of ethanolic extracts of mint leaf (*Mentha arvensis*) (0.5% w/v) and orange peel (*Citrus aurantium*) (1% w/v) solutions for 30 min. The fishes were then drained and frozen individually in a blast freezer at -40 °C. A significant antioxidant effect was observed for the plant extract treated samples during frozen storage of the fish.

Modified icing system containing plant extracts for shelf life extension of fish

The efficacy of ice containing mint leaf extract (700 mg/l) and orange peel extract (1000 mg/l) in retarding the quality. Presence of extracts in ice significantly reduced ($p<0.05$) the generation of total volatile base nitrogen (TVBN), trimethyl amine nitrogen (TMAN) and free fatty acids (FFA) during storage. A marked inhibition of lipid oxidation was also observed in samples stored in ice with extracts. Additionally, icing with extract substantially reduced the count of total viable bacteria and *Pseudomonas* population. Shelf life of Indian mackerel was 13-15 days for fishes stored under conventional icing system, 15-17 days for fishes stored in ice containing citrus extract and 17-18 days for the fishes kept in ice containing mint extract.

Restructured value added products from Bombay duck

The moisture content of the Bombay duck mince was reduced by a modified washing method using brine containing lemon extract. The restructured product containing 90% Bombay duck mince and 10% Dhoma mince gave higher flavor and taste.

Restructed product from Bombay duck

Preparation of dehydrated squid shreds

Dehydrated squid shreds were developed from fresh Indian Squid (*Loligo duvauceli*). Shreds were dried at various time-temperature combinations. The optimum drying time and temperature was determined based on elastic properties of the shreds after cooking. Shreds dried at 50 °C imparted better swelling and textural properties compared to that at 40 °C and 60 °C.

Fish protein isolate from Bombay duck

Fish protein isolate was prepared from Bombay duck meat by isoelectric precipitation method. The yield of isolate based on total protein content was about 78%. The pH of the dried isolate was found to be 6. Good to moderate gel forming ability was observed at pH values between 6-8, with 2.5% NaCl.

Innovative product development for value addition, nutrient fortification and shelf life extension of farmed and wild freshwater and marine fish (Visakhapatnam Research Centre)

Studies on texture and colour changes of Pangasius fish under live condition

Farmed live Pangasius fish was collected from Agricultural Harland Research Station, Panvel, and quality changes of Pangasius fish were evaluated under live condition up to three days. Texture profile analysis showed an increasing trend in hardness value (2977g- 5132g). Similar trend also observed for chewiness (816-1762) and springiness (0.69-0.89). Colour analysis showed a decreasing trend for L* value (72.67-57.11) and increasing b* value (26.98-27.59) for washed fillet. The fillet without washing showed less L* value (69.94- 56.66) and b* value of (27.15-27.36).

QUALITY ASSURANCE AND MANAGEMENT

Research projects handled

Institute projects

- Development of quality index system for commercially important fishes of India
- Risk assessment of emerging food-borne pathogens and chemical residues in aquatic ecosystem
- Innovative product development for value addition, nutrient fortification and shelf life extension of farmed, freshwater and marine fish
- Development of high value byproducts from fish and shellfish processing discards
- Development of standard processes and protocols for innovative products from aquatic resources, shelf life modelling and assessment of energy use

Externally funded projects

- Food safety interventions for women in fishery based micro-enterprises in coastal Kerala
- Characterization of harmful algal blooms along Indian coast
- Pesticide and antibiotic residues in fish and fishery products: Evolving frame work for fixation of MRLs
- Development of bioplastic based sustainable nanobiocomposite food packaging - Sustain Nanopack

Most significant achievements

- Quality index scheme for pearlspot was established with limit of acceptability of 16 days against the storage period of 22 days for 14 quality descriptors.
- The dry fish samples were generally free from any chemical and microbiological hazards, though some of the samples were found contaminated with *Staphylococcus aureus*.
- In tuna loins, high pressure treatments over 400MPa eliminated histamine formers completely.
- Microbial safety studies on Bluefin Trevally showed contamination with *Brochothrix thermosphacta***,** an organism normally found associated with meat and meat products.
- Quality assessment of whole marine crab *Charybdis cruciata* in chilled condition revealed acceptability up to 13th day. The biogenic amines putrescine, cadaverine and histamine were showing an increasing pattern during the storage.
- An LCMS MS method for the detection of 225 pesticides was standardized using fish matrix.
- Lactic acid was found to be an effective antimicrobial additive against *E. coli* and *S. aureus* in a study involving fish sausages.
- A RSM based optimization of salt concentration and lactic acid concentration (4.25% NaCl and 0.2% lactic acid level) for inhibition of *Salmonella enterica* indicated effective reduction of pathogen by 6.6 log in marlin fillets.
- Efficacy of commercial preparation of bacteriophages for control of *Salmonella paratyphi* and *S. typhimurium* was demonstrated in fish matrix.
- The aqueous extracts of *Garcinia cambogia, Tamarindus indica* , *Camellia sinensis* and *Citrus aurantifolia* at 5% and 10% levels demonstrated efficacy against pathogenic bacteria namely *Aeromonas hydrophila, Bacillus subtilis,*

Enterococcus faecalis, Salmonella enteritidis, Staphylococcus aureus, Vibrio cholera and *V. parahaemolyticus.*

- Developed protocol for melanosis inhibition using alternatives of metabisulphites. The combinations containing sodium citrate and EDTA have significantly controlled black spot formation in *Litopenaeus vannamei.*
- Analysis for the presence veterinary medicinal products in shrimp exported to the European Union (EU) during 2013 and 2014 showed that Nitrofuran (metabolite) Furazolidone (AOZ) (44%) and Nitrofurazone (SEM) (37%) were the major causes of notifications followed by Chloramphenicol (6%) and Oxytetracycline (2%).
- The median lethal concentration (LC_{50}) of Cadmium on tilapia indicates that the LC_{50} was (3.1 ± 0.2 g) 136.62 ppm.

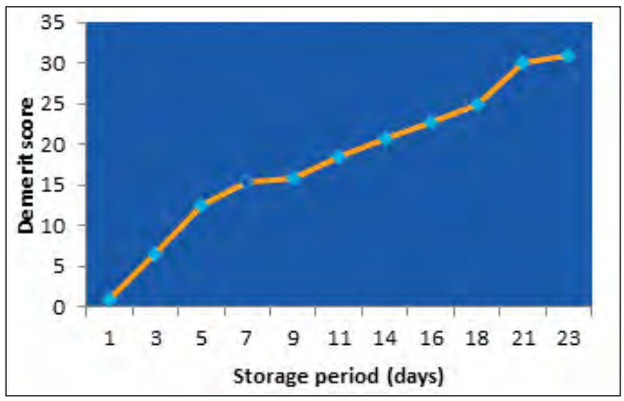
Chief findings

Institute projects

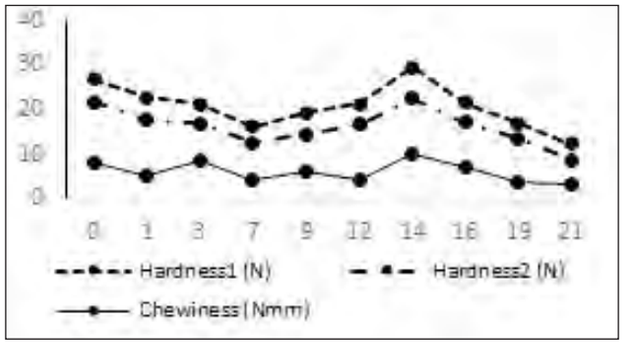
Development of quality index system for commercially important fishes of India

Quality index scheme for pearlspot

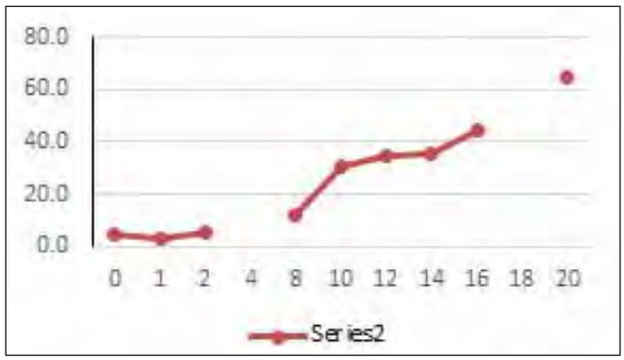
Quality index scheme for pearlspot (*Etroplus suratensis*) with 14 quality descriptors were established. The limit of acceptability was 16 days against the storage period of 22 days. Highest mean demerit score of 33 was obtained after the stipulated period. Microbiological validation of QIM scheme was evaluated with mesophilic count, psychroptrophic count, H_2S producer count and Enterobacteriaceae count, which linearly increased with progression of spoilage. A statistical formula for calculating freshness and probable shelf life was developed.



Changes in demerit score during storage of *E. suratensis*



Changes in K-value in *E. suratensis* during storage



Changes in texture profile in *E. suratensis*

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

Hazard assessment of fish markets of Kerala

The fishes (*Caranx*, anchovy and *Nemipterus*) from local markets of Kochi were found free from pathogens and their aerobic plate count varied from 1.8 x 104 to 2.1 x 10^7 CFU/g. The quality and food safety aspects of farmed fishes sourced from outside market of the state showed the presence of trace levels of formaldehyde in the samples of tilapia (0.04 ppm) and *Pangasius* (1.9 ppm).

Dry fish samples

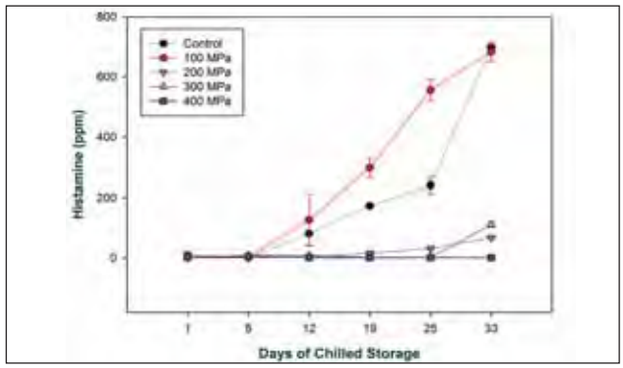
Hazard assessment of dry fish

Dry fish samples namely, silver bellies, *Ambassis* sp., anchovies, croackers, whitefish, soles, mackerel, shrimps, sharks, lizardfish, seerfish, *Aries* sp., barracuda, elops, *Anadontostoma chanunda, Colia dussumeri*, carrangids, mullets, murrels and pearlspot collected from the different markets in Ernakulam district, Kerala showed, the presence of coagulase positive *S. aureus* in 7.4% samples. The strains isolated from the dried fish were tested for enterotoxicgenicity. Only SEA and SEB toxin types were present in these strains. The results also showed that none of the samples were contaminated with *Listeria monocytogenes*.

Aerobic plate counts of the above samples were in the range of 4.2 to 5.9 log cfu/ g. Average yeast and mould counts of the above samples were 2.1 and 2.24 log cfu/g respectively. Presence of mold was noticed in most of the cases of the order of 2-3 log 10 cfu/g). The moisture content in the samples ranged from 15 to 49% and the salt content between 20-23%. The sand content varied between 0.1-0.5 depending upon the place of collection indicating the handling practices. Heavy metal content of dry fish samples showed the presence of lead (0.34 – 1.6 ppm). Arsenic, cadmium, chromium and nickel were detected in some of the samples and were within the acceptable limits.

Pressure treatment *vs* histamine formers

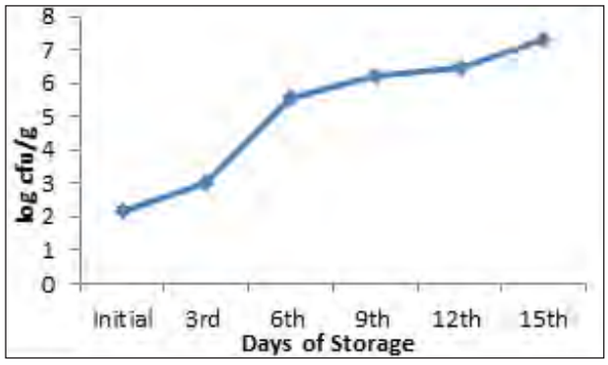
Histamine formation in scombroid fishes tuna, was evaluated after exposure to high pressure processing to different conditions. Histamine formers survived treatment of 100-300 MPa for more than 30 days. Histamine forming bactiria could survive only up to 21 days in 300 MPa treated fish during chilled storage while complete elimination was observed on treatment with 400 MPa high pressure.



Change in histamine concentration in high pressure treated Yellowfin tuna during chilled storage

Microbiological quality changes of Bluefin travelly on chilled storage

Microbial safety of bluefin trevally, *Caranx melampygusis* was evaluated in chill storage. The initial mesophilic count crossed $\log_{10}$ 6.73 cfu/g on 12th day. As the time of storage increased, psychrotrophic bacteria showed higher growth than the mesophilic bacteria, dominating the flora at lower temperatures, which reached 8.32 $\log_{10}$cfu/g on the 15th day of storage. *Brochothrix thermosphacta* usually found associated with meat was isolated indicting the contamination of the fish. The level increased by 2 log during the storage period.

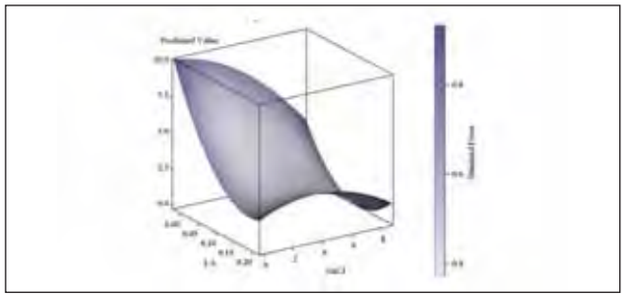


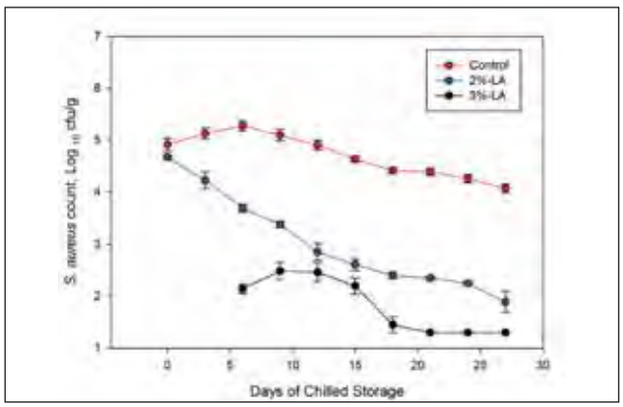
Changes in *Brochothrix thermosphacta* counts during chilled storage

Efficacy of lactic acid as an organic antimicrobial additive

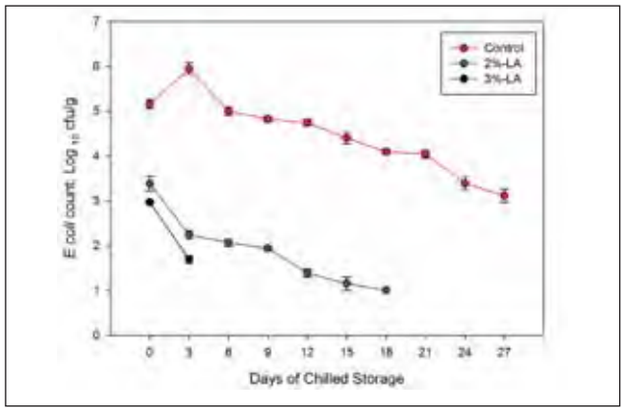
In RSM-based experiment, survival of *Staphylococcus aureus* and *Escherichia coli* was demonstrated in 0-3% lactic acid-incorporated pinkperch sausages (PPS). Lactic acid incorporation provided an additional hurdle in chilled storage. *S. aureus* sharply reduced by 2-3 logs at 2 and 3% level of incorporation. *S. aureus* could be recovered only after six days in 3% LA-PPS. *E. coli* could be recovered upto 18 days in 2% LA-PPS and upto three days in 3% LA-PPS.

Marlin (*Makaia indica*) fillets soaked in different concentrations for different lengths of time showed concentration-related inhibition of microbes. A RSM based optimization of salt concentration and lactic acid concentration for inhibition of *Salmonella enterica* ATCC 10708 indicated that 4.25% NaCl and 0.2% lactic acid level can effectively reduce the load of the pathogen by 6.6 log.





Survival of *Staphylococcus aureus* in lactic acid incorporated pinkperch sausages during chilled storage



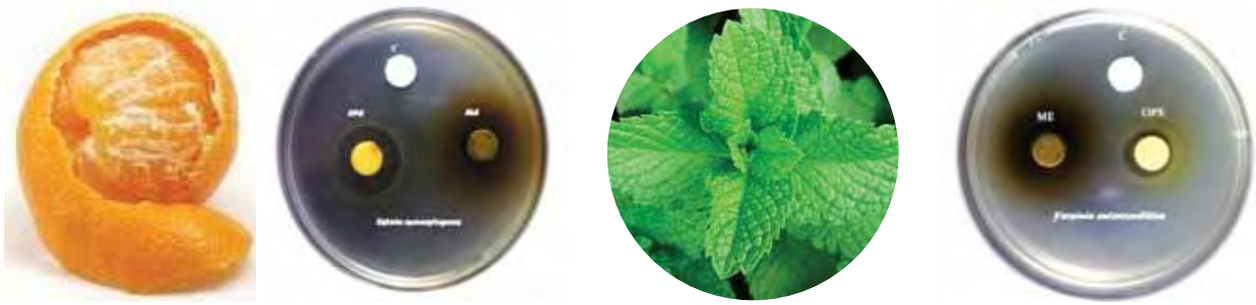
Survival of *Escherichia coli* in lactic acid incorporated pinkperch sausages during chilled storage

Bacteriophage for elimination of pathogens

Efficacy of commercial preparation of bacteriophage for control of *Salmonella paratyphi* A was optimized at 1:30 dilution. Complete elimination of *Salmonella typhimurium* occurred at lower dilution (1:3). Application of lytic bacteriophages of *Salmonella* to tuna chunks could effectively bring down *Salmonella* load from 10^6cfu/g to <0.3 MPN/g. In artificially contaminated clam meat, some protection was observed after 2.5 hours exposure, *Salmonella* could survive and a count of 2.3 MPN/g could be retracted.

Antimicrobial action of natural extracts

Antibacterial assay of natural extracts like ethanolic extract of Orange peel (Mandarin Orange - *Citrus reticulata*) exhibited high activity against *Listeria monocytogenes*, whereas mint (*Mentha arvensis*) extract against *Yersinia enterocolitica*.



Antimicrobial action of natural extracts

Antagonistic activity of microbes

The potential of *Bacillus subtilis* as pro-biotic cultures against food-borne pathogens showed antagonistic activity against a spectrum of food-borne pathogens. *B. subtilis* showed antagonistic activity against *S. aureus* with a zone of inhibition of 19 ±.3 mm diameter.

Determination of prevalence of *Yersinia enterocolitica* at various track points

Ten clam samples procured from retail market of Cochin were found to be contaminated with *Yersinia* spp. which is concluded after a series of biochemical tests. Fifty one isolates were primarily differentiated from 155 isolates as *Yersinia* spp. from *Yersinia* selective plates (CIN plates). Six isolates could be identified as *Yersinia* spp. from 51 presumptive isolates. *Oreochromis mossambicus* and *Etroplus suratensis* from aqua farms, nearby Cochin were analyzed for *Y. enterocolitica*. Thirty seven colonies from CIN plates (selective media for *Y. enterocolitica*) were isolated, out of which only 10 were found to be presumptive colonies. None were found to be *Y. enterocolitica*.

Innovative product development for value addition, nutrient fortification and shelf life extension of farmed and wild freshwater and marine fish

Ethoxyquin in fish and shrimp feed

Ethoxyquin is widely used in animal feed as an anti oxidant in order to protect the feed from lipid oxidation. Recently it has been banned in shrimp and fish feed industry of Japan. Hence, an experiment was started to monitor the level of Ethoxyquin in fish or shrimp feed by collecting the sample from the different feed companies in Visakhapatnam, Andhra Pradesh. Totally, 20 feed samples were collected from four shrimp feed producing firms. All 20 samples were analyzed for the Ethoxyquin level in the feed by standardizing the new methodology.

Level of Ethoxyquin (ppm) in shrimp feed producers

	Firm A	Firm B	Firm C	Firm D
Mean	0.009396	0.008852	0.004652	0.006545
Standard Deviation	0.009233	0.005154	0.004215	0.005396
Standard Error	0.004129	0.002305	0.001885	0.002413
Minimum	0	0.004010	0.000139	0.000214
Maximum	0.021	0.017600	0.008860	0.014100

The Ethoxyquin level of all 20 samples were less than 1ppm, and all shrimp producers are adding the Ethoxyquin within the limit. Among the four shrimp feed producers. The average level of the Ethoxyquin used by different companies vary from 0.004 to 0.009 ppm. In fish feed the average level of Ethoxyquin was around 0.2ppm, which is around 10 to 20 times higher than permissible limit in shrimp feed.

Level of heavy metals in Pangasius fish farms of Andhra Pradesh

Sample details	Fe (ppm)	Zn (ppm)	Cu (ppm)	Cd (ppm)	Pb (ppm)
Nellore : Water samples	3.06	0.05	0.09	BDL	BDL
Prakasham : Water samples	1004.90	2.32	3.29	BDL	BDL
East Godavari : Water samples	1.33	0.16	BDL	BDL	BDL
Nellore : Soil samples	2678.73	26.83	6.74	BDL	BDL
Prakasham : Soil samples	14.36	BDL	3.98	BDL	BDL

BDL : Below Detectable Level

Estimation of mineral content in Pangasius fish farms of Andhra Pradesh

In the samples collected from different fish farms of Andhra Pradesh, iron content was found to be more in Nellore soil samples (2678.73 ppm), followed by Prakasham water samples (1004.90) and in Prakasham sediment samples Fe content was (14.36 ppm). In Nellore water samples Fe content was 3.06 ppm and in East Godavari water samples Fe content was 1.33 ppm, followed by Nellore. In sediment samples Zn content highest in Nellore water samples (26.83 ppm). Zn content was 2.32 ppm in Prakasham water samples. In East Godavari Water samples Zn content was 0.16 ppm and Nellore water samples had the lowest of 0.05 ppm. Cu content in Nellore sediment samples was 6.74 ppm, in Prakasham sediment samples 3.98 ppm, in Prakasham water samples 3.29 ppm and in Nellore water samples it was lowest at 0.09 ppm. Copper was not found to be accumulated in East Godavari samples. Cadmium and lead were below the detectable levels in all water and sediments samples.

Chemical and biological risks associated with fish and fishery products

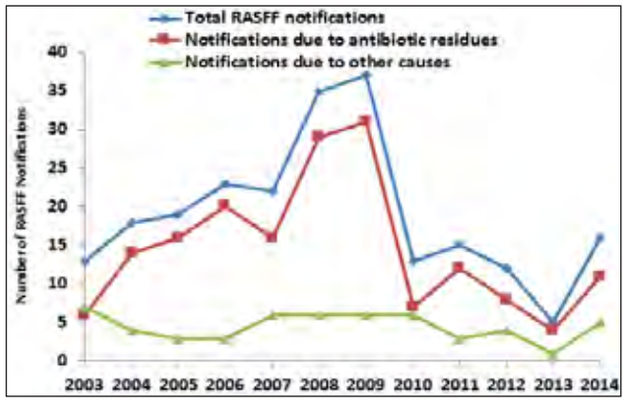
Dried fish samples (n=16) and dried shrimp (n=2) procured from wholesale fish market of Visakhapatnam were analyzed for copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn) and iron (Fe) content. Pb and Cd were not detected in dried shrimp but lead was detected in two dried fish samples at a concentration of 0.18 ppm and 0.06 ppm. The mean Cu, Fe and Zn content was relatively higher in dried shrimp at 38.3, 136.2, and 24.5 ppm, respectively. The mean Cu, Fe and Zn content in dried fish was 4.81±2.7, 72.5±67 and 3.6±2.3, respectively.

Microbiological examination of fish and shellfish samples (*Catla catla, Labeo rohita, Pangasianodon hypophthalmus, Rastrelliger kanagurta, Sardinella longiceps, Saurida undosquamis, Chanos chanos, Penaeus monodon, Metapenaeus* sp. and *Litopenaeus vannamei*) procured from retail fish markets in Visakhapatnam showed the presence of *Salmonella* in four fish samples (*C. catla, L. rohita, R. kanagurta* and *S. longiceps*) and one shellfish sample (*Metapenaeus* sp.). *V. harbour* was detected in three fish samples (*C. catla, R. kanagurta* and *S. longiceps*) and two shellfish samples (*L. vannamei*). *E. coli* was detected in all the fish and shellfish samples. *P. hypophthalmus* (n=8; weight 519g to 1500g) procured from wholesale freshwater fish market did not show the presence of pathogenic bacteria *Salmonella*, *V. cholerae* and *Listeria* and coagulase positive Staphylococci. The TPC ranged between 1.2 x 10^3cfu/g to 1.3 x 10^5cfu/g with a mean count of 4300±5200 cfu/g.

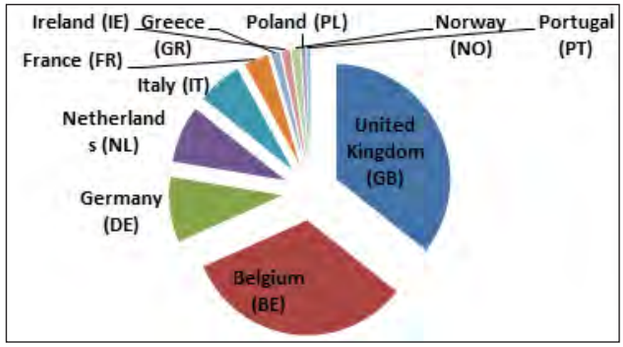
V. cholerae (n=15) isolated from fish were tested for their susceptibility against 26 antibiotics. All the *V. cholerae* isolated from fish were sensitive to 23 different but 70%, 60% and 10% of the *V. cholerae* isolated from fish were resistant to Norfloxacin, Tetracycline and Nitrofurantoin, respectively.

Trends in the veterinary medicinal products (antibiotics) in shrimp exported from India to the European Union (EU)

The Rapid Alert System for Food and Feed (RASFF) notifications pertaining to shrimp exported from India to the European Union (EU) during the period 1 January, 2003 to 1 November, 2014 was analyzed. A total of 228 RASFF notifications were notified of which 76% were due to the presence of antibiotic residues. The notifications showed an increasing trend from 2003, peaked in 2008 and 2009 followed by a decreasing trend. However, in 2014 there was a spurt in RASFF notifications due to antibiotic residues. The period between 2005 and 2009 was the turbulent period with two-thirds of the total notifications due to presence of antibiotic residues; of which 35% of the complaints were recorded in 2008 and 2009. Two thirds of notifications were notified by United Kingdom (36%) and Belgium (33%). Nitrofuran (metabolite) Furazolidone (AOZ) (44%), Nitrofurazone (SEM) (37%) were the major causes of notifications followed by Chloramphenicol (6%) and Oxytetracycline (2%). 94% of the complaints involving scampi were due to SEM, 85% of the complaints involving black tiger were due to AOZ and 90% of the notifications involving Vannamei were due to AOZ. The reported level of SEM in shrimp ranged between 1.1 and 170 ppb and AOZ ranged from 1.1 to 150 ppb.



RASFF notifications of shrimp exported from India to the European Union



Notifying country-wise trend of RASFF complaints due to antibiotic residues in shrimp exported from India

Melanosis inhibition using alternatives of metabisulphites

An attempt has been made to study the effectiveness of using alternative chemicals for melanosis inhibition in *Litopennaeus vannamei*. For this, the raw material was treated with 1) 1.25% Sodium metabisulphite for 1 minute, 2) A solution containing 0.5% Sodium metabisulphite, 0.5% Sodium citrate and 200 ppm EDTA for 5 min. 3) A solution containing 0.5% sodium citrate and 200 ppm EDTA for 5 min and 4) solution containing pomegranate extract for 5 min. The samples were kept in ice and were analyzed for melanosis development, TPC, TVBN and textural properties. The results of the study revealed a significant effect on controlling the black spot formation in which the treatment with solution containing pomegranate extract and those containing 0.5% sodium citrate and 200 ppm EDTA was equally effective than the treatment with 1.25% Sodium metabisulphite alone. In addition these two treatments has significantly reduced the growth of bacteria compared to control as observed from its lower TPC during the storage in ice up to 52 hr. In general, the hardness values reduced over the storage period in all samples, but the effect of treatment was not comparable.

Development of high value byproducts from fish and shellfish processing disards

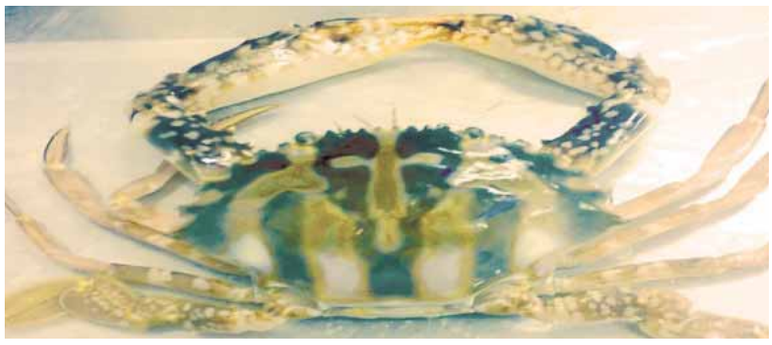
Quality assessment of monsex tilapia

Freshness assessment of whole and gutted monosex tilapia in chilled condition demonstrated that gutted samples got rejected by sensory panel on 21st day and whole samples by 24th day. The sensory evaluation results are in line with the results of K value. Histamine was absent in the samples. Presence of putrescine was noticed from the 21st day of storage in the case of whole and gutted sample. Spermine and spermidine was present in low levels.

Whole monosex tilapia

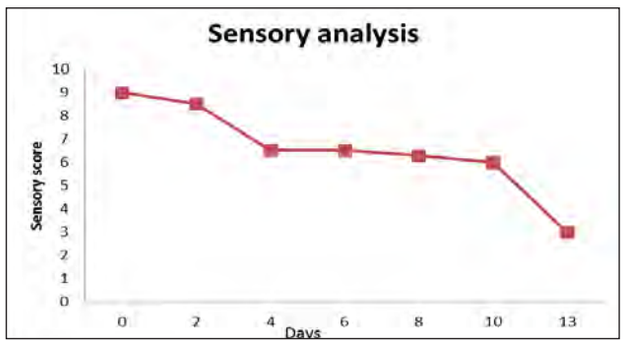
Freshness assessment of whole marine crab

Freshness assessment of whole marine crab *Charybdis cruciata* (individually air packed in polythene cover and sealed) in chilled condition showed that the samples were rejected on the 13th day of storage. The major biogenic amines present were putrescine, cadaverine and histamine and they were showing an increasing pattern along with storage.



Cadmium bioassay test

Static non renewable acute toxicity bio-assay was conducted to determine the median lethal concentration (LC_{50}) of $CdCl_2$ for tilapia. Under the experiment 120 live fish (3.1 ± 0.2 g) were distributed in six different treatment groups each with two replicates. Treatments were T1 (10 ppm), T2 (20 ppm), T3 (40 ppm), T4 (80 ppm), T5 (100 ppm) and T6 (200 ppm) of $CdCl_2$. Percentage cumulative mortality was recorded at 24, 48, 72 and 96 hrs interval. The result of the study indicates that the LC_{50} of $CdCl_2$ for tilapia of average weight 3.1±0.2 is 136.62 ppm.



Freshness assessment of whole marine crab

MICROBIOLOGY, FERMENTATION AND BIOTECHNOLOGY

Research projects handled

Institute projects

- 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
- Development of high value byproducts from fish and shellfish processing discards
- Species specific technologies for the improved utilization of the fishery resources of Maharashtra region

Externally funded projects

- Responsible harvesting and utilization of 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
- Genetic diversity of *Clostridium botulinum* in seafoods and development of Lateral Flow Immuno Assay (LFIA) for toxinotyping
- Assessment of myctophid resources in the Arabian sea and development of harvest and post- harvest technologies

Most significant achievements

- *V. cholerae* O139 serogroup pathogenic to shrimp was isolated from post-larvae of *P. monodon* from a shrimp farm which reported mass mortality. This is the first report of *V. cholera* O139 strain causing high mortalities in shrimp.
- Methicillin-resistant *Staphylococcus aureus* was detected in 9.5% of 63 samples from different retail markets and aquaculture farms of Kerala and MRSA isolates belonged to SPA ridom types t002, t657, t334, t311
- Multi-locus sequence typing of MRSA isolates revealed that the isolate which was t657 ridom spa type belonged to ST772 which is commonly called as Bengal Bay clone reported in many parts of India as community-associated MRSA in clinical infections.
- Molecular characterization of *Edwardsiella tarda,* an emerging gastroenteritis pathogen, isolated from the lesions of farmed *Pangasianodon hypophthalmus* revealed presence of T3SS gene *esaV* which is a potential virulence marker.
- Antibacterial activity against MRSA was detected in Actinobacteria belonging to Genera *Brachybacterium.*
- Two chitinase genes 19A and 18B were identified in *Paenibacillus elgii* with potent antifungal activity and a 70KDa chitnase gene was cloned in pET28 plasmid and expressed in *E. coli*
- *Lysinibacillus fusiformis* and *Bacillus thuringiensis* were identified as high density polyethylene (HDPE)-degrading bacteria.
- Yellow Head Virus was detected in imported processed shrimp. This is the first report on the presence of YHV in imported samples.

- RNA-seq based transcriptome analysis of *Mangrovibacter* sps. during aerobic to anoxic transition revealed that the number of genes up-regulated under aerobic condition was significantly lower than that during transition and anoxic stage.
- Two draft genome sequences of halophilic, highly halotolerant Gammaproteobacteria Strain MFB021 and bacteria associated with mangrove belonging to the Genus Mangrovibacter, have been published in NCBI.

Chief findings

Institute projects

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

Diversity of pathogenic bacteria in fish and fish products

Listeria monocytogenes showing umbrella shaped motility

Fish/shellfish and fish products from diverse sources in Kerala and Visakhapatnam were screened and high diversity of pathogenic bacteria was found. In fish/shellfish and fish products from retail outlets in Kerala, tdh$^+$ *Vibrio parahaemolyticus* and *Listeria monocytogenes* were detected. The gene encoding *hly*A (267 bp) was detected in three *L. monocytogenes* isolates out of 58 presumptive *L. monocytogenes* from fish. *Shigella* spp. and *C. botulinum* could not be detected in any of the fish samples analyzed. *Aeromonas hydrophila, A. veronii* biovar *sobria, A. caviae* and *A. veronii* biovar *veronii*, *V. cholerae* O139 and *V. vulnificus* were isolated from fish/shrimp samples from Kerala. In water and sediment samples from brackish water aquatic environment and farms located in Kerala and Visakhapatnam tested, *Salmonella, A. hydrophila, tdh*$^+$ *V. parahaemolyticus* and *V. cholerae* were detected. *Salmonella* was detected only in water samples collected from oyster farming sites located at Vadakara, Kerala. *V. cholera* harbouring *ctx* genes was isolated from water samples collected from Alappuzha district, Kerala. *V. parahaemolyticus* isolated from water and sediment samples from Kerala harbor *tdh* gene and not *orf* 8 (369bp amplicon) specific for O3:K6 *V. parahaemolyticus* strains.

Emerging pathogens in fish/shellfish and aquatic environment

Among the emerging pathogens screened, presence of Methicillin-resistant *Staphylococcus aureus* was found in fish/shellfish, water and mud from diverse sources and presence of *Edwardsiella tarda,* an emerging gastroenteritis pathogen, was detected in farmed catfish. 66.6% of samples were positive for *S. aureus.* MRSA was found in <10% samples.

Diversity of commensal and spoilage bacteria in freshwater fish and fish products

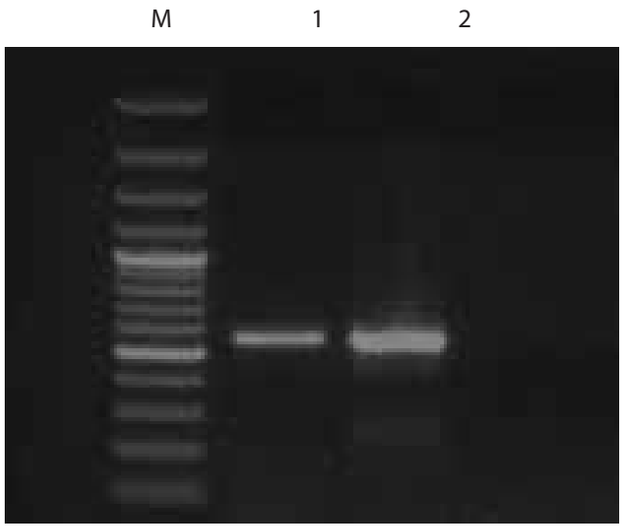
Studies on microbial profile of farmed gourami (*Osphronemus goramy*) and farmed catfish *Pangasianodon hypophthalmus* by 16S RNA sequencing revealed a more diverse bacterial flora belonging to Enterobacteriaceae and genera *Aeromonas, Pseudomonas, Bacillus* and *Staphylococcus.* Spoilage microflora associated with farmed catfish and marinated catfish stored under air and vacuum were identified and dominant genera belonged to *Chrysobacterium, Pseudomonas, Sphingobacterium* and *Aeromonas.* Studies on heterotrophic bacterial diversity of whole and gutted monosex tilapia stored under chilled conditions and monosex tilapia stored under air and vacuum at chilled storage revealed presence of H_2S producing bacteria, enteric bacteria and psychrotrophic bacteria.

Diversity of fish/shrimp pathogens

Studies on fish pathogens in farmed fish and farm environment samples revealed presence of *A. hydrophila, A. veronii* biovar *sobria, A. caviae* and *A. veronii* biovar *veronii* in catla, diseased gourami fish (*Osphronemus goramy*), tilapia (*Oreochromis niloticus*) and catfish (*Pangasianodon hypophthalmus*). *Vibrio cholerae* O139 and *V. vulnificus* strains pathogenic to post-larvae were isolated from *P. monodon* post-larvae from a farm which reported mass mortality. This is the first report of *V. cholera* O139 strain causing high mortalities in shrimp.

Challenge studies with *V. cholerae* O139 and *V. vulnificus* in post-larvae of shrimp

Experimentally exposed shrimp larvae with *V. cholerae* O139 and *V. vulnificus* exhibited significant mortalities. The LD_{50} value of *V. cholerae* O139 and *V. vulnificus* isolates were determined for post-larvae of *P. monodon, Fenneropenaeus indicus* and *Litopenaeus vannamei*. For *V. cholerae* O139 isolate, the LD_{50} value ranged from 10^4 for *L. vannamei* to 10^6 for *P. monodon*. Histopathological examination revealed rupture of basal laminae of hepatopancreatic tubules and severe necrosis. Histopathology of gills in *P. monodon* challenged with *V. vulnificus* revealed accumulation of haemocytes in the haemocoelic space, degeneration of secondary gill and abnormal gill tips. The intestinal tissue was oedematous and has expanded sinuses with haemocyte infiltration.



PCR assay for confirmation of *Vibrio cholerae* O139 isolated from diseased *P. monodon* post-larvae Lane M: Molecular weight marker 100bp, Lane 2, 3: Test and positive control strains *Vibrio cholerae* O139 specific *rfb* gene (449bp)

Antibiotic susceptibility of food-borne pathogens

Antibiotic susceptibility patterns of pathogens prevalent in fish/shellfish was determined for optimal empirical therapy. *V. parahaemolyticus* isolates when tested against 26 antibiotics revealed resistance only to Nitrofurantoin (300µg) in 60% isolates from Visakhapatnam. *Edwardsiella tarda* isolates were resistant to Penicillin, Ampicillin, Amoxyclavulanic acid, Oxacillin, Cephalothin, Linezolid, Vancomycin, Teicoplanin and Nalidixic acid.

Among *Vibrio cholerae* isolates, resistance was found to Cefopodoxime (40%), Ticarcillin (40%), Amoxicillin-Clavulanic acid (30%), Streptomycin (25%), Imipenam (25%), Norfloxacin (25%) and Gentamicin (25%). Two isolates were multi drug resistant (MDR) for three classes of antibiotics (Gentamicin, Amoxicillin-Clavulanic acid and Imipenam).

Antibiotic susceptibility testing of *A. hydrophila, A. veronii* biovar *sobria, A. caviae* and *A. veronii* biovar *veronii* isolates from fish revealed resistance to Cefopodoxime (75%), Amoxycillin-Clavulanate (64%), Ticarcillin (50%) and Andimipenam (38%). Multidrug resistance for 3 to 4 classes of antibiotics namely Cefopodoxime, Amoxycillin-Clavulanate, Imipenam and Nalidixic acid was found in *A. veronii* biovar *sobria A. veronii* biovar *veronii* and *A. jandaei.*

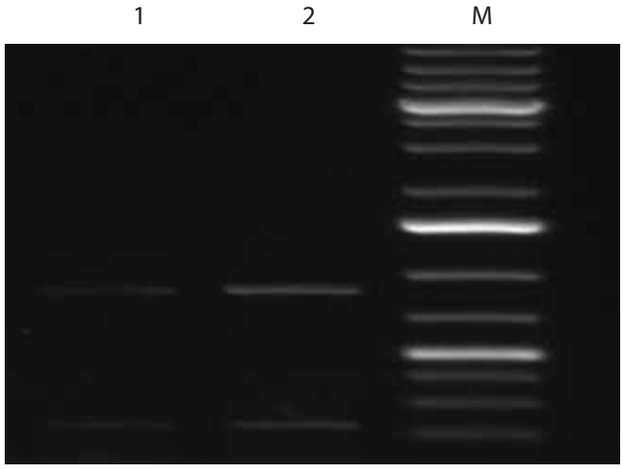
Molecular characterization of seafood-borne pathogens

Characterization of *Edwardsiella tarda* isolates by multiplex PCR revealed presence of *rpoS* and *esaV* genes (a pathogenicity marker) and confirmed that the isolate is pathogenic.

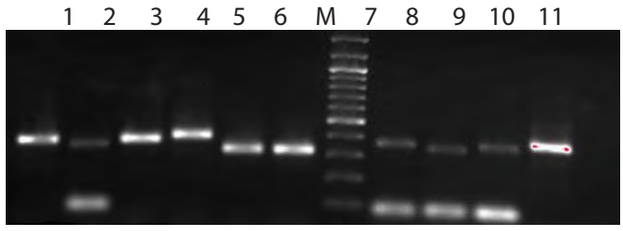
Characterization of virulence genes in *V. cholera* O139 isolate from infected post-larvae of *P. monodon* by PCR showed that the strain carry virulent gene *ctx* and genes encoding virulence determinants (*zot* and *tcpA*). *A. hydrophila*

isolate harboured all the genes (*Aer* coding for aerolysin gene; *Alt* for heat labile cytotonic enterotoxin, *ACT* for cytotoxic enterotoxin and *AST* for heat stable cytotonic enterotoxin). *Aeromonas veronii* isolated from an outbreak had five different genotypes. *V. vulnificus* strains, isolated from *P. monodon* post-larvae from a farm which reported mass mortality were found to be positive for genes encoding for hemolysin (*vvh*A), siderophore (*viu*B) and metalloproteae (*vvp*E).

For detection of MRSA clones that are most prevalent in fish, a duplex PCR was standardized by simultaneously detecting *spa* and *pvl* genes. For rapid detection of MRSA from fish, one multiplex PCR was standardized for simultaneous identification of 16s, *nuc* and *mec* genes. For rapid identification of antibiotic resistance in MRSA strains, a multiplex PCR was standardized targeting nine genes encoding for antibiotic resistance. Staphylococcal protein A typing and Multi-locus sequence typing of MRSA isolates identified 4 ridom types. The fish isolate which was t657 ridom spa type belonged to ST772 which is commonly called as Bengal Bay clone reported in many parts of India as community-associated MRSA in clinical infections.



Molecular characterization of *E. tarda*. Lane M: Molecular weight marker 1Kb plus, Lane 1, 2: Test and positive control (ATCC 15947) strains *E. tarda* specific. *esaV* gene (955bp) and *rpoS* gene (223bp)



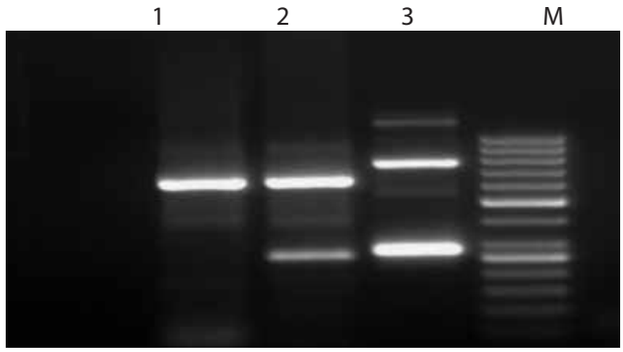
Staphylococcal protein A typing of MRSA strains. Lane 2, 7,8,9: pvl positive (80bp) MRSA strains with variable spa sizes (300bp-400bp), Lanes 1, 3,4, 5, 6, and 10 pvl negative MRSA with variable spa sizes (300bp – 400bp) and Lane 11: Negative control

Control of seafood-borne pathogens

Antibacterial activity of actinobacteria against MRSA: Out of 20 strains of actinobacteria tested for its activity against Methicillin-resistant *S. aureus* (MRSA), inhibition was found only with *Brachybacterium* spp.

Anti-Vibrio activities of organic compounds: As an alternative to antibiotics, experiments were conducted to test anti-Vibrio activity of approved organic compounds such as Potassium sorbate (0.25%, 0.5% and 1%), clove oil (0.025%, 0.05% and 0.1%) and chitosan (10ppm) on live *L. vannamei* post-larvae (PL10). Potassium sorbate, clove oil and chitosan showed reduction in the counts of both sucrose fermenting and sucrose non-fermenting Vibrios but even low concentrations of Potassium sorbate (0.25%) and clove oil (0.025%), chitosan (10ppm) affected the survivability of *L. vannamei* post-larvae. Mortality of the post-larvae treated with Potassium sorbate, clove oil or chitosan was observed within 30 minutes in most of the cases whereas control post-larvae were actively swimming.

Diversity of shrimp viral pathogens: Farmed and processed shrimp samples and shrimp larvae samples were screened for shrimp viral pathogens namely WSSV, YHV, TSV, IHHNV, HPV and MBV. Three shrimp samples harboured WSSV and one was positive for HPV. YHV was detected in one processed shrimp sample.



Detection of YHV in imported processed shrimp Lane1: Negative control, 2: Negative sample, 3. YHV positive, M - Molecular marker

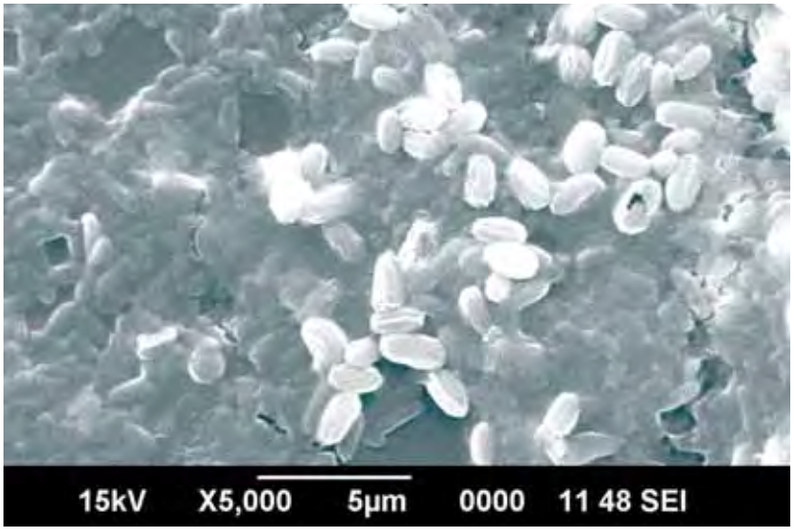
Studies of aquatic bacteria for production of biocatalysts

Chitinase genes from *Paenibacillus elgii*: Two chitinase genes such as 19A and 18B were identified in *P. elgii* with potent antifungal activity. A 70KDa chitnase gene was cloned in pET28 plasmid and expressed in *E. coli*.

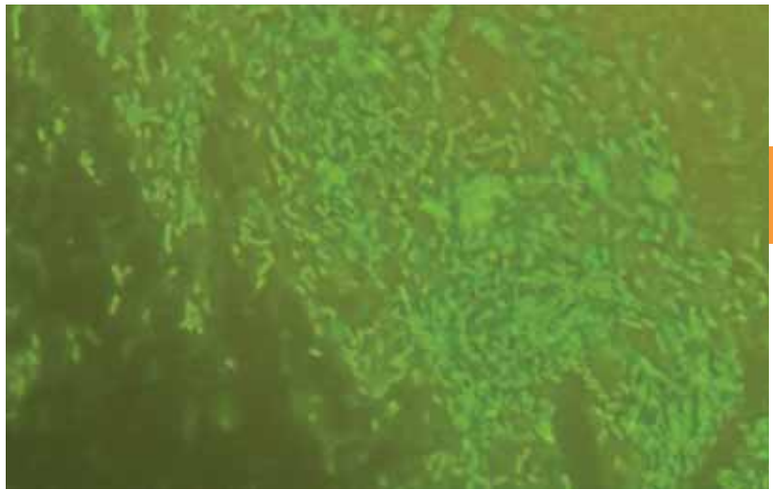
Ectoine producing bacteria: Thirty five bacterial isolates from aquaculture pond, marine environment and solar saltern were screened for ectoine production. Out of the 24 isolates from salterns, 22 were ectoine producers in initial screening using HPLC with production ranging from 0.0221-0.1431 g/L. The highest producer was identified as *Salinivibrio costicola* which grew over a wide range of NaCl concentration ranging from 2.5 to 25%. Two stage fermentations of *S. costicola* employed for obtaining high cell mass and for inducing high ectoine synthesis inside cells considerably increased the ectoine production to 0.79 g/L from 0.25 g/L in single stage fermentation. *S. costicola* was identified as a potential candidate for ectoine production.

Characterization of plastic degrading bacteria

High-density polyethylene (HDPE)-degrading bacteria isolated from plastic waste dumpsites in and around Cochin, Kerala (India) and identified as *Lysinibacillus fusiformis* and *Bacillus thuringensis* showed high bacterial adhesion to hydrocarbon in BATH assay. Adhesion was confirmed by attachment to the substrate as revealed by epi-fluorscence microscopy study, AFM and SEM analysis. Two strains when individually applied resulted in 3.5% weight loss after 150 days of incubation while when both the strains were incubated together, the weight loss was 4.8% of the initial weight.



SEM picture depicting the surface topology of *Lysinibacillus* attached to the polymer vs unattached area



Fluorescence microscopy - Live cells of *Lysinibacillus* attached onto the polymer shown as dark background

Biocellulose from bacteria

Biocellulose producing bacteria with good BC production were identified by 16s rDNA sequencing analysis as *Acetobacter ghanensis* and *Acetobacter* sp. *A. ghanensis* showed highest production. The optimal fermentation conditions and media components for enhanced BC production by *A. ghanensis* were investigated. Production of BC using optimized media components and culture parameters was 1.1 times higher (4.4 g/l) than initial non optimized media (4.0 g/l). The product was confirmed as pure bacterial cellulose by Fourier Transform Infrared spectroscopy spectra.

Biocellulose production by *Acetobacter ghanensis* in HS broth

Biosurfactant production by bacteria

Twenty four isolates of bacteria obtained from oil contaminated sites were screened for surfactant production. *Salinivibrio costicola* isolate that had an emulsification index of 45% and positive for other assays was identified as a potent strain for production of surfactant

Screening of Actinobacteria for bioactivity

16s rDNA sequencing analysis of Actinobacteria isolated from soil, water and fish collected from Tuticorin and Lakshwadeep islands identified the strains as *Gordonia sputi*, *Brachybacterium* sp., *Brevibacterium* sp., *Streptomyces rochei*, *Micrococcus luteus* and *Streptomyces* sp. Antibacterial activity of the isolates was tested against *E. coli, S. aureus, S. epidermidis, Klebsiella pneumonia* and Saccharomyces yeast. *S. rochei* produced inhibition to all the test organism. *G. sputi* inhibited all test organism except yeast.

Submissions to database

Ninety five sequences including 16SrRNA sequences and gene sequences were submitted to the NCBI GenBank database and were assigned accession numbers; KP240937-KP241013, KP058470-KP058476, KM983391, KP071939, KP071940, KP071941, KP071942, KP071943, KM983391 and KM269291

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

Studies on microflora on various fishes

Microflora associated with farmed *Pangasius* during iced and chilled storage was determined. The counts of mesophilic aerobic bacteria and hydrogen sulphide producing bacteria were evaluated. In iced storage, TPC exceeded the limit count of 10^7 cfu/g when the fish showed signs of spoilage.

Microflora associated with whole and gutted farmed monosex tilapia during chilled storage was determined. TPC gradually increased from 10^2cfu/g to 10^6cfu/g on Day 18 and the same level was maintained up to 24 day in whole tilapia samples. In gutted samples, TPC reached ≤10^6cfu/g on Day 21. The level of TPC and H_2S producing bacteria was ≤ 10^6cfu/g on Day 24.

Microflora associated with farmed monosex tilapia after dip treatment with 2% Potassium sorbate and packed under air and vacuum during chilled storage was evaluated. Fish samples without dip treatment and packed under air and vacuum served as control. The levels of mesophilic bacteria, spoilage bacteria and indicator bacteria were determined. In air pack samples (with and without dip), good quality was maintained (count ≤ 10^5cfu/g) up to 13 days and shelf life of 16 days was noticed. In vacuum packed samples without dip treatment, shelf life of 19 days was noticed whereas samples with dip treatment had a shelf life of 23- 25 days.

Development of high value byproducts from fish and shell fish processing discards

Screening for protease activity

Twenty five bacterial isolates collected from two deep sea water samples at points 100m and 1000m depth in Arabian Sea were screened for protease activity for fish scale utilization. None of the strains were found to possess gelatinase activity and specific activity against fish scales.

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

Screening for Methicillin resistance

Twenty *Staphylococcus aureus* isolates from seafood samples collected from retail markets in Maharashtra were screened for Methicillin-resistant *S. aureus* (MRSA) by multiplex PCR for 16s, *nuc* and *mec* genes. None of the isolates harboured Methicillin - resistance specific *mec* gene.

BIOCHEMISTRY AND NUTRITION

Research projects handled

Institute projects

- Biomonitoring and bioevaluation of marine resources and formulation of nutraceuticals in human nutrition and health
- Formulation of a fortified fish soup powder and its use in a nutritional intervention study against malnutrition

Extenally funded projects

- Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications
- Exploration and assessment of demersal fishery resources along the continental slope (200-1200m) of Indian Ocean and Central Indian Ocean
- 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
- Validation of tuna advisories of east coast

Most significant achievements

- A novel delivery system of thiamine and pyridoxine was developed by microencapsulating the vitamins with an antioxidant chitosan derivative (Ferulic acid-grafted chitosan). The microparticles were characterized with Scanning Electron Microscope (SEM) revealing spherical particles with no apparent cracks and pores. The particles showed thermal stability and slow release.
- A novel delivery system of β-carotene was developed by microencapsulating with vanillic acid-grafted chitosan. The particles showed slow release of β-carotene and provided stability against oxidation and light. A fish soup powder was developed incorporating microencapsulated β-carotene. *In vivo* studies in rat model showed enrichment of β-carotene in blood plasma.
- A solvent-free two stage enzymatic extraction protocol was developed for extraction of seaweed bioactives (peptide, phenolics, sulphated polysaccharides etc.). These extracts showed better antioxidant potential than solvent and hot water extracts. Two functional food products such as a nutraceuticals drink and fish soup powder were developed by enriching with these extracts.
- A collagen peptide hydrolysate was prepared by a combination of enzyme digestion from fish skin collagen. The peptide hydrolysate showed promising results in collagen protein expression in mouse embryonic fibroblast cells indicating its potential application as food supplement for treatment of arthritis.
- The encapsulation efficiency and oxidative stability of fish oil microencapsulates was enhanced by blending with sage/oregano essential oils.

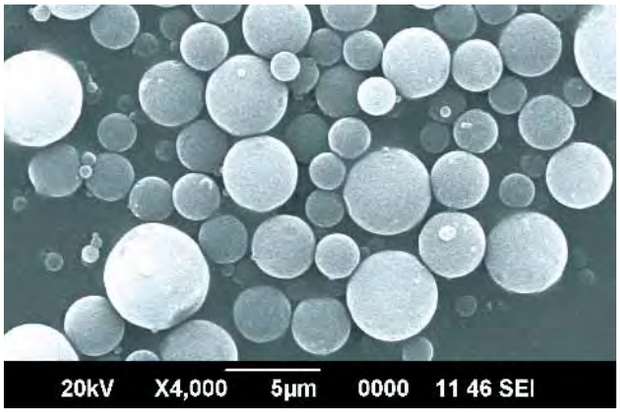
Chief findings

Institute Projects

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

Thiamine and pyridoxine loaded ferulic acid-grafted chitosan microspheres: A novel antioxidant dietary supplement

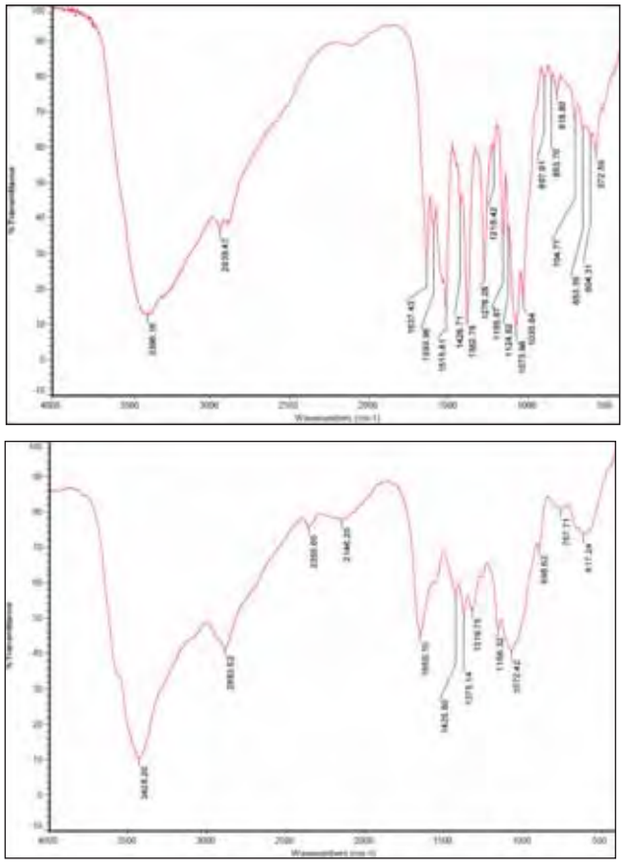
Therapeutic potential of water soluble vitamins has been known and recently they are widely supplemented with processed food. Phenolic acid-grafted chitosan derivatives can serve as an excellent biofunctional encapsulating



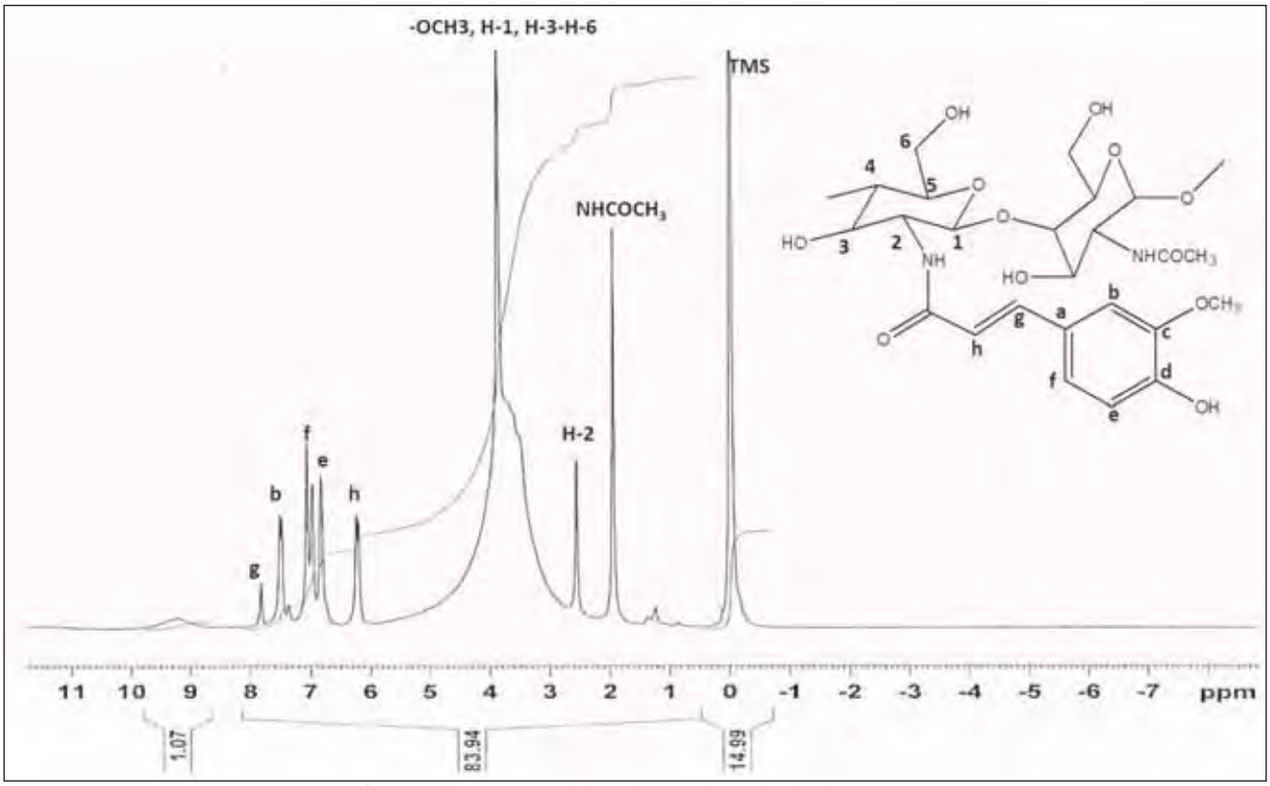
SEM image of vitamin loaded ferulic acid-grafted chitosan microspheres

material for these vitamins. As a proof of concept, thiamine and pyridoxine loaded ferulic acid-grafted chitosan microspheres have been developed and the structure was confirmed by FTIR and NMR analysis. Compact microspheres with smooth surface and no apparent cracks or pores were observed under scanning electron microscope.

Efficient microencapsulation was further proved by X-ray diffraction patterns. XRD spectra of ferulic acid-grafted chitosan (FCS) showed characteristic broader peak at around 20° and less crystallinity as compared to chitosan.



FTIR spectra of native chitosan and ferulic acid-grafted chitosan



^{1}H NMR spectra of ferulic acid-grafted chitosan

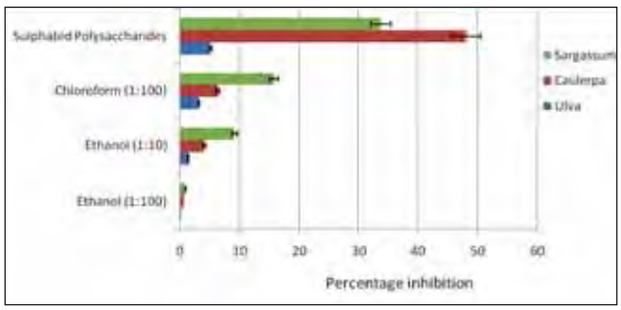
The thermo gravimetric analysis (TGA) and derivative thermo gravimetric analysis (DTG) of ferulic acid-grafted chitosan (FCS) and vitamins loaded microspheres (VMS) showed decreased decomposition temperature of chitosan due to reduced crystallinity after grafting of ferulic acid. Preliminary anti-inflammatory activity of the vitamin loaded microspheres has been demonstrated.

Two stage enzymatic extraction of seaweed bioactives and development of a nutraceutical drink and fish soup powder

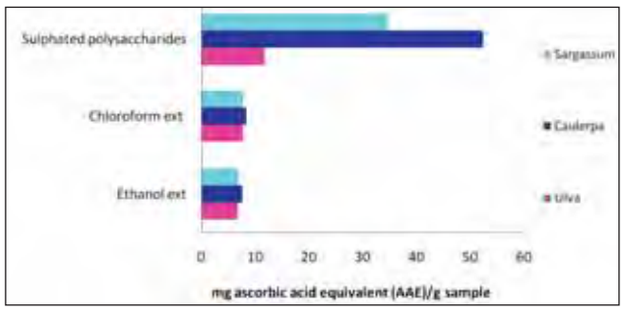
Nutraceutical drink developed

Two ready-to-eat nutraceutical products were developed, the first one being a nutraceutical drink rich in Ulvan and fucoidan polysaccharides. The developed nutraceutical drink was evaluated for its sensory parameters like taste, colour, flavour, aroma etc. by a sensory panel.

Caulerpa-rich insulfated polysaccharides isolated was incorporated to a fish soup powder at 20% level and was found acceptable.

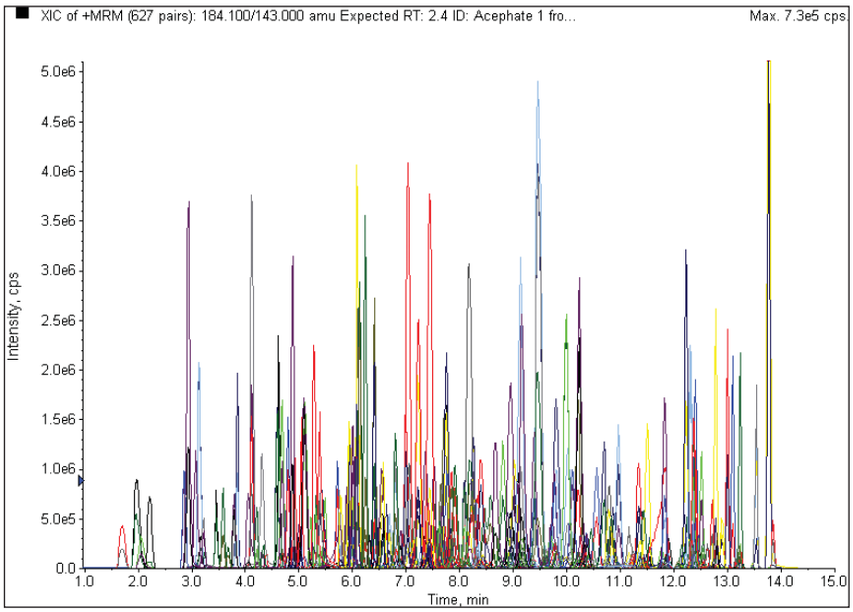


DPPH free radical scavenging activity of extracts in terms of percentage inhibition



Total antioxidant capacity of extracts in terms of mg ascorbic acid equivalent (AAE) per g seaweed sample

Development of a LC MS/MS multi-residue method for simultaneous analysis of 165 pesticides and veterinary drugs residue in fish



Representative LC MS/MS chromatogram of multiclass pesticides and veterinary drugs

A multiresidue method was developed for simultaneous analysis of multiclass pesticides and veterinary drugs in "Basa" catfish. LC MS/MS method parameters like MRM, linearity, LOD, LOQ, chromatographic separation etc. was optimized.

Formulation of a fortified fish soup powder and its use in a nutritional intervention study against malnutrition

Microencapsulation of β-carotene in vanillic acid-grafted chitosan and development of a fortified fish soup powder

The vanillic acid-grafted chitosan derivative was synthesized by a free radical-mediated reaction of vanillic acid and chitosan. Structure of vanillic acid-grafted chitosan was elucidated with the help of FTIR and NMR spectroscopy.

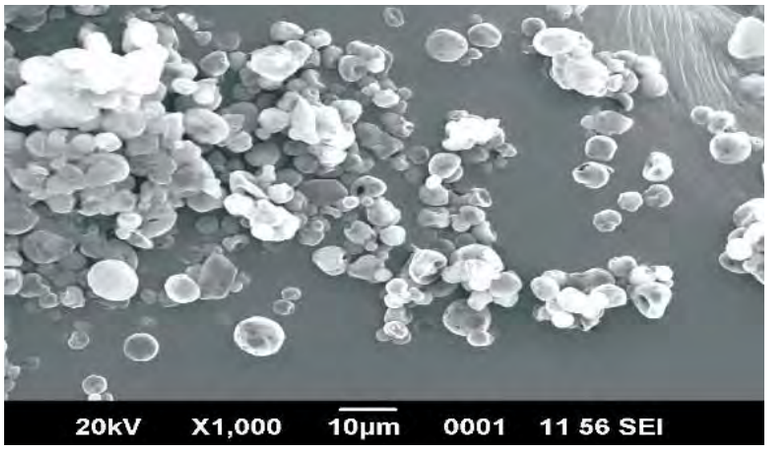
Microencapsulation of β-carotene with vanillic acid-grafted chitosan was carried out. Loading efficiency (60%) of β-carotene in the microcapsules was determined by HPLC. Microencapsulated particles were characterized by techniques *viz*. SEM, XRD, TGA, FTIR. SEM images of the β-carotene loaded micro particles showed spherical particles without apparent cracks and pores.

Fish soup powder was prepared and the process was optimized for various parameters with special reference to its protein content. Microencapsulated β-carotene (MBC) was incorporated into fish soup powder and *in vivo* bio-availability was studied.

Microencapsulated β-carotene

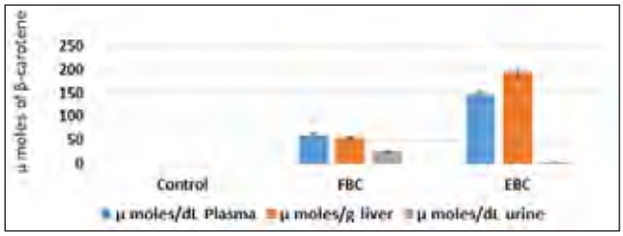
Blank fish soup powder

Soup powder with microencapsulated β-carotene



Scanning electron micrograph (SEM) image of encapsulated β-carotene

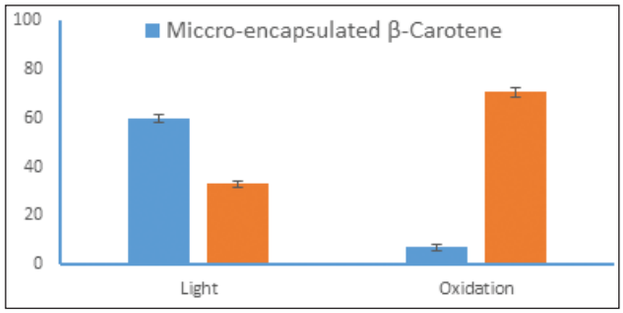
Soup powder in packet



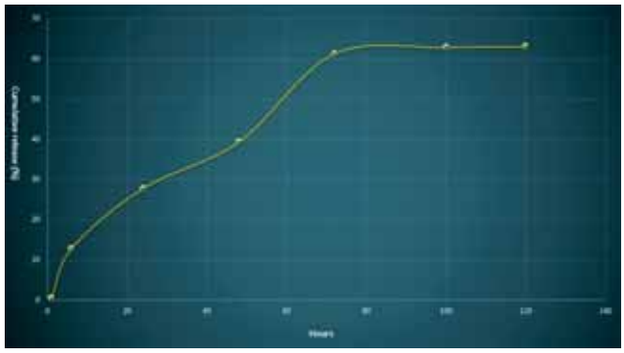
Levels of β-carotene in plasma, liver and urine of control and experimental groups of rats

Comparative analysis of β-carotene (BC) content in serum, liver and urine of mice following administration of MBC and free BC (FBC) in albino rats showed that MBC content remained high in serum and liver and urine for a longer time than FBC. MBC also significantly raised liver and plasma antioxidant glutathione content when compared to FBC while no change in the levels of TBARS, the indicator of lipid peroxidation was observed.

Sustained release of β-carotene was observed from the microparticles. After 120 h only 60% of the loaded β-carotene was released during *in vitro* release study. Stability of the β-carotene loaded particles against oxidation and light were studied for 21 days which showed better stability of microencapsulated β-carotene.



Oxidation and photostability of β-carotene after 21 days of storage



Slow release of β-carotene from the microparticles

ENGINEERING

Research projects handled

Institute projects

- Enhancing the fuel efficiency and safety of mechanized fishing vessel systems
- Thermal and non-thermal technologies for processing and packaging of fish products
- Development of standard processes and protocols for innovative products from aquatic resources, shelf life modeling and assessment of energy use

Collobarative project with ICAR-IISR, Calicut

- Developing energy efficient processing technologies for spices

Most significant achievements

- In a study on engine characteristics and quality perfomance of fishing vessals the engine validation procedure was refined to test the engine endurance by subjecting it to a judicious variation of maximum power and torque at specified rpm levels in 15 cycles of 16 hours with 8 hours cooling time in between the cycles.
- Designed and developed a prototype solar chiller of 5 kg capacity.
- Developed a hand held fish de-scaling machine of 5 kg capacity.

Chief findings

Institute projects

Enhancing the fuel efficiency and safety of mechanized fishing vessel systems

Engine characteristics and quality performance of fishing vessels

Engine testing in progress

The ongoing study brought out that the engine characteristics with respect to operational requirements of fishing vessels are not fully understood by the engine manufacturers and the essential data required for optimal integration of engine selection is not normally available.

The engine validation procedure was further refined to test the engine endurance by subjecting it to a judicious variation of maximum power and torque at specified rpm levels in 15 cycles. Torque generation characteristics at low rpms were studied to understand the possible overloading of engines during fishing operations and how it affects its service life. The data generated during the test which lasted for 40 days continuously during January-February, 2015 is being analyzed.

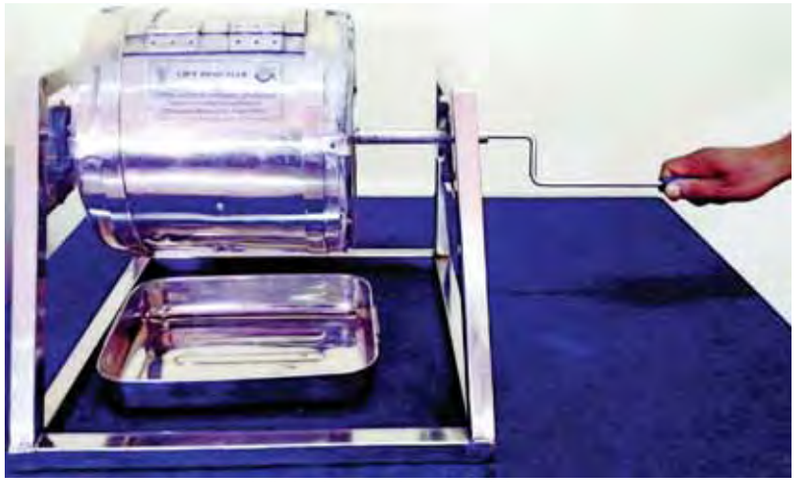
Data for profiling of mechanized fishing systems in existence on the Kerala coast, with respect to hull form, construction methods and quality, installed power, propulsion characteristics, energy utilization and use pattern and onboard equipments were collected using a well-designed questionnaire that was initially pre-tested at Munambam and Sakthikulangara in 30 boats.

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

Development of solar chiller

Designed and developed a prototype of solar chiller and trials have been conducted with mackerel in different loaded conditions. It was found that fish core temperature reduced from 22 °C to 8 °C in 45 minutes and the chamber temperature reached up to -5 °C. The cooling chamber was made of GI sheet of 18 gauge with 4" thermocol insulation. Power of the chiller was tapped from solar radiation through photo voltaic panels (500W) connected to 24V battery backup. Maximum fish loading capacity was 5 kg for the prototype chiller.

Designed and developed hand held fish de-scaling machine of 5 kg capacity. The machine is very simple and does not require electricity for operation. This low cost hand held model can easily be used in fish markets and also for domestic purpose.



Hand operated fish de-scaling machine

Development of standard processes and protocols for innovative products from aquatic resources, shelf life modeling and assessment of energy use

Energy consumption pattern of fish processing unit

A preliminary study on the electrical energy consumption pattern for different fish processing equipment was carried out. Data were collected from a private fish processing plant for processing equipment like plate freezer, blast freezer etc. Data were collected regarding electrical energy consumption of four different capacity plate freezers per batch per day. Analysis of data regarding product and process-wise is in progress.

Developing energy efficient processing technologies for spices (IISR-CIFT Collobarative Project)

Design of solar tunnel dryer

Design and developed a solar tunnel dryer with electrical backup having a capacity of 1000 kg. Trials were conducted on drying peeled ginger, bitter guard prawns, etc. Also a small unit of solar water heater is installed and fabrication/development of steam generation unit is in progress.

Solar tunnel dryer

EXTENSION, INFORMATION AND STATISTICS

Research projects handled

Institute projects

- Evaluation of technology transfer models in fisheries sector
- Management dimensions in fisheries: Policies, issues and implications
- Enhancing the fuel efficiency and safety of mechanized fishing vessels
- Development of standard processes and protocols for innovative products from aquatic resources, shelf life modelling and assessment of energy
- Processing and quality improvement of seafoods in Gujarat
- Reduction of environmental impact from trawling systems through bycatch reduction technologies and development of region specific sustainable fishing systems for east coast of India

Extenally funded projects

- Thematic studies on gender in aquaculture in Cambodia, Thailand, Vietnam and Lao PDR; under MARKET (Maximizing Agricultural Revenue Through Knowledge, Enterprise Development and Trade)
- National surveillance project on aquatic animal diseases

Most significant achievements

- Technology transfer programmes on responsible fishing and production of value added products were conducted in three fishing villages *viz.*, Thanga and Sarik Konjin fishing village, Manipur and Pulicat in Tamil Nadu. The awareness on improved practices and products was found to have increased after the training.
- Performance indicators were developed for assessing Fishermen Co-operative Societies in Kerala and the study showed that legal status, financial management, co-operative planning and administrative procedures, membership strategies and market linkages were the five major indicators determining the performance.
- The annual ice requirement of the fishing industry in Kerala was estimated as 8.5 lakh tonnes.

Institute projects

Evaluation of technology transfer models in fisheries sector

Evaluation of technology transfer programmes

Technology transfer programmes were conducted on 'Responsible fishing and production of value added products' at Thanga fishing village, Manipur and Pulicat lake, Tamil Nadu; 'Production of value added fishery products' at Sarik Konjin, Manipur; 'Hygenic fish handling, Value added fishery products and Responsible fishing techniques' at North Lakhimpur, Assam, Jairampur (KVK, Changlang) and Namsai, Arunachal Pradesh. The Socio-Economic Evaluation Index (SEEI), Average Awareness Index (AI) and Symbolic Adoption Index (SAI) scores were calculated for the respondents belonging

Training and distribution of critical inputs at Manipur

to different women SHGs and fishermen groups who participated in the above training programmes. Highest Average Awareness Index Symbolic Adoption Index was observed at Namsai, Arunachal Pradesh (AI=84.40, SAI=61.28) followed by Jairampur (KVK, Changlang) (AI=58.35, SAI=44.10). The Socio-Economic Evaluation Index (SEEI) in case of Thanga fishing village and Sarik Konjin, Manipur were 46.85 and 53.64 respectively. In case of Pulicat Lake, Tamil Nadu the average SEEI was 46.67.

Awareness programme at Pulicat

Technical efficiency and economic performance of small scale fishing units of Kerala

The technical efficiency of small scale fishing units *viz*., Marine Plywood Craft (MPC) and Mini-trawler (MT) in Alappuzha and Thiruvananthapuram were studied using Stochastic Frontier Production Function (SFPF). The results revealed that the 72 per cent of the crafts under MPC category were efficient than mini-trawlers under study. It was also found that the value of return to scale (RTS) showed the excessive use of inputs by the fishermen.

Economic performance of motorized FRP boat (9.75m L_{OA}) operation was estimated based on the data collected from four districts of Kerala. The motorized FRP craft (8.5–9.1m) had an average total investment ranging from ` 4.09 lakhs to ` 4.67 lakhs on a fishing unit. The average daily fishing expenditure was found to vary between ` 1769 to ` 1869. The average operational profit was found to range between `1.47 lakhs to ` 2.79 lakhs.

Studies on fishermen awareness and adoption related to turtle conservation policies and practices in Odisha

As Odisha coast is the largest rookery for Olive Ridley Turtle (*Lepidochelys olivacea*), a study was undertaken to assess the fishermen's awareness on turtle conservation practices and adoption of turtle conservation policies and practices. Data was collected from mechanized fishing boat owners and crew members in Paradeep, Odisha. Results showed that 97.44 percent of the fishermen were aware about the incidental mortality of turtle in different fishing gears and use of Turtle Excluder Devices (TED) in trawls. 100 per cent adoption was observed in case of turtle conservation policies (spatial and temporal ban) as it has been made mandatory by Department of Fisheries and Forest Department. Low level of adoption of fishing using TED in trawls has been observed among the fishermen.

Data collection on turtle conservation

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

Performance indicators for assessing fishermen Co-operative Societies

Various indicators including legal, financial and service variables were used to assess the performance of fishermen co-operatives in order to develop a generic model for assessment. Based on the relative importance and level of acceptance among members, the indicators were ranked and it was revealed that the legal status of the Society was one of the most important factors affecting the performance. Sound financial management and adherence to administrative procedures and planning were the other important aspects that make co-operatives viable. Strategies to improve membership and establishment of good market linkages, are the other important indicators.

The service functions of co-operatives was also assessed by estimating the mean technical efficiencies for the Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) and Data Envelopment Analysis (DEA) model which were 60 and 99 per cent respectively. It was evident that the technical efficiencies were mainly attributed to the credit and fish auctioning services of the society.

Estimation of ice required in the fisheries sector in Kerala

Ice is a major input for the fisheries sector in Kerala and a study was carried out to assess the ice production and utilization pattern in the sector. It was estimated that around 50.2% of the total ice production (8.5 lakh tonnes) is required by the fishing industry in the state. Considering the ice utilization pattern in the fishing industry, it is estimated that around 3.38 lakh tonnes of ice is required by the fish processing industry for pre-processing activities and an estimated 3.04 lakh tonnes is utilized by the fish marketing network in the state which is organized as wholesale, retail and roadside fresh fish markets. Ice is extensively used for transportation of fresh fish from the landing centres to processing units, fish markets and outside states for trade and the estimated requirement is 2.87 lakh tones (17%).

Assessing the impact of stakeholder organization on women empowerment

Different indicators were identified for measuring the impacts of *Godavari Maha Samkhya* (GMS), a consortium for fisher women empowerment in the East Godavari district of Andhra Pradesh. A detailed survey was conducted among the women members of GMS in Chinna Boddu Venkataya Palem (CBV Palem) in East Godavari district. Under the different dimensions of women empowerment, majority of the women seemed to come under empowered category, *vi.z*; access or control over assets (56.00%), gain in awareness and skill (60.00%), involvement in decision making pattern (68.00%), psychological empowerment (68.00%) and control over finance (72.00%). In case of political/legal empowerment, only 28.00% of the women were found to be empowered. Considering the overall empowerment status, 76.00 per cent of the women members in GMS were found to be coming under the empowered category.

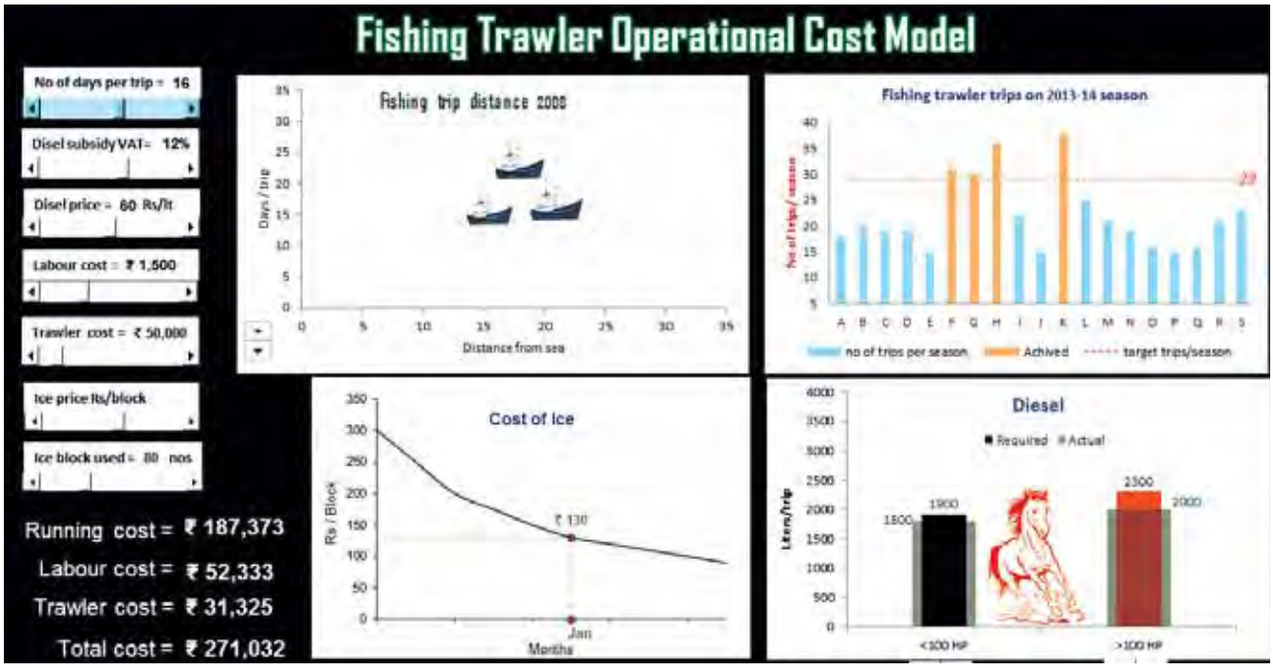
Methodological modification and estimation of harvest and post harvest losses in fisheries

Data collection at Njarakkal

Modified design was developed for estimating harvest and post harvest losses in fisheries using the post-stratified estimator along with multi stage stratified sampling design. The number of boats landed throughout the day was recorded. At the end of the day, number of boats landed, catch and loss recorded are post-stratified according to the gear type. Number of distinct gears is taken as the number post-strata. The resulting design can be regarded as a two stage random sampling with post-stratification at the second stage with first stage units as the landing centre and second stage units as the boats of specific gear type.

Development of market information models for fishing industry

Fishing Trawler Model: A decision making informational site for the trawl fisheries was developed to know the operational expenditure of the each fishing trip. In the model there are input options like number of days per trip, diesel subsidy percentage, diesel price, labor cost, number of crew members, trawler cost, cost of ice per block, number of ice block etc. which can be handled by fishermen themselves. This model can help the fishermen in decision making to optimize operational cost and improve efficiency. This model is generic and applicable to all type of fishing boats



by making required changes in the input on initial investment.

Diesel Consumption Model: Diesel Consumption Model for the fishing trawlers was also developed based on data for the year 2013-14 on quantity of diesel sold, price of diesel and subsidy amount for each fishing trawler and total quantity of diesel sale per day specifically for fishing for fish landing centers of Gujarat. This can be used for different states and specific landing centers and can be used to check improper use of diesel consumption.

Enhancing the fuel efficiency and safety of mechanized fishing vessels

Studies on technological changes in marine fisheries

Technology changes in marine fisheries sector was studied and found that the greatest changes were increase in size and power of vessels. Introduction of high power low cost Chinese engines was found to have very strong impact which lead the industry to increase the power of the fishing vessels in an unscientific manner. Results of the study showed that 41% of the vessels were having 100-200 HP engines, 26% with 200-300 HP, 17% with 300-400 HP and the remaining 16% of the vessels were having more than 400 HP engine.

Lack of proper knowledge and construction skill was found among the boat builders as well as propeller manufacturers who were playing a key role in deciding the safety, fuel efficiency and durability of the fishing boats. Hence it is recommended to bring a national standard for the boat building industry to improve the existing scenario.

Processing and quality improvement of seafoods in Gujarat (Veraval Research Centre)

Comparative studies between traditional and modern fish meal units

A comparative study was carried out between traditional and modern fish meal units in Veraval, Gujarat. Gujarat produces around 18,000 MT of fish meal annually. Trawler bycatch like trash and juvenile fish and waste generated from fish processing factories are the major sources of raw material for fish meal plants. The source of raw material come from places like Navabandar, Jaffarabad, Rajpara, Vanakbara, Okha and Mangrol. In Gujarat, almost 66% units follows traditional method of fish meal production. The installed capacity was 50-100 tonnes per day, but an average per day operations were at 10-20 tonnes for 8 to 9 months based on the availability of fish. In the improved sterilized method oil can also be extracted, but in Gujarat they use the method only for producing fish meal. Poor availability of oil sardine is a major constraint for this species not being a raw material for meal and oil production, unlike in other

states. The head waste of catfish that are dried is a major raw material and poultry industry from Tamil Nadu is the major buyer.

Studies on dry fish processing and export from Gujarat

Gujarat is a major exporter of dry fish. Major species of dry fish exported from Gujarat are catfish, leather jacket, Bombay duck and shrimp from places like Veraval, Okha, Una-Diu and Navabandar. Eleven export units and 350 domestic dry fish units are operating from various coastal regions of Gujarat. The drying season is from September to May. The quantity of dry fish export from each unit varies from 30 to 75 mt per month and its prices vary from ` 80 to 220 per kg. The net annual profit per dry fish export industry is calculated as 0.75 crores. Nearly 80- 90% of operational cost is for purchase of raw material (fishes). Sri Lanka is the major importer of dry fish from Gujarat, which is again re-processed and exported from there.

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

Economic evaluation of different fishing systems in Andhra Pradesh and Odisha

An appraisal of different fishing systems in Andhra Pradesh (Visakhapatnam and Kakinada) and Odisha (Paradeep) were done and the economics of operation were analyzed. During the study on the economics of operation of multiday trawl fisheries (7-12 days voyage) it was found that the average operational expenditure is ` 114667.95/- and the average operational profit as ` 26101.30/-.

In case of Andhra Pradesh, much diversified fishing systems were observed. Fishing vessels are engaged in trawling only, trawling and long lining operations, gill netting and long lining operations etc. During the study in Kakinada it was found that the average operational profit of vessels engaged trawling operations was Rs. 98730.77/- in case of multiday fishing.

Study on stakeholder preferences for turtle conservation policies and practices at Odisha

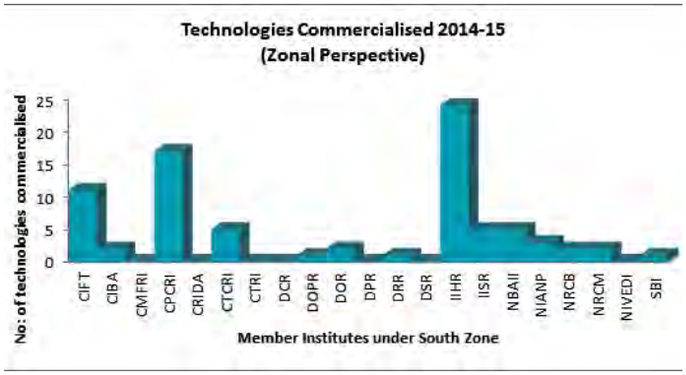
A pilot study was also undertaken in Odisha to identify stakeholder preferences for turtle conservation practices and perceptions regarding use of Turtle Excluder Device (TED) in trawls. Major stakeholders involved in turtle conservation are Department of Fisheries, Department of Forestry, Coast Guard, Civil Society Organizations like World Wild Life Fund, Central Government Research Organizations and the fishermen themselves. According to fishermen, multiple restrictions on fishing for conserving turtles was the major constraint. Fishermen's perception regarding Turtle Excluder Device was that it will result in loss of catch and escape of big fishes.

EXTERNALLY FUNDED PROJECTS

Indian Council of Agricultural Research Projects

Zonal Technology Management Centre - Business Planning and Development Unit

Facilitating intellectual property and technology management activities of South Zone member institutes



The Zonal Technology Management Centre (ZTMC) 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 in effective IP management, technology transfer / commercialization in database management of the intellectual assets. ZTMC provides reports for Results Framework Document on monthly basis regarding the activities related to IPR and technology commercialization of 21 ITMUs under the zone, to ICAR.

AgrIP 2014 - Annual Zonal Meeting

The ZTMC organized AgrIP2014, the South Zone Annual Meeting, in association with the Institute Technology Management Unit (ITMU), Indian Institute of Horticulture Research (IIHR), Bangalore during 9-10 October, 2014. The Meeting was aimed to provide an opportunity for ITMUs from 22 ICAR Research Institutes under South Zone to deliberate their inventions, IP related activities and the issues faced by them in IP management and technology commercialization.

Capacity Building Programmes

Training programme in progress

- As part of the residential training programme for the Senior Level Officers of Industries Department, Government of Kerala conducted by Kerala Institute for Entrepreneurship Development (KIED), a delegation of 30 officers visited BIC at ICAR-CIFT on 25 September, 2014. They interacted with the entrepreneurs in the Incubation Centre.
- As part of Industrial visit, a total of 60 students of the 1st Semester MBA visited BIC on 17 October, 2014. An interaction with the companies of the Incubation Centre was also arranged.

Entrepreneurship Development Programmes

- As part of Capacity Building Training programme for the Assistant District Industries Officers and Senior Co-operative Inspectors of Industries Department, Government of Kerala, 19 officers from various districts in Kerala visited Business Incubation Centre on 23 October, 2014.

- About 40 entrepreneurs from different parts of Kerala visited the Business Incubation Centre on 28 November, 2014.
- Around 30 newly recruited batch of Industry Extension Officers of Government of Kerala undergoing training at KIED visited the BIC on 14 January, 2015. They visited the Pilot-Plant Facility at ICAR-CIFT and interacted with the Incubatee companies and the incubatee companies shared their experiences.

Young Entrepreneurs Summit

Young Entrepreneurs Summit (YES) was an international summit organized by Government of Kerala on 12 September 2014, with the aim of fostering the growth of entrepreneurship and creating an enabling environment for startups in the state across all sectors. YES showcased the existing facilities and support services available to prospective young entrepreneurs to realize their business dreams. ZTMC and ITMU, ICAR-CIFT participated in the event and showcased all the entrepreneur ready technologies available with the zonal institutes, and the services offered and facilities available at the Business Incubation Centre of the Institute.

World Ocean Science Congress and Exhibition

World Ocean Science Congress (WOSC) was a quadrennial event starting with WOSC-2015 held at Cochin during 5-8 February, 2015. WOSC served as a common platform for Oceanographers, Environmentalists, Fishing community, Shipping industry, Navigators, Defense establishments, Ocean technocrats, Policy makers and Legal experts to share ideas and strengthen regional cooperation in the management and conservation of the ocean and its resources. Four Incubatees of ICAR-CIFT Business Incubation Centre, showcased their products developed using the technical support and guidance of ICAR-CIFT, in the exhibition organized in connection with the event.

National workshop on 'Extracting opportunities in the fisheries sector'

A National workshop on 'Extracting opportunities in the fisheries sector' was jointly organized by ZTMC, South Zone, ICAR-CIFT, District Industries Centre (DIC) Ernakulam and Federation of Indian Export Organization (FIFO) during 20-21 January, 2015 at ICAR-CIFT, Cochin. The workshop was targeted at identifying the emerging technological trends in seafood industry and also realizing the challenges in international and national trade, and in meeting consumer expectations. Fifty participants including entrepreneurs, technologists, business developers and government administrators attended the Workshop.

Inauguration of the workshop

Nutrient profiling and evaluation of fish as a dietary component

Nutrient profiling of four deep sea fishes

Rising population and inadequate food resources are serious twin issues that India faces in the current century. Fish is considered as an affordable source of essential amino acids, fatty acids, and minerals for all levels in the society. Very recently, focus has shifted to exploring the fishes of deeper waters along Indian EEZ. Four species of deep sea fishes as shown were analyzed for nutritional composition.

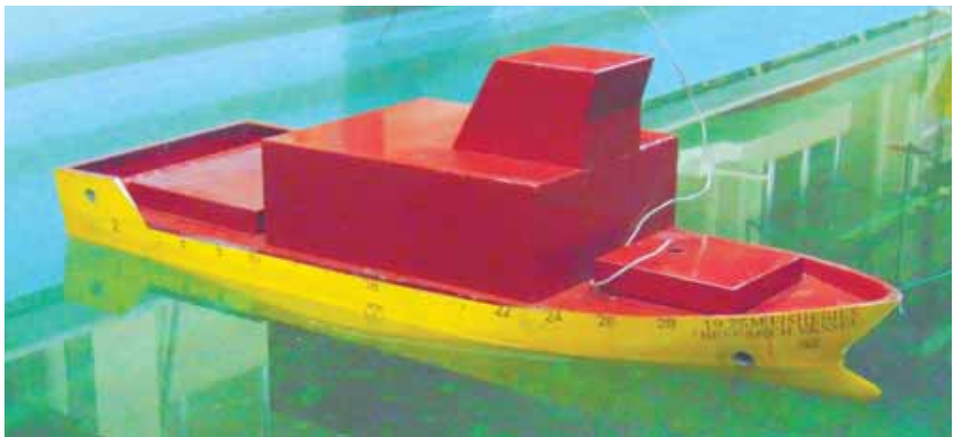
The deep sea fish samples were found to have high water content, in addition to high protein, lipids and minerals. Deep sea fish proteins consisted of significant quantities of essential amino acids that have physiological importance and they lack the presence of toxic metals. Hence it can be concluded that the deep sea fishes could be a perfect solution to reduce the rate of malnutrition

National Agricultural Science Fund Projects

Green fishing systems for tropical seas

Construction of a combination fishing vessel and stability analysis

3D design of 19.75 m L_{OA} combination fishing vessel



Model prepared for motion tests with super structure and mass distribution

By analyzing the designs of fishing vessels collected in the all India baseline survey, the design for 19.75 m combination fishing vessel was completed using ship design softwares. This design was then imported to Computational Fluid Dynamics (CFD) simulation software to simulate sea conditions. After arriving at a standard design, the ICAR-CIFT and Goa Shipyard Limited (GSL), Goa conducted a model test in the Towing Tank facility at Indian Institute of Technology, Madras. Preliminary stability analysis of the proposed vessel was performed to analyze the hydrostatic particulars, KN values, angle of down flooding at different loading conditions etc. After conducting model testing and stability analysis, the design has been finalized and handed over the GA drawing to GSL. The construction of the vessel has been initiated.

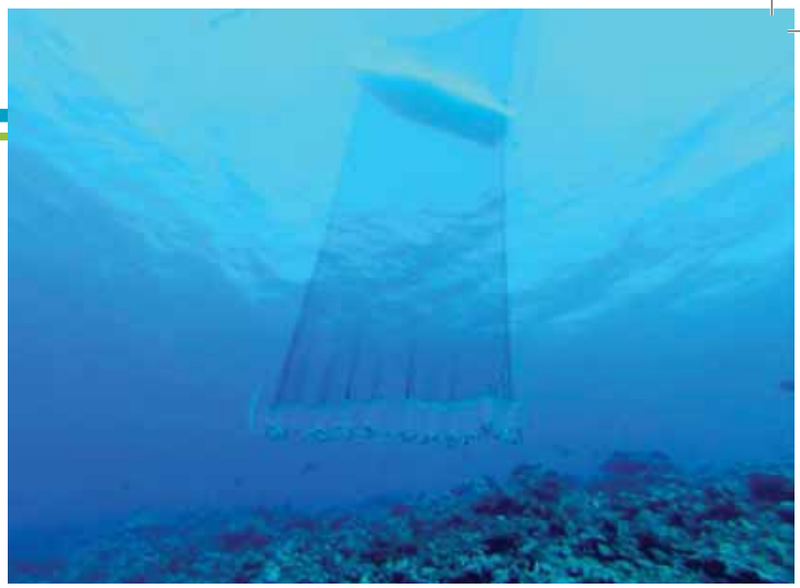
Development of database of existing fishing gear designs

Data collection of fishing gear designs

Documentation of designs of fishing vessels was done according to FAO standards (Fyson, 1986) and fishing gears according to FAO (1975, 1978). A total of 79 trawls, 31 gillnets, 11 purse seines, four ring seines, 14 hook and lines and two dolnet designs were documented and digitized. The data was collected from all India baseline technical survey of marine mechanized fishing vessel and gear and the study covered the fishing harbours and important landing centres along the maritime states and the islands of Andaman & Nicobar and Lakshadweep islands.

A modified method for calculation of sinking speed of ring seine

A modified method (mathematical formula) for calculating the sinking speed of seine nets has been derived. The *in situ* validation of the derived formula has been conducted at Lakshadweep Islands by trained project staff with the assistance from Scuba divers. The study uses model nets made of polyamide multifilament twines of 18 mm mesh size. The formula was applied for varying twine diameter, mesh size and lead weight. Telemetry sensors were engaged for measuring the depth and understanding the behavior of nets under water.



Ring seine sinking speed studies

Design of low drag trawl systems

Design details of trawl nets operated along the entire coast of India were analyzed and the drag experienced in these nets was calculated arithmetically. Measures to reduce drag of trawl nets were identified. Two new trawl nets, one fish trawl and one shrimp trawl each were fabricated incorporating drag reduction measures such as mesh size increase and twine size reduction. A comparative study of traditional and low drag trawls is in progress. The trawl telemetry system was installed and data collection has been initiated.

Design of gillnets and fishing lines with alternate materials

Based on the operational and economical analysis of the commercially operated gillnet designs, ICAR-CIFT developed a design for an optimized drift gillnet for targeting large pelagic species using new generation materials. The nets were handed over to the fishermen groups and the rigging is nearing completion.

Optimized new generation long line is fabricated. The operation of the fishing lines will be conducted along with gillnets.

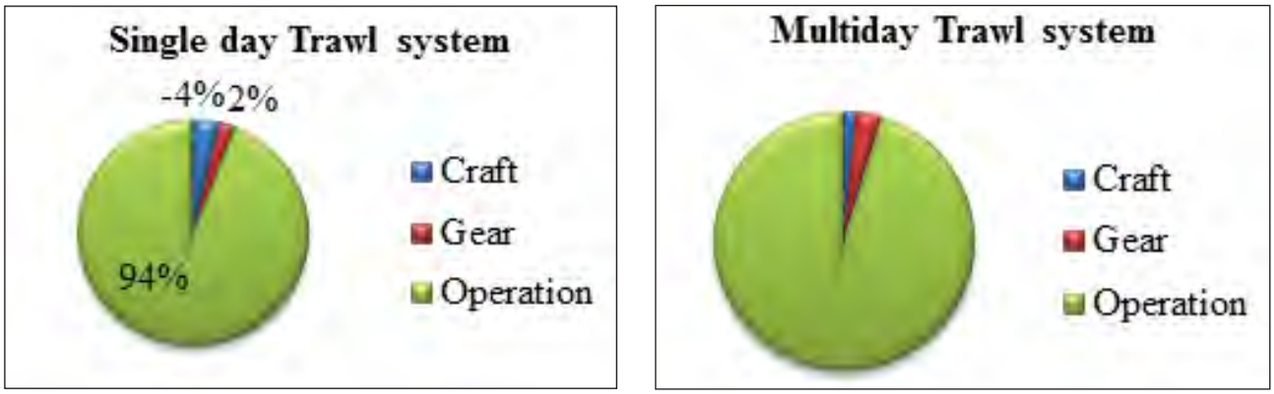
Characterization of bycatch in commercial trawlers

Characterization of bycatch sampled from trawlers of both single day and multiday fishing from Cochin fisheries harbour were carried out. The major bycatch species found were *Terapon jarbua, Lagocephalus* sp., *Cynoglossus* sp., *Oratosquilla nepa, Saurida* sp. and *Secutor insidiator.* Juveniles of commercially important species like *Nemipterus japonicas, Portunus* sp., *Urotenthis* (*Photololigo*) *duvauceli* and *Pampus argenteus* were also found in the bycatch.

Bycatch from commercial trawler

Carbon footprint and Life Cycle Analysis (LCA)

Life cycle analysis of different fishing systems has been conducted. The study has been done using the software GaBi. Life Cycle Assessments were conducted according to the ISO 14040 and ISO 14044 standards in four steps *viz.* goal and scope, definition, inventory analysis, impact assessment and interpretation. For studying the LCA of gears, the quantity of inventory used during the construction were collected by conducting detailed studies in boat yards, net making centers and harbours. LCA analysis for individual fishing unit (vessel and gear) and its operations were conducted using cradle to gate approach. System boundary has been limited to the point at which the catch reaches the harbor.

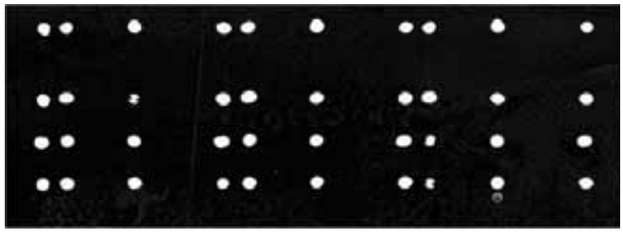


Percentage contribution of fishing sub systems to the total carbon emission (GWP 100 years) [kg CO_2-Equiv.]

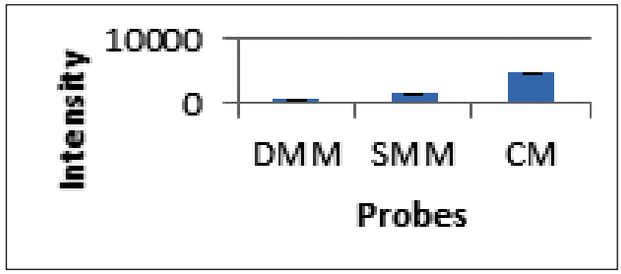
Development of multiplex microarray for detection of food-borne and shrimp pathogens

Diagnostic microarrays in detection of shrimp viral pathogens

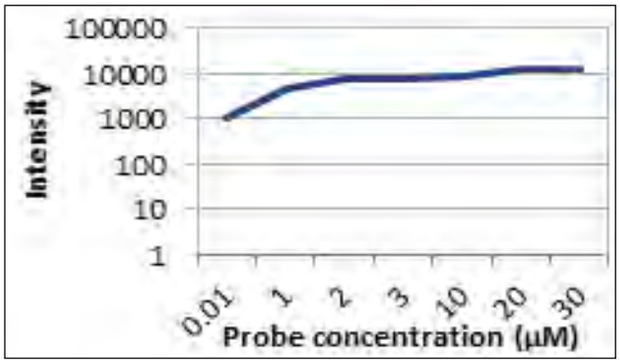
Investigating on the usefulness of epoxide-activated glass slides as substrate for diagnostic microarrays in detection of shrimp viruses was carried out with performing the spotting consistency tests with varying concentration (0.01µM - 30µM) of probes labelled with 5' amino modification and 3' Cy3 modification and the immobilization efficiency analysis with array overnight at 70% humidity. The results showed that the epoxide-modified surface is a useful substrate to be used in a DNA microarray. With this microarray, the shrimp viral genes were differentiated down to the level of a single mismatch in the sequence. Therefore, it is highly presumed that the epoxide-coated microarrays have a promising utility in the area of diagnostic microarrays. Standardization of a microarray for detection of four shrimp viral pathogens is being carried out.



Microarray slide showing the intensity of spots and specificity



Intensities of Double mismatch (DMM), Single mismatch (SMM) and Complete match (CM) probes



Spotting consistency test results

National Agricultural Innovation Projects

Responsible harvesting and utilization of small pelagics and freshwater fishes

Safe and durable FRP fishing boats for inland fishing

Nano-resin technique developed and perfected by NAIP-RHSSP project was used to build 20 numbers of 5.77m boats which have stability and wind friendliness for cast net operation by standing even in highly windy inland waters for the project partner, M/s Chellanam Panchayath SC/ST Cooperative Society Ltd., Kerala under the project supported by SCA-SCP programme of Govt. of Kerala. The cost of construction was ` 24,750/- per boat. The boats were distributed by Shri K. Babu, Hon. Minister for Fisheries, Ports and Excise, Govt. of Kerala to the beneficiaries on 4 July, 2014 in an august function held at ICAR-CIFT. The vessels were utilized by the fishermen on rental basis for 4182 man-days of fishing during 2014-15 and generated an income of more than ` 9 lakhs for the beneficiaries who do not own any boat of their own.

Distribution of FRP fishing boats

Shri K. Babu delivering Chief Guest's address

Evaluation and impact assessment

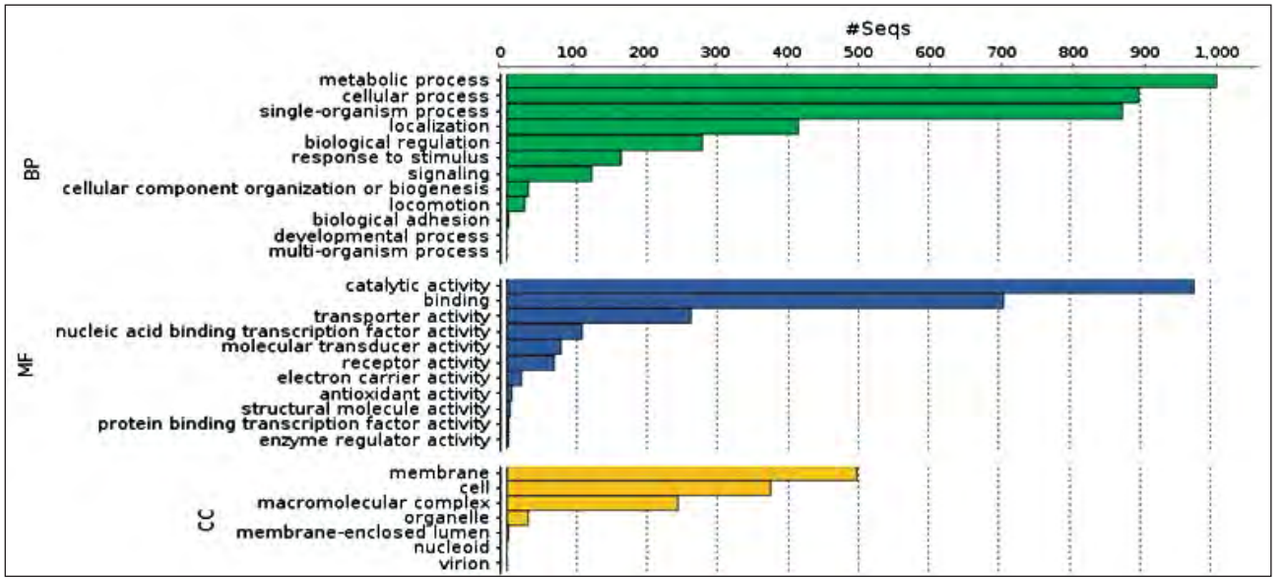
Impact assessment of the hygienic bulk drying system set up for Bombay duck in collaboration with NETFISH-MPEDA at Umbergaon, Gujrat revealed that the quality of dried Bombay duck samples from the yard is better compared to that of commercial samples collected from Mumbai market.

Dried Bombay duck samples

Bioprospecting of genes and allele mining for abiotic stress tolerance

Bioprospecting for abiotic stress tolerance

RNA-seq based transcriptome analysis of *Mangrovibacter* sps. during aerobic to anoxic transition was carried out. The genes and pathways involved in different stages of aerobic to anoxic transition *viz*. aerobic growth, transition stage and anoxic growth of *Mangrovibacter* spp. were identified using Next Generation Sequencing and putative functions of the identified genes were assigned using bioinformatics tools. Total number of genes expressed in aerobic, transition and anoxic stages are 2473, 2891 and 3117 respectively. The number of genes up-regulated under aerobic condition was 40 which was significantly lower than during transition (479) and anoxic stage (413). Genes involved in electron donation reactions and fermentations are significantly up-regulated in anoxic/transition conditions. Universal stress protein f (ATP binding protein, important co-enzyme and enzyme regulator)is up-regulated in aerobic condition and universal stress protein b (response to ethanol) and two other universal stress proteins was found to be up-regulated in anoxic/ transition stage. Nineteen unknown genes were up-regulated in aerobic condition and 60 unknown genes each were up regulated in anoxic/transition stages.



Heat map of Transcriptome analysis showing up-regulated or down-regulated cellular and other metabolic process

CMLRE Centre for Marine Living Resources and Ecology Projects

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

Performance evaluation of 28.4 m myctophid trawl

Designed and fabricated two 28.4 m four seam myctophid trawls and along with otter boards and accessories handed over to a commercial deep sea trawler operating off Kollam for performance evaluation under commercial operating conditions. The trawl was put into fishing trials from ICAR-CIFT research vessel Matsyakumari – II off Kollam at about 500m depth. Catch of myctophids was poor as the trawl sensors were not working properly and could not detect the DSL due to problems in the eco-sounder.

Fabrication of 23.5m myctophid trawl

Myctophid fishing trials off Kollam

A 23.5 m myctophid trawl was fabricated with inner lining of nylon net with10mm mesh for trials onboard ICAR-CIFT vessels.

Based on the comparative study conducted onboard FORV Sagar Sampada, 45 m myctophid trawls were given an inner lining with 10 mm nylon mesh net to retain smaller sized myctophids.

Microbiological quality of myctophid resources

Two myctophid minced meat product tested for microbiological quality revealed the presence of fungal counts >10 cfu/g, even though TPC is <1.5X10^5 during second month of storage. During 4th month of storage, frozen product from myctophids showed fungal counts >10cfu/g.

Assessment of fatty acid profile and proximate composition of myctophid fishes

Fatty acid profile and proximate composition of four myctophid fishes (*Benthosema pterotum, B. fibulatum, Diaphus jenseni* and *Myctophum spinosum*) were comparable with the edible fish anchovy (*Stolephorus commersonii*) containing high protein and good amount of omega 3 fatty acids especially DHA. *Diaphus jenseni* was found to contain very high content of polyunsaturated fatty acid (PUFA). However, the other myctophid species were found to be rich in saturated fatty acid (SFA) ranging from 56 to 65%.

Diaphus jenseni

Benthosema fibulatum

Myctophum spinosum

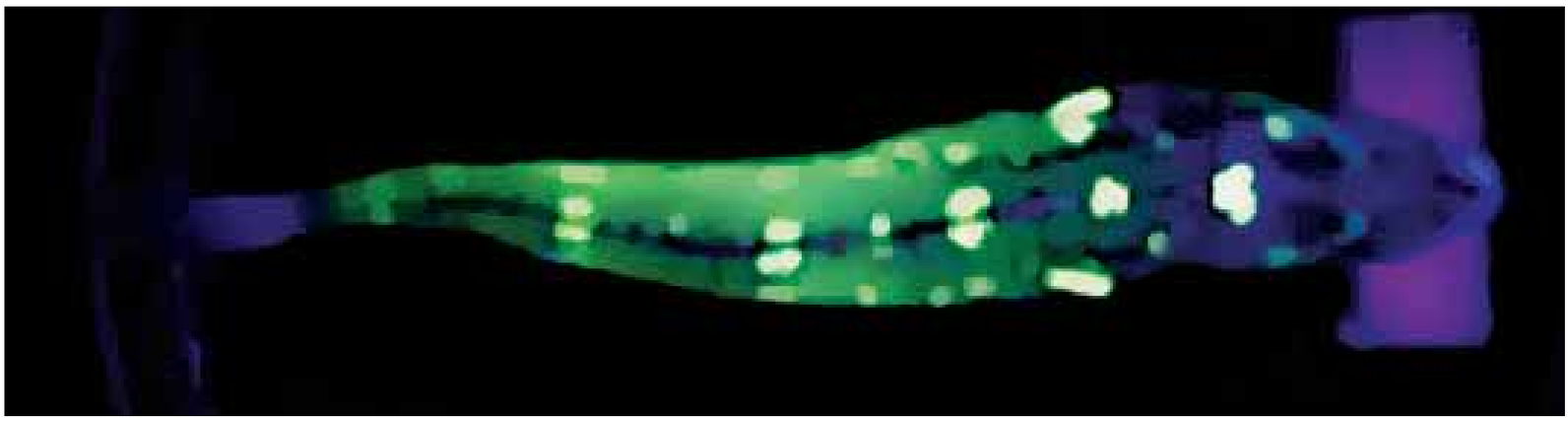
Stolephorus commersonii

Benthosema pterotum

Fatty acid profiling and proximate composition of *Bembrops* sp. caught from Kollam

Bembrops sp., a bycatch of deep sea shrimp trawling off Kollam exhibited fluorescent properties. Analysis showed high protein (20.30%) and omega 3 fatty acids.

Bembrops fish under normal light

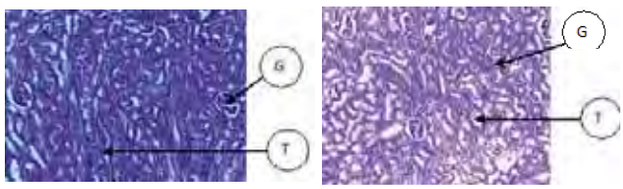


Bembrops fish under UV light

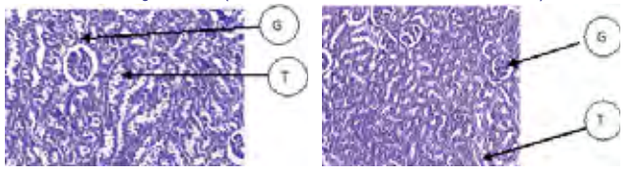
Cytoprotective effect of dietary squalene on cisplatin-induced cellular dystrophy in experimental rats

Squalene effectively reduced toxicity caused due to cisplatin as indicated by the increasing levels of antioxidant enzymes. Serum electrophoresis showed reduction in albumin content in cisplatin treated group which showed an increase in squalene treated group.

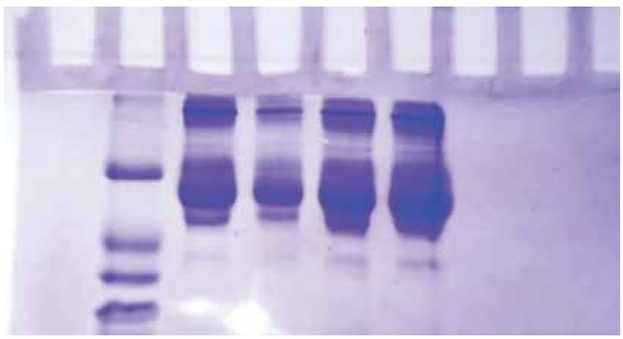
On comparing the cisplatin treated cells with control groups, the glomeruli were found to be damaged and tubules were observed as bulged due to toxicity. But when treated with squalene, the damage was reduced and shape of glomeruli observed was restored.



Control rat kidney cells and cisplatin treated rat kidney cells (G – Glomeruli, T – Tubules)



Squalene treated rat kidney cells and Squalene + cisplatin treated rat kidney cells (G – Glomeruli, T – Tubules)



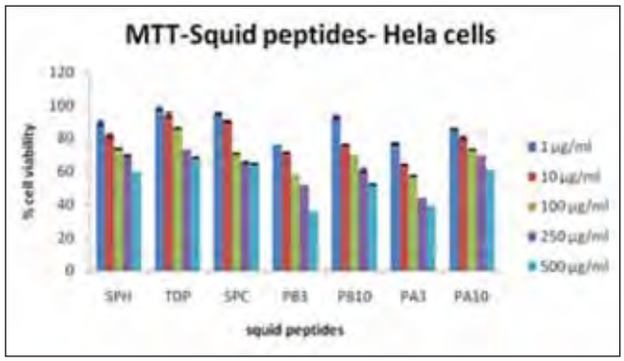
SDS-PAGE of serum in each group
(Lane 1: Low range marker, Lane 2: Control rat serum, Lane 3: Cisplatin-treated rat serum, Lane 4: Squalene treated rat serum and Lane 5: Squalene + cisplatin treated rat serum)

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

Anticancer activity of squid protein hydrolysates against cervical cancer cell line (HeLa)

The anticancer activity of the squid (*L. duvaucelii*) protein hydrolysate was investigated in the present study in HeLa cell line. Peptides (1-500µg/ml) inhibited the growth of HeLa cells in a dose-dependent manner.

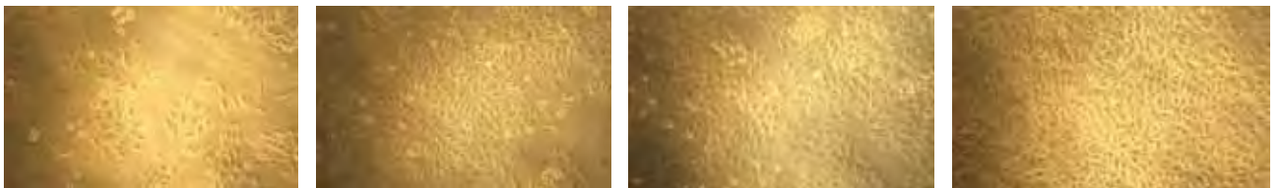
The morphology of the HeLa cells, in the presence of peptides, examined using a phase contrast microscope showed round morphology swelling, cell membrane lysis and disintegration of organelles, suggesting peptide -induced toxicity to HeLa cells.



Cell viability assay by MTT

Expression of collagen proteins in mouse embryonic fibroblast (MEF) cells upon treatment with fish collagen hydrolysate

Fish collagen hydrolysate (FCH) at concentration 0.5^{-1} mg/ml significantly enhanced the production of Type 1 collagen in a dose-dependant manner in embryonic fibroblasts.

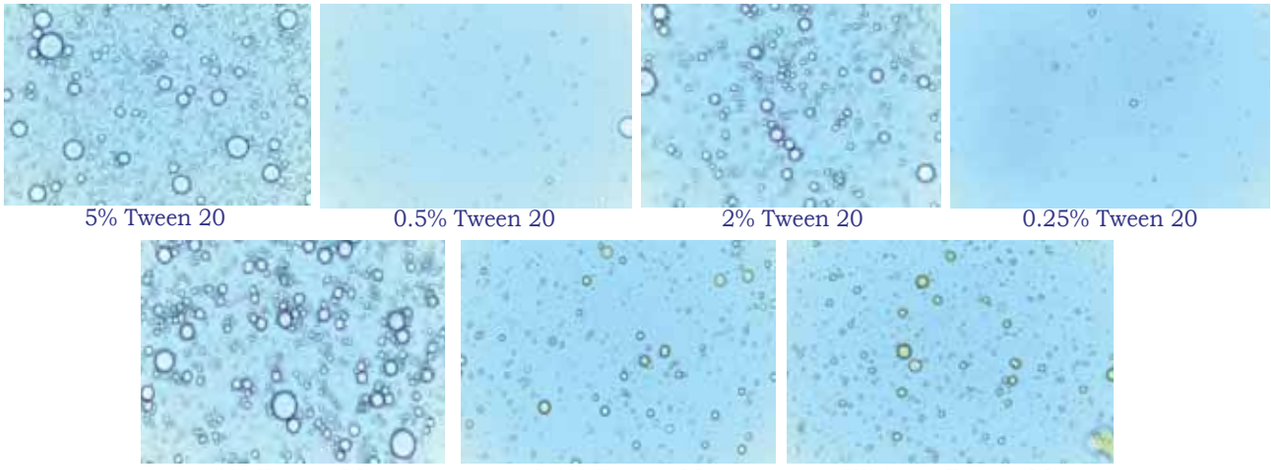


MEFs before FCH treatment | 24hr after FCH treatment | 48hr after FCH treatment | 72hr after FCH treatment

Growth of mouse embryonic fibroblast cells upon fish collagen hydrolysate treatment

Microencapsulation of sardine oil

Standardization of fish sardine oil emulsion was carried out using varying concentrations of Tween 20 emulsifying agent and β-carotene. It was observed that 0.1% emulsifier and without emulsifier sample showed similar characteristics with regard to their particle size and stability assay.



5% Tween 20 | 0.5% Tween 20 | 2% Tween 20 | 0.25% Tween 20

1% Tween 20 | 0.1% Tween 20 | Without Tween 20

Light microscopic image of oil in water emulsion of fish oil stabilized by different concentrations of emulsifier and vanillic acid-grafted chitosan

Enrichment of Betalain and seaweed polyphenolic through macroporous adsorbent resins

Betalain, an antioxidant pigment in red beet root and seaweed polyphenolics were extracted and purified by column chromatography using phenolic specific macro porous resins. Maximum concentration and antioxidant activity were observed in SP-207 eluted extracts in both cases. They will be used to develop industrially important oil in water stable emulsion.

Characterization of harmful algal blooms along Indian Coast

Harmful algal bloom collection onboard and analysis

Bloom sample from M V Bharat Darshan

Samples were collected from Latitude 09° 56' 256" and Longitude 75 ° 52' 216". The salinity (35.07 psu) and pH (7.69) were measured. The microscopic analysis showed the occurrence of *Trichodesmium* sp. Toxicity studies as per Mouse Bio Assay was found negative in the water samples. During FORV Sagar Sampada bloom occurrence was observed only in three stations. Preliminary microscopic analysis of the water samples showed the occurrence of two *Noctiluca* sp. Toxin analysis confirmation studies as per Mouse Bio Assay and using LC MS/MMS are under progress.

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

Studies on biology, biochemical parameters, residual contamination and bioactive compounds from deep sea fishery resources

Length frequency distribution, gonad staging and diet studies of finfishes, sharks, and crustaceans were made on-board. Different varieties of deep sea organisms like finfishes, sharks, shrimps, etc. have been collected for studies on their nutritional, biochemical, residual contamination and bioactivity. They were preserved in fresh condition, at -20 °C and will be analyzed for their potentials. The environmental data like temperature, salinity and dissolved oxygen were collected from CTD profile.

Onboard studies on deep sea fishery resources

Food and feeding habits of deep sea resources

More than 80% of the deep sea fishes analyzed for gut content had empty stomach. Higher proportion was observed in *Priacanthus harmur* (18%), *Psenopsis cyanea* (21.24%), *Bembrops caudimacula* (15.7%) and *Chashanosepta* sp. (60%). Identifying the food items to the species level was not possible in most of the samples as the food items were in the final stage of digestion and were classified broadly as fishes, shrimps and cephalopods.

Feeding habit of deepsea fish

Trawling with HSDT and EXPO nets

A total of seven trawling operations were carried out using HSDT and EXPO model nets. Important species recorded during trawling operations of Sagar Sampada Cruise No. 328 were fish samples such as *Bathytroctes* sp., *Bassozoetus* sp., *Roulina* sp., *Bathypterios guentheri*, Eel, shrimp, octopus, shark, brittle star, jelly Bathyuroconger, *Munidopsis* sp., Gastropode shell, Priacanthus, anchovies, *Neopinnula oriantalis*, Decapterus, Conus, Bivalves, *Bassozetus* sp., *Dicrolene* sp., *Bembrops caudimaculata*, Oceanic squid, Bombay duck, *Pterigotrygla hemistica, Sphyraena* sp., *Johnius* sp., Upeneus, soles, thryssa, mackeral, Ephinephalus, Pomadysis, *Paenus indicus*, Carnax and Scomberomorus. Sea water samples were collected from the different stations of south east coast of India. Bottom profiles of 26 stations were scanned using SIMRAD EK60 Echo sounder from Latitude 14° to 20° N and Longitude 80° to 87° E. Bottom topography of eight grounds were identified for carrying out demersal trawling. Out of eight, seven fishing operations were conducted and one operation could not be done due to long line fishing traffic.

Catch of trawling with HSDT and Expo nets

Isolation and characterization of cartilage proteoglycan extracted from deep sea shark *Echinorhinus brucus*

Proteoglycans were isolated and purified from deep sea shark *Echinorhinus brucus* cartilage. Chemical and structural characterization was done. FTIR and NMR analysis revealed the presence of functional groups such as sulfate, carboxylic, alcohol etc., which confirm the presence of proteoglycan.

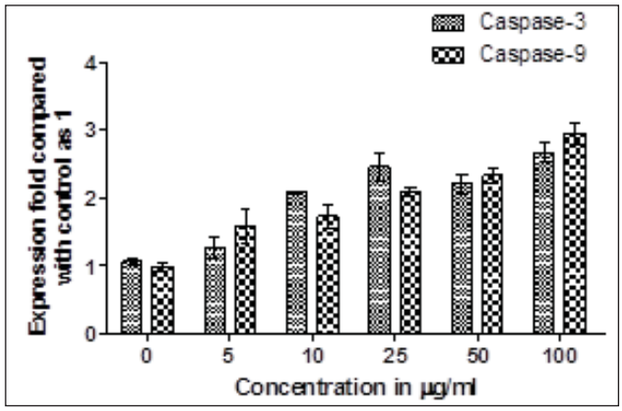
Anti-proliferative activity of proteoglycan extract against breast cancer cell line through apoptosis mechanism

Cell viability test: Fifty and 100 µg proteoglycan extract showed maximum activity of 70-75% cell death against MCF-07 (breast cancer) cell lines. The viability of cells was assessed by MTT assay.

Apoptosis assays: Apoptosis induced anti-cancer was confirmed by dual staining assay and fluorescence microscopic

analysis of dual staining for cell death analysis.

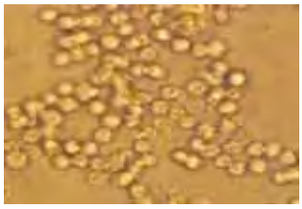
Caspase assay to distinguish apoptosis and cell necrosis: Caspase-3 and 9 are markers associated with apoptosis. Significant increase of both the caspases were observed in all the treated cells especially in 100 µg treated sample confirming the involvement of apoptosis in Cytotoxic activity of proteoglycan extract against MC7 cell lines.



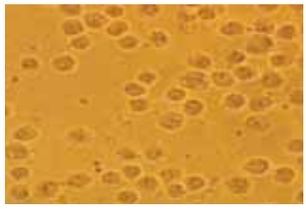
Caspase assay

Protective effects of Bramble shark liver oil against experimentally induced inflammation and ulceration in rats

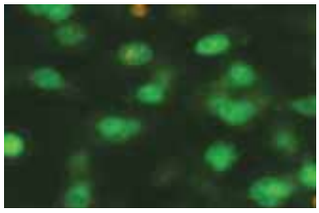
Oral administration of Bramble shark (*Echinorhinus brucus*) liver oil significantly attenuated the formalin-induced paw edema in experimental rats at 1mg/kg body weight concentration of oil. It also exerted potent anti-ulcer action through counteraction of acid-ethanol mixture-mediated lesion formation in the rat gastric mucosa. 100 µg treated sample showed many dead cell with orange to red fluorescence indicating late and early apoptosis.



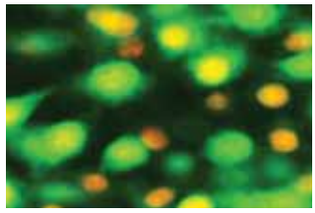
Control (MCF-7) without treatment



100 µg treated sample



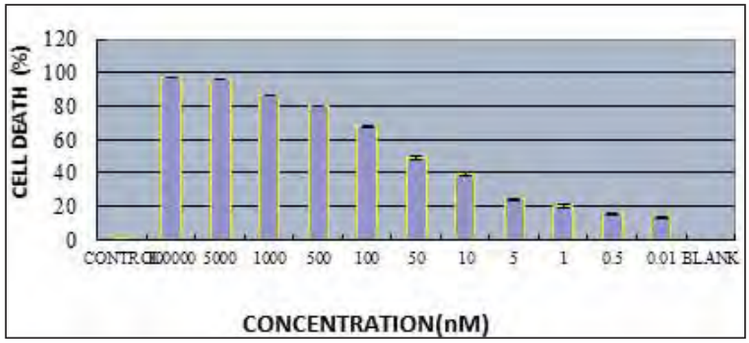
Control cell line showing active live cells



100 µg treated sample

Cytotoxic effect of *Echinorhinus brucus* liver oil on neuroblastoma cell lines (SHSY-5Y)

The relative of Bramble shark liver oil showed cytotoxic effect on human neuroblastoma cell lines (SHSY-5Y) which was determined by MTT assay.



Cytotoxic effect of liver oil using MTT Assay

Nutrient composition of Bramble shark liver oil

Fatty acid profile revealed significant presence of palmitic acid, oleic acid, stearic acid, linoleic acid, DHA (docosahexaenoic acid) and EPA (Eicosapentaenoic acid). Quantification of squalene in Bramble shark liver oil using GC-MS showed the presence of squalene at 38.5%. Fat soluble vitamins namely, Vitamin D_2 (15.04mg/100g oil), vitamin K_2 (11.45 mg/100g oil), Vitamin E and Vitamin A were identified and quantified by reverse phase HPLC method.

Comprehensive mineral profile of selected deep sea species from Indian EEZ

Minerals including heavy metals were quantified from 10 deep sea fishes from Indian EEZ. Method of mineral estimation included micro wave digestion and data analysis using ICP (integrated coupled plasma). The species studied were

Chelidoperca investigatoris, Daphus watasei, Psenopsis cyanea, Neoepinnula orientalis, Cubiceps whitelegii, Berynx mollis, Chlorophthalmis corniger, Glyptophidium argentium, Synagrops japonicas and *Echinorhinus brucus*. From the obtained data it is clear that minerals such as calcium, aluminium, potassium, sodium, iron, magnesium, manganese and zinc are present in all deep sea fishes analyzed. Heavy metals were found to be present in these fishes at permissible level.

Proximate composition on some deep sea fishery samples

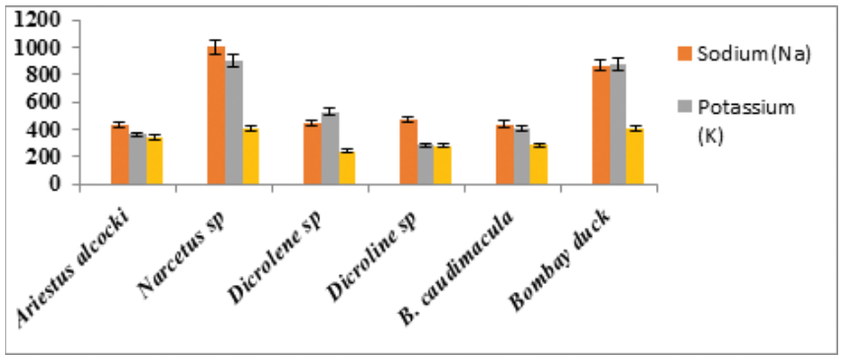
The deep sea fishery resources collected from east coast of India from 200 to 1200 m depths of Indian EEZ during deep sea expeditions of Fisheries and Oceanographic Research Vessel (FORV) Sagar Sampada, Cruise No. 328 were evaluated for nutritional composition.

Proximate composition on deep sea fishery samples of east coast of India

Species name	Depth (m)	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Ariestus alcocki	1000	79.66	16.64	1.11	2.3
Narcetus sp.	1000	74.21	23.65	0.83	1.47
Dicrolene sp.	1000	75.03	29.71	1.53	1.63
B. caudi-macula	500	72.05	28.76	2.49	3.31
Bombay duck	500	74.65	20.86	2.69	1.93

Mineral analysis of deepsea fishery samples of east coast of India

Mineral analysis of deep sea fishery samples of east coast of India were carried out. Mineral content was found to be similar to that of coastal species.



Mineral content of different deep sea fishery samples at 500m and 1000m depth in east cost of India

DBT

Department of Biotechnology Projects

Development of bioplastic based sustainable nano biocomposite food packaging

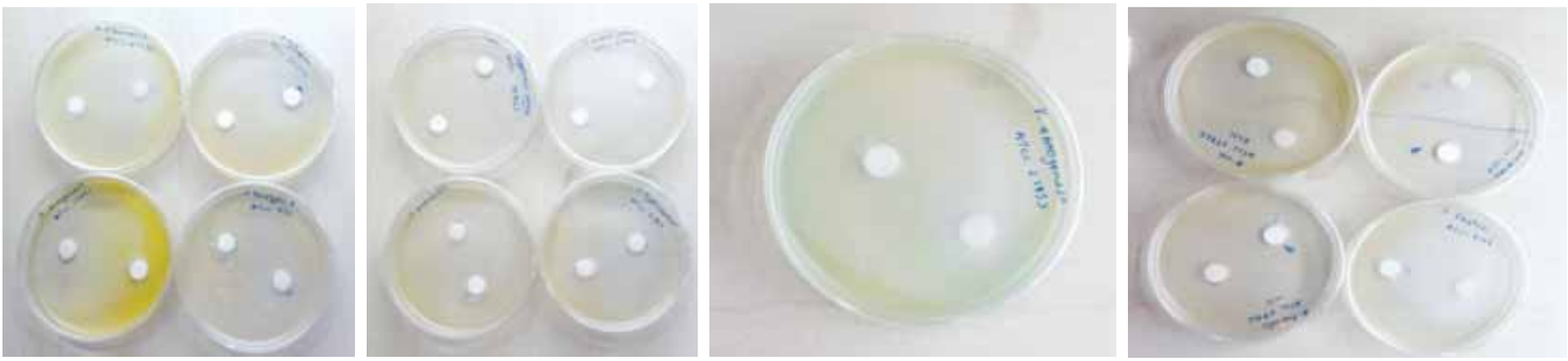
Packaging performance of organic acid-incorporated chitosan films on dried anchovy

Antimicrobial chitosan films were prepared with acetic acid and propionic acid with glycerol as plasticizer and its efficiency was compared with polyester-polyethylene laminate (PEST/LDPE). The tensile strength of acetic acid/chitosan (ACS) films was higher than propionic acid/chitosan (PCS) films. The elongation percentage (6.43-11.3) and water vapour permeability (0.015-0.03 g/m^2/day) were significantly lower ($p < 0.05$) for chitosan films when compared to control. Oxygen transmission rate (OTR) of control and propionic acid/chitosan (PCS) films were significantly higher ($p < 0.05$) than acetic acid/chitosan (ACS) films. Dried anchovy (*Stolephorus indicus*) wrapped in these films were stored at ambient temperature for three months. Quality indices like peroxide value (PV), thiobarbituric acid value (TBA) and microbiological parameters such as aerobic plate count (APC) and total fungal count (TFC) were

periodically determined. In terms of microbial and chemical indices, anchovies wrapped in ACS and PCS films were superior to those wrapped with PEST/LDPE films during storage. Study revealed the suitability of chitosan film as wraps for increasing storage stability of dried fish.

Antibacterial activity of chitosan (2%) and poly lactic acid (10%) film against food-borne spoilage organisms

The antimicrobial activity was analyzed using CLSI method. The result has confirmed that chitosan exhibits high antimicrobial activity against spoilage micro-organisms. This study has also found that the PLA was not having any antibacterial property against these spoilage organisms and chitosan showed high antibacterial property on *Streptococci, Aeromonas hydrophila* (ATCC 35654) and *Enterococcus faecalis* (ATCC 23715). They showed measurable antibacterial activity against *Pseudomonas aeruginosa* (ATCC 27853), *Klebesiella pneumonia* (ATCC 27736), *Salmonella typhimurium* (ATCC 51812), *S. paratyphi A* (ATCC 9150), *Salmonella entritidis, Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeruginosa* (ATCC 15442) and *E. coli* (ATCC 25922). Chitosan films are not only having biodegradable property and also highly efficient against food-borne spoilage organisms.



Antimicrobial activity of PLA and chitosan film

Genetic diversity of *Clostridium botulinum* in seafoods and development of Lateral Flow Immuno Assay (LFIA) for toxinotyping

Screening for *Clostridium botulinum*

A total of 72 food samples from super markets in major six cities in Delhi, Karnataka, Kerala, Mumbai, Gujarat and Andhra Pradesh were collected and processed for *Clostridium botulinum*. Standardized PCR assay for detection of *C. botulinum* from fish and fish products.

Processed fish products collected from super markets for *Clostridium botulinum* detection

DST

Department of Science and Technology Projects

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

Microbiological quality changes of *Caranx melampygus* on chilled storage

The changes in the microbial flora of *Caranx melampygus* on chilled storage in flake ice showed an increase in the initial mesophilic count (5.34 log10cfu g^{-1}) to log105.4cfug^{-1}, log105.84cfug^{-1}, log10 6.29cfug^{-1} and log106.73cfug^{-1} on 3rd, 6th, 9th and 12th days respectively. The microbial counts crossed the acceptable limit i.e. 7 log10cfu g^{-1} on15th day of storage. The psychrotrophic bacteria showed higher growth than the mesophilic bacteria. The incidence of *Brochothrix thermosphacta* was an important finding which indicated the contamination in retailing.

Quality and shelf life up gradation of Japanese threadfin bream using green tea extract

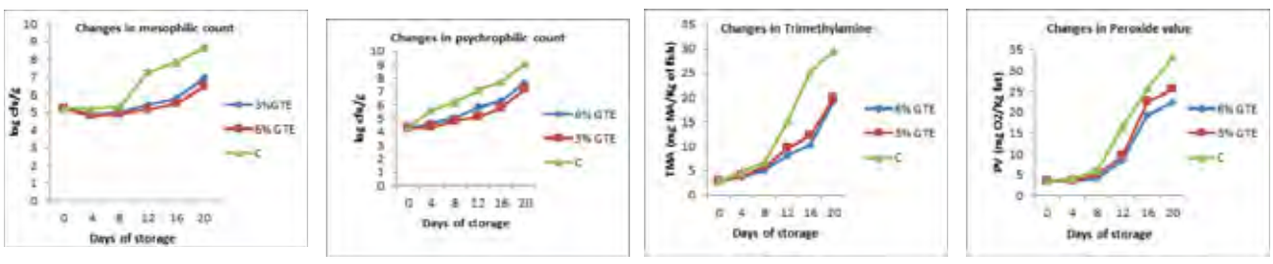
Bio-preservation using natural compounds can extend the shelf life and enhance the safety and quality of fish. The effect of green tea (3% and 6%) during chilled storage (2±1 °C) of Japanese thread fin bream (*Nemipterus japonicus*) was compared with control. Multivariate comparison was performed using Principal Component Analysis (PCA) for the mean sensory, microbiological and chemical attribute values. Samples stored in normal ice (control samples) gave only eight days shelf life where as both 3% GTE stored samples and 6% GTE stored samples gave a shelf life of 16 days. From an economic point of view 3% frozen GTE gave good preservative effect.

Changes in myofibrillar and sarcoplasmic proteins of *Stolephorus indicus* and *Leognathus splendens* during storage in ice

The study on the denaturation of sarcoplasmic and myofibrillar protein from the two species of fish during storage in ice showed that the sarcoplasmic proteins of *L. splendens* decreased by 14% during the storage up to 12 days while that of *Stolephorus indicus* decreased by 32%. The myofibrillar proteins of *L. splendens* decreased by 49% while that of *S. indicus* decreased by 28% during the same period. The 59.88% on initial day decreased to 42.95% on 12th day. The number of bands of sarcoplasmic proteins of *S. indicus* decreased during storage and that of *L. splendens* increased during storage. M-protein and c-proteins were developed in *S. indicus* on 12th day of storage. A band corresponding to actinin appeared in *L. splendens*.

Quality changes in *Cynoglossus macrolepidotus* during storage in ice

Biochemical quality indices of *C. macrolepidotus* during chilled storage showed changes in common quality indices such as TMA, TVA, PV and FFA which followed the usual trend during the storage upto 15 days. The TMA and TVBN values crossed the accepted limit by then. The sarcoplasmic and myfibrillar proteins become in solubilized by 45% and 24% respectively during the period. The shelf life of the product was found to be 12 days. The mesophilic and psychrotrophic counts were beyond acceptable limit by the end of storage period and microbiological analysis confirmed the absence of pathogens in the fish.



Quality changes in *Cynoglossus macrolepidotus* during storage in ice

Edible coating for quality improvement

The effect of gelatin coating and gelatin with lime (*Citrus aurantifolia*) coating in fish preservation and the quality changes of the coated fillets during the chilled storage (2±1 °C) showed that fish fillets (*Lethrinus lentjan*) coated with gelatin kept under chilled storage was better with 15 days compared to the control samples (9 days). Gelatin and lime coated fillets covered in polythene could be kept longer (18 days) under similar conditions.

In vitro antibacterial activity of natural extracts against food-borne pathogens

The efficacy of aqueous extracts of *Garcinia cambogia* (w/v), *Tamarindus indica* (w/v), *Camellia sinensis* (green tea leaf) (w/v) and *Citrus aurantifolia* (v/v) at 5% and 10% levels against pathogenic bacteria were studied. Of the 14 food poisoning organisms analyzed only seven organisms, i.e., *Aeromonas hydrophila*, *Bacillus subtilis*, *Enterococcus faecalis*, *Salmonella enteritidis*, *Staphylococcus aureus*, *Vibrio cholera* and *V. parahaemolyticus* were found to be susceptible to green tea extract. Maximum susceptibility was shown by *S. aureus* against 10% lime with a ZOI of 22 mm in agar well diffusion technique and the most resistant organism found in this study was *E. coli* which did not exhibited any sensitivity to aqueous extracts of green tea and tamarind.

Antibacterial activity of natural extracts

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

Microencapsulation of fish oil/sage essential oil blends

The SEM images indicated better encapsulation efficiency for fish oil blended with sage essential oil. The particle size and the stability of spray dried microencapsulates in suspension were evaluated by dynamic light scattering technique. The thermal stability of the microencapsulates were evaluated by DSC.

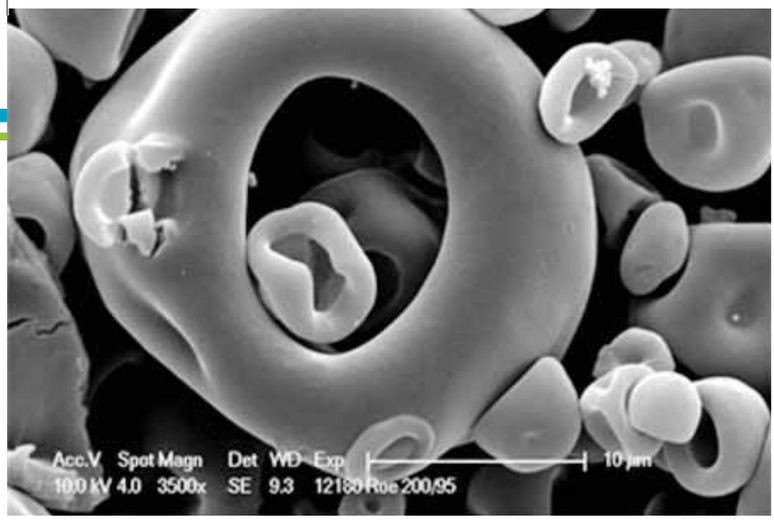
Characterization of gelatin-gum polymer blends

The gelation and functional characteristics of fish gelatin extracted from fish scale was modified by adding natural gums. The optimum pH for the interaction and formation of stable gel was found to be at pH 8. Among the various gums studied, gum Arabic gave the strongest network followed by tragacanth and xanthan gum. Guar gum exhibited the least interaction with gelatin and yielded the weakest gel.

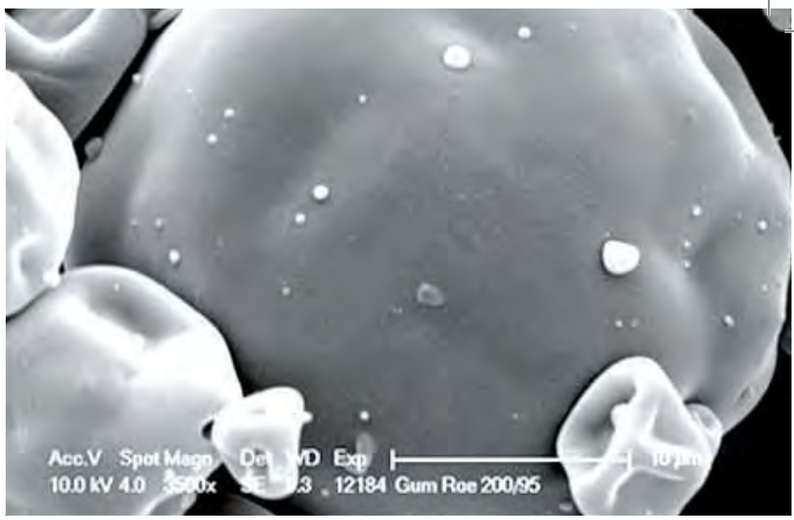
Spray dried fish roe powder

The roe of *Labeo rohita* was spray dried at different temperatures of 220 °C and 200 °C. Higher yield was obtained for roe spray dried at 220 °C, with more than 90% solubility in distilled water. The isoelectric point of both the powder was observed at pH 5.5-6. The roe spray dried at 200 °C showed better emulsion capacity at 4% concentration as compared to that at 220 °C of the same concentration. However, fat binding capacity was more at 220 °C.

The rohu fish roe powder was encapsulated using gum Arabic and guar gum in spray drier which impoved the keeping quality.



Control roe



Roe-gum

Edible gum coating for gutted mackerel

The effect of edible coating using natural gum Arabic (GC) on quality of fresh gutted mackerel stored at 4 °C was investigated. Coating with gum Arabic markedly retarded lipid oxidation process in gutted mackerel compared to vacuum (VP) and cantrol (CP) samples. VP and CP samples showed higher degree of textural deterioration compared to GC samples. Microbiologically, the shelf life of chilled gutted Indian mackerel was estimated to be 7-8, 17 and 19-20 days for CP, GC and VP samples, respectively.

Pest repellant edible coating for dried fish

Pest repellant edible resin coating formulations were prepared incorporating various herbal extracts. The formulations were coated on 'dried Bombay duck leaves' and subjected to higher incidence loads of the pest *Dermestes* sp. in mason jars. The pest attack and breeding rate was considerably reduced in samples coated with resin-herb mixture compared to control uncoated samples. A total of 19 formulations were evaluated on dried Bombay duck and the three best formulations based on least incidence of pest attack were selected.

Antibacterial activity of natural gums and resins

Antimicrobial properties of natural gums *viz.* Gum ghatti, Gum Arabic, Tragacanth gum, Ester gum, Xanthan gum and Guar gum were tested against pathogenic organisms such as *E. coli, Staphylococcus aureus, Vibrio cholerae, V. parahaemolyticus, Salmonella, Listeria monocytogenes, Aeromonas hydrophila, Bacillus cereus* and *B. subtilis.* Guar gum showed potent antibacterial activity against the *S. aureus.*

Potent antibacterial activity was found against *S. aureus* and *B. cereus* and a lesser amount activity against the *A. hydrophila.*

Antibacterial activity of gum

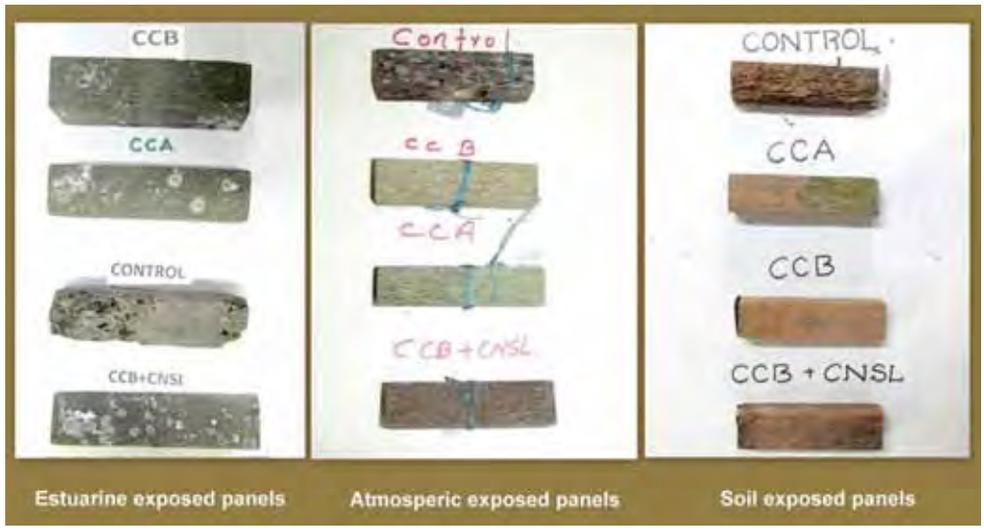
Antibacterial activity of resin

Coconut Development Board Project

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

Field exposure studies of untreated and treated coconut wood panels

Coconut wood panels treated with CCB, CCA and CCB+CNSL were subjected to estuarine, atmospheric and soil conditions. The panels were retrieved and analyzed after one year of exposure as per ASTM standards.



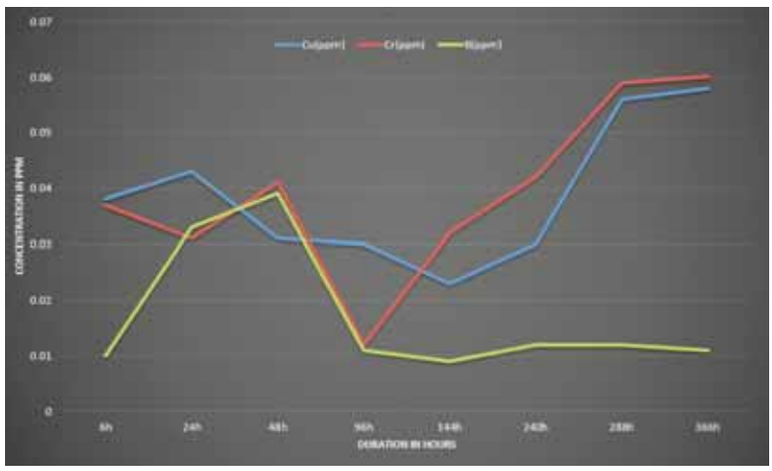
Field exposure of coconut wood panels

The estuarine exposed samples of untreated panels were destroyed while those treated with CCA and CCB+CNSL were free from attack and light attack was observed on CCB treated panels. In the case of soil exposed panels, portion below the soil of untreated panels were heavily attacked by termites when compared to the treated panels. CCA and CCB+CNSL treated panels showed better resistance against termite attack and decay.

The atmospheric exposed untreated panels showed grayish discolouration and slight splitting and cracking, while colour fading was observed in CCB+CNSL treated panels. The panels treated with CCA maintained its greenish colour throughout the exposure period.

Leachability of CCB components in the treated coconut panels during accelerated condition

Leachability of CCB components Copper (Cu), Chromium (Cr) and Boron (B) in the treated coconut wood panels was assessed as per AWPA E11. Chromium leaching rate was low in initial hours while boron leaching rate was high in initial hours and after 144 hour it decreased.



Leaching of CCB from the treated panels

Construction of coconut wood canoe for use in south west coast of India

Construction of coconut woodw canoe (L_{OA} 9.0 m, breadth 1.30 m and depth 0.70 m) was completed. For the construction purpose, five coconut palms of more than 60 years were culled. The preservative treatment with CCB was done at the ICAR-CIFT pilot level wood preservation facility for boat building timbers. The fishing canoe was constructed based on the traditional method of boat construction prevalent in Kerala. The outer and inner portion of the canoe was coated with fiberglass reinforced plastic (FRP).

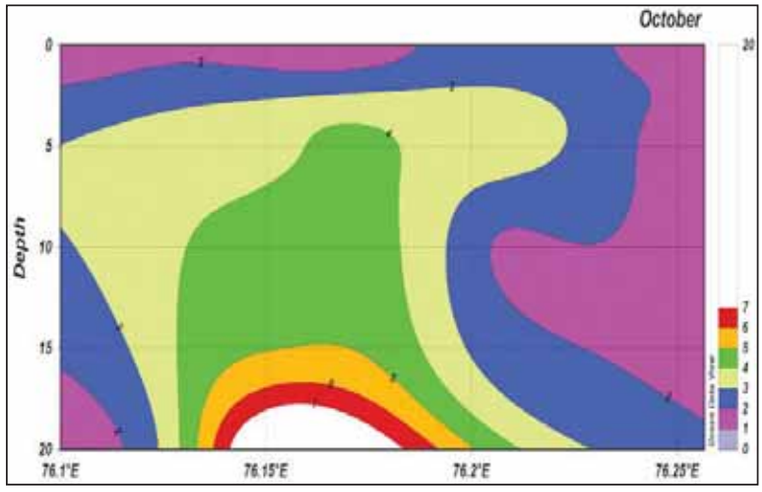
Coconut wood canoe under construction

Indian National Centre for Information Services Projects

Retrieval of phytoplankton biomass and associated optical constituents based on long term bio-optical studies

Variation of bio-optical and physico-chemical parameters

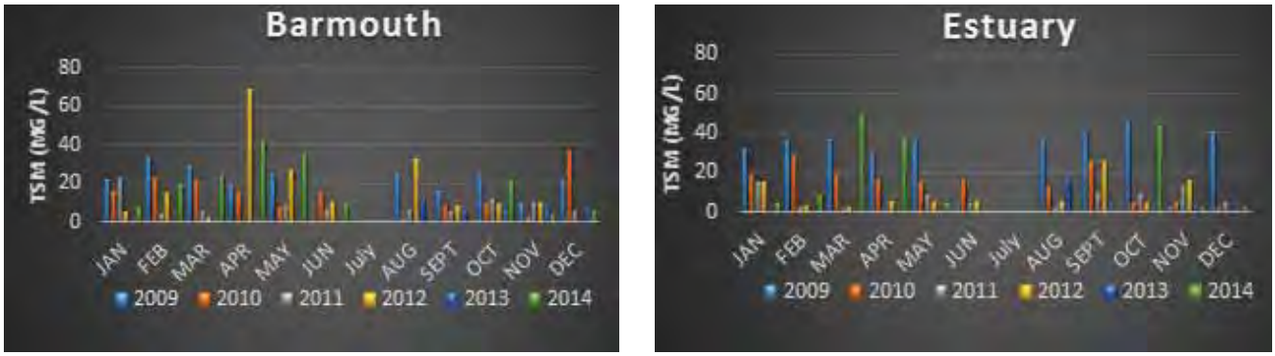
Field surveys conducted at nine stations off Kochi covering each month including spatial and time series stations showed that Chlorophyll specific absorption at 443 nm ranged from 0.018 to 0.539 m^2 mg^{-1}. Chlorophyll a concentration varied from a minimum of 0.249mg/m^3 to a maximum of 39 mg/m^3. Nitrite values ranged from 0.003 to 1.529 µmol/L. Phosphate concentration ranged from 0.025 to 1.153 µmol/L and silicate concentration ranged from 0.035 to 125.655 µmol/L. pH and dissolved oxygen varied from 7.57, 0.80 ml/L respectively and to a maximum of 8.39, 7.5 ml/L respectively.



Spatial and vertical distribution of chlorophyll a off Kochi during October 2014

Long term variation of bio-optical and physico-chemical parameters in the estuarine and barmouth region of Cochin

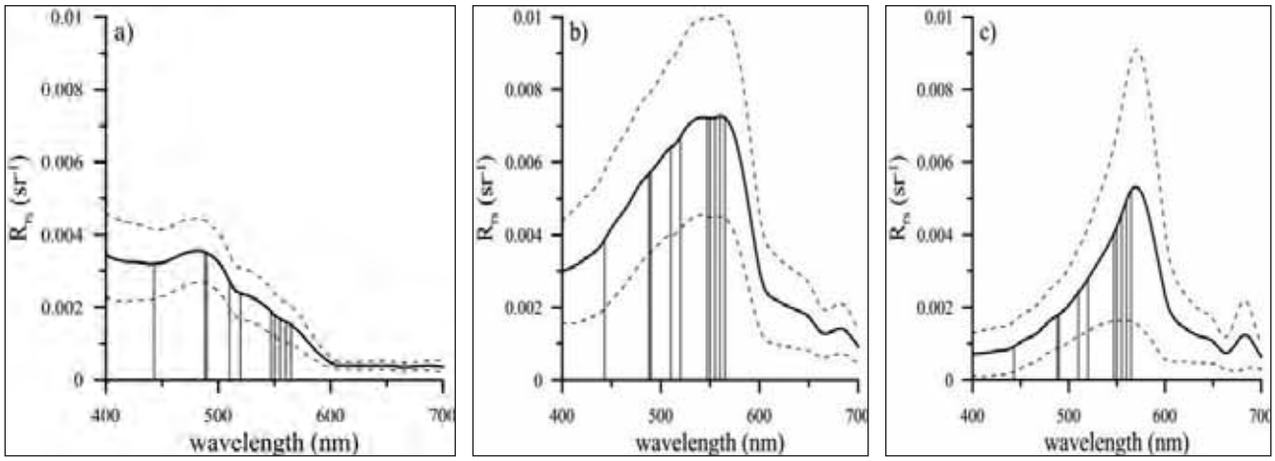
Physico-chemical and bio-optical data from 2009 to 2014 showed that pH has consistent alkaline nature in both estuarine region and offshore regions of Cochin. Dissolved oxygen, nutrients, silicates and phosphates were analyzed. Chlorophyll concentration has two peaks in a year in the estuarine region, one during March-May and another during inter-monsoon season. Total suspended solids concentration showed an increasing trend from January to March and then from August to September. Absorption by CDOM at 440 nm showed less variation throughout the year. Remarkable change was observed in silicate concentration in the estuarine region.



Total suspended materials in different years

Evaluation of algorithms and remote sensing reflectance

The spectral remote sensing reflectance showed three distinct water types that were associated with the variability in optically active substances such as chlorophyll-a (chl-a), chromophotric dissolved organic matter (CDOM) and volume scattering function at 650 nm (β650). The assessment of six operational empirical algorithms for Chla (OC3C, OC4O, OC4, OC4E, OC3M and OCMO2) showed that OC3M and OC4 performed better. Chla concentration, more than 1.0 mg-m^{-3}, showed that the ratio of 488/510/520 nm to 547/550/555/560/565 nm dominated. The assessment of algorithms in different water types indicated better performance of all the algorithms in Type-1 waters. The performance was poor in Type-2 and Type-3 waters which could be attributed to the significant co-variance of Chla with CDOM.



Three different spectral types exhibited based on chlorophyll a and CDOM in the Kochi coastal waters

Validation of tuna advisories off east coast

Studies on the tuna catches off east coast

Data collected from tuna liners operating off Visakhapatnam and Chennai was analyzed during the study period. The hooking rate at Visakhapatnam observed during the study period is about 2.177 and Chennai is about 0.739. Yellowfin tuna (*Thunnus albacares*) was the most dominant catch in both Visakhapatnam and Chennai coast. At Visakhapatnam, Yellowfin tuna hooking rate was about 1.91 and marlin and swordfish was about 0.23. At Chennai hooking rate of Yellowfin tuna was about 0.6 and marlin and swordfish was about 0.03.

A detailed study by correlating the tuna catches from industry with the chlorophyll gradients observed in the satellite images is being carried out. Nearly 90% real time data has been correlated with sea truth data.

Phytoplankton biodiversity along Visakhapatnam coast

In the study conducted from three stations of AP, a total of 39 planktonic species belonging to Bacillariophyta and Pyrrophyta were observed. Collections were made from June 2014 to till March 2015. Thirty nine species out of which 23 belonging to 17 genera and 16 families were found to be Diatoms. Remaining 16 species belonging to six genera and four families were found to be Dinoflagellates.

Locations of phytoplankton biodiversity studies

Proximate composition of Yellowfin tuna and Skipjack tuna

Analysis of proximate composition of Yellowfin and Skipjack tuna meat (red meat) indicated that Yellowfin tuna meat was rich in protein (22.59%) while fat content of the composite meat was 0.64%.

Nutritional composition of Yellowfin tuna and Skipjack tuna

Nutritional composition	Yellowfin tuna	Skipjack tuna
Moisture (%)	72.45	70.99
Protein (%)	20.29	24.59
Fat (%)	1.86	1.50
Ash (%)	4.40	0.92

Studies on the ecological linkages between plankton production and *Acetes* sp. abundance along Gujarat coast

Relationship between chlorophyll content and *Acetes* sp. abundance

In order to study the relationship between plankton production (Chlorophyll taken as a proxy), and other physico-chemical parameters, a Canonical Correlation Analysis (CCA) was carried out on the data set with the available data. The results showed the abundance of *Acetes* sp. and total catch was most correlated to the chlorophyll content in the water and temperature. The abundance of *Acetes* in the diet correlated with the reported abundance

of *Acetes* for different seasons along the coast. The indicators based on ocean colour were found to be most suitable and predictable, and a series of them proposed by Platt and Satyendranath, 2009, were taken as base. The abundance of *Acetes* can be linked to the abundance of the prey item, which are mostly diatoms occurring in the region. Highest productivity occurring in the winter months along Gujarat coast could be used as an indicator of productivity.

Item	NP	PF
TSS	w	0.22
Transparency	5.0	3.2
Temperature	25.3	24.0
TDS	0.864	1.85
Phosphate	0.410	0.644
Nitrate	3.59	3.85
CPUE	9.30	11.78
Chlorophyll	0.427	0.760

(NP - Non Potantial Fisihing Zone, PF - Potantial Fisihing Zone)

National Fisheries Development Board Projects

National surveillance programme on aquatic animal diseases

Surveillance of fish and shrimp samples

Fish and shrimp samples (n=512) collected from 50 farms were screened for OIE listed bacterial and viral pathogens. Baseline data was collected from 50 farms in 5 districts of Kerala. Five passive surveillances were done from various regions in Kerala. *Aeromonas hydrophila* infection was reported in a fish farm located at Ernakulam district. Two shrimp farms in Alapuzha district showed mortality and WSSV infection was detected in shrimp. Mortality was reported from two fish farms located at Wayanad and Thrissur districts and no pathogens could be isolated. Environmental problems such as increased levels of ammonia, low dissolved oxygen and high algal blooms were noticed in these farms. Forty imported samples were also screened for the OIE listed pathogens. Three shrimp samples were positive for WSSV.

Farmed gourami infected with *Aeromonas hydrophila*

Four awareness workshops were conducted in four districts of Kerala. In Thrissur district, 52 farmers and 12 Panchayat co-ordinators attended the programme. An interactive session on different fish diseases prevalent in farms located at Thrissur and farm management issues were held with farmers wherein farmers shared their experiences. In Palakkad district, 39 participants including

Awareness workshop at Thrissur

Interaction with participants

20 farmers and 19 Panchayat co-ordinators attended. Technical session on Importance of water quality parameters in aquaculture and fish disease management was elaborated. In Alappuzha district, 51 participants including 47 farmers and four Panchayat co-ordinators attended the awareness programme. A detailed discussion on finfish and shrimp diseases and farm management issues in farms located at Alappuzha district was held by the project team with farmers wherein farmers shared their experiences and issues related to water quality due to dumping of fishery waste from pre-processing shed. Health card was introduced to the farmers. In Kottayam district, nine farmers attended the programme. In technical session, water quality parameters and their association with fish/shrimp diseases was elaborated.

Monitoring the health status of fishes

Health card for fish was prepared, which was made in local language (Malayalam) for distributing to the fish farmers and shrimp farmers, for monitoring the health status of the fishes. Four field level Awareness programmes about fish and shell fish diseases were organized in the districts of Thrissur, Alappuzha, Kottayam and Palakkad in collaboration with State Department of Fisheries.

UNDP - Global Environment Facility Project

Demonstration and field testing of bycatch reduction devices, juvenile fish excluder devices and promotion of square mesh codend in Sindhudurg district of Maharashtra

Experimental field trials

Ninety six field trials of square mesh were conducted. The average escapement from square mesh codend is approximately 2 kg/haul

Awareness programmes

Four awareness programmes on bycatch reduction devices were conducted; wherein 199 males and seven females attended.

Five hands on training programme, on fabrication of square mesh codend was conducted. 105 persons were trained. 200 square mesh codends will be distributed to trawlers at the start of the fishing season.

Training on Fabrication of square mesh codend

USAID-MARKET Project

Thematic studies on gender in aquaculture in Cambodia, Lao PDR, Thailand and Vietnam

Gender studies

As an initiative from the Network of Aquaculture Centres in Asia-Pacific (NACA) in gender studies a sub-project under the USAID–MARKET (Maximising Agricultural Revenue through Knowledge Enterprise Development and Trade) project was taken upon "Thematic studies on Gender in Aquaculture in Cambodia, Lao PDR, Thailand and Vietnam".

The project envisaged In-Country Assessment and Case Studies of selected value chains in Cambodia, Vietnam and Thailand addressing gendered roles and contributions in small scale aquaculture systems, which are important from the point of view of both livelihood and food security of poor households.

Dr. Nikita Gopal (Second from left) Co-chairing the Workshop on Gender in aquaculture at Lucknow

A project planning workshop was held at Bangkok, Thailand during 5-7 June, 2014 and was attended by the teams from all the countries to brainstorm and finalize work plans. The value chains selected were red tilapia and rice-shrimp for Vietnam, reservoir aquaculture for Cambodia and tilapia cage culture and small scale shrimp aquaculture for Thailand. The value chains were to be mapped for gender roles, issues and opportunities and selected nodes in the value chains will be selected in detail to assess in depth the gender dimensions. A Synthesis Workshop was held from September 29 – October 1, 2014 at Bangkok, Thailand for monitoring the project and a training on 'Gender integration in aquaculture' was organized for looking at the USAID Gender Dimension Framework. A presentation on 'Gender integration in aquaculture and fisheries research in India' was presented. A Regional Practitioner Network Action Plan was discussed through country-specific group discussions and presentations. The 5th Global Symposium on Gender in Aquaculture and Fisheries (GAF5) was held at Lucknow, India during 12-14 November, 2014 in which a special workshop was organized based on the project. A Regional Gender Workshop on 'Gender in Aquaculture: Equity and Empowerment in the Fisheries and Aquaculture Value Chain' was held during February 24-25, 2015 at Bangkok, Thailand. The workshop reviewed the project and case studies conducted by respective country teams. A presentation was made by Dr. Nikita Gopal on "Gender Challenges in Fisheries and Aquaculture" under the theme 'Gender Equity and Empowerment in the Fisheries and Aquaculture Sector' and she also led a session on 'Gender Networks: Creating Change in the ASEAN Region'. The workshop concluded with discussions on how the Network will move forward and the action items, for the Network and for the key stakeholders present, that arose from the discussions in the earlier workshops.

Food Safety and Standards Authority of India Project

Pesticide and antibiotic residues in fish and fishery products: Evolving frame work for fixation of MRLs

Development of LCMS MS method for pesticides

An LCMS MS method for the detection of 225 pesticides was standardized using fish matrix. Calibration standards were injected over the range of 0.1 to 100 ng/mL. For a maximum residue level of 10 µg/kg, the limit of quantitation (LOQ) will depend on the dilution factor of the extract. The method utilizes the scheduled MRM algorithm in combination with fast polarity switching and acquisition of MS/MS spectra for compound. LOQ were measured for all pesticides at 0.1 ng/mL or below.

GENERAL INFORMATION

(1 April, 2014 to 31 March, 2015)

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Communicating Research Outcome

Participation in Symposia/Seminars/Workshops etc.

Scientists from the Headquarters and Research Centres participated in several national and international symposia, seminars and workshops. A total of 57 meetings, 50 workshops, 17 seminars, 11 conferences and eight symposia were attended during the past year. Some of the notable events were the 1st World Ocean Science Congress held at Cochin during 5-8 February, 2015 where about 40 Scientists participated in various capacities as Organizers, Committee members, Invited speakers, Editors, Rapporteurs etc. Seventeen Scientists from the Institute also attended the 10th Indian Fisheries and Aquaculture Forum on 'Towards Responsible Aquaculture and Sustainable Fisheries' organized by ICAR-NBFGR, Lucknow during 12-15 November, 2014. Topics of the workshops ranged from 3rd International Phytoplankton Programme to International Trade in Fish Products. Seminars have been on subjects like International Seminar on Modern Trends in Biotechnology and Gender in Aquaculture. Symposiums attended were in diverse fields like Nutrition security (Nutritionally sensitive and environmentally sustainable agriculture for food and nutrition security) and Fish processing (6th Symposium on Ready to eat products).

Papers on responsible fishing, nutritional aspects of fish advancements in processing technologies, techniques for detection and diagnosis of pathogens, quality aspects in fish trade, socio-economic issues etc. were presented by Scientists, Technical Officers and Research Scholars of the Institute.

The scientific meetings were attended by scientists, researchers, policy makers, students, teachers, administrators etc. and productive deliberations were held.

Training / Awareness Imparted

Sl. No.	Subject	No. of beneficiaries	Venue and date
1.	Purification of chitinase enzyme from *Paenibacillus elgii*	1	Cochin (1 April – 30 June 2014)
2.	Identification and characterization of plastic degrading bacteria	1	Cochin (1 April – 30 June 2014)
3.	Production of chitin and chitosan	3	Cochin (3-4 April 2014)
4.	Trace metal analysis with regard to ISO 17025	2	Cochin (17-18 April 2014)
5.	Laboratory techniques in microbial biotechnology	2	Cochin (21 April – 3 May 2014 and 23 April – 6 May 2014
6.	Food processing technology	10	Cochin (28 April – 20 May 2014 and 3-27 May 2014)
7.	Modern food processing technology	32	Cochin (1 May – 31 July 2014, 13-14 May 2014, 16 June – 15 September 2014, 23-27 June 2014 and 30 June – 11 July 2014)
8.	Microbiological methods	3	Visakhapatnam (5 May – 23 June 2014 and 27 January – 26 February 2015)
9.	Biochemical profiling of oyster protein hydrolysate and its antioxidant properties	1	Cochin (5 May – 5 August 2014)
10.	Graft copolymerization of phenolic acids on chitosan and its application in food and nutraceuticals	1	Cochin (5 May – 5 August 2014)
11.	Fabrication and field trial of square mesh codend	18	Ratnagiri, Maharashtra (20-22 May 2014)

Modern analytical techniques in Biochemistry (Cochin) - Participents with faculty

Sl. No.	Subject	No. of beneficiaries	Venue and date
12.	Analysis of crude fibre	2	Cochin (24-30 May 2014 and 28-30 May 2014)
13.	Mono filament ling lining	10	Cochin (26-28 May 2014)
14.	Fish products development and value addition techniques	32	Little Andamans (26-28 May 2014)
15.	Chemical and microbiological analysis of water	4	Cochin (26 May – 6 June 2014)
16.	Responsible fishing and Hygienic handling of fish and preparation of value added fish products	60	Thoubal district, Manipur (27 May – 1 June 2014)
17.	Bioactivity of Actinobacteria isolated from aquatic environment	1	Cochin (10 March – 9 June 2014)
18.	Isolation and characterization of Methicillin-resistant *Staphylococci* from seafood	1	Cochin (10 March – 9 June 2014)
19.	Isolation and characterization of *Vibrio parahaemolyticus* from aquatic environment	1	Cochin (10 March – 9 June 2014)
20.	Potential of Lactic acid techniques in biochemical analysis of food	1	Cochin (10 March – 9 June 2014)
21.	Study on effect of Lactic acid treatment on microbiological quality of Yellowfin tuna during chilled storage	1	Cochin (10 March – 9 June 2014)
22.	Modern analytical techniques in Biochemistry by GC, GCMS, HPLC, LCMS-MS, AAS, ICP-OES and FTIR	25	Cochin (29 May –9 June 2014 and 18-28 June 2014)
23.	Modern analytical techniques in nutrient profiling and residue monitoring of fish	11	Cochin (18-28 June 2014)

Modern food processing technology (Cochin)

Fish product development and value addition techniques (Harminder Bay) - Participants with faculty

Sl. No.	Subject	No. of beneficiaries	Venue and date
24.	Exploration and bioprospecting of Vibriocin from the marine environment	1	Mumbai (20 June – 20 August 2014)
25.	Bycatch reduction devices for shrimp trawling	85	Malvan and Devagad, Maharashtra (21 and 23 June 2014)
26.	HACCP concepts	60	Cochin (23-27 June 2014, 22-27 December 2014 and 23-27 March 2015)
27.	Process engineering in fisheries	8	Cochin (30 June – 4 July 2014)
28.	Heavy metal analysis by AAS	1	Visakhapatnam (1-31 July 2014)
29.	Testing of packaging materials and thermal processing	5	Cochin (7-29 July 2014)
30.	Demonstration of FRP coracles, eco-friendly fishing gear and preparation of value added fish products	136	Madduvalasa, A.P. (11 July 2014)
31.	Practical aspects of seafood safety	12	Cochin (14-24 July 2014)
32.	Preparation of value added fish employing low cost marine fish	20	Gopinadpur, Odisha (16-17 July 2014)
33.	Isolation and identification of bacteria of public health significance	14	Cochin (16-22 July 2014 and 25-30 August 2014)
34.	Fabrication of square mesh panels		Malvan (17 July 2014), Vengrula (18 July 2014) and Devagad, Maharashtra (19 July 2014)
35.	Hygienic handling of fish and preparation of value added fish products	28	Ganjam, Puri, Odisha (18-19 July 2014)
36.	Microbiological quality of seafood	34	Veraval (21-26 July 2014 and 19-24 January 2015)
37.	Analytical techniques in microbiology	4	Mumbai (23-26 July 2014)

Fabrication and field trials of square mesh codend (Ratnagiri)

Thermal processing of fish (Cochin)

Sl. No.	Subject	No. of beneficiaries	Venue and date
38.	Seafood quality assurance	11	Mumbai (23 July-1 August 2014 and 26-28 July 2014) and Cochin (25 August – 4 September 2014)
39.	Preparation of value added fish product with low cost fish and post harvest handling and salt curing of fish by hygienic and scientific methods	15	Chinavalasa, East Godavari, A.P. (25-26 July 2014)
40.	Advanced analytical techniques in nutritional biochemistry	13	Cochin (1-13 August 2014 and 5-13 August 2014)
41.	Biochemical and molecular characteristics of pathogenic and commensal bacteria from fish	1	Cochin (5-21 August 2014)
42.	Preparation of value added fish employing low cost fish	29	Para and Pandi village, A.P.(6-7 August 2014)
43.	Value added fish products	11	Cochin (11-13 August 2014, 19-20 September 2014 and 30-31 March 2015)
44.	Laboratory techniques for microbiological examination of seafoods	30	Visakhapatnam (11-22 August 2014 and 27 January – 7 February 2015) and Cochin (11-23 August 2014)
45.	Biochemical and analytical techniques	2	Cochin (11 August – 12 September 2014 and 11-12 September 2014)
46.	Hygienic preparation of salt cured fish and preparation of value added fish employing low cost fish	16	Ramanna Palem, A.P. (13-14 August 2014)
47.	Thermal processing of fish	1	Cochin (25 August 2014)
48.	Biochemical analysis of fishery products and fish meal	1	Cochin (27 August – 2 September 2014)

Advanced analytical technique in nutritional bio-chemistry (Cochin)

Fish processing, quality control and HACCP (Cochin)

Sl. No.	Subject	No. of beneficiaries	Venue and date
49.	Value added fish processing	4	Cochin (1-3 September 2014,)
50.	Introduction of mid water trawling	56	Visakhapatnam Harbour (4 September 2014)
51.	Exposure of CIFT technologies	35	Visakhapatnam (11 September 2014 and 19 September 2014)
52.	Quality control of fish and fish products	14	Cochin (18-28 September 2014)
53.	Preparation of chitin, chitosan and glucosamine	1	Cochin (22-23 September 2014)
54.	Analytical techniques in food science	15	Cochin (22-24 September 2014)
55.	Responsible fishing	20	Pulicat Lake, Tamil Nadu (8-9 October 2015)
56.	Sanitation and hygiene for fish vendors	34	Aroor, Alappuzha (14 October 2014)
57.	Importance of hand hygiene in seafood processing and food-borne diseases	33	Moothakunnam, Ernkulam (15 October 2014)
58.	Fish processing, quality control and HACCP		Cochin (20-26 October 2014)
59.	Molecular characterization of pathogens isolated from seafood	1	Cochin (21 October – 4 November 2014)
60.	Fishing craft designing	1	Cochin (10-15 November 2014)
61.	Correct practices of surface preparation and painting of steel vessels	35	Kollam, Azheekal and Kayangulam (11-13 November 2014)
62.	Seafood safety and hygiene	42	Moothakunnam, Ernakulam (12 November 2014)
63.	Use of insulated fish bags	45	Rampuram, A.P. (16 November 2014)

Value added fish products (North Lakhimpur, Assam)

Sl. No.	Subject	No. of beneficiaries	Venue and date
64.	Identification and characterization of biosurfectant from r-proteobacteria	1	Cochin (17 November 2014 – 16 February 2015)
65.	Fish/prawn value addition	23	Vizianagaram (21 November 2014)
66.	Post harvest handling of fish	196	Pudimadaka and Mangamaripetta, Visakhapatnam (4 and 5 December 2014,
67.	Value addition of freshwater fishes	17	Cochin (15-20 December 2014)
68.	Production of chitin and chitosan	1	Cochin (16-17 December 2014)
69.	Responsible fishing, hygienic fish handling and fish processing techniques	1000	North Lakhimpur, Assam (20-22 December 2014), Changlang, Arunachal Pradesh (27-28 December 2014) and Namsai, Arunachal Pradesh (30-31 December 2014)
70.	Use of eco friendly FRP coracles and preparation of value added fish products	61	Rampachodavaram, AP (22-24 December 2015)
71.	Hygienic preparation of salt cured fish and value added fish products	40	Gangasagar, West Bengal (28-30 December 2014)
72.	Conservation of diamond mesh to square mesh codend and experimental fishing demonstration of large mesh semi pelagic trawl system	51	Vengurla (11 January 2015) and Malvan, Maharashtra (13 January 2015)
73.	Modern analytical techniques in biochemical analysis of food	1	Cochin (12-22 January 2015)
74.	Laboratory techniques for the determination of antimicrobial activity of seaweed extracts	2	Cochin (12-23 January 2015)

Responsible fishing, hygienic fish handling and fish processing technique (Namsai, Arunachal Pradesh)
- Participants and faculty

Sl. No.	Subject	No. of beneficiaries	Venue and date
75.	Five keys to food safety	33	Kasaragod (16 January 2015)
76.	Food-borne illness, preventive measures and treatment	38	Kasaragod (17 January 2015)
77.	Turtle Excluding Devices	50	Chennai Fishing Harbour (20-22 January 2015)
78.	Social and policy issues of fisherfolk	60	Ernakulam (5 February 2015)
79.	Socio-economic issues of fisherwomen	68	Ernakulam (6 February 2015)
80.	Drying aspects of fish using solar dryer	4	Cochin (9-12 February 2015)
81.	Production of improved quality dried fish using solar dryer	20	Veraval (9-12 February 2015)
82.	Various applications of electronic and communication equipments used onboard fishing vessels	2	Cochin (9 February - 7 March 2015)
83.	Biochemical techniques of fish quality analysis		Veraval (13-19 February 2015)
84.	Microbiological analysis of water	1	Cochin (24-28 February 2015)
85.	Chitin and chitosan production technology	2	Cochin (25-26 February 2015)
86.	Fish/shellfish diseases	121	Thrissur (10 March 2015), Palakkad (11 March 2015) and Kottayam (27 March 2015)
87.	Value addition and hygienic handling of fish	29	Cochin (12-13 March 2015 and 20-21 March 2015)
88.	Seafood quality assurance	18	Cochin (16-26 March 2015)
89.	Harvest and post harvest technologies	60	Vizianagaram (18 March 2015)
90.	Shrimp/fish diseases and farm nagament	56	Pattanakkad, Alappuzha (24 March 2015)
91.	Responsible fishing techniques for resource conservation	75	Veraval (24-26 March 2015)

Value added fish products
(Gangasagar, West Bengal)

Production of improved quality fish (Veraval)

Sl. No.	Subject	No. of beneficiaries	Venue and date
92.	TDH positive *Vibrio parahaemolyticus* from aquaculture ponds or farms	1	Cochin (25 March – 23 May 2015)
93.	Antifungal effect of chitinase from *Paenibacillus elgii*	1	Cochin (25 March – 23 May 2015)
94.	Employment of eco-friendly fishing gears and preparation of value added products with low cost fish	75	Siltiguda, Odisha (30 March – 1 April 2015)

Indicates outstation training programmes

Use of eco-friendly FRP coracles and preparation of value added fish products (Ramapachodavaram, AP)

Outreach Programmes

Outreach training programmes

During the period (April 2014 to March 2015) 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 Previous Chapter on 'Training / Awareness imparted'.

Exhibitions

The Institute participated in the following exhibitions during the period:

- Exhibition held at Thodupuzha in connection with 'Green Fest 2014' during 21-26 April, 2014.
- Exhibition organized during ICAR- CIFT Foundation Day Celebrations on 29 April, 2014
- Exhibition held in connection with the National conference on 'Sustainability of natural resources and environment with emphasis on aquatic ecosystem for livelihood security' held at G.B. Pant University of Agricultural Science and Technology, Pant Nagar during 10-12 October, 2014.
- 'Swasraya Bharat-2014' held at Kerala Agricultural University, Padannakkad, Kasaragod during 14-19 October, 2014.

Shri P. Karunakaran, M.P., Kasargod visiting ICAR-CIFT stall in Swasraya Bharat

Smt. Ansajitha Rassal, President, Thiruvananthapuram Dist. Panchayath visiting ICAR-CIFT stall at PIB Campaign

- Exhibition held in connection with the 10th Indian Fisheries and Aquaculture Forum held at ICAR-NGBFR, Lucknow during 12-15 November, 2014.
- Exhibition held in connection with India-International Food and Agri-Aqua Expo 2014 held at KUFOS, Kochi during 30 October to 3 November, 2014.
- Exhibition held in connection with the Public Information Campaign by Press Information Bureau, Thiruvananthapuram during 26-28 November, 2014.
- Exhibition held in connection with the International Symposium on Marine ecosystems: Challenges and opportunities (MECOS-2) at Kochi during 2-5 December, 2014.
- Exhibition held in connection with 21st Plantation Crops Symposium (PLACROSYM) at ICAR-IISR, Kozhikode during 10-12 December, 2014.
- Exhibition held in connection with Indian Biodiversity Expo at SRM University, Kattankulathur, Chennai during 17-20 December, 2014.
- Exhibition held in connection with Karshika Mela at Thodupuzha during 26 December, 2014 to 4 January, 2015.
- Exhibition held in connection with Turtle Festival at Srikakulam during 6-7 January, 2015.
- Rural Technology Mela-2015 at NIRD, Hyderabad during 8-12 January, 2015.
- Exhibition held in connection with the Maritime Expo Anchorage 2015 organized by Department of Ship Technology, CUSAT, Kochi during 10-11 January, 2015.
- Kerala Science Congress at Alappuzha during 27-30 January, 2015.
- Exhibition held at V.S. Krishna College, Visakhapatnam on 3 February, 2015.
- Exhibition held in connection with 'Technology

Dignitories visiting ICAR-CIFT stall in 10th IFAF

MECOS-2 at Kochi

PLACROSYM at Kozhikode

Indian Biodiversity Expo at Chennai

Week Celebrations' at Krishi Vigyan Kendra, Amadalavalasa on 5 February, 2015.

- Exhibition held in connection with World Ocean Science Congress–2015 at Kochi during 5-8 February, 2015.
- Machinery exhibition organized by District Industries Department at Kochi during 17-20 February, 2015.
- Aqua Aquaria 2015 at Andhra Loyola College, Vijayawada during 20-22 February, 2015.
- Karma–2015 exhibition held at KMCT College of Engineering, Kozhikode during 26 February to 1 March, 2015.
- Exhibition held in connection with "Nutra India Summit-2015" at Mumbai during 18-19 March, 2015.
- Exhibition held in connection with the Silver Jubilee Celebrations of All India Radio FM Station, Kochi on 31 March, 2015.

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 Talk

A radio talk on Tropical cyclones like Hudhud in Bay of Bengal and climatic factors impacting fishers (In Telugu), was given by Dr. M.M. Prasad, SIC, Visakhapatnam on 18 December, 2014.

North Eastern Hill (NEH) Region Programmes

At Manipur: In collaboration with the National Association of Fishermen (NAF), Manipur State Unit, ICAR-CIFT, Kochi conducted a training programme at Thanga fishing village, Bishnupur district during 29–30 May, 2014 on Responsible fishing and production of value added products. Shri Umananda Singh, Fishery Officer (Extension), Directorate of Fisheries, Imphal was the Chief Guest. About 40 fishers participated in the programme. The responsible fishing techniques and the fabrication of improved gillnets were explained to the trainees. A training on Production of value added fishery products was conducted at Tokpaching and Sarik Konjin Fishing village, Thoubal district during 31 May - 1 June, 2014. About 40 fishers participated in the programme. Fishing impliments were also distributed on the occasion.

At North Lakhimpur, Assam: A training on 'Responsible fishing, hygienic fish handling and fish processing techniques' was conducted by ICAR-CIFT, Kochi at North Lakhimpur, Assam during 20-22 December, 2014. Eighty fishers attended the training which was conducted in collaboration with District Rural Development Agency (DRDA). Shri D.J. Hazarika, Project Director, DRDA, North Lakhimpur presided over the inaugural function. Demonstrations were conducted on the preparation of fish pickles, fish balls, fish cutlets and dried fish products.

Arrangements were also made for the distribution of ten FRP canoes (6 m length) and five FRP coracles.

At Changlang, Arunachal Pradesh: A training programme on 'Responsible fishing, hygienic fish handling and fish processing techniques' was conducted at KVK, Jairampur, Changlang during 27-28 December, 2014. Demonstrations were conducted on fabrication of castnets and about 2 to 3 kgs of net materials and sinkers were distributed to the participants after the training. About 40 participants attended the programme.

At Namsai, Arunachal Pradesh: Another training programme on 'Responsible fishing, hygienic fish handling and fish processing techniques' was conducted at Namsai, Arunachal Pradesh during 30-31 December, 2014 in the Conference Hall of the Deputy Commissioner, Namsai. Shri R.K. Sharma, Deputy Commissioner's office, Namsai was the Chief Guest of the inaugural programme. Demonstrations were conducted on the fabrication of castnets. After the demonstration, net materials were distributed to three SH groups of fisherfolk. About 40 participants attended the programme.

Tribal Sub Plan (TSP) Programme

At Harminder Bay, Little Andamans: A training programme on "Fish product development and value addition techniques for Nicobari tribes" was jointly organized by the ICAR-CIARI, Port Blair and Department of Fisheries, A&N Administration in collaboration with ICAR-CIFT, Kochi at Harminder Bay, Little Andamans during 26-28 May, 2014 under the Tribal Sub Plan. Thirty two tribal fishermen and women beneficiaries were trained. The training imparted was on hygienic handling of fish, different types of dressing like filleting, preparation of steaks, chunks, mince etc. Salt curing and drying of mackerel was practically demonstrated to them. Value added products prepared included battered and breaded products like fish balls, fish fingers and fish cutlets using mince of mackerel, fish pickle and fish chutney powder. The importance of packaging materials, mainly films and trays for storage of different value added fish products were taught to the trainees.

Trainees with resource persons at Harminder Bay

At Madduvalasa, A.P.: A Tribal Sub Plan Programme on "Demonstration of FRP coracles, eco-friendly fishing gear and preparation of value added fish products" was conducted at Madduvalasa, Srikakulam, Andhra Pradesh on 11 July, 2014 for the benefit of 136 participants. Fishing inputs were also distributed to the beneficiaries.

Distribution of fishing nets to the beneficiaries at Madduvalasa

At Ramapachodavaram, A.P.: Under the Tribal Sub Plan, a Training cum demonstration programme on **"**Use of eco-friendly FRP coracles and Preparation of value added fish products**"** was organized at Integrated Tribal Development Authority at Ramapachodavaram, East Godavari district ,Andhra Pradesh during 22-24 December, 2014. The programme for the benefit of 61 participants was inaugurated by Shri Gandham Chandrudu, IAS, PO (Project Officer), ITDA. Inputs like foldable fish traps, gillnets and insulated fish bags based on the technologies developed by ICAR-CIFT were distributed. Ice boxes and electrical heat sealers were also given to the tribal fishers of Surampalem and Bhoopathipalem Reservoirs.

At Surampalem and Bhoopathipalem Reservoirs, A.P.: The FRP coracle was launched and demonstrated in Bhoopathipalem Reservoir. Instructions were given on the operation and precautions to be taken during the operation of FRP coracles. At the end of the programme, feedback session was held.

At Gangasagar, West Bengal: A training cum demonstration under TSP was conducted at Gangasagar

of Sagar Islands, West Bengal in collaboration with Vivekananda Institute of Biotechnology (VIB) of Shri Ramakrishna Ashram during 28-30 December, 2014. During the three day programme, lectures were given on importance of fish as food, hygienic handling of fish at different stages right from harvest to post harvest, product development, storage till it reaches the consumer/plate; reasons for spoilage of fish and the measures to control the same, preparation of different value added fish products and advantages of improved gears like eco friendly gears with less drudgery. The value added fish products namely fish pickles, cutlets and pakoda were demonstrated. Salt curing of fish in hygienic and scientific way were also demonstrated.

The inputs such as foldable fish traps, gillnets, insulated fish bags, heat sealers and ice boxes were given 'gratis' to the participants. Posters showing importance of consuming fish for nutritional needs and also for increasing awareness among the tribal fishers were also distributed. A field visit was undertaken to the dry fish curing yards of Beguamkhali village of Gangasagar Gram Panchayat, Sagar Block of 24 Parganas district of West Bengal to assess the quality of cured fish.

At Veraval, Gujarat: Under the Tribal Sub Plan a Training cum demonstration programme on "Production of improved quality dried fish using solar dryer" was organized at Veraval Research Centre of ICAR-CIFT during 9-12 February, 2015. The beneficiary of the training was tribal fisherfolk from "Bharat Adim Juth Matsyadhyog Sahakari Mandali", a society formed for the welfare of Siddi tribes from Talala region near Veraval, Gujarat.

During the training programme of hands on training to the participants was imparted on Good manufacturing practices for dry fish, salt curing of fish by hygienic and scientific methods, economic as well as operational procedure of solar drying etc. Shri Jeyapalan, Deputy Director, EIA was the Chief Guest. A brochure prepared on local language titled "Solar Dryer - An improved and hygienic method of fish drying" was distributed among the participants. An interactive session of faculty with the trainees was arranged and feedback was also obtained at the end of programme.

At Siltiguda, Odisha: A TSP training cum demonstration on 'Employment of eco-friendly fishing gears and Preparation of value added products with low cost fish" was conducted at Siltiguda, Rayagada district, Odisha from 30 March to 1 April, 2015. During the three days programme the participants were given lectures on handling of fish at different stages right from harvest to post harvest, product development, storage till it reaches the consumer/plate; reasons for spoilage of fish and the measures to control the same, preparation of different value added fish products and uses of gears namely eco-friendly nature and less toil of the same over traditional one employed by them. The value added fish products demonstrated were fish pickles, cutlets and pakoda.

Training programme on Responsible fishing: In Kolathimedu village, situated in the southern part of Pulicat lake, 166 fishermen belonging to *Iruler* caste (ST) are enrolled under 12 SHGs. After conducting preliminary assessment, ICAR-CIFT, Kochi conducted two days training programme on "Responsible fishing techniques" for the tribal fisher folk in Pulicat Lake on 8th and 9th October, 2014. Dr. S. Balasubramaniam, HOD, EIS Division presided over the inaugural function held on 8 October, 2014. About 50 trainees participated in the programme. In the programme a presentation on the methods of Responsible fishing was made and fabrication of castnet from readymade netting was also demonstrated to the participants.

Assessment of training requirement at Kolathimedu village

Workshops/Short Courses/Seminars etc. conducted

Workshops on Fuel efficient propellers

Three workshops were conducted on fuel efficient fishing practices. Ten boats fitted with engines from 172 Hp to 427 Hp and 52 fishermen onboard at Neendakara, Kollam (9-10 May, 2014) and 10 boats fitted with engines from 172 Hp to 495 hp with 56 fishermen onboard at at Thankassery, Kollam, (23-24 May, 2014) participated in the programmes. At Kozhikode, 49 fishermen belonging to 49 small vessels participated in the programme con-

ducted on 6-7 June, 2014 to get trained in fuel efficient techniques. Impact assessment of the intervention on fuel efficient propeller was also conducted during the workshops.

Workshop on Fuel efficient propeller

Short course on Practical aspects of seafood safety: The Quality Assurance and Management Division of ICAR-CIFT, Kochi organized an ICAR sponsored short course on "Practical aspects of seafood safety" during 14-24 July, 2014. The 10 days short course was aimed at providing the participants the latest information on food safety issues with emphasis on seafood and demonstrated the methods of its detection and control. The Course was designed to benefit young scientists/teachers/researchers in ICAR institutes/Agricultural/other Universities in the field of fisheries. About 25 participants from different R&D institutions and Universities across India attended the course. Dr. K. Paulose Jacob, Pro Vice Chancellor, Kochi University of Science and Technology, Cochin inaugurated the programme. Dr. T.K. Srinivasa Gopal, Director, ICAR-CIFT, Kochi presided over the function.

Eminent experts from ICAR-CIFT, EIA and MPEDA handled various technical sessions related to the emerging problems in seafood industry and analytical methods used for the detection. The major topics covered during

Dr. K. Poulose Jacob inaugurating the programme

Faculty and participants of the Short Course

the Short Course included theory and practical classes *viz*. Good laboratory practices, HACCP, Chemical, physical and biological hazards, Isolation and identification of food-borne pathogens, Ion chromatography and its application in food safety, Liquid chromatography and its application in food safety, Heavy metal residues and its determination, Gas chromatography determination of pesticides, LC-MS/MS as tool for antibiotic residue monitoring, Additives in seafood industry, Emerging chemical contaminants in seafood, PAH as contaminants in fish and fishery products, Histamine and other biogenic amines in seafood, Regulations and limits for residues, Validation of analytical methods and accreditation for food safety laboratories etc. The course also included a field visit to the M/s Mangala Marine Exim, Cochin fish processing establishment for enabling the participants to assess the food safety measures adopted in the seafood sector.

Winter School on Development of neutraceuticals, health foods and fish feed from fish and shellfish processing discards: The ICAR sponsored Winter School on "Recent advances in the development of neutraceuticals, health foods and fish feed from fish and shellfish processing discards" was conducted at ICAR-CIFT, Kochi during 10 November - 1 December, 2014. Dr. A.A. Zynudheen, Senior Scientist was the Course Director. The Winter School was officially inaugurated by Prof. (Dr.) Mohan Joseph Modayil, Former Chairman, ASRB, and Former Director, ICAR-CMFRI, Kochi on 10 November, 2014. On the occasion, Course-Manual and brochures were also distributed to the participants. The 32 participants of the Winter School were from Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Jharkhand, Jammu & Kashmir, etc. The course duration was 21 days and the course content was covered in 36 lectures and 12 practical sessions.

Practical sessions under laboratory conditions and in pilot scale levels were conducted on preparation of fish

Dr. Mohan Joseph Modayil inaugurating the Winter School

protein hydrolysate, extraction of gelatin, preparation of fish silage, fish meal, squalene and its quality evaluation, Fatty acid profiling of fish oil, Utilization of frame meat from fish processing, preparation of feed and quality evaluation of chitosan and glucosamine hydrochloride. The out-station visit including industrial visits to pre-processing plant, chitosan plant, fish-meal and oil plant helped the participants to know the recent trends in the utilization of fish and fishery wastes.

Stakeholder Consultation Workshop: One day Stakeholder Consultation Workshop for Finalization of fishing systems design was conducted at ICAR-CIFT, Kochi on 28 February, 2015. The Workshop was conducted as part of the ad hoc project on "Green Fishing Systems for Tropical Seas". The Workshop was attended by 20 stakeholders representing different fields. Issues regarding the problems faced by the fishing industry and fishing technology were discussed during the Workshop.

Participants and faculty of the Winter School

Pre-conference workshop on An Overview of Harvest and Post Harvest Fisheries Technologies: A pre-conference workshop on "An Overview of Harvest and Post Harvest Fisheries Technologies" was organized by ICAR-CIFT during 2-3 February, 2015 as part of the First World Ocean Science Congress (WOSC) held at Cochin during 5-8, February, 2015. Dr. V. N. Sanjeevan, Former Director, CMLRE, Kochi and Secretary General, WOSC 2015, inaugurated the Workshop. Dr. C.N. Ravishankar, Director, ICAR-CIFT presided over the function and outlined the role of ICAR-CIFT in organizing the Congress. Dr. Leela Edwin, Head, Fishing Technology Division and Co-ordinator of the Workshop welcomed the gathering and Dr. T.V. Sankar, Head, Quality Assurance Management Division proposed the vote of thanks. Twenty research students from CIFNET, CMLRE, CUSAT, KUFOS and ICAR-CIFT participated in the two day workshop.

Dr. C.N. Ravishankar giving the Presidential Address

Representation in Committees

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

Dr. C.N. Ravishankar, Director

As Member

- Technical committee, Food Safety Standards Authority of India, New Delhi
- 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
- Expert committee, Sacred Heart College (MG University), Kochi
- Committee for drafting curriculam and syllabi, KUFOS, Kochi
- Review committee of DBT, New Delhi for reviewing projects in post harvest technology of fish
- Technical committee, Lakshadweep Development Corporation Ltd., Kochi for setting up of tuna canning factory at Minicoy island
- Consultant, NACA, Bangkok, Thailand
- National Business Incubation Association, USA
- Agri-innovate India Pvt. Ltd. for technology valuation and pricing of ICAR technologies

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

As Member

- Institute Management committee, ICAR-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. Suseela Mathew, Head, 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. A.A. Zynudheen, Acting Head, Fish Processing Division and Engineering Division

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Board of examiners, M.Sc. Aquaculture and Fish Processing Technology, MG University, Kottayam
- Technical committee of Matsyafed for setting up of fish meal plant and glucosamine plant

Dr. Leela Edwin, Acting Head, Fishing Technology Division

As Member

- Academic Council, KUFOS, Kochi
- Expert committee for Comprehensive review of deep sea fishing policy and guidelines
- Committee to review the duration of the fishing ban period and suggest further measures for conservation and management
- Project Monitoring and Review Committee (PMRC) for the Project Solar enabled boats at Kanyakumari

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

As Chairperson

- Curriculum committee for drafting PG curriculum and syllabi for Marine Microbiology and Marine Drugs course, KUFOS, Kochi

As Member

- Assessment committee for promotion of Scientists, ICAR-CMFRI, Kochi
- Inter Department Panel of experts for approval of fish processing plants for export to EU
- Examiner, M.F.Sc./M.Sc. and Ph.D., ICAR-CIFE, Mumbai and CUSAT, Kochi

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

As Member

- Committee of AQUDIRECT.ORG
- Assessment panel of experts of Export Inspection Council and Marine Products Emport Development Authority

Dr. G.K. Sivaraman, Scientist Incharge, Veraval Research Centre

As Member

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

Dr. L.N. Murthy, Scientist Incharge, Mumbai Research Centre

As Member

- Assessment panel of experts of Export Inspection Council

Shri M. Nasser, Principal Scientist

As Member

- Inland Harbour Crafts and Fishing Vessel Sectional Committee, TED 18, Bureau of Indian Standards, New Delhi
- Transport Engineering Division Council, BIS, New Delhi

Dr. Saly N. Thomas, Principal Scientist

As Chairperson

- Textile material for marine fishing purpose, Sectional Committee TX18, BIS, New Delhi

As Member

- Institute Management Committee, ICAR-CMFRI, Kochi
- Expert committee constituted by Matsyafed, Kerala for the implementation of fish net factory at Thiruvananthapuram
- Institute Management Committee, ICAR-CMFRI, Kochi

Dr. P. Pravin, Principal Scientist

As Member

- Expert committee on 'Fish wealth and scientific study', Govt. of Kerala

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, Kochi

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

- Executive committee, Agricultural Economics Research Association, New Delhi

Dr. Femeena Hassan, Senior Scientist

As Member

- Interest subsidy committee, MPEDA, Kochi
- Inter Departmental Panel of experts for approval of seafood processing plants for EU

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 CUSAT, Kochi

Dr. George Ninan, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Board of examiners, Calicut University, Calicut/ CUSAT, Kochi/MG University, Kottayam
- Committee for financial aid for setting up of modern ice plants constituted by MPEDA, Kochi

Dr. S. Ashaleta, Senior Scientist

As Member

- Purchase committee for purchase of equipment for the 'Fishmaid' outlets of KSCADC in the state

Dr. U. Sreedhar, Senior Scientist

As Member

- Examiner for A.S. Raja Women's College, Visakhapatnam
- Examiner for CIFNET, Visakhapatnam

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 procedures 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 fisheries 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 ICAR-CMFRI, Kochi
- Committee to finalize the specification and construction of a Research Vessel for the Department of Industrial Fisheries, CUSAT, Kochi

Dr. B. Madhusudana Rao, Senior Scientist

As Member

- Assessment panel of experts of Export Inspection Council and Marine Products Export Development Authority

Dr. Toms C. Joseph, Senior Scientist

As Member

- Inter Departmental Panel of experts for approval of seafood processing plants for EU
- Animal Ethics Committee, ICAR-CMFRI, Kochi
- Institutional biosafety committee, College of Veterinary and Animal Sciences, KAU, Thrissur
- Examiner and question paper setter for B.F.Sc. course, KUFOS, Kochi

Dr. S.K. Panda, Senior Scientist

As Chairman

- E-working group on Semi-preserved fish and fish products, including molluscs, cristaceans and echinoderms fish paste constituted by FSSAI
- E-working group 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 crustacean 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. S. Visnuvinayagam, Scientist

As Member

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

Dr. C.O. Mohan, Scientist

As Member

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

Shri Ankur Nagori, Scientist

As Member

- Expert committee on Tuna long line and fish hold subsidy scheme of MPEDA
- Project monitoring committee for BOBP-IGO on solar powered refrigerated truck transportation of fresh fish, funded by NFDB

Shri C.G. Joshy, Scientist

As Member

- Faculty, course work for Ph.D. programmes, CUSAT, Kochi

Dr. P. Viji, Scientist

As Member

- Assessment panel of experts of Export Inspection Council and Marine Products Export Development Authority

Kum. Jesmi Debbarma, Scientist

As Member

- Assessment panel of experts of Export Inspection Council and Marine Products Export Development Authority

Dr. P. K. Binsi, Scientist

As Member

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

- Research Advisory Committee of ICAR-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, Kochi

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, Kochi
- Panel for Apprentice trainees in the discipline B. Tech. (Mechanical and Electrical & Electronics)

Capacity Building

Human Resources Development Activities

During the period under report, the Human Resources Committee of the Institute met eight times to discuss 95 cases. As recommended by the HR Committee the scientists and officers of the Institute participated in 45 training programmes during the period. The total amount spent towards HR activities during the year 2014-15 is ` 398780/-. Further four scientists were sent abroad to attend workshop and conferances.

Visits Abroad

Dr. Suseela Mathew, Head, Biochemistry & Nutrition Division, ICAR-CIFT, Kochi was deputed to Japan to attend the "1st Asian conference on Oleo science" held at Hokkaido, Japan during 8-10 September, 2014. Dr. Suseela Mathew also delivered an invited talk on "Marine lipids of deep sea fishes" in the Conference.

Dr. Nikita Gopal, Principal Scientist, Extension, Information & Statistics Division, ICAR-CIFT, Kochi attended and led the Project Planning Workshop for the NACA-MARKET project 'Thematic Studies and Outreach on Gender in Aquaculture in Cambodia, Lao PDR, Thailand and Vietnam' at Bangkok, Thailand during 1-7 June, 2014 and during 29 September to 1 October, 2014.

Dr. Nikita Gopal was also deputed to Thailand to attend a Seminar on Gender in aquaculture: Equity and empowerment on the fisheries and aquaculture value chain during 24-25 February, 2015. Dr. Nikita Gopal also gave a presentation on "Gender Challenges in Fisheries and Aquaculture" for the focal theme 'Gender Equity and Empowerment in the Fisheries and Aquaculture Sector'. She also led a group activity for the 'Gender Networks : Creating Change in the ASEAN region'.

Dr. V.R. Madhu, Senior Scientist, Fishing Technology Division, ICAR-CIFT, Kochi was deputed to Thailand to attend the Workshop on "Use of available science in developing and promoting best practices for trawl fishing operations in South and South East Asia" held at Bangkok, Thailand during 13-14 September, 2014.

Dr. P.K. Binsi, Scientist, Mumbai Research Centre of ICAR-CIFT was deputed to Germany to attend the 6th Indo-German Conference on Frontiers of Engineering held at Postdam, Germany during 22-25 May, 2014. Dr. Binsi also presented a poster on "Bioactive hydrolysates and mineral supplements from fish processing discards" in the Conference.

Dr. Nikita Gopal with other participants (Sitting second from right)

Training Acquired

Sl. No	Name(s) of Participant (s)	Training attended	Venue and Date
1.	Dr. V.R. Madhu	Data analysis using R software	Kerala University, Thiruvananthapuram 21-23 April 2014
2.	Smt. P. Jeyanthi	Subscriber awareness programme on NPS	Kochi 26 April 2014
3.	Smt. P. Jeyanthi	Structural equation modeling (SEM) using AMOS	Thiruvananthapuram 28-30 April 2014
4.	Smt. P. Jeyanthi	Qualitative research techniques and analysis using R methods	Thiruvananthapuram 2-4 May 2014
5.	Dr. S. Balasubramaniam	Workshop for the PME Cell Incharges of ICAR Institutes	New Delhi 27 May 2014
6.	Dr. K.K. Asha Dr. N.S. Chatterjee	Modern analytical techniques	Veterinary College, Thrissur 31 May 2014
7.	Dr. C.N. Ravishankar (As resource person)	Post harvest technologies for increasing shelf life of agricultural products	Dept. of Food Sci. & Technol., Pondicherry 19 June 2014
8.	Dr. George Ninan (As resource person)	Technology development programme	NIT, Calicut 25 June 2014
9.	Dr. R. Raghu Prakash Dr. B. Madhusudana Rao Kum. Jesmi Debbarma	Application of EU requirements for fishing vessels and landing sites	CITD, Visakhapatnam 16-19 July 2014
10.	Dr. L.N. Murthy (As resource person)	Empowerment of fish farmers and entrepreneurship development	FR&IC, Bangalore 19 August 2014
11.	Dr. P. Pravin	Technology management for researchers	ICAR-NAARM, Hyderabad 19-23 August 2014
12.	Dr. J. Bindu Kum. S. Vimalakumari	Recent trends and developments in bioplastics and their applications	CBPST, Kochi 22-23 August 2014
13.	Dr. Toms C. Joseph Shri V.N. Sreejith	Data analysis of bacterial transcriptome in the CLC Bio software	ICAR-IASRI, New Delhi 20-28 August 2014
14.	Dr. M.P. Remesan Dr. V.R. Madhu	Training for Journal editors	ICAR-CMFRI, Kochi 1-2 September 2014
15.	Shri V. Radhakrishnan Nair	Geospatial knowledge management for sustainable agriculture using open source GIS	ICAR-NAARM, Hyderabad 2-12 September 2014
16.	Dr. K. Ashok Kumar Dr. S.K. Panda	Seafood HACCP Train-the Trainer (TTT) Course and Sanitation Control Procedures (SCP)	New Delhi 11-13 September 2014

Sl. No	Name(s) of Participant (s)	Training attended	Venue and Date
17.	Dr. P.K. Binsi	Application of electrospun nanofibres in crop health and post harvest technology	ICAR-CIRCOT, Mumbai 15-24 September 2014
18.	Dr. P. Pravin	Knowledge management and knowledge sharing	IIPA, New Delhi 22-26 September 2014
19.	Shri K.A. Roshan Shri James J. Pulikkotil Shri H. Akhildas	Wood technology	RRII, Kottayam 24-26 September 2014
20.	Smt. S.J. Laly Smt. U. Parvathy	Fish processing, quality control and HACCP	ICAR-CIFT, Kochi 20-26 October 2014
21.	Smt. K. Renuka	Recruitment rules	ISTM, New Delhi 10-21 November 2014
22.	Dr. M.M. Prasad (As resource person) Dr. A. Jeyakumari Shri S. Sreejith Kum. H. Mandakini Devi	Recent advances in the development of nutraceuticals, health foods and fish feed from fish and shellfish processing discards	ICAR-CIFT, Kochi 10 November -1 December 2014
23.	Shri T. Viswanathan Smt. Suni Surendran	Service tax	KSPC, Kochi 26 November 2014
24.	Shri K.B. Sabukuttan	Record management	NAI, Puducherry 26-28 November 2014
25.	Dr. N.S. Chatterjee	Mass spectrometric techniques	ICAR-NRC Grapes, Pune 1-10 December 2014
26.	Dr. P. Pravin	Leadership management	ICAR-NAARM, Hyderabad 1-12 December 2014
27.	Shri K. Rushinadha Rao	Geospatial technologies: Wetland ecosystem	Andhra University, Visakhapatnam 1-21 December 2014
28.	Dr. M.M. Prasad	Post harvest handling of fish	Visakhapatnam 4 December 2014
29.	Dr. Femeena Hassan Dr. S.K. Panda Dr. Pankaj Kishore	Food safety and SPS, technical regulations and standardization and support to Post Clearance Audit (CA) in customs	Kochi 10-13 December 2014
30.	Shri V. Radhakrishnan Nair	Advances in omics data analysis: Learning by examples	ICAR-IASRI, New Delhi 3-23 December 2014
31.	Smt. P. Jeyanthi (As resource person)	ICTs in fisheries sector	SAMETI, Thiruvananthapuram 8 January 2015
32.	Dr. L.N. Murthy Dr. S. Visnuvinayagam (As resource persons)	Value addition and recent trends in packaging materials in sea food industry	EIA, Mumbai 16 January 2015

Sl. No	Name(s) of Participant (s)	Training attended	Venue and Date
33.	Dr. C.N. Ravishankar	Leadership Management	ICAR-NAARM, Hyderabad 19-23 January 2015
34.	Shri P.S. Nobi	6th Capacity Building Programme for Technical Assistants	IIPA, New Delhi 2-13 February 2015
35.	Shri Ranjithkumar Nadella Shri K.K. Ajeeshkumar Shri K.V. Vishnu Shri K. Rushinadha Rao Kum. B. Prema Raju Kum. S. Lavanya	Molecular markers	PMFGR, Kochi 9-14 February 2015
36.	Dr. Toms C. Joseph (As resource person) Shri Ranjithkumar Nadella Shri K.K. Ajeeshkumar Shri K.V. Vishnu	Development of finfish cell lines for viral disease diagnosis	PMFGR, Kochi 23-28 February 2015
37.	Dr. N.S. Chatterjee Smt. U. Parvathy Smt. S.J. Laly Shri G. Kamei	Laboratory management system and internal audit	CETE, Bangalore 24-27 February 2015
38.	Dr. Saly N. Thomas	Training needs assessment of HRD Nodal Officers of ICAR	ICAR-NAARM, Hyderabad 26 February 2015
39.	Dr. Pankaj Kishore Shri K. Ahamed Basha	Microbial risk assessment in fresh and processed aquafoods	FC&RI, Tuticorin 26 February – 18 March 2015
40.	Smt. P.K. Shyma Smt. N.C. Shyla	Office automation using Oracle ERP	ICAR-IASRI, New Delhi 16-20 March 2015
41.	Dr. B. Madhusudana Rao (As resource person)	Post harvest technologies and value addition in fisheries	Vizianagaram 18 March 2015
42.	Dr. A.R.S. Menon	Innovative/Best practices in National e-Governance Plan (NeGP) – Agriculture and allied sectors (Animal Husbandry, Veterinary Sciences and Fisheries	Port Blair 24-26 March 2015
43.	Dr. S. Visnuvinayagam	Data analysis through statistical software SPSS	ICAR-CIFE, Mumbai 24-27 March 2015
44.	Dr. M.M. Prasad (As resource person)	Science journalism for women in Andhra Pradesh	Andhra University, Visakhapatnam 25 March 2015
45.	Dr. B. Madhusudana Rao (As resource person)	HACCP	NIFPHTT, Visakhapatnam 25 March 2015

Linkages/Partnerships

Collaboration with other institutes

Institutions in the area other than ICAR Institutes

- Goa Shipyard Ltd., Goa
- Marine Products Export Development Authority
- Export Inspection Agency
- Naval, Physical and Oceanographic Laboratory
- Fishery Survey of India
- National Institute of Oceanography
- Central Institute of Fisheries Nautical Engineering and Training
- Kerala Fishermen's Co-operative Federation (MATSYAFED)
- National Institute of Fisheries Post Harvest Technology and Training
- Kerala State Pollution Control Board
- Cochin University of Science and Technology
- Kerala Biotechnology Commission, Thiruvananthapuram
- Kerala University of Fisheries and Ocean Studies, Kochi

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
- ICAR-Central Marine Fisheries Research Institute, Kochi
- ICAR-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
- ICAR-National Bureau of Fish Genetic Resources Research Centre, Kochi

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., Kochi
- 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, Kochi
- 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

Consultancies

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

- With M/s Fisheries Institute of Technology and Training (FITT), Chennai for providing technical advice and assistance for the purchase of 40 feet long Fibreglass Reinforced Plastic (FRP) boats.
- With M/s Accelerated Freeze Drying Company Ltd., Ezhupunna, Alappuzha for conducting nutritional analysis and toxicological studies of their new seafood based product, "Seafood mix powder".
- With Ernakulam Regional Co-operative Milk Producers Union Ltd. (MILMA), Edappally, Cochin for providing technical guidance for designing and setting up of laboratory and facilitating NABL accreditation.
- With M/s Rahul Foods, Goa for providing technical guidance for setting up of an Effluent Treatment Plant (ETP) at their factory premises at Goa.
- With M/s Kerala Livestock Development Board Ltd., Thiruvananthapuram for 'Renewal of HACCP certification' for three sperm stations functioning at Mattupatti, Kulathupuzha and Dhoni under the Board.
- With M/s Shandong Heavy Industry India Pvt. Ltd., Hinjewadi, Pune for providing validation and certification of two diesel engine models (WP6C Model and WD10C Model) manufactured/marketed by the party for fishing vessels.
- With Department of Fisheries, Andaman and Nicobar Administration, Port Blair for implementation of the scheme, 'Introduction of intermediary mechanized fishing craft' in A&N Islands under the Rashtriya Krishi Vikas Yojana.
- With M/s Herald Marine Products Pvt. Ltd., Govindapuram, Palakkad for providing 'Technical guidance for the production and quality assessment of fish meal and oil'.

- With Department of Fisheries, Govt. of Maharashtra, Taraporewala Aquarium, Mumbai for providing the detailed specifications, general arrangement drawing and preparation of estimate for a 15 m long FRP training cum patrolling vessel developed by ICAR-CIFT.
- With Kerala State Co-operative Federation for Fisheries Development Ltd. (Matsyafed), Thiruvananthapuram for providing technical assistance for the modernization of chitin and chitosan plant functioning at Neendakara, Kollam district with GMP certification.
- With Marine Products Export Development Authority, Kochi for undertaking the CFC-FAO project on Promotion of processing and marketing of freshwater fish products.

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 Government 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 ICAR-CIFT and test reports were sent to the concerned.

Past year in the life of ICAR-CIFT

Events

National trainers training programme on Monofilament long lining: ICAR-CIFT, Kochi and the CIFNET, Kochi, jointly organized the 2nd National Trainers Training Programme on Monofilament long lining for eight stakeholders sponsored by the Department of Fisheries, Govt. of Tamil Nadu during 26-28 May, 2014. The training programme started on 26 May, 2014 with a three day voyage fishing trip onboard CIFNET Training Vessel M.V. Prashikshani and fishing operations were carried out at a depth of 1300 m. The participants were familiarized with handling, shooting and hauling of the monofilament long lines.Trainee representative gave the feedback of the training programme and requested for arranging marketing links for export of sashimi grade tuna and hands-on training on tuna handling.

Participants onboard Vessel M.V. Prashikshani

Training programme on Fabrication and field trial of square mesh codend: Veraval Research Centre of ICAR-CIFT offered three days training cum field demonstration of square mesh codend to fishermen at Ratnagiri during 20-22 May, 2014. The programme was organized by NETFISH, MPEDA in association with 'Manav Vikas Sevabhavi Sanstha' (an NGO), Thane, Mahartshtra. The programme was attended by 18 active fishermen and net makers of the village Karla, Ratnagiri. Two day commercial fishing trials were also conducted with the modified codend.

Participants and faculty of the training programme

ICAR-CIFT, Kochi Received ISO Certification: ICAR-CIFT, Kochi was awarded ISO 9001:2008 Certificate (Certificate No. 63371/A/0001/NB/En) for "Provision of Research and Development Services to Promote Sustainable and Responsible Harvest and Post Harvest Technologies in Fisheries Sector, including Consulting,

Dr. Meenakumari handing over the ISO Certificate document to Dr. Srinivasa Gopal

Training, Testing, Business Incubation and Transfer of Technologies". The certificate was awarded by the URS Certification Ltd. (Member of Registrar of Standards (Holdings) Limited, UK. Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi officially handed over the ISO Certificate document to Dr. T.K. Srinivasa Gopal, Director, ICAR-CIFT, Kochi in a simple function held on 11 April, 2014.

Digital repository launched: ICAR-CIFT Digital Repository developed using Dspace open source software is an important step undertaken to provide world wide access to Institute's research output. Currently the digital library houses 1551 publications including journal articles, conference papers, reports, course materials, book chapters, newsletters etc. The repository was officially launched by Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi on 11 April, 2014.

Pilot level wood preservation facility inaugurated: The pilot level wood preservation facility of Fishing Technology Division of ICAR-CIFT, Kochi was inaugurated by Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi on 11 April, 2014. The unit provides facility for mixing of preservatives, storage and impregnation treatment of wood. The fishers can utilize the facility to construct canoes from low value and easily available timbers.

Dr. Leela Edwin, HOD, FT explaining the facility

Punjab Chief Minister visited ICAR-CIFT, Kochi: Shri Parkash Singh Badal, Hon'ble Chief Minister of Punjab visited ICAR-CIFT, Kochi on 13 May, 2014. He had discussions with the Director-in-charge and Heads of Divisions and also visited the laboratory of the Fish Processing Division.

Shri Parkash Singh Badal having discussion with Heads of Divisions

International training at ICAR-CIFT, Kochi: ICAR-CIFT, Kochi conducted an International training course on "Fish processing, quality control and HACCP" during 20-26 October, 2014. The training course was sponsored by SAARC Agriculture Centre (SAC), Dhaka, Bangladesh and 12 participants from different SAARC countries *viz*. Bangladesh, Bhutan, Sri Lanka, Maldives and India attended the training.

Ms. Leena Nair, IAS, Chairman, MPEDA, Kochi formally inaugurated the training course on 20 October and Dr. C.N. Ravishankar, Director, ICAR-CIFT presided over the function. Dr. Md. Nure Alam Siddiky, Senior Programme Officer (Livestock), SAC, Dhaka, Bangladesh addressed the audience as the Chief Guest.

The course included different aspects of post harvest technologies such as advances in post harvest technology of fish and shellfish, pilot scale production of coated fishery products and chilled fish products, testing of packaging materials, pilot scale production of canned products, fish packaging technologies, hands on training sessions on emerging technologies like High Pressure Processing and Pulse Light preservation and on the preparation of silage and silage-based feed formulations.

Inauguration of the programme

Participants and faculty of the programme

Under the quality control aspect, the training covered detailed sessions on Fish quality assurance, chemical, physical and biological hazards and panel discussions, Standard sanitary operation procedures (SSOP), HACCP, Hazard analysis and HACCP Plan form. A faculty from industry Shri Satyan, Manager, M/s Mangala Seafoods, Aroor, also took classes during the industrial visit. The valedictory session of the training was conducted in advance on 25 October and the certificates were distributed to the participants by Dr. C.N. Ravishankar, Director, ICAR-CIFT.

Sensitization programme on Insulated fish bags: The fish retailers of Visakha Freshwater Fish Sellers and Farmers Association wholesale fish market at Rampuram carry the purchased fish in crates, insulated fish boxes and in bags stitched from plastic gunny bags. Fisherwomen who sell fish in the Visakhapatnam urban area were found transporting the fish in the bags with ice to the markets in auto rickshaws. Hence, a sensitization programme on Insulated fish bags was conducted by the Visakhapatnam Research Centre of ICAR-CIFT. The insulated fish bag was demonstrated to few fish retailers in the whole sale fish market on 16 November, 2014. The fish retailers appreciated the usefulness of the insulated fish bags and have requested for insulated bags for their use.

Demonstration of insulated fish bag

IAS Officer trainees visit ICAR-CIFT: A batch of 18 IAS Officer Trainees of the 2014 batch visited ICAR-CIFT, Kochi on 4 February, 2015 as a part of their Winter Study Tour (Bharat Darsan) and Public Sector Attachment Training. An interactive meeting of the Trainees with the Heads of research divisions of ICAR-CIFT was held. The meeting was chaired by Dr. C.N. Ravishankar, Director, ICAR-CIFT, Kochi and Dr. T.V. Sankar, Head, Quality Assurance and Management Division gave a presentation highlighting the activities and achievements of ICAR-CIFT. Dr. Nikita Gopal, Principal Scientist was the Nodal Officer for the visit.

Visit of the IAS Officers to ICAR-CIFT

ARS Scientist Probationers attend FET Programme at ICAR-CIFT: A team comprising of six ARS Scientist probationers belonging to 101st FOCARS from ICAR-NAARM, Hyderabad was attached to ICAR-CIFT, Cochin for their Field Experience Training from 19th February to 11th March, 2015. Perumbalam Island was selected for conducting field survey and application of PRA tools.

The team visited the Perumbalam Grama Panchayat, Krishi Bhavan, Veterinary Hospital, Co-operative Society, Prawn peeling units, Coir society etc. in the island. They also interacted with key informants and progressive farmers. A visit was organized to a fish processing factory - Moon Fisheries, Aroor, and ICAR-CMFRI, Kochi as a part

Village seminar in progress

of their training. The team also underwent onboard training on the Institute fishing vessel - Sagar Shakthi. A village seminar was conducted on 6 March, 2015, at the Krishi Bhavan, Perumbalam under the guidance and supervision of FET Coordinator Dr. Nikita Gopal, Principal Scientist, ICAR-CIFT and Monitoring Faculty Dr. Ganesh Kumar, Principal Scientist, ICAR-NAARM, Hyderabad. About 38 farmers and fishers attended the seminar. Smt. V.P. Sherly, Gram Panchayat President and Smt. Latha, Agricultural Officer were also present. The training programme concluded with an Institute seminar organized at ICAR-CIFT, Kochi on 7 March, 2015 which was presided over by Dr. C.N. Ravishankar, Director, ICAR-CIFT.

FISH MAID launch: The first 'Fish Maid' outlet, an initiation of Kerala State Coastal Area Development Corporation (KSCADC), selling value-added and ready-to-eat fish-based products developed under the project NAIP-RHSSP was inaugurated on 23 February, 2015 by Shri K. Babu, Minister for Fisheries, Excise and Ports, Govt. of Kerala. The outlet was opened at the Centre Square Mall on MG Road. The Minister did the first sale by handing over Fish Maid product to actor Ms Swetha Menon in the presence of Shri Dominic Presentation, Shri Luidy Louis and Shri Hibi Eden, MLAs; Mayor Shri Tony Chammany; District Collector Shri M.G. Rajamanickam, IAS, KSCADC MD Dr. K. Ampady and Director, ICAR-CIFT, Dr. C.N. Ravishankar. The technological contributions of the NAIP-RHSSP by way of introducing business models on value added products like "FishMaid", high quality dry fish branded under "Drish" were appreciated by the Minister.

Launching of Fish Maid

Meetings

QRT Meeting: The Quinquennial Review Team (QRT) Meeting of the Visakhapatnam Research Centre was held on 30 June, 2014 under the Chairmanship of Dr. S.D. Tripathi. Presentations were made by the Scientists and extensive discussions were made in different aspects of research. The QRT of the Mumbai Research Centre was conducted on 27 August, 2014.

QRT visiting the laboratories at Visakhapatnam

RAC Meeting: The meeting of the Research Advisory Committee was held on 22 April, 2014 at ICAR-CIFT, Kochi. Dr. T.K. Srinivasa Gopal, Director, ICAR-CIFT presented the salient achivement of the institute and Dr. Leela Edwin, Member Secretary presented the Action Taken Report. The Heads of Divisions presented the progress of work. Dr. V. Prakash, Distinguished Scientist, CSIR and Chairman, RAC and members critically evaluvated the projects of the Institute and gave guidance for future programmes.

Institute Research Council Meeting: The Institute Research Council (IRC) under the Chairmanship of Dr. T.K. Srinivasa Gopal, Director met during 10-12 June, 2014 to discuss the progress in the ongoing research programmes as well as to finalize the research projects for the year 2014-15. The house discussed in detail the 14 ongoing research projects, four new projects, four concluded projects and the various ad hoc externally funded research projects. Presentations were also made on the visits of Scientists abroad to attend training programmes, symposia etc.

SATCORE Inter Comparison Exercise: ICAR-CIFT, Kochi and INCOIS, Hyderabad jointly organized the SATCORE Inter comparison Exercise (SICOME 2014) at Fishing Technology Division of ICAR-CIFT, Kochi during 28 September - 2 October, 2014.

National Consultative Meeting on Ring Seine Fishing: The ICAR-CIFT, Kochi conducted a National Consultative-Meeting on "Management of ring seine fishing for conservation of resources and reduction of carbon footprint" on 13 March, 2015. Dr. E.G. Silas, Former Vice Chancellor, Kerala Agricultural University, Thrissur and Former Director, ICAR-CMFRI, Kochi inaugurated the meeting which was primarily aimed at discussing the technical status of the present ring seine fishing along the Indian coast. The meeting was presided over by Dr. C.N. Ravishankar, Director, ICAR-CIFT. A total of 21 invited participants from State Fisheries Departments, research institutions and academia attended the meeting.

Presentations were made on Contribution of ring seine sector in marine fish production, Evolution and growth of ring seine fishing systems and Life Cycle Assessment (LCA) and carbon footprint. Participants discussed the technical issues raised in the presentations which was moderated by Dr. M.R. Boopendranath, former Principal Scientist, ICAR-CIFT. The participants felt that the fishing systems need to be standardized; low cost user friendly sonar system appropriate for ring seiners need to be developed; and appropriate material with high breaking strength may be identified for partial replacement of areas which are vulnerable to dolphin and pufferfish attack.

Dr. C.N. Ravishankar delivering the presidential address. On the dias are Dr. P. Pravin, Dr. M.R. Boopendranath, Dr. E.G. Silas and Dr. Leela Edwin

Participation in Agri Innovation Conclave: The project on Responsible harvesting and utilization small pelagic and freshwater fishes was selected for participation in Agri-Innovation Conclave organized by National Agricultural Innovation Project (NAIP) of ICAR organized during 18-19 May, 2014 at NASC Complex, New Delhi. The Conclave was the culmination of the *Krishi Parivartan Yatra* of 50 NAIP projects, farmer beneficiaries across five cities to share success stories on agri-ventures, and the Agri-Biz Idol Camps held to reach out to the youth and start-up entrepreneurs.

An Expo was also arranged on the occasion to showcase NAIP innovations and technologies. The Project team participated in the Expo and showcased six technologies and six business models based on the value chain concept for the socio-economic upliftment and income augmentation of the rural fisherfolk. The display of 25 high end value added fish products under the brand name FISHMAID was developed under the project. The Expo was inaugurated by Dr. S. Ayyappan, DG, ICAR who also visited the stall along with Mr. Onno Ruhl, World Bank Country Director for India, Mr. Peter Kenmore, Food and Agriculture Organization (FAO) representative in India and other dignitaries.

Capacity building of coastal women: In an effort to empower coastal women, the RHSSP Project in collaboration with KSCADC, Government of Kerala imparted training to more than 100 women in four batches at Nalapakam, the central production facility of the KSCADC at Kollam district on production of premium value-added fish products. Awareness programmes were conducted for fisher women for creating employment through fish-based micro enterprises at Kollam, Ernakulam and Palakkad districts of Kerala. Under the project 700 fisher women were given training. The technologies developed such as hygienically processed and packed fresh fish, hygienically processed and packed dried fish and their marketing using the fish kiosks developed in the project could promote technopreneurship among fisher women in coastal villages.

Celebrations

World Environment Day Celebrations: As part of the World Environment Day 2014 celebrations at ICAR-CIFT, Kochi, saplings were planted by the Heads of different Divisions, scientists and staff in the premises of the Institute during the 'Green hour' on 5 June, 2014. In the afternoon Dr. Leela Edwin, Director-in-charge addressed the gathering and conveyed the theme (*Raise Your Voice, Not the Sea Level*) of the World Environment Day 2014 after which a 40 minute documentary film of National

Dr. M.P. Remesan, Principal Scientist planting a sapling

Geographic Channel "*Earth Under Water*" directed by Tilman Remme was screened.

Institute Foundation Day: The Institute celebrated its 57th Foundation Day on 29 April, 2014. 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 Institute.

Students being explained in Open House

The formal Foundation Day Celebrations was held in the afternoon. Dr. K. Gopakumar, Former Deputy Director General (Fisheries), ICAR, New Delhi was the Chief Guest of the function. Dr. T.K. Srinivasa Gopal, Director, ICAR-CIFT, Kochi presided over the meeting. Selected retired staff of the Institute namely Dr. V.C. George, Scientist, Shri C.C. Gandhi, Technical Officer and Shri V.N. Rajasekharan Nair, AAO were honoured on the occasion.

ICAR Foundation Day: ICAR-CIFT, Kochi celebrated the 86th Foundation Day of ICAR on 16 July, 2014. 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 technological achievements of the Institute. The expert scientists and technicians of the Institute facilitated the visit of students in large numbers from in and around Kochi.

ICAR Foundation Day celebrations (L to R: Shri P.P. Anil Kumar, Dr. Leela Edwin, Dr. T.K. Srinivasa Gopal and Dr. Beena Manoj)

A formal function was held in the afternoon. Dr. T.K. Srinivasa Gopal, Director, ICAR-CIFT, Kochi presided over the function. In his presidential address he gave a brief account of the activities and achievements of ICAR. This was followed by a talk on "Creating a better work environment" by Dr. Beena Manoj, Faculty, Art of Living, Cochin Chapter.

Sadbhavana Diwas: The Institute observed National "Sadbhavana Diwas" on 20 August, 2014 in connection with the observance of 'Communal Harmony Fortnight'. The Director and staff of the Institute assembled together and took the Sadbhavana Day Pledge.

'Onam': The state harvest festival of Kerala, 'Onam' was celebrated at ICAR-CIFT, Kochi on 4 September, 2014 with pomp and gaiety. Floral carpet competition was held in the morning followed by traditional 'Sadya' (feast). Shri Ramesh Pisharadi, noted mimicry artist and actor was the Chief Guest of the afternoon function. A cultural programme also followed.

Shri Ramesh Pisharadi inaugurating the celebrations

World Fisheries Day: World Fisheries Day was celebrated at Mangamaripeta, Andhra Pradesh on 21 November, 2014 in collaboration with MPEDA, NETFISH and ACTION AID NGO. More than 300 women fishers participated in the programme. A formal meeting was conducted which was presided over by Dr. M.M. Prasad, Scientist in Charge, ICAR-CIFT Visakhapatnam Research Centre. The Scientists from the Centre participated in the celebrations. Dr. G. Rajeswari, Principal Scientist talked on conservation of fish resources fisheries and role of women in fisheries development. Dr. U. Sridhar, Senior Scientist focused on the role of advanced technologies in harvesting fish from marine waters. Dr. B. Madhusudana Rao, Senior Scientist discussed on hygienic handling of fish. Dr. Ali, MPEDA and Shri Hanumantha Rao, State Coordinator of NETFISH spoke on the occassion. The meeting came to an end with vote of thanks from Shri Arjuli Das from the NGO.

The main session was followed by interactive session in which women fisher representatives from different fishing hamlets expressed their needs and aspirations. Two important aspects that garnered attention were role of fish as food in development and growth of children and also need for quality and quantity of ice catering the needs of fishers especially during the glut catches.

Participants in large numbers

'Swachh Bharat Abhiyan': As a part of 'Swachh Bharat Mission' a massive cleaning programme was carried out from 27 September, 2014 onwards. During the drive all the laboratories and office rooms of the Institute were cleaned by the staff members. Banners of 'Swachh Bharat' were displayed in the Office and Residential Complex. Cleaning drive in the ICAR-CIFT, Kochi Residential Complex was carried out on 28 September, 2014 by the inmates of the Complex. On 2 October the Director, and staff of the Institute assembled in the corridor and took 'Swachh Bharat Pledge'. All employees of the Institute including Director attended the cleaning campaign.

Director administering the Swachh Bharat Pledge

Cleaning the premises at Kochi

Swachh Bharat Mission is being observed in the Visakhapatnam Research Centre of ICAR-CIFT on every Saturday for two hours. After the World Fisheries Day celebrations the participants including resource persons from host institutes and other governmental agencies participated in "Swatcha Bharat Mission" and cleaned up Mangamaripeta Beach.

Swachh Bharat Mission started successfully in Mumbai Research Centre of ICAR-CIFT on 25 September, 2014 with a special programme on 2 October, 2014 in which a pledge was taken in the office building by the staff and the Scientist Incharge of the Centre. Dr. L.N. Murthy, SIC explained the importance of the cleanliness drive in Swachh Bharat Mission. During the drive the laboratories and office rooms of the Centre were cleaned by the staff members.

Veraval Research Centre of ICAR-CIFT carried out cleaning activities of their office premises and the adjoining areas on 24th January and also on the Republic Day on 26th January, 2015.

Vigilance Awareness Week: The Institute celebrated Vigilance Awareness Week during 27 October to 1 November, 2014. On 27 October, the Director and staff of the Institute together took 'Vigilance Awareness Pledge'.

Rashtriya Ekta Diwas: The Institute celebrated Rashtriya Ekta Diwas on 31 October, 2014. On the occasion, the Director and staff of the Institute assembled together

and took 'Rashtriya Ekta Pledge' followed by collective singing of National Anthem.

Quami Ekta Week: The Institute celebrated Quami Ekta Week during 19-25 November, 2014. On 25 November, the Director and staff of the Institute assembled together and took 'National Integration Pledge'.

Awards and Recognitions

ICAR-CIFT, Kochi Team Received Technology Innovation Award: A team of researchers from ICAR-CIFT, Kochi, received the 4th National Awards for Technology Innovation in Petrochemicals & Downstream Plastics Processing Industry (Runner Up) in the field of Polymer Science and Technology from Hon'ble Minister of Chemicals & Fertilizers, Govt. of India, Shri Ananth Kumar. Also present was Shri Nihal Chand, MoS, Ministry of Chemicals and Fertilizers, Govt. of India. The award was presented on 17 July, 2014 at a function held at Manekshaw Centre, New Delhi. The award instituted by the Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Government of India, was presented to the team 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. Others in the team were Dr. P. Muhamed Ashraf, Dr. Nikita Gopal, Dr. M. Ajith Peter, Dr. A. Sreeja, Dr. Saly N. Thomas and Dr. B. Meenakumari.

ICAR National Fellowship to Dr. R. Anandan: Dr. R. Anandan, Senior Scientist, Biochemistry and Nutrition Division, ICAR-CIFT, Kochi has been selected as ICAR National Fellow by ICAR, New Delhi. The project proposal submitted by him on "Biomodulation of marine biopolymers for the preparation of biomaterials of healthcare importance" has been awarded ICAR National Fellowship for a period of five years (2014-2019). This award is given to Indian Scientists, active in research, working in the ICAR-Agricultural University system to promote excellence at national level in agricultural research and education, and to recognize the meritorious contribution of individual agricultural scientists/teachers and facilitate their research and related activities in agriculture.

AFSIB Young Scientist Award to Smt. S. Remya: Smt. S. Remya, Scientist, Veraval Research Centre of ICAR-CIFT has bagged AFSIB Young Scientist Award instituted by the Asian Fisheries Society, Indian Branch (AFSIB) for scientists below the age of 35, working in the field of fisheries, aquaculture and related disciplines. The award was presented during the valedictory function of 10th Indian Fisheries and Aquaculture Forum held at ICAR-NBFGR, Lucknow during 12-15 November, 2014.

Shri Ananth Kumar presenting the award to Dr. Leela Edwin, Team Leader and other team members (R to L : Dr. Ajith Peter, Dr. Nikita Gopal, Dr. B. Meenakumari and Dr. Saly N Thomas). Shri Nihal Chand, MoS, looks on

Smt. Remya receiving the award from Dr. B. Meenakumari, DDG (Fy.), ICAR, New Delhi

Dr. K. Ravindran Endowment Award to Smt. S. Remya: Smt. Remya, Scientist, Veraval Research Centre of ICAR-CIFT also bagged Dr. K. Ravindran Endowment Award for the best paper presentation in the National seminar, '24th Swadeshi Science Congress', organized by Swadeshi Science Movement – Kerala and Thunchath Ezhuthachan Malayalam University, during 6-8 November, 2014, at Tirur, Kerala. The award winning paper was on 'Development of a novel biodegradable and antimicrobial packaging system for extending the shelf life of fish' by S. Remya, C.O. Mohan, G.K. Sivaraman, C.N. Ravishankar and T.K. Srinivasa Gopal.

Smt. Remya receiving the award from Dr. K. Muralidharan, President, SSM

Young Marine Biologist Award to Dr. K.K. Prajith: Dr. K.K. Prajith, Scientist, Veraval Research Centre of ICAR-CIFT bagged Young Marine Biologist Award for his paper entitled "Square Mesh Window Bycatch Reduction Devise (SMW-BRD) for stationary bagnets of Hooghly riverine system" authored by K.K. Prajith, V.R. Madhu, M.P. Remesan and P. Pravin presented during International symposium on 'Marine ecosystems – Challenges and opportunities' (MECOS-2) held at Cochin during 2-5 December, 2014.

Dr. Prajith receiving the Young Marine Biologist Award from Prof. (Dr). Rashid Sumalia, Director, Fisheries Economics, University of British Columbia, Canada

Best Poster Awards to ICAR-CIFT Teams: Dr. S.K. Panda, Senior Scientist, ICAR-CIFT, Kochi received the Best Poster Award for the poster titled, "Nutritional evaluation of processing discards from Tiger Tooth Croaker (*Otolithes ruber*)" by V. Renuka, A.A. Zynudheen, S.K. Panda, S. Remya, G.K. Sivaraman and C.N. Ravishankar presented at 10th Indian Fisheries and Aquaculture Forum at ICAR-NBFGR, Lucknow during 12-15 November, 2014.

The posters entitled, 'Gender roles in fisheries along the Vembanad estuarine system', by P. Sruthi, Liya Jayalal and Nikita Gopal and 'Workspaces of women in the ornamental fish value chain in Kerala', Liya Jayalal, P. Sruthi and Nikita Gopal bagged the best poster awards during the 5th Global Symposium on Gender in Aquaculture and Fisheries held at ICAR-NBGFR, Lucknow during 13-15 November, 2014 as a parallel event during the 10th Indian Fisheries and Aquaculture Forum.

Smt. Sruthi and Smt. Liya receiving the award from Dr. B. Meenakumari, DDG (Fy.), ICAR, New Delhi

Best Poster Award to Smt. Renuka: Smt. V. Renuka, Scientist, Veraval Research Centre of ICAR-CIFT participated and presented a poster on "Preservative effect of chitosan on Ribbonfish steaks" in National conference on "Recent trends in processing, quality and

safety of ethnic and organic foods", organized by College of Food and Dairy Technology, TANUVAS, Chennai during 26-27 June, 2014.The poster received the First Prize for best poster presentation in the technical session of "Chemical and microbiological safety and certification of ethnic and organic foods".

Smt. Renuka receiving the award from Thiru. K. Veera Raghava Rao, IAS, District Collector, Thiruvallur

Best oral presentation award to Smt. Remya: Smt. S. Remya, Scientist, Veraval Research Centre of ICAR-CIFT has bagged the best oral presentation award in the category of 'Applications in food processing and agriculture' in the National Conference on 'Application of the derivatives of chitin and chitosan' organized by Indian Chitin & Chitosan Society and Gandhigram Rural Institute, Dindigul during 22-23 August, 2014 at Dindigul.

Poetry Award to Dr. Santhosh Alex: Dr. Santhosh Alex, Senior Tech. Officer, ICAR-CIFT, Kochi received the 2014 Thalassery Raghavan Memorial Poetry Award instituted by Chennai 'Kerala Samajam' on 27 July, 2014. The award was given to him by Shri V.V. Dakshinamurthy, Chief Editor, Deshabhimani for the collection of poems in Malayalam entitled, "Njangalude Colony' (Our Colony).

Dr. Santhosh Alex receiving the award

Dr. Santhosh Alex also received the "Sirjanlok Kavi Samman" during the function held in SRM University, Chennai on 13 March, 2015. Dr. S. Balasubramaniam, Director, Science and Humanities Department, SRM University gave the award in presence of Shri Shreyans, Chairman, Sirjanlok Organization.

Post Graduate Studies

Smt. P. Viji, Scientist, Visakhapatnam Research Centre of ICAR-CIFT was awarded Ph.D. Degree of ICAR-Central Institute of Fisheries Education (CIFE), Mumbai (Deemed University) for her theses entitled "Effects of plant extracts on the quality of Indian mackerel, *Rastrelliger kanagurta* (Cuvier, 1817), preserved by chilled and frozen condition". She worked under the guidance of Dr. T.K. Srinivasa Gopal, Former Director, ICAR-CIFT, Kochi.

Shri P. Shankar, Technical Officer, ICAR-CIFT, Kochi was awarded Ph.D. (Hindi) degree for his thesis entitled, "Dr. Abdul Kalamkrit vision 2020 ka anuvad Bharat 2020 navanirman ki rooprekha: Samiksha" from the Post Graduate and Research Institute, Dakshina Bharat Hindi Prachar Sabha, Chennai. Shri Shankar worked under the guidance of Prof. S.V.S.S. Narayana Raju, Assistant Director, Distance Education Regional Office, DBHPS, Kochi.

Shri Ginson George, Senior Research Fellow, ICAR-CIFT, Kochi was awarded Ph.D. degree for his thesis entitled, "Optimization of high pressure parameters for Indian white prawn (*Fenneropenaeus indicus*) and its shelf life evaluation during chilled storage". He worked under the guidance of Dr. J. Bindu, Senior Scientist, Fish Processing Division, ICAR-CIFT, Kochi.

Important Visitors

The following were some of the dignitaries who visited the Institute during the period:

- Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi (Kochi on 11 April, 2014)

Shri Parkash Singh Badal visiting the Fish Processing Division

Dr. B. Madhusudana Rao, Senior Scientist explaining about ICAR-CIFT technologies to the deligats from Eritrea

- Shri Parkash Singh Badal, Chief Minister of Punjab (Kochi on 13 May, 2014)
- Dr. S.D. Tripathi, Dr. V.C. George, Prof. B.A. Shyam Sunder and Dr. Krishna Srinath, Quinquennial Review Team members (Visakhapatnam on 30 June, 2014).
- Shri K. Babu, Minister for Fisheries, Port and Excise, Govt. of Kerala (Kochi on 4 July, 2014).
- Dr. K. Poulose Jacob, Pro VC, CUSAT, Kochi (Kochi on 14 July, 2014).
- Dr. Mohan Joseph Modayil, Former ASRB Member (Kochi on 26 July, 2014 and 10 November, 2014).
- Prof. B. Madhusudana Kurup, VC, KUFOS, Kochi (Kochi on 14 September, 2014).
- Dr. Madan Mohan, Asst. Director General (Marine Fisheries), ICAR, New Delhi (Visakhapatnam on 12 September 2014).
- Ms. Leena Nair, IAS, Chairman, MPEDA, Kochi and Dr. Md. Nure Alam Siddiky, Senior Programme Officer (Livestock), SAC, Dhaka, Bangladesh (Kochi on 20 October, 2014).
- Dr. A. Gopalakrishnan, Director, ICAR-CMFRI, Kochi (Visakhapatnam on 26 October 2014).
- Dr. Krishna Mohan, Director of Fisheries, Odisha (Visakhapatnam on 8 October, 2014).
- Dr. V. Ramakantha, IFS, Director, IWST, Bangalore (Visakhapatnam) .
- Six delegates from Marine Resources Development Department, Ministry of Marine Resources, Eritrea (Visakhapatnam on 11 November 2014).
- Dr. A.K. Pal, Joint Director, ICAR-CIFE, Mumbai (Veraval on 9 January, 2015).
- Dr. Mohan Joseph Modayil, Former ASRB Member and Dr. Shyam Sundar, Head, Fish Processing Division, Fisheries College, Mangalore (Veraval on 18 February, 2015).
- Dr. Pathak, Asst. Director General (Animal Sciences), ICAR, New Delhi (Veraval on 26 March, 2015).

Invited Talks

The following talks were delivered by experts at ICAR-CIFT, Cochin during the period:

- Dr. Beena Manoj, Faculty, Art of Living, Cochin Chapter – "Creating a better work environment" (16 July, 2014).
- Dr. Mohan Joseph Modayil, Former ASRB Chairman and President, Association of British Scholars, Kochi Unit - "Time management" (26 July, 2014).
- Dr. A. Vasantha Shenoy, Joint Secretary (PR), SORT, Kochi – "Organ donation" (26 November, 2014).

Dr. Mohan Joseph Modayil giving the talk

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.

Administration

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

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

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

Cases considered by the Departmental Promotion Committee

Category	Promotion	Declaration of probation and Confirmation	Granting MACP
Scientific	2	7	-
Technical	6	-	-
Administrative	4	6	7
Supporting	-	-	9
Auxiliary	-	-	-

Priority setting, Monitoring and Evaluation Cell

The PME Cell dealt with the following technical matters during the year:

Varification of CAS reports of Scientists

The PME Cell verifies the Career Assessment Reports submitted by Scientists for their promotion and gives due recommendations.

Submission of monthly, quarterly and half yearly reports

Monthly reports on the important activities of the Institute and significant research findings were compiled and sent to ICAR regularly for inclusion in the ICAR monthly report to the Cabinet Secretariat. Quarterly and six monthly reports on the targets and achievements of the Institute comprising both research and financial aspects were regularly furnished to the Council.

Publication of the scientific papers

The scientific research papers meant for publication in research journals and for presentation in Symposia/ Seminars by scientists of the Institute were arranged for reviewing and further approval of the recommended papers communicated.

Institute Research Council

The Institute Research Council meeting was convened during 10-12 June, 2014, to review the progress achieved in the ongoing research projects of the Institute during 2013-14 and to discuss the research project proposals for the year 2014-15. The Institute Research Project Document for the year 2014-15 was compiled and brought out for discussion at the Meeting. The House discussed in detail the 14 ongoing research projects, besides four completed projects and four new projects apart from the various ad hoc projects.

PERMISnet, IRS and PIMS-ICAR

The PME Cell 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

One issue of Fish Technology Newsletter and three issues of CIFT Newsletter were published during the period. Besides, the Institute Annual Report 2014-15 and Research Highlights 2014-15 were also brought out.

Human Resources Development Activities

The Human Resources Committee functions at the PME Cell. During the period HR Committee met eight times to discuss 95 cases. As recommended by the HR Committee the scientists and officers of the Institute participated in 45 training programmes during the period (Details under the Chapter - Training acquired).

Other technical matters

The Cell continued to answer queries on various technical matters received from other organizations and individuals. The queries received by the CTO, PME Cell 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 PME Cell functions as the nodal point for releasing Press Releases and Reports.

Official Language Implementation

Hindi Chetana Mas

Hindi Chetana Mas was celebrated during 19 August-15 September, 2014 at the Institute. During the celebrations different competitions like terminology writing for Administration and Divisions, Quiz for Administration and Technical, Cross word, Advertisement and Nukkad Natak were conducted. The valedictory function of Chetana Mass was held on 18 September, 2014. Prof. B. Madhusudana Kurup, Vice Chancellor, KUFOS, Kochi was the Chief Guest for the occasion. Dr. C.N. Ravishankar, Director presided over the meeting. Dr. Santosh Alex, Senior Technical Officer welcomed the gathering while Dr. C. Jessy Joseph, DD(OL) proposed vote of thanks.

Dr. B. Madhusudana Kurup delivering the Chief Guest's address

Dr. K.K. Asha, Senior Scientist, Biochemistry & Nutrition Division was awarded the Rajbhasha Prathiba Puraskar and Quality Assurance and Management Division was adjudged as the Best Division in Hindi Implementation.

Official Language Workshops

As a part of Official Language Implementation nine workshops were conducted during the year for the benefit of Administrative Staff and young scientists of the Institute. Dr. Santosh Alex, Senior Technical Officer and Dr. P. Shankar, Technical Officer, were the resource persons for the workshops.

Participation in OL National Seminar

Dr. Santosh Alex, Senior Technical Officer took part in the National Seminar organized by NPOL, Kochi on 12 November, 2014. He also presented a paper entitled, "Vigyan Evam Praudyogiki ke Prasar main Hindi ki Bhumika" in the Seminar.

Prize in TOLIC 2014

The staff members of ICAR-CIFT, Kochi took part in the Joint TOLIC Competitions held at Income Tax Office, Kochi during 24-26 November, 2014. Smt Asha Gopalan, Asst. won 2nd prize in paragraph writing and Smt. Subin George, LDC won 2nd prize in Hindi Typing competition.

TOLIC meeting attended

Shri P.J. Davis, Senior Administrative Officer and Dr. Santosh Alex, Senior Technical Officer participated in the 60th meeting of Kochi TOLIC on 5 December, 2014 at Income Tax Department, Kochi.

Technical Talks

Two technical talks in Hindi were organized in the Institute during the period under report as given below:

1. Shri O.B. Satish Kumar, Technical Officer 'A' Grade, NPOL, Kochi - "Transducers and Sonar" (13 February, 2015).
2. Dr. P. Pravin, Principal Scientist, ICAR-CIFT, Kochi -"Pole and line fishing in Lakshwadeep" (21 March, 2015).

Library

The library is well equipped with modern facilities and resources in the form of online databases, CD-ROMs, DVDs, books, e-journals, e-standards, theses, reports etc. During the period under report, library acquired 47 books and 46 scientific periodicals. 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.

Library Portal

The library home page provides electronic access to bibliographic databases and full text documents. Bibliographic databases have been developed using WINISIS and search interfaces have been developed using *GenISISweb*.

Outcome of eGranth Project

The e-Granth project initiated by ICAR system to serve the need for an union catalogue of 38 NARS libraries using *Koha* open source software was successful and now ICAR-CIFT Library is part of "IDEAL" (http://ideal.egranth.ac.in/), a ready platform for NARS libraries for sharing library catalogues through union catalogue AGRICAT 2.0. *Koha* software is being used by the library not only for online public access catalogue but also for managing house-keeping operations such as circulation (Check-outs and check-in), acquisition, serials management etc.

Digital Repository of ICAR-CIFT

Digitization of ICAR-CIFT publications and putting them in the open digital repository is an important activity of the library. During the period 113 documents have been digitized and added to the repository. At present ICAR-CIFT Digital Repository holds 1664 digital documents.

Remote access to e-resources

Remote access to subscribed e-resources has been provided to the users by introducing a web proxy server. Now the users are getting access to IP protected resources outside the campus also *via*. the library's list of online resources. The facility is also available to the faculty members of the Research Centres.

CeRA (Consortium of e-Resources on Agriculture)

More than 2000 journals are available online through CeRA (Consortium of e-Resources on Agriculture). Library has supplied copies of 436 articles under DDR (Document Delivery Request) facility of CeRA (Consortium of e-Resources on Aquaculture).

IAMSLIC membership

ICAR-CIFT library is a member of IAMSLIC (The International Association of Aquatic and Marine Science Libraries and Information Centers) and is part of the Inter-library Loan programme, with more than 90 member libraries from more than 25 countries offering materials to other member libraries *via.* interlibrary loan and document delivery.

ASFA Input Centre

The library in association with NIO, Goa continued to act as a National Input Centre of ASFA (Aquatic science and Fisheries Abstracts) database.

NABL Activities

ICAR-CIFT, Kochi got ISO/IEC: 17025:2005 Accreditation in the year 2005 and the quality system is in position for the last 10 years. Surveillance audit by NABL, New Delhi was conducted during the months of April-May, 2014. Total parameters in the NABL accredited scope is 112 which include 89 parameters in Chemical, 17 parameters in Biological and six parameters in Mechanical field. During 2014-15 Inter Laboratory comparison was carried out for biological parameters in fish (6 Nos.), chemical parameters in fish (8 Nos.) and chemical parameters in water (10 Nos).

During the period under report a total of 1369 samples were analyzed. Samples included NABL, Non-NABL, water, ILC and Customs Samples. A total revenue of R ` 30,44,438/- was realized.

Committees

Quinqennial Review Team

Chairman: Dr. S.D. Tripathi, Former Director, ICAR-CIFE, Mumbai

Members

1. Dr. K. Venkatesh Murthy, Senior Principal Scientist, CFTRI, Mysore
2. Dr. V.C. George, Director, Aquaculture Department, SH College, Kochi
3. Prof. B.A. Shyam Sunder, College of Fisheries, Mangalore
4. Dr. Krishna Srinath, Former Director, ICAR-DRWA, Bhubaneswar
5. Shri S.S. Rajpathak, Vice President, M/s Garware Wall Ropes Ltd., Pune

Member Secretary: Dr. P. Pravin, Principal Scientist, ICAR-CIFT

Research Advisory Committee

Chairman: Dr. V. Prakash, Former Director, CFTRI, Mysore

Members

1. Dr. Rintu Banerjee, 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/Dr. C.N. Ravishankar, Director, ICAR-CIFT

Member Secretary: Dr. Leela Edwin, HOD, FT, ICAR-CIFT

Institute Management Committee

Chairman: Dr. T.K. Srinivasa Gopal/Dr. C.N. Ravishankar, Director, ICAR-CIFT

Members

1. Dr. V.V. Kulkarni, Director, ICAR-NRC on Meat, Hyderabad
2. Dr. Samantha, Principal Scientist, ICAR-CIFRI, Barrackpore
3. Dr. V. Kripa, HOD, FEMD, ICAR-CMFRI, Kochi
4. Adv. Ranjeet Srinivas, Alappuzha
5. Shri K. Radha Madhavan, Kozhikode
6. Dr. T.V. Sankar, HOD, QAM, ICAR-CIFT
7. Assistant Director General (M. Fy.), ICAR, Krishi Anusandhan Bhavan II, Pusa, New Delhi
8. Finance and Accounts Officer I/c, ICAR-CIFT

Member Secretary: Shri P.J. Davis, Senior Administrative Officer, ICAR-CIFT

Grievance Committee

Chairman: Dr. T.K. Srinivasa Gopal/Dr. C.N. Ravishankar, Director, ICAR-CIFT

Members

1. Dr. Suseela Mathew, HOD, B&N
2. Shri R. Anil Kumar, Administrative Officer
3. Shri P.P. Anil Kumar, Asst. Finance & Accounts Officer
4. Shri P.K. Somasekharan Nair, Asst.
5. Shri P.T. Viswambharan, Tech. Officer
6. Shri V. Deepak Vin, Skilled Support Staff

Member Secretary: Shri T. Viswanathan, Asst. Administrative Officer, ICAR-CIFT

Institute Joint Staff Council

Chairman: Dr. T.K. Srinivasa Gopal/Dr. C.N. Ravishankar, Director, ICAR-CIFT

Members (Official side)

1. Dr. Suseela Mathew, HOD, B&N
2. Dr. A.A. Zynudheen, HOD I/c, FP
3. Dr. M.P. Remesan, Principal Scientist
4. Shri R. Anil, Kumar, Administrative Officer
5. 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
3. Shri P.K. Somasekharan Nair, Assistant
4. Shri K.K. Karthikeyan, Skilled Support Staff
5. Shri P.N. Nikhil Das, Skilled Support Staff

Secretary (Staff Side)

Shri P.S. Nobi, Tech. Officer

On-going Research Projects

Institute Projects

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
1.	Responsible fishing systems for marine sector	Dr. P. Pravin	Kochi & Veraval	Kochi Veraval	Dr. Saly N. Thomas Dr. M.P. Remesan Shri M.V. Baiju Dr. V.R. Madhu Shri G. Kamei Shri Karan Ramteke Dr. K.K. Prajith
2.	Development of appropriate fishing systems for rivers	Dr. M.P. Remesan	Kochi, Visakhapatnam & Veraval	Kochi Visakhapatnam Veraval	Dr. P. Pravin Shri M.V. Baiju Dr. V.R. Madhu Dr. G. Rajeswari Dr. R. Raghu Prakash Dr. U. Sreedhar Dr. K.K. Prajith Dr. R.K. Manna (ICAR-CIFRI, Barrackpore) Dr. A.K. Sahoo (ICAR-CIFRI, Barrackpore)
3.	Processing and quality improvement of seafoods in Gujarat	Dr. G.K. Sivaraman	Veraval	Veraval	Dr. A.K. Jha Shri V. Chandrasekar Smt. V. Renuka Smt. S. Remya
4.	Development of a quality index scheme for commercially important fishes of India	Dr. T.V. Sankar	Kochi & Mumbai	Kochi Mumbai	Dr. K. Ashok Kumar Dr. Femeena Hassan Dr. S.K. Panda Smt. S.J. Laly Dr. Pankaj Kishore Smt. T.K. Anupama Dr. L.N. Murthy Dr. P. Viji Dr. A. Jeyakumari
5.	Diversity of seafood-borne pathogenic and commensal bacteria and bioscreening for novel genes and biocatalysts	Dr. K.V. Lalitha	Kochi & Visakhapatnam	Kochi Visakhapatnam	Dr. Toms C. Joseph Dr. V. Murugadas Dr. B. Madhusudana Rao

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
6.	Bio-monitoring and bio-evaluation of marine resources and formulation of nutraceuticals in human nutrition and health	Dr. Suseela Mathew	Kochi & Visakhapatnam	Kochi Visakhapatnam	Dr. R. Anandan Dr. K.K. Asha Dr. N.S. Chatterjee Dr. B. Madhusudana Rao Dr. L.N Murthy Kum. Jesmi Debbarma
7.	Bio-monitoring of bivalve mollusks and crustaceans from Indian waters as health promoters and indicators of environmental contaminants	Dr. Suseela Mathew	Kochi & Visakhapatnam	Visakhapatnam	Dr. B. Madhusudana Rao Kum. Jesmi Debbarma
8.	Enhancing fuel efficiency and safety of mechanized fishing vessel systems	Shri M. Nasser	Kochi	Kochi	Dr. V. Geethalakshmi Dr. S. Ashaletha Shri Ankur Nagori
9.	Evaluation of technology transfer models in fisheries sector	Dr. S. Balasubramaniam	Kochi & Visakhapatnam	Kochi Visakhapatnam	Dr. S. Ashaletha Dr. George Ninan Smt. P. Jeyanthi Smt. Arathy Ashok
10.	Management dimensions in the fisheries sectors – Policies, issues and implications	Dr. Nikita Gopal	Kochi, Visakhapatnam & Veraval	Kochi Visakhapatnam Veraval	Dr. V. Geethalakshmi Shri V. Radhakrishnan Nair Smt P. Jeyanthi Smt. Arathy Ashok Shri V. Chandrasekar
11.	Nano technological intervention to mitigate fishing craft and gear material degradation	Dr. P. Muhamed Ashraf	Kochi	Kochi	Dr. Leela Edwin Dr. Saly N. Thomas Shri G. Kamei
12.	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	Visakhapatnam	Visakhapatnam	Dr. G. Rajeswari Dr. U. Sreedhar Smt. Arathy Ashok

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
13.	Thermal and non-thermal technologies for processing and packaging of fish products	Dr. J. Bindu	Kochi, Visakhapatnam & Mumbai	Kochi Visakhapatnam Mumbai	Dr. S.K. Panda Dr. R. Venkateswarlu Dr. C.O. Mohan Shri Ankur Nagori Kum. Jesmi Debbarma Dr. P. Viji Dr. A. Jeyakumari
14.	Risk assessment of emerging food-borne pathogens and chemical residues in aquatic systems	Dr. K. Ashok Kumar	Kochi & Veraval	Kochi Veraval	Dr. K. Ashok Kumar Dr. Femeena Hassan Dr. S.K. Panda Dr. C.O. Mohan Smt. S.J. Laly Dr. N.S. Chatterjee Dr. Pankaj Kishore Smt. T.K. Anupama Dr. G.K. Sivaraman
15.	Species specific technologies for the improved utilization of the fishery resources of Maharashtra region	Dr. L.N. Murthy	Mumbai, Veraval & Kochi	Mumbai Veraval Kochi	Dr. S. Visnuvinayagam Dr. P.K. Binsi Dr. P. Viji Dr. G.K. Sivaraman Dr. V. Murugadas Dr. A. Jeyakumari
16.	Innovative product development for value addition, nutrient fortification and shelf life extension of farmed and wild freshwater and marine fish	Dr. M.M. Prasad	Visakhapatnam	Visakhapatnam	Dr. B. Madhusudana Rao Kum. Jesmi Debbarma Dr. P. Viji
17.	Development of standard processes and protocols for innovative products from aquatic resources, shelf life modeling and assessment of energy use	Dr. George Ninan	Kochi, Verval & Mumbai	Kochi Veraval Mumabi	Dr. K.V. Lalitha Dr. A.A. Zynudheen Dr. C.O. Mohan Dr. V. Ronda Shri C.G. Joshy Shri Ankur Nagori Smt. P. Jeyanthi Smt. S.J. Laly Smt. U. Parvathy Dr. A.K. Jha Smt.V. Renuka Smt. S. Remya Dr. L.N. Murthy Dr. S. Visnuvinayagam Dr. P.K. Binsi Dr. A. Jeyakumari Dr. P. Viji

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
18.	Development of high value byproducts from fish and shellfish processing discards	Dr. A.A. Zynudheen	Kochi, Visakhapatnam, Veraval & Mumbai	Kochi Visakhapatnam Veraval Mumbai	Dr. George Ninan Dr. S.K. Panda Dr. V. Murugadas Shri C.G. Joshy Smt. U. Parvathy Kum. Jesmi Debbarma Smt. V. Renuka Smt. S. Remya Dr. S. Visnuvinayagam Dr. P.K. Binsi Dr. A. Jeyakumari
19.	Formulation of a fortified fish soup powder and its use in a nutritional intervention study against malnutrition	Dr. K.K. Asha	Kochi	Kochi	Dr. Suseela Mathew Dr. R. Anandan Dr. J. Bindu Shri C.G. Joshy Dr. N.S. Chatterjee
20.	Innovative product development for value addition, nutrient fortification and shelf life extension of farmed and wild freshwater marine fish	Dr. M.M. Prasad	Visakahapatnam & Mumbai	Mumbai	Dr. L.N. Murthy
	Indian Council of Agricultural Research (ICAR) projects				
21.	Zonal Technology Management – Business Planning and Development Unit	Dr. C.N Ravishankar/ Dr. George Ninan	Kochi & Visakhapatnam	Kochi Visakhapatnam	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 K.J. Aravind* Dr. B. Madhusudana Rao Dr. L.N. Murthy
22.	Intellectual property management and technology transfer/ commercialization	Dr. C.N. Ravishankar/ Dr. George Ninan	Kochi	Kochi	Shri M. Kiran Das* Smt. K.A. Anju*

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
23.	Nutrient profiling and evaluation of fish as a dietary component	Dr. R. Anandan	Kochi & Veraval	Kochi	Dr. Suseela Mathew Dr. K.K. Asha Dr. N.S. Chatterjee Smt. V. Susmitha* Smt. Divya K. Vijayan*
				Veraval	Dr. G.K. Sivaraman
	National Agricultural Science Fund Projects				
24.	Green fishing systems for tropical seas	Dr. Leela Edwin	Cochin, Goa, Pune & Mumbai	Kochi	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 Sherief* Shri P.T. Sreejith* Smt. K.A. Sayana* Shri Rithin Joseph* Shri Pradip Kumar Mahato*
				Goa	Shri B.K. Upadhyay, GSL Shri Asoka Naik, GSL
				Pune	Shri R.N. Savasere, GWRL Shri Kishore Darda, GWRL
				Mumbai	Kum. Margot Wunnik-van, DSM Shri Rakesh Gaikwad, DSM
25.	Development of multiplex microarray for detection of food-borne and shrimp pathogens	Dr. Toms C. Joseph	Kochi & Veraval	Kochi	Dr. K.V. Lalitha Shri Thobias P. Antony*
				Veraval	Dr. G.K. Sivaraman
	National Agriculture Innovation Projects (NAIP)				
26.	Responsible harvesting and utilization of selected small pelagic and freshwater fishes	Dr. K.V. Lalitha	Cochin	Cochin	Dr. S. Sanjeev Shri M. Nasser Dr. V. Geethalakhmi Dr. S. Ashaletha Dr. R. Anandan 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	
27.	Bioprospecting of genes and allele mining for abiotic stress tolerance	Dr. Toms C. Joseph	Kochi	Kochi	Dr. K.V. Lalitha Kum. Anju Baby* Kum. Aswathy Mary Varghese*
	Centre for Marine Living Resources & Ecology (CMLRE) Projects				
28.	Assessment of myctophid resources in the Arabian sea and development of harvest and post harvest technologies	Dr. M.P. Remesan	Kochi, Visakhapatnam & Veraval	Kochi Visakhapatnam Veraval	Dr. George Ninan Dr. A.A. Zynudheen Dr. V. Murugadas Shri F. Daniel Raj* Shri R. Navaneethan* Shri M.M. Lijin Nambiar* Dr. G. Rajeswari Dr. R. Raghu Prakash Dr. K.K. Prajith
29.	Extraction and purification of marine bio-molecules and their derivatives for nutritional and industrial applications	Dr. Suseela Mathew	Kochi	Kochi	Dr. K.K. Asha Dr. N.S. Chatterjee Kum. K.R. Remyakumari*
30.	Characterization of harmful algal blooms along Indian coast	Dr. K. Ashok Kumar	Kochi	Kochi	Dr. T.V. Sankar Dr. R. Anandan Dr. S.K. Panda Kum. R. Rajisha* Kum. Rose Mary Mathew*
31.	Exploration and assessment of demersal fishery resources along the continental slope (200-1200m) of Indian EEZ and central Indian Ocean	Dr. U. Sreedhar	Visakhapatnam, Mumbai & Kochi	Visakhapatnam Mumbai Kochi	Dr. G. Rajeswari Dr. R. Raghu Prakash Shri B. Prema Raju* Kum. S. Lavanya* Shri K. Rushinadha Rao* Dr. L.N. Murthy Dr. Suseela Mathew Shri Anish*
	Department of Biotechnology (DBT) Projects				
32.	Development of bioplastic based sustainable nanobiocomposites food packaging - Sustain Nano Pack	Dr. J. Bindu	Kochi	Kochi	Dr. S.K. Panda Smt. Vimala Devi*

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
33.	Genetic diversity of *Clostridium botulinum* in seafoods and development of Lateral Flow Immuno Assay (LFIA) for toxinotyoping	Dr. K.V. Lalitha	Kochi	Kochi	Dr. Toms C. Joseph Shri Arun Jyothi* Smt. Athira Vidyadharan* Smt. R. Deepika*
	Department of Science and Technology (DST) Projects				
34.	Food safety interventions for women in fishery based microenterprises in coastal Kerala	Dr. Femeena Hassan	Kochi	Kochi	Dr. S. Balasubramaniam Kum. Treesa Gracious* Kum. K.V. Nija*
35.	Use of natural resins and gums for preservation and value addition of fishery products	Dr. P.K. Binsi	Mumbai, Kochi & Ranchi	Mumbai Kochi Ranchi (IINRG)	Dr. S. Visnuvinayagam Kum. Natasha Nayak* Dr. George Ninan Kum. Upali Sahoo* Dr. P.C. Sarkar*
	Coconut Development Board (CDB) Project				
36.	Techno-economic feasibility of coconut wood canoes for the small-scale fisheries sector in the southwest coast of India and lakshadweep	Dr. Leela Edwin	Kochi	Kochi	Dr. Nikita Gopal Shri M.V. Baiju Dr. V.R. Madhu Shri Jomey George* Shri K.A. Roshan* Smt. K.L. Chithrakala*
	Indian National Centre for Ocean Information Services (INCOIS) Projects				
37.	Retrieval of phytoplankton and associated optical constituents based on long term bio-optical studies	Dr. P. Muhamed Ashraf	Kochi	Kochi	Kum. P. Minu* Smt. V.P. Souda*
38.	Validation of tuna advisories off east coast	Dr. U. Sreedhar	Visakhapatnam	Visakhapatnam	Shri R. Uma Maheswara Rao* Shri D. Dhanunjaya*
39.	Studies on ecological linkages between plankton production and *Acetes* sp. along Gujarat coast	Dr. V.R. Madhu	Veraval	Veraval	Dr. K.K. Prajith Kum. Vadher Kiran*

Sl. No	Name of Project	Principal Investigator	Location of Project	Co-investigators	
	National Fisheries Development Board Project				
40.	National surveillance programme for aquatic animal diseases	Dr. K.V. Lalitha	Kochi	Kochi	Dr. Toms C. Joseph Dr. V. Murugadas Shri. K. Ahamed Basha Dr. S. Ashaletha Shri Akhil Nath* Shri Saheer*
	UNDP-Global Environment Facility Project				
42.	Demonstration and field testing of bycatch reduction devices and juvenile fish excluder devices and promotion of square mesh codend in Sindhudurg district of Maharashtra	Dr. V. R. Madhu	Maharashtra	Maharashtra	Shri Paresh S. Khanolkar* Shri Prashanth S. Dudha wadekar* Shri Harshal B. Redkar* Shri Hareshwar B. Khavale Kum. Priyanka B. Satam*
	USAID-MARKET Project				
43.	Thematic studies on gender in aquaculture in Combodia, Lao PDR, Thailand and Vietnam	Dr. Nikita Gopal	Kochi	Kochi	Smt. P. Sruthi* Smt. Liya Jayalal*
	Food Saftey Standards Authority of India Projects				
44.	Pesticide and antibiotic residues in fish and fishery products: Evolving frame work for fixation of MRLs	Dr. S.K. Panda	Kochi		

* Research Fellow

List of Personnel in ICAR-CIFT

(As on 31st March, 2015)

Managerial Personnel

Director: Dr. C.N. Ravishankar

Heads of Division

Fishing Technology Division	:	Dr. Leela Edwin, Principal Scientist
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
Biochemistry and Nutrition Division	:	Dr. Suseela Mathew, Principal Scientist
Fish Processing Division & Engineering Division I/C	:	Dr. A.A. Zynudheen, Senior Scientist
Senior Administrative Officer	:	Shri P.J. Davis
Assistant Finance & Accounts Officer	:	Shri P.P. Anil Kumar

Scientist-Incharge of Research Centres

Visakhapatnam Research Centre	:	Dr. M.M. Prasad, Principal Scientist
Veraval Research Centre	:	Dr. G. Sivaraman, Senior Scientist
Mumbai Research Centre	:	Dr. L.N. Murthy, Senior Scientist

Other Personnel

Headquarters, Cochin

Scientific Personnel

Principal Scientist

1. Shri M. Nasser
2. Dr. Saly N. Thomas
3. Dr. P. Pravin
4. Dr. K. Ashok Kumar
5. Dr. M.P. Remesan
6. Dr. Nikita Gopal
7. Dr. V. Geethalakshmi

Senior Scientist

1. Dr. R. Anandan
2. Dr. Femeena Hassan
3. Dr. S. Ashaletha
4. Dr. J. Bindu
5. Dr. P. Muhamed Ashraf
6. Dr. George Ninan
7. Shri M.V. Baiju
8. Dr. Toms C. Joseph
9. Dr. S.K. Panda
10. Dr. V.R. Madhu
11. Dr. K.K. Asha

Scientist

1. Shri V. Radhakrishnan Nair
2. Smt P. Jeyanthi
3. Dr. C.O. Mohan
4. Dr. R. Venkateswarlu
5. Shri Ankur Nagori
6. Dr. V. Murugadas
7. Shri C.G. Joshy
8. Smt. S.J. Laly
9. Dr. Niladri Sekhar Chatterjee
10. Smt. U. Parvathy
11. Shri Gaihimngam Kamei
12. Dr. Pankaj Kishore
13. Shri K. Ahamed Basha
14. Shri Karankumar K. Ramteke

15. Shri N. Ranjith Kumar
16. Shri G.M. Siddaiah
17. Shri S. Sreejith
18. Smt. T.K. Anupama
19. Kum. Hanjabam Mandakini Devi
20. Shri Anuj Kumar

Technical Personnel

Chief Technical Officer

1. Dr. A.R.S. Menon

Assistant Chief Technical Officer

1. Shri C.R. Gokulan
2. Smt. K.B. Beena
3. Smt. P.K. Shyma

Senior Technical Officer

1. Dr. M. Baiju
2. Dr. G. Usha Rani
3. Smt. T. Silaja
4. Shri T.V. Bhaskaran
5. Smt. M. Rekha
6. Shri K.D. Jos
7. Dr. B. Ganesan
8. Smt. K.K. Kala
9. Shri Sibasis Guha
10. Shri P.S. Babu
11. Shri G. Omanakuttan Nair
12. Dr. Santhosh Alex
13. Smt. G. Remani

Technical Officer

1. Shri T.N. Sukumaran
2. Shri Jose Kalathil
3. Shri Thomas Teles
4. Shri K.B. Thampi Pillai
5. Smt V.C. Mary
6. Shri K.P. Vijayan
7. Shri P.T. Viswambharan
8. Shri C. Rajendran
9. Smt. K.G. Sasikala
10. Shri V.N. Dileepkumar
11. Shri P.S. Nobi
12. Shri P.N. Sudhakaran
13. Shri Aravind S. Kalangutkar
14. Shri K.K. Narayanan
15. Shri Arockia Samy
16. Smt. Ancy Sebastian
17. Shri K.C. Gopalan
18. Smt. K.S. Mythri
19. Dr. P. Sankar

Senior Technical Assistant

1. Shri T.P. Haridasan
2. Smt P.K. Geetha
3. Shri C. Subash Chandran Nair
4. Shri A.K. Naik
5. Shri Sajith K. Jose
6. Shri P.V. Sajeevan
7. Shri V.K. Siddique
8. Smt. P.A. Jaya
9. Shri T. Mathai
10. Shri T.B. Assisse Francis
11. Smt. N. Lekha
12. Shri K.S. Babu
13. Shri P. Bhaskaran
14. Smt. Bindu Joseph
15. Shri T.P. Saju
16. Smt. N.C. Shyla
17. Shri G. Gopakumar
18. Shri P.D. Padmaraj
19. Smt. Tessy Francis

Technical Assistant

1. Shri N. Sunil
2. Shri P.S. Sunil Kumar
3. Shri V.A. Sudhakarn
4. Shri K.V. Mohanan
5. Shri C.K. Suresh
6. Shri V.T. Sadanandan
7. Shri P.A. Aneesh
8. Shri K.D. Santhosh
9. Shri K. Dinesh Prabhu
10. Shri K.A. Noby Varghese

11. Kum. Vineetha Das
12. Shri J. Saju
13. Shri V. Vipin Kumar
14. Shri T. Jijoy
15. Smt. P. Sruthi
16. Shri Rahul Ravindran
17. Smt. U.P. Prinetha
18. Shtri Rakesh M. Raghavan

Senior Technician

1. Shri K.C. Anish Kumar

Technician

1. Shri K. Nakulan
2. Shri G. Vinod
3. Shri Ajith V. Chellappan
4. Smt. N. Karthika
5. Shri M.T. Udayakumar
6. Smt. K. Reshmi
7. Smt. Anu Mary Jose
8. Smt. G. Archana
9. Shri V.N. Sreejith
10. Smt. P.J. Mary
11. Shri P. Suresh

Administrative Personnel

Adminstrative Officer

1. Shri R. Anil Kumar

Assistant Administrative Officer

1. Smt. Pushpalatha Viswambharan
2. Shri P. Krishna Kumar
3. Shri T. Viswanathan
4. Shri K.B. Sabukuttan

Private Secretary

1. Shri P.K. Reghu
2. Smt. S. Kamalama

Assistant

1. Smt. T. D. Usheem
2. Shri K.K. Sasi
3. Smt. A.R. Kamalam
4. Smt. T.K. Shyma
5. Smt. G.N. Sarada
6. Shri C.K. Sukumaran
7. Smt. V.K. Raji
8. Smt. K. Renuka
9. Shri M.N. Vinodh Kumar
10. Shri K. Das
11. Shri P.K. Somasekharan Nair
12. Smt. G. Surya
13. Smt. Nilina Elais
14. Smt. N.R. Akhila
15. Shri A.P. Kushwaha
16. Smt. Asha Gopalan
17. Smt. A.R. Raji
18. Shri P. Mani
19. Smt. Jaya Das
20. Smt. E. Jyothilakshmy
21. Smt. P.R. Mini
22. Shri T.N. Shaji

Personnel Assistant

1. Smt. N. Leena
2. Shri K.V. Mathai
3. Shri R.D. Goswami
4. Smt. Anitha K. John

Upper Division Clerk

1. Smt. Shiji John
2. Shri P.G. David
3. Shri Santhosh Mohan
4. Smr. K.V. Suseela
5. Shri P. Rajeev

Lower Division Clerk

1. Shri T.D. Bijoy
2. Shri P.P. George
3. Shri Subin George
4. Smt. Suni Surendran
5. Kum K.S. Sobha
8. Kum. T. Deepa
9. Shri G.S. Sahoo

Supporting Personnel

Skilled Support Staff

1. Shri P.A. Sivan

2. Shri G.B. Mahanandia
3. Smt. C.G. Radhamoney
4. Shri E. Damodaran
5. Shri P.V. Raju
6. Shri A.V. Chandrasekharan
7. Shri M.M. Radhakrishnan
8. Shri K.K. Karthikeyan
9. Smt. U.K. Bhanumathy
10. Shri T.K. Rajappan
11. Shri O.P. Radhakrishnan
12. Shri P. Raghavan
13. Shri T.M. Balan
14. Shri V. Deepak Vin
15. Smt. P.T. Mary Vinitha
16. Shri K.R. Rajasaravanan
17. Shri K. Thinakaran
18. Shri P.N. Nikhil Das
19. Shri A. Vinod
20. Shri K.S. Ajith
21. Shri S.N. Dash

Auxiliary Staff

1. Shri M.V. Rajan

Visakhapatnam Research Centre

Scientific Personnel

Principal Scientist

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2. Dr. R. Raghu Prakash

Senior Scientist

1. Dr. U. Sreedhar
3. Dr. B. Madhusudana Rao

Scientist

1. Smt. Arathy Ashok
2. Kum. Jesmi Debbarma
3. Dr. P. Viji

Technical Personnel

Chief Technical Officer

1. Dr. M.S. Kumar

Asst. Chief Technical Officer

1. Shri B.K. Panda
2. Shri K.V.S.S.S.K. Harnath

Senior Technical Officer

1. Shri A.K. Panigrahi

Technical Officer

1. Shri U. Alagumalai
2. Shri Damodar Rout
3. Shri P. Radhakrishna

Senior Technical Assistant

1. Shri H.S. Bag

Technical Assistant

1. Shri M. Prasanna Kumar
2. Shri S.N. Dishri

Technician

1. Shri G. Bhushanam

Administrative Personnel

Assistant Administrative Officer

1. Smt. V.S. Aleyamma

Personnel Assistant

1. Smt. D.A.L. Satyanarayanamma

Assistant

1. Shri L.N. Badi

Lower Division Clerk

2. Shri D.L. Pattanaik
3. Shri Amit Vengraj
4. Shri Ramesh Mirdha

Supporting Personnel

Skilled Support Staff

1. Shri V.V. Ramana
2. Shri Sanyasi Ganik
3. Shri M.S. Prabhakar Rao
4. Smt. Nalla Naveena
5. Smt. Gyana Netri Nag
6. Shri S.K. Mehar

Veraval Research Centre

Scientific Personnel

Scientist

1 Dr. A.K. Jha
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4. Smt. V. Renuka
5. Dr. K.K. Prajith

Technical Personnel

Assistant Chief Technical Officer

1. Shri J.B. Paradwa

Technical Officer

1. Shri K.U. Sheikh

Senior Technical Assistant

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Technical Assistant

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

Technician

1. Shri K. Ajesh
2. Shri J.B. Malmadi
3. Shri Y.D. Kriplani

Administrative Personnel

Assistant Administrative Officer

1. Shri M.M. Damodara

Assistant

1. Shri S.B. Purohit
2. Shri D.P. Parmar

Upper Division Clerk

1. Shri Arockia Shaji

Supporting Personnel

Skilled Support Staff

1. Shri B.M.A. Khokhar
2. Shri K.J. Damor
3. Shri D.K. Viram
4. Shri R.N. Gosai
5. Shri A.M. Vala
6. Shri M.K. Kana
7. Smt. Harshaban A. Joshi
8. Shri N.K. Masani
9. Smt. Motiben K. Fofandi
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3. Dr. A. Jeyakumari

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Assistant Chief Technical Officer

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2. Smt. Triveni G. Adiga

Technical Officer

1. Shri P.S. Gadankush

Senior Technician

1. Shri T.A. Waghmare

Technical Assistant

1. Smt. Priyanka S. Vichare

Administrative Personnel

Assistant

1. Shri A.N. Agawane

Lower Division Clerk

1. Shri Deu Umesh Aroskar

Supporting Personnel

Skilled Support Staff

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2. Shri V.S. Salvi
3. Smt. Priyanka P. Bait

Burla Research Centre

Technical Personnel

Technical Officer

1. Shri Kirtan Kisan

Supporting Personnel

Skilled Support Staff

1. Shri Jaisingh Oram
2. Shri T.N. Banchoor
3. Shri S.K. Mehar

Results-Framework Document (RFD) for ICAR - Central Institute of Fisheries Technology (2013-2014)

SECTION 1:

VISION, MISSION, OBJECTIVES AND FUNCTIONS

VISION

To facilitate sustainable harvesting and total utilization of fishery resources through innovations in harvest and post harvest technologies.

MISSION

Ensure responsible harvesting of fishery resources through eco-friendly, energy efficient and economical means; ensure total utilization of the harvested fish through appropriate processing, value addition, packaging and waste utilization; ensure food safety and nutritional security to the consumer and minimize carbon and water footprint per unit volume; and to ensure equitable benefits to the stakeholders, across the value chain.

OBJECTIVES

- Improvisation of responsible fish harvesting systems
- Development of post harvest technologies
- Transfer of technology and training

FUNCTIONS

- 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 aquatic sources.
- To design innovative implements and machineries for fishing and fish processing and pilot plant for facilitating commercialization of technologies developed.
- To do advanced research in seafood safety and quality.
- To provide training and consultancy services in fishing and fish processing.

SECTION - 2

Inter se Priorities among Key Objectives, Success Indicators and Targets

Sl. No	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target / Criteria Values				
							Excellent	Very Good	Good	Fair	Poor
							100%	90%	80%	70%	60%
1	Improvisation of responsible fish harvesting systems	14	Development of responsible fishing craft/ gear and accessories	Responsible fishing craft/gear and accessories designed and developed	No.	10	4	3	2	1	0
			Identification/evaluation and standardization of Improved craft and gear materials	Alternate materials for fishing craft and gear identified/ evaluated and standardized	No.	4	3	2	1	0	0
2	Development of post-harvest technologies	40	Development of appropriate post-harvest technologies and packaging systems for total utilization & value addition of fishery resources	Protocols for value addition and packaging systems developed/	No.	17	6	5	4	3	2
			Development of suitable technologies for fish waste utilisation and high value byproducts	Products from fish wastes/ processes for fish waste utilization developed	No.	6	4	3	2	1	0

			Development of indigenous processing machinery	Processing machinery developed	No.	2	3	2	1	0	0
			Development of technologies for isolation of bioactive compounds and industrially important products from aquatic sources and nutrient profiling of fishes	Bioactive compounds/ industrially important products identified/nutrient profiling/chemical contaminants done	No.	5	7	6	5	4	3
			Development / implementation of quality and safety system for fish and fishery products	Protocols/concepts/technologies/methods for implementation of quality and safety systems for fish and fishery products	No.	5	8	7	6	5	4
			Assessment of microbial seafood safety hazards and bio-prospecting of aquatic microbial resources	Seafood borne pathogens characterized / Biomolecules prospected from microbial sources/ Protocols/ technologies/ methods for diagnostics/ bio-catalyst production	No.	5	5	4	3	2	1
3.	Transfer of technology and training	35	Extension and HRD programmes for stakeholders in fisheries sector	Training in Harvest and post-harvest technologies & Skill upgradation programmes conducted	No.	15	160	150	140	130	120
				Exhibitions participated	No.	5	20	15	10	8	7
			Consultancy services / Commercialization of products and processes	Analytical and advisory support to the industry	No.	8	1000	800	700	600	500
				Technical guidance / Consultancy	No.	7	10	9	8	7	6

				services provided							
	Efficient Functioning of the RFD System	11	Timely submission draft RFD (2013-14) for approval	On-time submission	Date	2	15/05/2013	16/05/2013	17/05/2013	20/05/2013	21/05/2013
			Timely submission of Results for RFD (2012-13)	On-time submission	Date	1	01/05/2013	02/05/2013	05/05/2013	06/05/2013	07/05/2013
	Administrative Reforms		Implement ISO 9001 as per the approved action plan	% Implementation	%	2	100	95	90	85	80
			Prepare an action plan for Innovation	On-time submission	Date	2	30/07/2013	10/08/2013	20/08/2013	30/08/2013	10/09/2013
	Improving internal efficiency/ responsiveness / service delivery of Ministry / department		Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	2	100	95	90	85	80
				Independent Audit of Implementation of Public Grievance Redressal System	%	2	100	95	90	85	80

SECTION – 3

Trend Values of the Success Indicators

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual Value for FY 11-12	Actual Value for FY 12-13	Target Value for FY 13-14	Projected Value for FY 14-15	Projected Value for FY 15-16
1.	Improvisation of responsible fish harvesting systems	Development of responsible fishing craft/ gear and accessories	Responsible fishing craft/gear and accessories designed and developed	No.	7	2	3	3	3
		Identification/evaluation and standardization of Improved craft and gear materials	Alternate materials for fishing craft and gear identified/ evaluated and standardized	No.	3	1	2	2	2
2.	Development of post-harvest technologies	Development of appropriate post-harvest technologies and packaging systems for total utilization & value addition of fishery resources	Protocols for value addition and packaging systems developed/	No.	7	5	5	6	6
		Development of suitable technologies for fish waste utilisation and high value byproducts	Products from fish wastes/ processes for fish waste utilization developed	No.	3	2	3	4	4
		Development of indigenous processing machinery	Processing machinery developed	No.	4	1	2	2	2
		Development of technologies for isolation of bioactive compounds and	Bioactive compounds/ industrially important products identified/nutrient	No.	27	6	6	7	8

		industrially important products from aquatic sources and nutrient profiling of fishes	profiling/chemical contaminants done						
		Development / implementation of quality and safety system for fish and fishery products	Protocols/concepts/technologies/methods for implementation of quality and safety systems for fish and fishery products	No.	4	2	7	8	8
		Assessment of microbial seafood safety hazards and bio-prospecting of aquatic microbial resources	Seafood borne pathogens characterized / Biomolecules prospected from microbial sources/ Protocols/ technologies/ methods for diagnostics/ bio-catalyst production	No.	5	7	4	5	5
3.	Transfer of technology and training	Extension and HRD programmes for stakeholders in fisheries sector	Training in Harvest and post-harvest technologies & Skill upgradation programmes conducted	No.	498	425	150	150	150
			Exhibitions participated		33	15	15	16	17
		Consultancy services / Commercialization of products and processes	Analytical and advisory support to the industry	No.	712	750	800	810	820
			Technical guidance / Consultancy services provided	No.	12	7	9	10	11
	Efficient Functioning of the RFD System	Timely submission of draft RFD (2013-14) for approval	On-time submission	Date			16/05/2013		
		Timely submission of Results for RFD (2012-13)	On-time submission	Date			02/05/2013		

	Administrative Reforms	Implement ISO 9001 as per the approved action plan	% Implementation	%			95		
		Prepare an action plan for Innovation	On- time submission	Date			10/08/2013		
	Improving internal efficiency/ responsiveness / service delivery of Ministry / department	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%			95		
			Independent Audit of Implementation of Public Grievance Redressal System	%			95		

SECTION – 4 : ACRONYMS

Sl. No	Acronym	Description
1	UTM	Universal Testing Machine
2	HRD	Human Resource Development
3	NFDB	National Fisheries Development Board
4	MPEDA	Marine Product Export Development Authority
5	EIA	Export Inspection Agency
6	UTs	Union Territories
7	NGOs	Non-Governmental Organizations
8	NABL	National Accreditation Board for Testing and Calibration Laboratories
9	IDP	Inter-Departmental Panel

Section 4 : Description and Definition of Success Indicators and Proposed Measurement Methodology

Sl. No	Success Indicators	Descriptions	Definitions	Measurement	General Comments
1.	Responsible fishing craft/gear and accessories designed and developed	Responsible fishing craft /gear and accessories for sustainable harvesting of fishery resources will be designed and developed through comparative fishing experiments based on fish behaviour and distribution and measurement will be in terms of number of designs developed / fabricated and field tested.	Materials identified, evaluated and standardized and also the prototypes constructed for field operations.	Number	Nil
2.	Alternate materials for fishing craft and gear identified/ evaluated and standardized	Comparative evaluation of alternate material for craft and gear will be done using Universal Testing Machine (UTM) and accelerated weather testing equipment; corrosion evaluation will be done using salt spray chamber and corrosion measurement system	Materials identified, evaluated and standardized and also the prototypes constructed for field operations.	Number	Nil
3.	Protocols for value addition and packaging systems developed/	Value added products and improved packaging materials and systems will be identified / developed, will be measured in terms of number of products/processes developed and packaging materials and systems identified/developed.	Value added products and packaging materials	Number	Nil
4.	Products from fish wastes/ processes for fish waste utilization developed	Products from fish / fish waste / processes for fish water utilization will be measured in terms of number of products/processes developed	Valued added products and processes for fish waste utilization	Number	Nil
5.	Processing machinery developed	design and development of processing machinery / solar dryer and instrumentation system will be measured in terms of number of machinery	Design and development of machinery /solar dryer and instrumentation	Number	Nil

		developed/ dryers/ instrumentation			
6.	Bioactive compounds/ industrially important products identified/nutrient profiling/chemical contaminants done	Bioactive compounds for nutraceuticals or industrial significance	Bio active compounds synthesized	Number	Nil
7.	Protocols/concepts/technologies/methods for implementation of quality and safety systems for fish and fishery products	Quality and safety system for fish and fishery products, will be measured in terms of number of systems developed or implemented for seafood quality and safety.	Quality systems characterized	Number	Nil
8.	Seafood borne pathogens characterized / Biomolecules prospected from microbial sources/ Protocols/ technologies/ methods for diagnostics/ bio-catalyst production	Characterization of pathogens; success indicator will be in terms of number of species from different sources characterized. Characterization of pathogens will be done using standard microbiological and molecular biology procedures and success indicator of bio-prospecting from microbial sources will be in terms of number of bacteria characterized for production of biomolecules.	Pathogens characterized	Number	Nil
9.	Training in Harvest and post-harvest technologies & Skill upgradation programmes conducted	HRD programmes for different stakeholders will be measured in terms of number participations.	Training and awareness programmes	Number	Nil
10.	Exhibitions participated	Participations in exhibitions will be measured in terms of number of participations.	Participations in exhibitions	Number	Nil

11.	Analytical and advisory support to the industry	NABL accredited laboratories for conducting analytical tests and advisory support by conducting IDP visits	Analytical tests carried out	Number	Nil
12.	Technical guidance / Consultancy services provided	Technical guidance and consultancy services	Technical guidence and consultancy serrvices carried out.	Number	Nil

SECTION – 5 : Specific Performance Requirements from other Departments/ Organizations

Location	State	Organization Type	Organization Name	Relevant success indicators	What is your requirement from organization	Justification for this requirement	Please quantify your requirements from this organization	What happens if your requirement is not met
Within the country	Maritime states and UTs	State & Cooperatives	Directorate of Fisheries of State Governments and UTs Fishermen cooperatives	Responsible fishing craft/gear and accessories designed and developed	Facility for field trials	Field trial testing	As and when required	Technology development process delayed
				Alternate materials for fishing craft and gear identified/ evaluated and standardized	Facility for field trials	Field trial testing	As and when required	Technology development process delayed
	All states	State & Private entrepreneurs	Department of dairying & fisheries NFDB	Protocols for value addition and packaging systems developed/	Testing and Commercialization of the product	Commercialization/ adoption of technologies	As and when required	Technology development process delayed
				Products from fish wastes/ processes for	Testing and	Commercialization/	As and when	Technology

			MPEDA EIA NGOs Fishermen cooperatives	fish waste utilization developed	Commercialization of the product	adoption of technologies	required	development process delayed
				Processing machinery developed	Testing and Commercialization of the product	Commercialization/ adoption of technologies	As and when required	Technology development process delayed
				Bioactive compounds/ industrially important products identified/nutrient profiling/chemical contaminants done	Testing and Commercialization of the product	Commercialization/ adoption of technologies	As and when required	Technology development process delayed
	All states	Sea food industry	Department of dairying & fisheries NFDB MPEDA EIA NGOs	Protocols/concepts/technologies/methods for implementation of quality and safety systems for fish and fishery products	Facility for testing of protocols	To demonstrate the quality and safety	As and when required	Standardisation processes delayed
				Seafood borne pathogens characterized / Biomolecules prospected from microbial sources/ Protocols/ technologies/ methods for diagnostics/ bio-catalyst production	Validation and standardization	To demonstrate the quality and safety	As and when required	Standardisation processes delayed
	All states	Central State Private Cooperatives Entrepreneurs	Individuals and organisations	Training in Harvest and post-harvest technologies & Skill upgradation programmes conducted	Request for training	For Capacity building	As and when required	-
				Exhibitions participated	Extension of technologies developed		As and when required	-
				Analytical and advisory support to the industry	Provision of services - clients		As and when required	Revenue generation
				Technical guidance / Consultancy services provided	Provision of services - clients		As and when required	Revenue generation

SECTION – 6
Outcome / Impact of activities of the Organization

Sl. No.	Outcome / Impact of the organization	Jointly responsible for influencing this outcome / impact with the following Deptts & Ministries	Success indicators	Unit	2011-12	2012-13	2013-14	2014-15	2015-16
1	Saving in maintenance cost of craft and gear for fishermen	Fisheries department Stake holders	Responsible fishing craft/gear and accessories designed and developed	No.	7	2	3	3	3
2	Additional e employment and income in the fish processing sector	Private Industries	Value added products from fish / fish waste	No.	10	7	8	10	10
3	Trained manpower through HRD programmes	Other organizations	HRD programmes conducted	No.	498	425	150	150	150