



2016 to
2017

ICAR-CIFT

RESEARCH **HIGHLIGHTS**



ICAR-Central Institute of Fisheries Technology
CIFT Junction, Matsyapuri P.O., Kochi - 682 029



Research **Highlights** 2016-2017



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Printers : **Print Express, Kaloor, Cochin -17**

December, 2017



Preface



Every year at this time, it is with amazement that we look back at what was accomplished in 365 days. The Research Highlights tries to single out those happenings from April 2016 to March 2017 that are truly noteworthy. It is more than just a catalog of events, though; it is an exploration of the phenomenal occurrences-both high-profile and subtle-that comprise a project. Here are just a few memorable entries: Commissioning of 'Sagar Harita', a 19.75 m energy efficient green fishing vessel, design of a four equal panel, 30 m semi pelagic trawl for capture of off-bottom fish and 28 m four seam for specifically targeting anchovies, optimizing processing conditions for preparing

brown seaweed (*Sargassum wightii*)-incorporated extruded snack, development of fish-based nutritional bar with shelf life of three months in normal conditions and functional fish sausages with enhanced omega-3 fatty acids, characterization of pilot scale production of water-soluble chitosan, optimization of thermal process conditions for ready to eat ethnic products in different containers, validation of cold-fill process of fish pickles developed as per 21 CFR 114 USFDA regulation and optimization of cold holding period for five variety of commercial fish pickles, development of a multiple barrier process involving treatment with liquid smoke, modified atmosphere packaging followed by chilling for preservation of fishery products, development of a specific and sensitive HPLC-based standard operating procedure for quantification of sodium benzoate in fresh fish, development of pictorial guidelines for sensory grading of 33 varieties of finfish and shellfish species for export to European Union and isolation of a new clone of MRSA, 115669-ST, from seafood, ice and water.

Standardization of genes encoding the resistance for ESBL producing Enterobacteriaceae in seafood, elucidation of mechanisms involved in the lipid lowering effect of PUFA-rich sardine oil using RNA expression studies, demonstration of anti-ulcerogenic effect of maltodextrin-encapsulated squalene, development of a co-delivery system of betalain and PUFA by multiple emulsification and microencapsulation by spray drying, development of two seaweed-based products viz., Seaweed incorporated juice-NutriDrink, and Seaweed-enriched soup powder, development of calcium and iron-fortified fish soup powder and testing among adolescent girls in West Jaintia Hills District, Meghalaya, performance evaluation study of ICAR-CIFT solar dryers for various fishes, design of a multi-purpose solar thermal conversion system with biomass water heater backup, design of a portable household electrical dryer, survey on fish arrivals in three selected fish markets and studies on length of market chain.

With utmost pride and satisfaction in this Diamond Jubilee Year I present before you a gist of the major research achievements of ICAR-Central Institute of Fisheries Technology.

(Dr. C.N. Ravishankar)
Director

Kochi
20 December, 2017



Fishing Technology

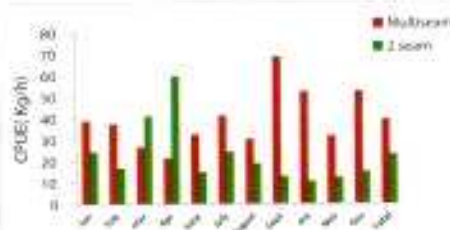
■ 'Sagar Harita', a 19.75 m energy efficient green fishing vessel designed by ICAR-CIFT was commissioned.

■ The catch efficiency of a modified trap with dimensions of 1×0.6×0.6 m was determined as 1.05 kg and 1.02 kg respectively for crabs and Pearlsplit (*Etroplus suratensis*).



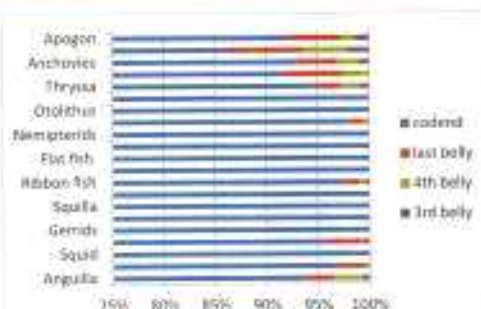
Modified collapsible trap for capture of Pearlsplit

■ Multi-seam trawl caught significantly higher catches with a CPUE of 40 kg/h compared to the two seam trawl (23 kg/h) operated along Visakhapatnam coast.



Monthly variation in the CPUE of the multi-seam and two seam trawls

■ Rainbow sardines and lesser sardines together constituting 80% were the major species that escaped from the 60mm square mesh panels attached to 30m off-bottom trawl operated along Visakhapatnam coast.



Fish escapement and retention (%) from different panels

■ The L_{50} value for *Johnius dussumieri* in 40 mm diamond mesh codend was 7.51 cm and the selection range was 3.4 cm (6.70 cm – 8.45 cm).

■ The L_{50} values for *Parapenaeopsis stylifera* were 95 and 105 mm respectively in the 22 and 25 mm spacing squilla exclusion grids. The L_{50} values for *Metapenaeus monoceros* were 113, 128 and 129 mm, respectively for 22, 25 and 30 mm spacing.

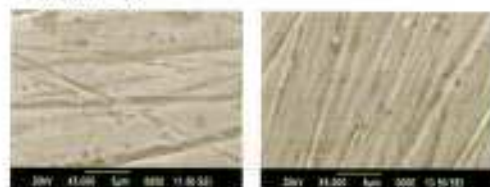
■ Comparative analysis of the use of diamond and square mesh codends along Sindhudurg coast (Maharashtra) showed that the mean length of 12 out of the 15 commercially important species increased by 7.85%. The rate of escapement from the square mesh codends was 0.76 kg per hour, which is 3.9% of the total catch retained (2142.4 kg).

■ Surface modification of boat building steel was done using nano iron oxide, titanium oxide, cerium oxide mixtures in different combinations. The results showed that the combination of 0.005:0.01:0.005% of Fe_2O_3 : CeO_2 : TiO_2 has good corrosion resistance property.



Untreated Treated
Atomic Force Micrographs of untreated and nano Fe_2O_3 , TiO_2 and CeO_2 treated steel

■ The boat building steel surface was modified with nano zinc oxide, titanium oxide, cerium oxide in varied concentrations and the results showed that the ratio of 0.01:0.01:0.005% Fe_2O_3 : CeO_2 : TiO_2 has excellent corrosion resistance.



Z0 Z6
SEM images of control and ZTC treated boat building steel

■ HDPE aquaculture cagenet surface was modified using: 1) Polyaniline and nano copper oxide, 2) Polyaniline nano copper oxide, titanium dioxide, and 3) Polyaniline zinc oxide, titanium oxide, copper oxide mixtures. All the three

treatments exhibited excellent biofouling resistance even after 90 days of exposure in the estuary.



Control PANI treated
SEM images of control and PANI treated webbing

■ CDOM source in the coastal waters during monsoon was from the estuary and during post-monsoon, the main source of CDOM was the decomposed organic matter of coastal origin.

■ Designed a four equal panel, 30 m semi pelagic trawl for capture of off-bottom fish and 28 m four seam for specifically targeting anchovies,

■ High catches of yellowfin tuna were recorded in the areas where Monthly Mean Mixed Layer Depth (MMLD) ranged between 35 m to 47 m. Hooking rate studies of long line catches suggests that the best fishing season for yellowfin tuna is between December to February in east coast of India.

Fish Processing

■ Batter formulations with carboxy methyl cellulose and hydroxy propyl methyl cellulose significantly reduced the oil uptake in deep fried fish fingers.

■ Processing conditions for preparing brown seaweed (*Sargassum wightii*) - incorporated extruded snack was optimized.

■ Fish-based nutrition bar with shelf life of three months in normal conditions was developed.



Sargassum-enriched coated extruded snack



Fish-based nutritional bar

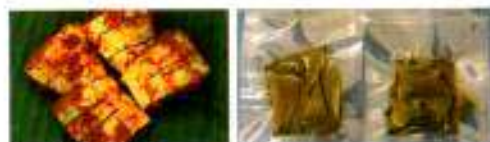


- Functional fish sausages with enhanced omega-3 fatty acid content were developed.



Tuna-Sardine combination sausages (1:0, 1:1, 2:1 ratio)

- Optimized thermal process conditions for ready to eat ethnic products ('Ah-eemo') in different containers.



Marinated Ah-eemo Ah-eemo in retort pouch



Retort cooked Ah-eemo

- Pilot scale production of water-soluble chitosan was optimized and its properties were characterized.



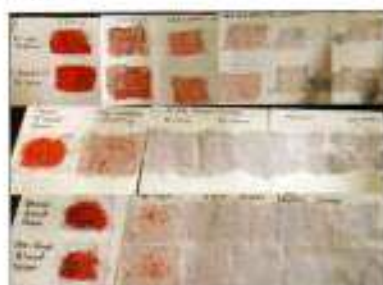
Preparation of water-soluble chitosan

- Developed osmo-dehydration protocol for drying small sized shrimp.
- Pangasius fish sausage fortified with

up to 3% of dietary fibre from *Gracilaria edulis* and *S. wightii* gave better consumer acceptability.

- Incorporation of squilla protein hydrolysate significantly reduced the oil absorption and lipid oxidation in deep-fried fish cutlets.

- Crude visceral proteases extracted from little tuna (*Euthynnus affinis*) viscera was found to be effective as blood destainer.



Tuna visceral protease as blood destainer

- Bombay duck protein isolate was prepared from mince by isoelectric solubilization. Nutritional, physical and functional properties of isolate were determined and restructured products with good gel properties were prepared.



Bombay duck mince

Protein isolate



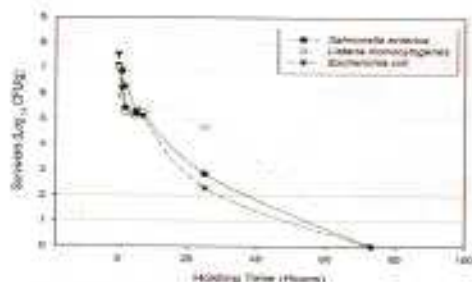
Restructured product



Quality Assurance and Management

■ Organochlorine pesticides like δ -BHC and endrin were detected at higher than prescribed levels in water of shrimp farms.

■ Validation of cold-fill process of fish pickles was developed as per 21 CFR 114 USFDA regulation and cold holding period for five variety of commercial fish pickles were optimized.



The survival of *S. enterica*, *L. monocytogenes* and *E. coli* O157:H7 strains in acidified dry shark pickles

■ A multiple barrier process involving treatment with liquid smoke modified atmosphere packaging followed by chilling was developed for preservation of fishery products.

■ Based on complete inhibition of *Pseudomonas* and *Brochothrix thermosphacta*, gallic acid-grafted chitosan was found to be a potential additive in shelf life extension of fishery products.

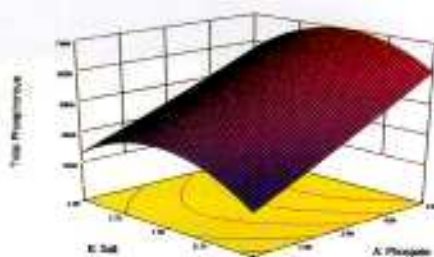
■ A multiple emulsion, using chitosan, whey protein isolate, green tea extract and Bay leaf essential oil was found to enhance the storage life of chilled tuna chunks.

■ Application of high pressure (200 MPa and 400 MPa; holding time of 5 min.) could effectively eliminate the contaminating *E. coli* population in non-depurated clam (*Villorita cyprinoides*) to non-detectable levels.

■ Simulation studies on enterotoxin production by *Staphylococcus* in sun-dried white sardine indicated initiation of enterotoxin production after 6 h of drying, when *S. aureus* level reached 10^6 cfu/g, water activity 0.968 and moisture content 54.79%.

■ A prior dip in propionic acid at 1% level prevents formation of Staphylococcal enterotoxin during sun-drying.

■ Maximum allowable phosphate uptake takes place in shrimp with 1.65% STPP treatment containing 0.15% salt, tissue to treatment solution ratio of 1:3 and soaking period of 7 h.



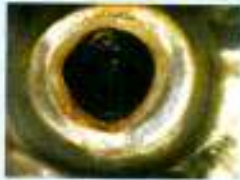





Response surface plot showing effect of phosphate treatment of shrimp

■ A specific and sensitive HPLC-based standard operating procedure was developed for quantification of sodium benzoate in fresh fish.



- Incidence of Ciguatoxin was observed in *Lutjanus bohar* landed along south west coast of India.
- Pictorial guidelines for sensory grading of 33 varieties of finfish and shellfish species for export to EU was developed.

Pictorial guideline for *Mugil cephalus* (Flathead grey mullet)

	E - (1 st Day)	A - (2 nd Day)	B - (4 th Day)
Eyes	Convex, bright black pupil, clear silvery cornea 	Convex, black pupil, clear cornea without silvery shine 	Sunken, completely cloudy, ingression of blood in the cornea 
Gill	Dark red, gill rakers visible 	Dark red, gill rakers visible 	Bleaching of gill with dark brown end 

Microbiology, Fermentation and Biotechnology

■ *Salmonella* was prevalent in 41.1% of the 95 seafood samples collected from markets in and around Kochi.

■ *V. cholerae* O1 Ogawa strains were isolated from well water of areas affected with cholera outbreak in Palakkad, Kerala.

■ All MRSA isolates exhibited multi-drug resistance for three or more classes of antibiotics and 81.5% of the isolates of MRSA were enterotoxigenic.



Multi-drug resistance of MRSA.



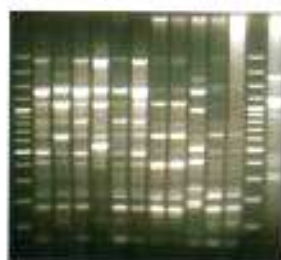
■ A new clone of MRSA, t15669-ST, was isolated from seafood, ice and water.

■ Two Actinomycetes isolates out of 55 strains screened were found to have antibacterial activity against MRSA and identified as *Streptomyces* spp. and *Lysinibacillus* spp.



Antibacterial activity of *Streptomyces* spp. against MRSA

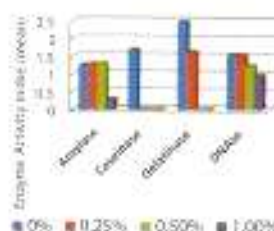
■ Extensive genetic heterogeneity (55% to 100% similarity) was observed in *V. parahaemolyticus* isolated from marine fish by ERIC PCR.



ERIC PCR for determining heterogeneity of *V. parahaemolyticus* isolated from fish

■ Thyme oil was found to inhibit amylase, caseinase, gelatinase and DNase activity of *V. parahaemolyticus* and *V. cholerae* isolates at different concentrations.

■ Bacteria from plastic dumping sites were able to reduce the weight of PVC by 43%.



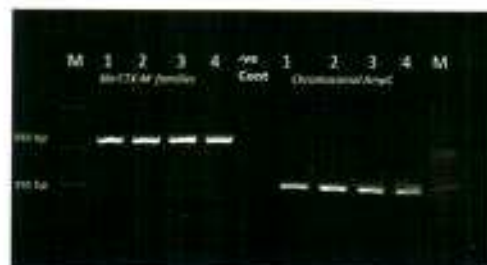
Effect of thyme oil on enzyme activity of *V. parahaemolyticus*

■ The LD₅₀ value of 15 strains of *A. hydrophila* and nine strains each of *A. jandaai* and *A. veronii* isolated from farms with disease outbreak ranged between 10⁶-10⁹, 10⁷ and 10⁴-10⁵, respectively in rohu fingerlings.

■ Crude enzyme preparations of *P. elgii* was found to be effective as biocontrol agent for the control of fungal infestation in dried fish.

■ *Vibrio parahaemolyticus* isolates from marine fish caught from the east coast showed varying levels of genetic heterogeneity (55% to 100% similarity). Majority of the *V. parahaemolyticus* isolates clustered at 80% similarity level.

■ Multiplex Polymerase Chain Reaction (PCR) assay was standardized for the genes encoding the resistance for ESBL producing Enterobacteriaceae in seafood and their antimicrobial resistance pattern in seafood was assessed.



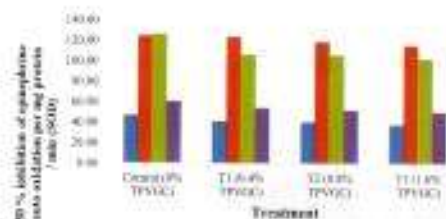
PCR amplification of ESBL producing *E. coli*



Biochemistry and Nutrition

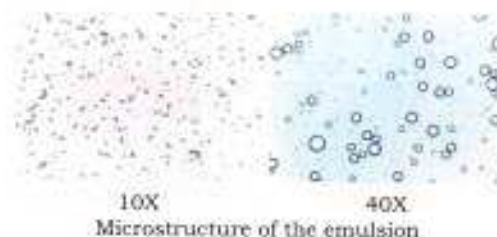
■ Fish oil rich in poly unsaturated fatty acid (PUFA) supplementation affect the mRNA and protein expression of enzymes of lipid metabolism. Mechanisms involved in the lipid lowering effect of PUFA-rich sardine oil were elucidated using RNA expression studies, western blotting and proteomic approaches.

■ Thiamine-pyridoxine-vanillic acid-grafted chitosan showed stress mitigatory effect in stress-induced rats.



Impact of dietary supplementation of TPVGC on SOD activity in muscle, liver, kidney and brain tissue of male albino rats exposed to swimming stress

■ Microencapsulation of squalene with maltodextrin and whey protein isolate gave an encapsulation efficiency of 96% and oxidative stability of more than four months. Anti-ulcerogenic effect of maltodextrin-encapsulated squalene was demonstrated.



10X 40X
Microstructure of the emulsion

■ Chitosan-whey protein-encapsulated squalene was proved to be as good as gum Arabic for encapsulation of squalene. Cakes fortified with squalene microencapsulated with chitosan-whey protein complex had superior oxidative stability and textural quality.

■ Developed a co-delivery system of betalain and PUFA by multiple emulsification and microencapsulation by spray drying.



Emulsion microstructure of water in oil in water (W/O/W) emulsion

■ Supercritical fluid extraction of fucoxanthin and lipid from brown seaweed *Sargassum* sp. was attempted. Two seaweed-based products viz., Seaweed incorporated Juice-NutriDrink, and Seaweed-enriched fish soup powder were developed.

■ Calcium and iron-fortified fish soup powder developed was tested among adolescent girls in West Jaintia Hills District, Meghalaya. The intervention resulted in a rise in hemoglobin levels in 96% of the subjects involved.



Fortified fish soup

■ The moisture, protein and fat content of hepatopancreas of *Litopenaeus vannamei* were 32.00%, 23.75% and 41.88%, respectively. Oleic (31%) and linoleic (25%) were the predominant fatty acids while lysine (20%) and glutamic acid (16%) were the main amino acids.

■ Absorption spectra of acetone extract of *Ulva lactuca* revealed two peaks at 425 nm and 660 nm corresponding to chlorophyll *a* and showed antibacterial

*Ulva lactuca* seaweed

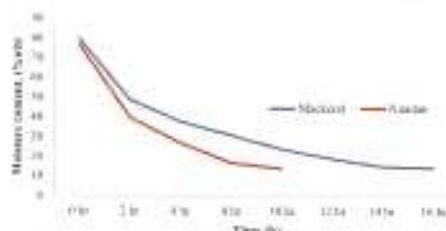
activity towards *E. coli* and *V. cholerae*.

■ DHA-fortified nutritional supplement was found in acceptable condition even after one year shelf life storage.

■ Nutritional profiling of cage-farmed grouper fed with different feed fishes indicated *Decapterus russelli* as the best feed for enhancing meat quality.

Engineering

■ Performance evaluation study of ICAR-CIFT solar dryers was conducted for various fishes (mackerel, sardine, nandan and solefish).



Drying curve of mackerel and nandan in solar cabinet dryer

■ A multi-purpose (fish drying, water heating and electricity generation) solar thermal conversion system with biomass water heater backup was designed and fabrication work is in progress.

■ Redesigning of the existing ICAR-CIFT solar-LPG hybrid dryer has been completed.

■ Preliminary trials were conducted for the development of fish freshness sensor by measuring colour of fish eye, flesh, skin and gill over one week storage



period, and corresponding TMA and TVN values of fish flesh were also measured.

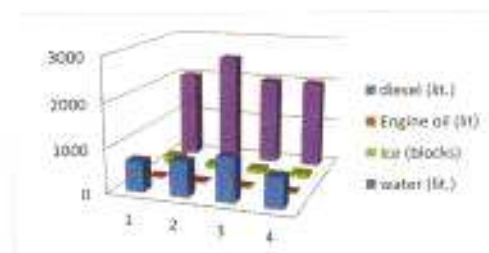
■ A new portable household electrical dryer of 10 kg capacity was designed and fabricated. Initial testing has been completed and the dryer can be used for household or micro scale drying of fish and fishery products with lower capital investment. Also, provision for supplemental heating by solar power was incorporated in the design.



Portable household electrical dryer

Extension, Information and Statistics

■ Economic input indicators of trawl fishery in Ernakulam showed that average operational cost during a fishing trip is: Operational costs including cost of diesel - ₹ 42,117.50/-, Engine oil - ₹ 525/-, Ice - ₹ 7000/-, Ration - ₹ 5000/- and Repair and maintenance - ₹ 1000/-. The crew's share amounted to 40% of the owners' revenue. The trip-wise income from trawl fishing ranged from ₹ 17,750/- to ₹ 70,800/-.



Input indicators - Quantitative aspects (trip-based)

■ Fish supply chain for three selected fish markets in Ernakulam revealed that the fish arrivals to these markets were from outside Kerala (Tamil Nadu, Andhra

Pradesh, Odisha and Gujarat) besides local harbours and landing centres. The length of market chain is diverse ranging from 10 km to 60 km.

■ The body mass index (BMI) status of the fisher respondents was compared using the WHO classification. The results showed that majority of adults were in the healthy weight group (64.71%). Among the respondents studied, 56% males and 73% females were falling in the healthy weight category. This also revealed that the gaps between healthy weight and obese were very narrow in males than in females.

■ Fishermen perception on fishing capacity utilization at Puthiyappa, Kozhikode revealed that most important dimension is 'Increasing fishing pressure and cost'. It is followed by their concern about resource depletion and need for conservation. The same study at Kollam



showed that the perception towards community participation in management was the most preferred among the five factors regulating the community resources, with a mean ranking score (MRS) of 4.83 followed by community sea rights (MRS-4.67) and inter-intra conflicts between different fish stakeholders with MRS of 4.60.

■ The major impact indicators of Fishermen Co-operative Societies as perceived by the fishermen on various activities were compared for Kerala and Tamil Nadu. In Kerala, activities undertaken by Fishermen Co-operative Societies had impacted on access to institutions (85.79%), production (76.70%), profit (73.26%), management (62.48%) and livelihood (52.91%). In Tamil Nadu, the figures were lesser in comparison to Kerala ranging from 53.82% for management to a low of 35.87% on livelihoods. The impacts were classified as high, moderate and low for various parameters.

■ The inter-temporal energy consumption of seafood processing units showed a fluctuating trend over the period of 2009-2017. The average estimated monthly energy consumption and the cost was 127987.30 Kwh units and ₹ 7,93,869.20, respectively. Short

term energy forecasting of seafood processing plants was estimated using ARIMA (0,0,0) which showed a significant estimated value and standard deviation of 0.073.

■ Completed documentation of all the S&T outputs of ICAR-CIFT (768 technologies), including all new/improved technology products and processes consultancies and policy inputs. Assessed the technology transfer status of technologies and 43 were selected for impact assessment.

■ Studied the modes of technology transfer of each of the S&T outputs for the past 20 years and categories were made. Completed profiling of technologies, based on their expected impact in field, mode of dissemination, intended beneficiary and nature of technology.

■ Indicators of three types, technological, economic and social are finalized for assessing the impact of S&T outputs separately based on information gathered from concerned scientists and secondary information for developing impact assessment tool.

■ Assessment tools are prepared separately for different categories of S&T outputs.



“

Science is a beautiful gift to humanity;
we should not distort it.

-A. P. J. Abdul Kalam

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एक कदम विद्यया की ओर



जो कदम, जो पद
विज्ञानों के समुद्रों
में ही पद अमृतमश्नुते

Aquaculture with a human touch



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