



BOOK OF ABSTRACTS

NATIONAL TECHNICAL WORKSHOP
INDIAN PERSPECTIVE ON FOOD SAFETY
SECURITY AND STANDARDS

7 - 8 JUNE 2023



ICAR-Central Institute of Fisheries Technology
Cochin, Kerala, India



Organizers



ICAR-Central Institute of Fisheries Technology,
Cochin.



Society of Fisheries Technologists (India), Cochin,
Kerala.



Food Safety and Standards Authority of India.



India Section of AOAC International

Book of Abstracts



National Technical Workshop
On
**INDIAN PERSPECTIVE ON FOOD SAFETY,
SECURITY AND STANDARDS**

7 & 8 June, 2023

Jointly Organized by
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MESSAGE

Quality of food plays a significant role in the development of healthy life and its safety remains utmost importance in the food production system. Today, lot of concern has been raised globally by consumers on different food safety related issues. Food contamination in the food chain is happening on regular basis and proper identification of hazards associated with the food production systems is the need of the hour as hazards may be introduced at any stage. Food-borne outbreaks have been occurring due to the consumption of contaminated food. Frequent outbreaks have been reported which are caused by different human pathogenic bacteria such as *Salmonella*, *Vibrio parahaemolyticus*, *E. coli* O157:H7 and *Listeria monocytogenes* etc. Apart from this contamination is also happening due to the adulteration of food with different chemical substances and also due to residues of pesticides, antibiotics and accumulation of heavy metals as a result of increase in pollution. Proper identification of these contaminants in food is required for mitigating the risks raised due to the emerging contaminants in foods and thereby improving its quality and safety to consumers.

ICAR-Central Institute of Fisheries Technology (CIFT) being a premier government organization has been continuously working on the quality and safety of fish and fishery products since its inception. In India, ICAR-CIFT is involved in the formulation of several international and national standards pertaining to the quality and safety of fish and fishery products. Apart from this, ICAR-CIFT is the driving force for setting the standards for packaged drinking water in India. A significant achievement in the ICAR-CIFT's relation to the seafood processing sector has been associated with the introduction and implementation of Hazard Analysis and Critical Control Point (HACCP) based quality assurance system in the processing industries throughout the nation. In collaboration with Food Safety Standards Authority of India (FSSAI), ICAR-CIFT is working to set standards for the quality of Fish and Fish products and its consumption domestically. Based on the pioneering work carried out by this institute, FSSAI recognised ICAR-CIFT as the National Referral Laboratory as well as National Reference Laboratory for fish and fishery products. ICAR-CIFT has extended its support to FSSAI in formulation of development of food safety standards, food testing protocols and development of code of practise.

World Health Organization celebrates World food safety day with the theme "Food Standards Saves Lives" on 7th June, 2023 In this context, I am happy to note that ICAR-CIFT, SOFTI, FSSAI and India Section of AOAC International have joined hands to come together in organizing a two day national technical workshop on "Indian Perspective on Food Safety, Security and Standards" on 7th and 8th June, 2023 at ICAR-CIFT, Cochin I hybrid mode. In this workshop experts from the domains of food preservation, food fortification, and value addition, novel foods and nutraceuticals, food safety, standards, and risk assessment are invited to deliver lead lectures and industry application oriented lectures. My hearty welcome to all the delegates' especially young researchers, students and scholars from different parts of the country. I wish Dr. Femeena Hassan, Head, Quality Assessment and Management Division & Organizing secretary and her whole team of scientists, technical personnel, scholars, students, members of different committee's administrative staff and the whole team of SOFTI, FSSAI and India Section of AOAC International in the smooth and successful conduct of National Technical Workshop

Date: 01.06.2023

Place: Cochin, Kerala, India

Dr. George Ninan
Director, ICAR-CIFT
& President SOFTI

PREFACE

Food safety is a global concern due to its direct effect on human's health. Fish and fishery products constitute a significant component of human diet. Contribution of fish and other aquatic products in the average animal protein consumed worldwide is around 15 percent. Fish and other seafood in daily diet is a smart choice for health-conscious consumers. There are proven health benefits of consumption of aquatic products that out-weigh risks. Though fish provide many health benefits, seafood can be compromised by different chemical and biological contaminants which are harmful to consumers, if they are harvested from waters contaminated with industrial chemicals, heavy metals, pesticides antibiotics residues and different human health hazard bacterial pathogens. These contaminants may accumulate in fish at levels that are harmful for human health (e.g. carcinogenic and mutagenic effects). Food can become contaminated with contaminants at any point during production, distribution and preparation. Everyone along the production chain, from producer to consumer, has a role to ensure the safety of seafood. The seafood may get contaminated with various pathogenic bacteria due to unhygienic handling practices, cross contamination of raw foods with cooked or ready-to eat foods, and lack of proper time - temperature control. Bacterial and viral pathogens including parasites which occur naturally are the primary food safety concern with regard to seafood. The vital tools commonly used to define the requirements for an effective Food Safety Management System are ISO 22000 and HACCP (Hazard Analysis and Critical Control Points). These are the basis for Food Safety principles defined by Codex Alimentarius Commission of World Health Organization. HACCP is an internationally recognized risk management tool, which is proactive in nature, while ISO 22000 is a complete food safety management system, enabling continual improvement of performance. The National Technical Workshop on "Indian Perspective on Food Safety, Security and Standards" is organised at ICAR-CIFT, Cochin on June 7th and 8th, 2023 on occasion of world food safety day. The workshop is jointly organised in collaboration with SOFTI, FSSAI and India Section of AOAC International. It is an attempt to give a clear picture to the participants specifically on the aspects of food preservation, food fortification, and value addition, novel foods and nutraceuticals, food safety, standards, and risk assessment. We would like to thank industry persons for their generous contribution and arranging of funds to conduct this workshop. We acknowledge the entire resource persons for immensely contributing for delivering special invited talks on different aspects of food safety, security and standards. In fact the entire abstract book was prepared well advance of organizing the workshop and without the support of all technical committee members it would not have been possible. I would convey my sincere thanks to all the members of different committees constituted for smooth conduct of this workshop. Finally, I would like to acknowledge Dr. George Ninan, Director, ICAR-CIFT & SOFTI President, for all the support, guidance and encouragement given for the conduct of the National Technical Workshop. On behalf of Director & President SOFTI, ICAR-CIFT, and staff of QAM Division, I extend a warm welcome to all the delegates of National Technical Workshop on "Indian Perspective on Food Safety, Security and Standards"



Dr. Femeena Hassan

**HoD (I/c), QAM Division, ICAR-CIFT
& Organizing secretary**

Date: 01.06.2023

Place: Cochin

CONTENTS

S. No.	Abstract Title	Code	Page No.
Technical Session I : Food preservation, fortification, and value addition			1
1.	Development of quick dried soup powder from skipjack tuna (<i>katsuwonus pelamis</i>) - Patel Shivangi Bharatbhai and Shyni K	FP1A1	2
2.	Extraction and characterization of fish gelatin from sword fish <i>Xiphius gladius</i> and fucoidan from brown seaweed <i>Rosenvingea intricata</i> as active ingredients for biodegradable films - Arjun Arulvel and Radhika Rajasree S.R	FP4A2	3
3.	Development of tutti frutti based on nutmeg pericarp as a valorized product - Nehidha fathima C.J., Sreelakshmi A and Krishna M	FP5A3	4
4.	Isolation of cellulose and cellulose nanocrystals from <i>Dictyota bartayresiana</i> and their characterization for the development of biodegradable packaging films - Sobiya M and Radhika Rajasree S.R	FP6A4	5
5.	Process protocols for shrimp fortified cracker and its shelf life prediction - Parvathy U., C.G. Joshy, Binsi P.K., Anupama T.K. and George Ninan	FP11A5	6
6.	Quality characteristics of dehydrated restructured product from protein isolate of selected fishes - Jeyakumari A., George Ninan, Narasimha Murthy L. and Laly S J.	FP13A6	7
7.	Optimization and shelf-life assessment of functional surimi nuggets from <i>Nemipterus japonicus</i> (Bloch, 1791) - Anjana Jose E., Sreepriya Prakasan, Toms C. Joseph, George Ninan	FP16A7	8
8.	Chitosan based edible coating on the physico-chemical quality of Apple, (<i>Malus domestica</i>) - Kavya Vijayan, Mohan, C.O, Remya S, Pankaj Kishore and Bindu J	FP17A8	9
9.	Effect of concentration and molecular weight on the physico-chemical and antimicrobial properties of chitosan films - Sagarnaik C, C. O. Mohan, Remya S, Bindu J, Pankaj Kishore, Elavarasan, K., A. K. Balange and H. Sanath Kumar	FP18A9	10
10.	Chitosan-gold nanocomposites as time temperature indicator for frozen mackerel - Sreelakshmi, K.R, Pankaj Kishore and Mohan C. O.	FP19A10	11
11.	Histamine formation in different parts of Yellowfin tuna (<i>Thunnus albacares</i>) during refrigerated storage - Mohan, C.O., Remya, S., Pankaj Kishore, S. K. Panda, and Bindu, J.	FP20A11	12

12.	Fortification of gluten free cookies with bio calcium extracted from tuna bone (<i>Thunnus albacares</i>) - <i>Ligi Jose and Dr.Blossom K L</i>	FP2B1	13
13.	Development of piri piri marinated mantis shrimp and its shelf life study during packaging conditions at chilled storage - <i>Sukanya, Ahana Vijayan and Shyni K</i>	FP7B2	14
14.	Antioxidant and bioactive properties of the various solvent extracts of <i>Kappaphycus alvarezii</i> (Doty) cultivated in the Gulf of Mannar coast - <i>Devadharshini Sakthivel, Balasundari S, Neethiselvan N, Padmavathy P, and Alamelu Venkat</i>	FP8B3	15
15.	Food preservation, fortification, and value addition - <i>Suman Soni</i>	FP12B4	16
16.	Impact of various doses of electron beam irradiation on steamed blood clam (<i>Anadara granosa</i>) stored under refrigerated condition - <i>Rehana Raj, Greeshma S.S, Remya S, Bhaskar Sanyal, and Asha K. K</i>	FP14B5	17
17.	Seaweed enriched chocolate: a novel confectionery - <i>Jesmi Debbarma, Remya, S., Viji, P. and Madhusudana Rao, B.</i>	FP15B6	18
18.	Optimizing process parameters and evaluating shelf-life of hot-smoked Ariid catfish (<i>A. dussumierii</i>) chill stored under vacuum packaging - <i>Sreejith. S., Ashish Kumar Jha, Sarika. K., Kriplani Yogeshkumar Dharamdas and Parmar Ejaz A. Rahim</i>	FP21B7	19
19.	Evaluation on the nutritional and quality characteristics of extruded products fortified with green seaweeds - <i>Radhika Rajasree S.R and Roopa Rajan</i>	FP9AP1	20
20.	Literature study on the quality of salted and dried fishes in the coastal regions of Kerala - <i>Shaniya Yesudas and Saritha Sadasivan</i>	FP3BP1	21
21.	Sustainable utilization of vegetable waste in shelf-life extension of chilled fish - <i>Kurapati Nagendrasai and Kishore Kumar Krishnani</i>	FP10BP2	22
Technical Session II: Novel foods and nutraceuticals			23
22.	Insights from untargeted metabolomics on the effect of infrared drying and electrical oven drying of <i>Turbinaria conoides</i> (J. Agardh) Kuzing for nutraceutical application - <i>Dona Jaiju, Aniesrani Delfiya, Devananda Uchoi, and Niladri Sekhar Chatterjee</i>	FN10A1	24
23.	Nutritional and safety evaluation of <i>Nannochloropsis oculata</i> , a marine microalgae for use as protein and antioxidant source in cookies - <i>Viji P., Sirisha, S., Binsi P.K., Jesmi Debbarma and Madhusudana Rao, B.</i>	FN13A2	25
24.	Emerging need and nutritional benefits of pseudo cereals - <i>Henna Hameed and Neha Sharma</i>	FN3B1	26

25.	Extraction of bio-calcium from tuna fish bone powder, characterisation and development of calcium fortified wheat pasta - <i>Archana Santhosh, and Blossom K.L.</i>	FN11B2	27
26.	β -chitin and chitosan from Squid pen: effect of cold extraction method on its characteristic properties - <i>Sarika, K., Ashish Kumar Jha and Sreejith S</i>	FN12B3	28
27.	Effect of ensilation of seaweed on its physical and nutritional composition - <i>Ashish Kumar Jha, Sumit Kumar Verma, Sreejith S Sarika K and Pankaj Kishore</i>	FN14B4	29
28.	Effect of dietary protein and lipid sources on flesh quality parameter of striped catfish, <i>Pangasianodon hypophthalmus</i> (Sausage 1878) - <i>J. K. Jakhar, A. K. Pal, N. P. Sahu, S. Gupta, G. Venkateswarlu and H.K Vardia</i>	FN15B5	30
29.	Biochemical and nutritional analysis of 3d printed fish product developed through fortification with marine lipids - <i>Rasheeda, M., Mohan, C. O., Remya, S., and Bindu, J</i>	FN2AP1	31
30.	Preparation and characterization of a novel edible seaweed laver from <i>Ulva reticulata</i> (Forsskal, 1775) - <i>Vaishshali Prakash Arul Prakasam and Radhika Rajasree S.R.</i>	FN4AP2	32
31.	Development of fish sausages from Daggertooth pike eel <i>Muraenesox cinereus</i> (Forsskal, 1775) and its quality characterization - <i>Lekshmi S., and Radhika Rajasree S.R.,</i>	FN6AP3	33
32.	Extraction and physicochemical characterisation of gelatin from the skin of eel <i>Muraenesox cinereus</i> (Forsskal, 1775) - <i>Vishnupriya B., and Radhika Rajasree S.R.,</i>	FN7AP4	34
33.	Production and optimization of Fish Protein Hydrolysate from discarded skin of eel <i>Muraenesox cinereus</i> (Forsskal, 1775) and its antioxidant potential - <i>Priyadarshini M. and Radhika Rajasree S.R.,</i>	FN8AP5	35
34.	Tuna, a major seafood industry in Androth, UT of Lakshadweep - <i>Najva AI, Raisa KCP, Nadilla Maryam and Rekha Govindan</i>	FN1BP1	36
35.	Evaluation of Fourier Transform Infrared Spectroscopy as a tool for the evaluation of structural properties of protein hydrolysates - <i>Vignaesh Dhanabalan, K.A. Martin Xavier, K. K. Asha, Narasimhamurthy L., Sahna Don, Amjad Balange and Binaya Bhusan Nayak</i>	FN5BP2	37
36.	Food applications of chitin nanomaterials derived from crustacean shell waste - <i>Soibam Ngasotter & K. A. Martin Xavier</i>	FN9BP3	38
37.	SeaFox – a blend of seaweed and millet milk - <i>Meena N and Pavuluri Srinivasa Rao</i>	FN16BP4	39

Technical Session III: Food safety, standards, and risk assessment			40
38.	Private Food Safety Standards in Kerala Seafood Export Supply Chain - <i>Asha Reymond</i>	FS1A1	41
39.	Trace metal variability in different matrix along Mangaluru, Dakshina Kannada - <i>Bindu Sulochanan, Veena Shettigar, Shrinath B, Nagaraj Sommaya Gond, Naveen Raju K.G. Naik and Dharmaraju L.B</i>	FS4A2	42
40.	Untargeted lipidomics approach using liquid chromatography - Orbitrap high resolution mass spectrometry for shrimp Geographical authentication. - <i>Pranamy C.H., Rajesh, R., Pankaj Kishore, Satyen Kumar Panda, Niladri Sekhar Chatterjee</i>	FS6A3	43
41.	Development and validation of an analytical method to determine Emamectin Benzoate as mixture of emamectin b1a and emamectin b1b in fish using QTRAP Mass Spectrometry - <i>Rajisha R., Ranjit Kumar Nadella, Niladri Sekhar Chatterjee, Nanitha Krishna E. K and Prasanna Kumar Patil</i>	FS7A4	44
42.	Verification studies on alternative rapid technique for enumeration of yeast and mold in two distinct food matrices. - <i>Geetha K.G.,</i>	FS9A5	45
43.	Virulence of <i>Escherichia coli</i> isolated from seafood - <i>Sreepriya Prakasan and Sanath Kumar H</i>	FS13A6	46
44.	Non-destructive freshness assessment of Indian Mackerel using Convolutional Neural Network - <i>S. Murali, B. Sreelekshmi, R. Reshma, D.S. Aniesrani Delfiya, V. Murugadas, P.K. Binsi and George Ninan</i>	FS14A7	47
45.	Microbial changes of white snapper (<i>Macolor niger</i>) packed under different packaging conditions during chilled storage - <i>Ranjit Kumar Nadella, Staniya K. Seejo, D. uchoi, P. Kishore, Remya S, Mohan C.O., Femeena Hassan, and Bindu J.</i>	FS16A8	48
46.	Screening and identification of allergens in giant freshwater prawn, humpback nylon shrimp and green tiger prawn - <i>S.J. Laly, Satyen Kumar Panda, and Pankaj Kishore</i>	FS19A9	49
47.	Migration study of packaging materials for assessing chemical contamination and safety of packaged takeaway food - <i>Remya S., K. Sathish Kumar, Mohan C.O., J. Bindu and Tanweer Alam</i>	FS21A10	50
48.	Sodium benzoate content of fish pickles marketed in India - <i>Priya, E. R., Satyen Kumar Panda, Pankaj Kishore and Femeena Hassan</i>	FS22A11	51

49.	Efficacy of Carbon Nano dots from fish scales for ensuring hygiene and sanitation in fish/food contact surfaces - <i>Femeena Hassan, Naiji Noble, Laly, S.J. and Ashraf, P.A.</i>	FS25A12	52
50.	Biomonitoring of micropollutants from Black clams (<i>Villorita cyprinoides</i>) in Vembanad estuary, India: Human Health Risk Assessment using an untargeted metabolomics approach - <i>Niladri Sekhar Chatterjee, Nasreen Nazar, Satyen Kumar Panda, and Femeena Hassan</i>	FS26A13	53
51.	qPCR assay optimization and efficacy of dyes for detection of <i>Vibrio cholerae</i> in seafood - <i>Pankaj Kishore, Vrinda vishwanathan, Ranjit Kumar Nadella, Minimol V.A., Mohan, C.O., Niladri S. Chatterjee and Femeena Hassan</i>	FS27A14	54
52.	Quality and safety assessment of salted dried fishes available in Saurashtra coast - <i>T K Anupama, Ashish Kumar Jha, Ejaz Parmar, Laly S J, and Satyen Kumar Panda</i>	FS28A15	55
53.	Investigation of hemolysin genes in <i>Vibrio alginolyticus</i> isolates of seafood origin - <i>Minimol V.A., Pankaj Kishore, T. Muthulakshmi, and Ezhil Nilavan S</i>	FS28A16	56
54.	Aeromonas infections in Indian major carp, <i>Labeo rohita</i> from farm ponds of Andhra Pradesh, India: Antimicrobial resistance and possible health risk - <i>Chethurajupalli Lavanya, Tambireddy Neeraja and T. V. Ramana</i>	FS2B1	57
55.	Survival characteristics of <i>Salmonella enterica</i> on fish and shrimp at low temperature storage - <i>Sahna Don and Sanath Kumar, H.</i>	FS3B2	58
56.	Bioaccumulation of microplastics in humans through seafood – implications for food security - <i>Palika Revathi Devi and Kakarlapudi Ramaneswari</i>	FS15B3	49
57.	New insights into promising antibacterial activity of <i>Ulva lactuca</i> against <i>Pseudomonas aeruginosa</i> - <i>Greeshma S. S, Rehana Raj, Niladri. C. S, and Asha K. K</i>	FS17B4	60
58.	Determining the factors affecting consumer willingness to pay for sea food safety decisions in Texas, United States - <i>Pratheesh Omana Sudhakaran, Subodh Raj Pandey</i>	FS20B5	61
59.	Bacteriophages as biocontrol agents for augmenting Food safety: Observations using Coliphage Cocktail for controlling <i>Escherichia coli</i> on shrimp - <i>Madhusudana Rao, B., Manikantha, B. and Murugadas, V.</i>	FS23B6	62
60.	Incidence, antibiogram, biofilm forming ability of <i>Staphylococcus aureus</i> from farmed <i>Penaeus vannamei</i> shrimp and their response to plant essential oils - <i>Ahamed Basha Kusunur, Navya Gongada, and Madhusudana Rao Badireddy</i>	FS24B7	63

61.	Rapid authentication of species identity of commercially important shrimps using a portable FT-NIR sensor combined with chemometric modelling - <i>Rajesh R., Pranamyia, C.H., Pankaj Kishore, Satyen Kumar Panda, and Niladri Sekhar Chatterjee</i>	FS5AP1	64
62.	A random sample survey of aflatoxin M1 in UHT processed milk using a commercially available quantitative Rapid Method - <i>Pradnya Ambekar (Sr. Manager – Professional services) and Sanal S (Asst Manager – Professional services)</i>	FS8AP2	65
63.	The estimation of Chloramphenicol and Nitrofurantol metabolites in shrimp using microwave-assisted derivatization and LC-MS/MS - <i>Nanitha Krishna E.K., R Rajisha, Ranjit Kumar Nadella, Devi Krishna, Satyen Kumar Panda, Niladri Sekhar Chatterjee</i>	FS10AP3	66
64.	Comparative evaluation of large volume injection and split less injection technique with conventional and high throughput SPE clean-up for GC/MS/MS analysis of persistent organic pollutants in aquaculture feed - <i>Athira A.S., Devi Krishna, Nasreen Nazar R., Pankaj Kishore, Satyen Kumar Panda, and Niladri Sekhar Chatterjee</i>	FS11AP4	67
65.	Benchmarking of a portable mass spectrometer with GC-MS/MS for determination and uptake of Formaldehyde in fish and shrimp - <i>Sajeena, K.N. and Niladri Sekhar Chatterjee</i>	FS12AP5	68
66.	Formation of nucleotide degradation products in Indian mackerel and Indian oil sardine during temperature abused condition - <i>Laly S.J., Priya E.R., Satyen Kumar Panda, Ranjit Kumar Nadella, Devanada Uchoi and Femeena Hassan</i>	FS18AP6	69
67.	Occurrence of <i>Vibrio cholerae</i> O139 in seafood and its molecular characterization - <i>Minimol VA, Pankaj Kishore, Ranjit Kumar Nadella, T. Muthulakshmi, and Ezhil Nilavan</i>	FS30AP7	70
68.	Extraction and characterization of liquid smoke from locally available wood - <i>Reshma CS, Bindu J, Sathish Kumar K and Niladri Sekhar Chatterjee</i>	FS31A17	71
69.	Microplastic contamination and its associated risks in fishery products - <i>K. A. Martin Xavier, Sandhya Venkatesh, Chanikya Naidu, Suguna V, Udai Gurjar, Rakesh R. Soibam Ngasotter, Asha K.K & George Ninan</i>	FS31A18	72
70.	Storage study of Analogue Shrimp Products from Lizard fish (<i>Saurida tumbil</i>) in Retortable Pouches - <i>Hema, K., Velayutham, P., Sukumar, D., Athithan, S., Mohan, C.O., Sugumar, G and Ravishankar, C.N.</i>	FP70BP3	73

Sub-Theme 1: Food preservation, fortification, and value addition

FP1A1**Development of quick dried soup powder from skipjack tuna (*Katsuwonus pelamis*)****Patel Shivangi Bharatbhai^{1*} and Shyni K²**^{1,2}Department of Fish processing technology, Kerala University of Fisheries and Ocean Studies,
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Abstract

Due to their convenience of use, dry fast soups are becoming more and more popular. This study developed a fast soup powder from tuna (*Katsuwonus pelamis*) and evaluated its shelf life by biochemical parameter, organoleptic parameters, and microbiological quality. Recipes for tuna soup powder was prepared based on trial and error method and sensory analysis. In a lab setting, fresh tuna (*Katsuwonus pelamis*) and other veggies were dehydrated to make flour, which was then added to this soup combination in predetermined proportions. By combining dried tuna powder, sprouted and non sprouted wheat flour, milk powder, salt, black pepper, tomato, onion, garlic, ginger, coriander, fennel, carrot, sweetcorn and oil, formulations of both soup powder were created. These formulations were initially subjected to proximate analysis (tuna soup powder -moisture – 13.48 %, ash -12.68 %, Crude protein – 38.43 %, fat - 0.0518%) on dry weight basis. Biochemical, microbiological and sensory quality analysis were carried out during 50 days of storage period at chilled condition (4 to 4.50 C) on dry basis during 50 days of storage and also workout the cost of production of tuna soup powder. pH, water activity, TBA,TVB-N content of tuna soup powder increased during 50 days of storage and it remained at the level of acceptability. Tuna soup powder had an total plate count of 700 cfu/ml (0.7 X 10³ cfu/ml) at 0th day, at two months, there was a rise in the number of total plate count 1411 cfu /ml (1.411 X 10³ cfu/ml) in samples at 50th days of storage. Even though the trend was increasing until the storage period of 50 days, stayed within the limitations. tuna soup powder samples were free of mould and yeast growths. Sensory analysis was observed from hedonic scale 9 to 8 in tuna soup powder during 50 days of storage. According to the results of research on shelf life evaluation, including moisture content, sensory assessment, and microbiological investigation, tuna soup powders could be kept for two months without losing quality. The cost of production analysis' findings showed that the unit (10 grams) prices for tuna soup powder was 12 rupees.

Keywords: Tuna soup powder, Proximate analysis, Quality analysis, Shelf life.

FP4A2

Extraction and characterization of fish gelatin from sword fish *Xiphias gladius* and fucoidan from brown seaweed *Rosenvingea intricata* as active ingredients for biodegradable films

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Abstract

Fish gelatin extracted from skin wastes of sword fish (*Xiphias gladius*) was evaluated in terms of extraction yield, viscoelastic properties, biochemical composition. The sword fish gelatin yield shows a value of 9.5 %, foaming capacity of 75±0.8% and stability 80±0.7% which was stable up to 10 mins. The FTIR profile of extracted fish gelatin showed the presence of all major peaks and functional groups of gelatin situated in Amide I, II, III, A and B regions. The amino acid profile of sword fish gelatin shown major amino acids such as glycine, proline, alanine and glutamic acid. The composition of extracted sword fish gelatin was well suited to the standard of food industries. Fucoidan was extracted from the brown seaweed (*Rosenvingea intricata*) and characterized fucoidan results showed a yield of 2.8% and 43.7% of total fucose, 35.5% of sulfate, 18.1% of uronic acid and 63% of carbohydrates. Further, the structural characterization FT-IR shows major peaks of functional groups of sugar ring, ester, carbonyl group and monosaccharide monomer. ¹HNMR results of the extracted fucoidan show peak at its resonance signals at 4 to 5 ppm. The antioxidant result showed maximum activity of 76.8±1.3 % at highest concentration of 100 µg/ml. The antimicrobial activity with 23±0.9mm zone of inhibition area was obtained against E. coli with 2% concentration of fucoidan solution. Thus, extracted fucoidan and fish gelatin can be utilized as suitable biopolymers for active biodegradable film.

Keywords: Sword fish gelatin, Amino acid profiling, *Rosenvingea intricata*, Fucoidan, Antioxidative properties, Antimicrobial properties.

FP5A3

Development of tutti frutti based on nutmeg pericarp as a valorized product

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Abstract

Tutti frutti is an innovative and natural product that harnesses the power of pericarp of nutmeg to offer a delightful and healthy culinary experience. My research work aims to introduce tutti frutti as a unique and versatile ingredient, revolutionizing food industry with its exceptional flavour. By utilizing the pericarp of nutmeg which often overlooked, this product offers a sustainable and cost effective solutions to the problem of agricultural waste in the form of nutmeg pericarp. This is also a preservation technique of the nutmeg pericarp and also an asset to the field of food valorisation. The osmotic agents used is sugar that creates a high osmotic pressure gradient between the pericarp and the surrounding solution causing water to move out of the pericarp and into the solution. This process can help in reducing microbial growth and extending shelf life, enhancing flavour absorption, and improving texture.

FP6A4

Isolation of cellulose and cellulose nanocrystals from *Dictyota bartayresiana* and their characterization for the development of biodegradable packaging films

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Abstract

Cellulose nanocrystals (CNC) production is a major area of nanotechnology research as cellulose has a high potential for bio-based food packaging development and it has been widely used as a filler to improve the properties of other biopolymers. CNC has the characteristics of excellent mechanical properties, biocompatibility, non-abrasive, and biodegradability in nature. Cellulose was isolated from the seaweed *Dictyota bartayresiana* by acid-base pre-treatment, KoH treatment, bleaching and the cellulose nanocrystals were isolated by acid hydrolysis followed by ultrasonication. The yield of isolated cellulose and CNC is about 30% and 10% respectively. Spectral characterization of both cellulose and CNC was carried out by FTIR. Morphological analysis and Thermal analysis such as SEM, TEM, TGA, and DSC were performed. XRD and CHNS were carried out. XRD data confirmed the isolated compounds were found to have high crystallinity. The higher crystallinity region enhances the strength of the biopolymer. Therefore, the isolated Cellulose and cellulose nanocrystals are a good alternative for some of the synthetic polymers and are also cost-effective compared to other materials.

Keywords: CNC, Cellulose, Seaweed, Bio-packaging film, SEM, TEM, XRD, CHNS, TGA, Crystallinity.

FP11A5

Process protocols for shrimp fortified cracker and its shelf life prediction

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Abstract

Shrimps are nutrient rich and serve as a main ingredient in several dishes/products. Current study was carried out to standardize protocols for developing cracker incorporating Indian white shrimp mince. Further the quality characteristics as well as shelf stability of the developed product was evaluated. Preliminary product acceptability study was carried out to select the concentration of shrimp desirable for the preparation of shrimp crackers. Sensory analysis conducted for the product indicated 40% as ideal shrimp concentration. Five different types of dip/sauces were also formulated as a supplement for the cracker and subjected to acceptability studies. Nutritional as well as quality analysis was carried out using standard protocols for the selected cracker. The nutritional evaluation of cracker indicated it to be dehydrated sufficiently with a moisture content of 7.74%. Protein, ash and fat of cracker was 10.97%, 5.95% and 0.05%, respectively. All the quality and safety parameters exhibited only slight variations indicative of very minimum deteriorations during the storage period. Shelf life prediction studies conducted for the product using Q10 values indicated good stability for the product under ambient conditions. Present study explores the possibility of using seafoods like shrimps for fortification of snack products of low nutritional profile as well as for improving its taste and flavor.

Keywords: Shrimp, cracker, Shelf life prediction, Q10

FP13A6

Quality characteristics of dehydrated restructured product from protein isolate of selected fishes

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Abstract

Fish is considered a highly nutritious and easily digestible animal protein. Though it is highly nutritious, it is one of the most perishable food items. Fish protein isolate is a concentrated source of complete muscle protein (i.e., myosin and actin) of high nutritional quality as well and it can be used as an ingredient for the production of value-added products. In the present study, fish protein isolate was prepared from Indian anchovy (*Stolephorus indicus*) and Indian mackerel (*Rastrelliger kanagurta*) by alkali solubilization method. The protein content of isolate ranged between 89.65- 92.5%. Protein isolate from anchovy showed the highest solubility than mackerel isolates. The water absorption capacity of the isolate ranged from 4.26 g water/g sample to 5.29 g water/g sample. Restructured products were prepared from fish protein isolate with a blend of calcium chloride and sodium alginate by steam cooking. Then it was freeze-dried and stored in an airtight container. Biochemical and microbial quality analysis of dehydrated restructured products was carried up to 2 months. Total volatile base nitrogen content was varied from 2.5-8.5mg%. Thiobarbituric acid values were found to be high in products from mackerel (2.10 -4.8 mgMDA/kg) than anchovy (1.65 -2.5mgMDA/kg). The total plate count was within acceptable limits in both samples during storage. Results suggested that dehydrated restructured product from protein isolate of anchovy can be used as a protein supplement in soup mix with improved biochemical and functional properties.

Keywords: Fish protein isolate, freeze drying, restructured product, quality

FP16A7

Optimization and shelf-life assessment of functional surimi nuggets from
Nemipterus japonicus (Bloch, 1791)

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Abstract

The purpose of the study was to optimize the concentration of banana pseudo stem flour (BPF) in surimi nuggets prepared from *Nemipterus japonicus* (Threadfin bream) and to assess the shelf life of nuggets under frozen storage (-18±2°C). Based on the textural and sensory properties, nuggets incorporated with 5% BPF was found to be more acceptable. Further, the effects of BPF on nutritional, organoleptic and microbial quality of surimi nuggets were evaluated, and it was found that the product was shelf stable upto 6 months. The proximate analysis showed that moisture and crude protein content were higher in control surimi nuggets whereas carbohydrates, crude fat, ash and dietary fiber content were observed to be higher in functional surimi nuggets. Biochemical analysis showed that trimethylamine and total volatile base nitrogen content, were within the limit of 10-15 mg% and 35-40 mg% during the entire study. The thiobarbituric acid, free fatty acid and peroxide values of control surimi nuggets at the end of the storage were 0.28 mg of malonaldehyde/kg, 2.82 mg KOH/g and 4.32 meq/kg respectively whereas the values of BPF incorporated surimi nuggets were 0.21 mg of malonaldehyde/kg, 2.34 mg KOH/g and 5.33 meq/kg respectively. The microbial analysis indicated that there was one log reduction in the total plate count of functional surimi nuggets when compared to control surimi nuggets. This may be because of the presence of bioactive compounds in BPF along with dietary fiber. The results showed the potential of BPF as a functional ingredient for production of functional surimi-based products.

Keywords: Functional foods, banana pseudo stem, surimi, nuggets, value addition, ready to eat products.

FP17A8**Chitosan based edible coating on the physico-chemical quality of Apple,
(*Malus domestica*)****Kavya Vijayan¹, Mohan, C.O^{2*}, Remya S², Pankaj Kishore³ and Bindu J²**¹College of Indigenous Food Technology (MG University), CFRD Perinjottakkal P.O., Konni²Fish Processing Division, ICAR- Central Institute of Fisheries Technology, Cochin- 682 029³Quality Assurance & Management Division, ICAR-Central Institute of Fisheries
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Abstract

Apple, (*Malus domestica*) is cultivated and consumed widely globally including in India. It loses its quality during continuous storage due to external atmospheric condition prompting to use wax. However, many countries including European Union is refusing to accept apples treated with wax, especially when it contains morpholine or other amines. There is an increasing research on search for novel edible coating of natural origin. Present study aimed to formulate chitosan – corn starch based edible coating on apple and to assess its influence on the physico-chemical quality of apple. Chitosan (1.5 and 2% w/v, in 1% acetic acid, treatment 1 & 2, respectively) in combination with corn starch (7%, w/v) was used as an edible coating along with sorbitol and glycerol. Apples were given a dip treatment in the edible solution for 1 min at room temperature, drained, dried and stored at room temperature. The fruit was sampled weekly throughout the storage. Various physico-chemical parameters like weight loss, total phenolic content, moisture, titrable acidity, instrumental colour and texture were monitored for control and treated samples. Moisture loss in control sample was 3.4 and 4.5% after 1st and 2nd week of storage compared to only 0.95 and 2.4% for treatment 2. Loss of total phenolic content was least (4.55%) after 1st week for control samples compared to 41 and 18% for treatment 1 & 2, respectively. However, after 2nd week, control sample exhibited 59.1% loss compared to only 36.3% for treatment 1 & 2, respectively. Least weight loss was observed for apple with treatment 2. Better colour and texture was observed for treated samples compared to control samples.

Keywords: Chitosan; edible coating; apple; quality

FP18A9

Effect of concentration and molecular weight on the physico-chemical and antimicrobial properties of chitosan films

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Abstract

Chitosan, a natural mucopolysaccharide consists of a linear (1-4) linked 2- amino-2-deoxy-D glucan, is a non-toxic, biodegradable and biocompatible polymer, which finds its application for food packaging. Present study aimed to assess the effect of chitosan concentration (1.5 & 2%; w/v) and molecular weight (low, medium and high MW) on the antimicrobial and physico-chemical properties. Film properties viz., thickness, tensile strength, elongation (%), heat seal strength, solubility, swelling index, moisture content, Fourier transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), transparency, instrumental colour were monitored. Antimicrobial activity against test food pathogens, namely *Staphylococcus aureus*, *Listeria monocytogenes*, *Salmonella enteritidis*, *Vibrio cholera*, *Escherichia coli* and spoilage organism, *Pseudomonas aeruginosa*, were assessed. Solubility ranged between 17 to 36% for chitosan films with different MW. Better transparency and higher solubility was observed for films prepared using lower concentration. Chitosan films prepared using 1.5 and 2% exhibited endothermic reaction between 103 to 128°C and 107 to 127°C, respectively and T_{max} ranged between 103.27 to 128.87°C for different films. Chitosan film prepared with high molecular weight exhibited better antimicrobial properties.

Keywords: Chitosan, molecular weight; antimicrobial properties; structural properties

FP19A10

Chitosan-gold nanocomposites as time temperature indicator for frozen mackerel

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Abstract

The efficiency of time temperature indicator for frozen Indian mackerel were studied with chitosan-AuNP nanocomposite. The AuNP synthesised with 0.2% chitosan was used for the study. The nanocomposites and mackerel were studied for the effect of exposure to 5⁰C, 10⁰C, 22⁰C, 35⁰C and 45⁰C as abused temperatures for 1hr, 2hr, 3hr, 4hr, 5hr, 24hr and 48 hr. There was evident colour change for the samples exposed to 24hr and 48hr at 35⁰C and 45⁰C followed by freezing while the lower temperature exposure didn't show colour change. The quality indices of fish were also studied for the changes. The activation energy (Ea) calculated for higher temperatures studied were 6.91kJ/mol for TVBN, 6.73kJ/mol for APC and 30.9kJ/mol for indicator colour change. The difference in activation energy (Ea) of fish quality indices and indicator colour was <25kJ/mol which indicates the effectiveness of the developed indicator.

Keywords: Time temperature indicator, Frozen Mackerel, Quality, Colour, Activation energy

FP20A11

Histamine formation in different parts of Yellowfin tuna (*Thunnus albacares*) during refrigerated storage

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Abstract

Tunas are one of the highly sought after fish due to its unique taste and culinary properties. Histamine forms one of the important safety threat for the increased consumption of scombroid fishes including tuna. Present study aimed to evaluate the formation of histamine and other biochemical quality changes in different muscle parts of tuna during refrigerated storage. Bigger size yellowfin tuna weighting 49-50 kg was used in the study. The fish divided into six portions, two each from upper, middle and lower back and belly portion from dorsal and abdominal part (15±2 cm each). Muscle from each portion was packed in LDPE pouches maintaining a temperature of 2 to 3°C. Each portion was monitored for histamine formation, pH, TMAN, TVBN and sensory quality for 0, 5 and 10 days Initially, TVBN content was in the range of 14.7 to 18.7 mg N₂/100g, which increased to 30.1 to 33.9 mg N₂/100g by 10th day. Initially, histamine was not detected from any part indicating the freshness of tuna. On 5th day, it ranged between 0 – 3.2 ppm reaching 1.8 to 8.9 ppm on 10th day. Histamine content was observed least in the middle portion of dorsal meat and highest in the lower portion of dorsal meat. The study indicates, formation of histamine is not uniform in all the meat portions of bigger size tuna.

Keywords: Histamine; Yellowfin Tuna; Dorsal meat; Refrigerated storage

FP2B1

Fortification of gluten free cookies with bio calcium extracted from tuna bone (*Thunnus albacares*)

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Abstract

The research was aimed for standardization and development of gluten free cookies with the incorporation of tuna bone (*Thunnus albacares*) bio calcium powder at 5 % of gluten free flour (w/w). Calcium deficiency and metabolic bone diseases are a frequent co-morbidity of celiac disease (CD). Celiac disease is an immune-mediated chronic intestinal disorder triggered by the ingestion of gluten or related prolamines in genetically susceptible individuals. Most of all newly diagnosed celiac disease patients have calcium deficiency, reduced bone mineral density and therefore osteopenia and osteoporosis are considered as signs of atypical celiac disease presentation. Strict and lifelong adherence to a gluten-free diet (GFD) incorporated with calcium is the only proven treatment for reducing celiac disease and followed by calcium deficiency. Yellow Fin Tuna (*Thunnus albacares*) species is selected for extraction of calcium and it incorporated at 5 % of gluten free flour (w/w). The extracted fish bone powder used for fortification comprised of 30.5 % calcium. By adding 5 % bone powder (2.2925g) to flour will incorporate 699 mg calcium to 100 g product helps to meet the recommended daily allowance (RDA) for calcium. Proximate constituents was analyzed for control and bio calcium powder added cookie sample. Scanning electron microscopic images showed that the 5% incorporated sample cookie were less porous and had a denser structure, compared to the control. Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) analysis revealed that sample cookie were abundant in all important minerals making them a good source of calcium and phosphate ratio compared to control cookie.

FP7B2

Development of piri piri marinated mantis shrimp and its shelf life study during packaging conditions at chilled storage

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Abstract

The study investigated on the development of spiced piri piri marinated ready to cook value added product of mantis shrimp (*Oratosquilla nepa*), (Latreille, 1828) through standardization of marinade and also the shelf life study of the prepared product under air packed and vacuum packed conditions in chilled storage. Marination was done using freshly obtained spices and herbs which on then dried and pulverised applied on squilla by vacuum tumbling. The applied marinades helps in enhancing the shelf life of the product due to its natural antioxidative and antimicrobial activity. In order to enhance the shelflife of the different batches of product developed sensory analysis, biochemical analyses (pH, TBA, TVBN, TMA), microbiological analysis, colour analysis and melanosis assessment was conducted. The analysis clearly implied on a better shelf life of marinated and vacuum packed sample that could extend the shelf life for 33 days whereas air packed marinated could give only 30 days based on quality parameters. Air packed and Vacuum packed mantis shrimp sample without marination could give only a shelf life of 6 and 8 days respectively. Hence the study well established the importance of Indian spiced marinade alone which could made a significant effect on extending the shelf life of squilla with good sensorial attributes fulfilling all attributes for the development of value added products from underutilized crustacean by-catch species.

FP8B3

**Antioxidant and bioactive properties of *Kappaphycus alvarezii* (Doty)
cultivated in the coast of Gulf of Mannar**

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Abstract

The aim of the present study is to evaluate the efficiency of two types of solvents (aqueous, 40% ethanol, 60% ethanol, and 80% ethanol) for extracting the compounds from *Kappaphycus alvarezii* (Doty) to assess the total phenolic content, total flavonoid content, antioxidant activity and bioactive properties. The nutrient composition of seaweed powder in terms of its protein, fat, carbohydrate, fiber, ash content, and energy were found to be 6.20 ± 0.092 %, 1.426 ± 0.061 %, 57.71 ± 0.715 %, $6.70\% \pm 0.120$, 16.3 ± 0.2715 % and 3092 ± 1.525 % (on dry basis) respectively. The FTIR analysis of the seaweed extracts confirmed the presence of polyphenols and flavonoids, which was predominant in the ethanolic extract. The phenolic content ranges from 9.87 ± 0.073 to 12.82 ± 0.067 mg of GAE g⁻¹. In this study, the 60% extract obtained using 60% ethanol showed enhanced phenolic content (value), flavonoid content (4.44 ± 0.07 mg of QE.g⁻¹) and DPPH assay (IC₅₀ 6.50 ± 0.07 mg.ml⁻¹). It also possesses significant anti-diabetic properties as identified by α -Amylase (IC₅₀ 0.089 ± 0.01 mg/ml), α -glucosidase (IC₅₀ 0.085 ± 0.01 mg/ml), and anti-inflammatory activity (IC₅₀ 0.10 ± 0.01 mg/ml). From the results of this study it is concluded that extraction of compounds from *Kappaphycus alvarezii* (Doty) using 60 % ethanol was found to be effective in extracting bioactive compounds which are rich in antioxidant and bioactive properties.

Keywords: Seaweed extract, FTIR, antioxidant, antidiabetic, and anti-inflammatory properties

WORLD FOOD SAFETY DAY, 2023

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FP12B4

Food preservation, fortification, and value addition

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Abstract

Food preservation, fortification, and value addition are necessary in a country like India, where biodiversity exists in its deep layers. The main aim of all these three terms is to preserve food so that should be a part of everyone's diet. In India, The surplus food produced in one place should be transported everywhere. Before the surplus food reaches one place it got spoiled if not preserved well. Value addition is a type of food preservation that add long shelf life to a raw product. Mostly the value-added products are agricultural products that are modified to enhance their market value along with longer shelf life for e.g surplus apple into jam, meat into jerky/smoked or dried meat products, cauliflower in sauerkraut, milk to cheese and other milk products, unripe mangoes to achar, chutney, etc. Food fortification is done to overcome malnutrition in India. The healthy and macro/micro-nutrient-rich food on the plate is everyone's right. So, food fortification is done in agricultural foods like wheat flour, rice, salt, milk, etc that are included in the diet of more than 95% population. For the year 2018-19, wheat consumption is forecasted at 93 MMT. Therefore, wheat flour is selected as a suitable vehicle for fortification to improve the nutritional status of the mass population. Rice fortification is a cost effective, culturally appropriate strategy to address micronutrient deficiency in countries with high per capita rice consumption. Fortifying rice makes it more nutritious by adding vitamins and minerals in the post - harvest phase; many of which are lost during the milling and polishing process. Rice fortification may be considered as having the highest potential to fill the gap in current staple food fortification programs as it is the staple food of 65 percent of the Indian population and reaches the most vulnerable and poorer section - with the highest uptake in the government safety net programmes. Milk is a rich source of high quality protein, calcium and of fat-soluble vitamins A and D. Vitamins A and D are lost when milk fat is removed during processing. Many countries have a mandatory provision to add back the vitamins removed as it is easily doable. It is called replenishment as the nutrients lost during processing are added back. Fortification of milk with Vitamin A and Vitamin D is required in India because of the widespread deficiencies present in the population. Dual fortification of salt with iodine and iron could be a sustainable approach to combat iodine and iron deficiencies. India's National Institute of Nutrition (NIN) has pioneered the development of double fortified salt (DFS). NIN has also taken the initiative to transfer the technology to iodized salt manufacturers in the country and provides continuous quality control support. Value-added processing can be very simple to extremely complex. Adding value can be something as simple as sorting fruits and vegetables by size and selling through unique packaging to the complexity of processing salsa, jams, jellies, chutney, and meat animals. Value-added processing is also a means to utilize produce not used for fresh market sales and the surplus of product during the growing season. Depending on the raw ingredients and the final product there are usually processing regulations that need to be addressed. The food preservation, fortification and value addition are related to each other to combat nutritional deficiencies in peoples.



FP14B5

Impact of various doses of electron beam irradiation on steamed blood clam (*Anadara granosa*) stored under refrigerated condition

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Abstract

Live blood clam (*Anadara granosa*) procured from local supplier of Vashi Navi Mumbai, was steamed to collect the clam meat. The product was packed and kept under iced condition in insulated box until irradiation. The steamed meat was subjected to irradiation with Co-60 at Bhabha Atomic Research Centre (BARC), Trombhay. The meat was irradiated at three different dosages, 1K Gy, 2K Gy and 5K Gy under refrigerated condition. A control group was maintained to study the comparison with the treatment. Irradiated product was bought back to the laboratory under iced condition. The product was subjected to study the biochemical and microbial changes with respect to the control under refrigerated condition. Biochemical and microbiological analysis were carried out during the storage period which exhibited an extended shelf life of 5 to 20 days depending upon various irradiation doses.

Keywords: Blood clam, Irradiation, Refrigerated storage, Shelf life

FP15B6**Seaweed enriched chocolate: a novel confectionery****Jesmi Debbarma^{*1}, Remya, S.², Viji, P.¹ and Madhusudana Rao, B.¹**¹Visakhapatnam Research Centre, ICAR-Central Institute of Fisheries Technology (ICAR- CIFT),
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Abstract:

Seaweeds possess a wide array of nutritional and diverse phytochemicals with therapeutic properties, therefore, they can be used as a supplement in the functional food industry. The present study was aimed to develop seaweed based chocolates and evaluate their nutritional, textural and sensory properties. Red seaweed powder prepared from *Gracilaria edulis* and *Kappaphycus alvarezii* were added, separately, to dark chocolate at different concentration of 1%, 2.5%, 5%, 7.5% (w/w) and kept at 2-4°C for further studies. Water activity of the control chocolate and seaweed enriched chocolate were in the range of 0.71 to 0.73. Snap strength test was analyzed to determine the breaking strength and deformation of chocolate. Addition of seaweed significantly ($p < 0.05$) increased the breaking strength of the chocolate, as the concentration of seaweed increased the force required to break the chocolate also increased. Significantly ($p < 0.05$) lower breaking strength was found for *K. alvarezii* enriched chocolate than *G. edulis* enriched chocolate. Similarly, textural profile analysis had similar results as concentration of seaweed increased hardness and chewiness also increased. Chocolate enriched with 1% and 2.5% *K. alvarezii* had similar hardness and chewiness of that of control chocolate. Sensory evaluation revealed that chocolate with seaweed up to 7.5% were sensorily acceptable with no seaweed smell in the products as the flavor of dark chocolate completely diminish the seaweed flavour and odour. Also, organoleptic acceptance was significantly ($p < 0.05$) higher for chocolate enriched with *K. alvarezii* as compared to chocolate enriched with *G. edulis*. There was no significant ($p > 0.05$) difference in colour value of all the sample. In addition, incorporation of seaweed in chocolate improved the fibre content in the products. Results shows that red seaweed such as *G. edulis* and *K. alvarezii* can be considered as a potential ingredient for formulating healthy confectionery products without effecting consumer acceptance.

Keywords: Seaweed, *Gracilaria edulis*, *Kappaphycus alvarezii*, Chocolate

FP21B7

**Optimizing process parameters and evaluating shelf-life of hot-smoked
Ariid catfish (*A. dussumierii*) chill stored under vacuum packaging**

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Abstract

Ariid catfishes which are nutritionally rich and are available in abundance in Gujarat coast but are presently underutilized has the potential for smoked fish production on an industrial scale. Evaluating the suitability and formulating optimal pre-processing and processing parameters for hot-smoking can contribute to utilization of this resource and product diversification. Conducted thermal validation studies for hot-smoked Ariid catfish (*A. dussumierii*) which was further chill stored at $2\pm 1^{\circ}\text{C}$ under vacuum packaging. Thermal validation studies for hot-smoked and chilled Ariid catfish (with pre-cooking at 50°C for 30 minutes) reached cumulative F-value of 1 with reference temperature 63°C at 3 hours 53 minutes 46 seconds and reached cumulative F-value of 1 with reference temperature 72°C at 4 hours 25 minutes 46 seconds considering 6 log reduction of *L. monocytogenes*. Analyzed the shelf-life of hot-smoked Ariid catfish in chilled condition under vacuum packaging. Changes in the quality of hot-smoked Ariid catfish were determined just after smoking and during chilled storage in vacuum packaging. Chemical, sensory and microbiological analyses revealed that Total viable count, Total volatile base nitrogen and Thiobarbituric acid values increased, while sensory scores decreased during storage. The pH values were found to slightly increase by storage time. It was found that hot-smoked catfish samples were unfit for human consumption by 28th day according to microbiological and sensory analysis. There was no significant difference in the shelf life between samples processed at 63°C and 72°C .

FP9AP1

Evaluation on the nutritional and quality characteristics of extruded products fortified with green seaweeds

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Abstract

The present study aims to evaluate the effect of seaweed extracts from edible green seaweeds *Ulva reticulata* and *Ulva lactuca* as healthy ingredients in extruded products like pasta and noodles formulations. The wheat flour was substituted by seaweed biomass at concentrations 0, 2.5, 5, 7.5 and 10% levels and the technological and nutritional qualities of both products were determined in terms of color parameters, cooking properties, amino acid profiling, and *In vitro* antioxidant assay. The presence of essential amino acids like leucine, tryptophan, phenylalanine, arginine, etc. was found in 5 and 10% formulations and the water-holding capacities were improved with increasing seaweed content. Samples with 10% seaweed concentration had reduced glutamic acid content compared to the control in both products. The lightness (L*) of the products gets decreased in response to the seaweed concentration and were greenish in appearance after cooking. The total antioxidant value and total phenolic contents ranges were 11.38-19.11 ascorbic acid equivalents and 17.26-26.41% for seaweed pasta whereas, 19.01-28.55 ascorbic acid equivalents and 23.46-36.23%, respectively for green seaweed noodles. The present investigation can be used to develop extruded snacks incorporated with seaweeds to address the malnutrition.

Keywords: *Ulva reticulata, Ulva lactuca, Fortification, Nutritional qualities.*

FP3BP1

Literature study on the quality of salted and dried fishes in the coastal regions of Kerala

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Abstract

Fish is an easily spoiled highly perishable food which is easily digestible good source of nutrients. The common and one of the traditional methods of preserving fish to compensate for its perishability is salting and drying. This method is mainly practicing to extend the shelf life of excess catch in areas where other preservation mechanism like cold storage is rare, hence the quality of such products are uncertain especially microbial quality. The common quality check for dried fishes is analysis of moisture content, nutrient analysis, microbial quality and shelf life status. Among the dry fish consumers in Kerala, Ernakulam and Palakkad stands first (33% respectively), and then Kottayam (24%). The moisture content of the dried fish was high and low salt content in all the seasons that affects the quality of the dried fishes. In case of microbial quality, if it is dried enough then its having a good shelf life and low microbial load irrespective of the season. From the many research and review articles, it is suggesting that there is a need of revision in prerequisite programs and improvement in hygiene and sanitation practices during handling and processing of finfishes and shellfishes from landing centre to consumer table.

FP10BP2

**Sustainable utilization of vegetable waste in shelf-life extension of chilled
fish**

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Abstract

Bio-preservation is the rational exploitation of the antimicrobial potential of naturally occurring chemical compounds/microorganisms' metabolites in food for its extended shelf life. Any agent used for bio-preservation can be termed a bio-preservative. In post-harvest technology, bio-preservation aims at extending the storage/shelf life of food by utilizing plant-based product which has great potential to become a common use for most fresh fruits and vegetable. Fish is a rich source of protein, polyunsaturated fatty acids, several vitamins, and minerals is a highly perishable food commodity and in order to preserve fish many technologies have been developed. A combination of chilling and plant extracts can reduce spoilage and increase the shelf life of the product. Hence in the present study, fish fillets were initially treated with potato peel extract and then stored in ice for preservation. The antioxidant and antimicrobial properties of Potato (*Solanum tuberosum*) peel led to an increase in the shelf life of chilled fish fillets, as compared to the untreated samples.

Keywords: Bio-preservation, spoilage, shelf life.

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Sub-Theme 2: Novel foods and nutraceuticals



FN10A1

Insights from untargeted metabolomics on the effect of infrared drying and electrical oven drying of *Turbinaria conoides* (J. Agardh) Kuzing for nutraceutical application

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Abstract

Seaweeds in dried and powdered form have gained popularity as an ingredient in nutraceutical/dietary supplements. Drying of seaweeds prior to their processing prevents microbial attack, helps in their preservation and also serve the purpose of easy handling and storage. However, not much is known on how different drying techniques affect the phytochemical and nutritional composition of seaweeds. In this study, brown seaweed, *Turbinaria conoides* (J. Agardh) Kuzing, dried separately, using Infrared (IR) dryer and conventional electrical oven dryer was evaluated to find whether the two drying techniques had any significant effect on the phytochemical and nutritional composition of seaweed. Proximate composition of the dried seaweed samples exhibited no significant difference for crude fat (%) and ash content. Electrical dried sample showed higher crude protein content (12.67 %) as compared to IR dried sample (9.625 %). Water activity (a_w) of the dried seaweed powder from both methods were below acceptable level for microbial growth, $a_w = 0.6$ (IR dryer $a_w = 0.45$; electrical dried $a_w = 0.33$). Ethanolic extract of both samples exhibited no significant difference for DPPH scavenging activity, ABTS scavenging activity, total antioxidant assay and total flavonoid content ($p > 0.05$). However, total phenolic content was higher in electrical dried sample (18.83 ± 1.75 mg GAE/g) than IR dried sample (13.95 ± 1.06 mg GAE/g). Metabolites were profiled using LC-HRMS and further analysis was carried out using Progenesis Qi and SIMCA applications. IR dried and electrical oven dried samples clustered separately in the PCA score plot, indicating changes in phytochemical profile based on drying. From IR dried sample, and electrical oven dried sample, 22 and 20 significant compounds were identified respectively. Bioactive compounds such as phytosterols and carotenoids were abundant in IR dried sample, whereas glycerolipids and vitamin D derivatives were more in electrical dried sample. It is concluded that both drying methods could be used for drying seaweeds without compensating for its nutraceutical potential.

Keywords: Nutraceuticals, IR dryer, Electrical dryer, *Turbinaria conoides*, Seaweed bioactive compounds

FN13A2

Nutritional and safety evaluation of *Nannochloropsis oculata*, a marine microalgae for use as protein and antioxidant source in cookies

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Abstract

Recently, there is an ever-growing interest in the application of microalgae for the development of healthier, innovative, and attractive food products. *Nannochloropsis oculata* is a marine single celled microalgae having high levels of protein, polyunsaturated fatty acids, and antioxidant pigments. Freez dried *N. oculata* had 65% protein and the amino acid profiling indicated the presence of 17 amino acids. Fatty acid profiling indicated 18 major fatty acids starting from C12: 0 to C23:0. Total phenolic content of the freez dried algae was equivalent to 35.66 µg gallic acid/g. Total carotenoids is estimated as 230.3 mg/100g. Total chlorophyll content was 1.057 g/100 g which included 854.5 mg/100 g Chlorophyll a and 204.4 mg/100 g chlorophyll b. Cytotoxicity assay of *N. oculata* was performed in three cell lines and was found nontoxic. A technology was standardized for developing *N. oculata* fortified cookies (@1, 1.5 and 2%) with enhanced bioactive properties. Addition of microalgae into cookies increased the protein content from 5.25% (control) to 10.9 % (2% micro algae added cookies). The antioxidant activities such as singlet oxygen scavenging capacity, DPPH free radical scavenging activity, metal chelating and reducing power also increased with higher concentration of microalgae in cookies. Content of n-3 PUFAs was markedly higher in micro algae fortified cookies compared to control cookies. In-vitro protein digestibility of microalgae incorporated cookies was in the range of 89-91%. Though the lightness value of cookies with 2% *N. oculata* was significantly lower compared to control cookies, its acceptability was comparable to the later. The studies have proven that dried form of microalgae can be used as a functional ingredient in cookies to enhance its bioactivities.

Keywords: *Nannochloropsis oculata*, nutritional profiling, cookies, antioxidant activity, digestibility

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FN3B1

Emerging need and nutritional benefits of pseudo cereals

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Abstract

Pseudo cereals are non-cereals, which resembles the cereals in their usage and some of the properties. Pseudo cereals are promising crops of future due to their high genetic variability that is advantageous for them to be adapted to different environments from tropical to temperate climatic conditions. Pseudo cereals are a current trend in human diets as they are gluten-free (GF) grains and have an excellent nutritional and nutraceutical value. They are rich in starch, fibre and proteins of high quality with a balanced essential amino acid composition characterized by abundant amounts of sulphur- rich amino acids. They are also a good source of minerals (calcium, iron and zinc), vitamins, and phytochemicals such as saponins, polyphenols, phytosterols, phytosteroids, and betalains with potential health benefits. They are free from gluten content, so do they have many applications in gluten free formulations. These can be used as an alternative source of nutrition for people suffering from celiac disease. Some of the types of pseudo cereals are quinoa, amaranth, buckwheat, canahua, wattleseeds, breadnut, acorn etc. Pseudo cereals during processing are subjected to certain treatments which improves the nutritional profile by decreasing the amount of anti-nutrients and increasing the bio-availability of nutrients. Because of their high nutritional, medicinal and functional qualities, they have great potential to be utilized for the development of functional foods and prevention of various lifestyle diseases.

Keywords: Pseudo cereals, gluten free, celiac disease, anti-nutrients, functional foods



FN11B2

Extraction of bio-calcium from tuna fish bone powder, characterisation and development of calcium fortified wheat pasta

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Abstract

The work focused on the extraction of bio-calcium from fish bone resources of tuna bone via two standard extraction methods. The bones were treated with 2% alkali (NaOH) in order to remove the protein and fat and then treated with 1% hydrochloric acid and deionized water to neutralize the product. Then the residue was kept in hot air oven and pulverized. Enzyme extraction was also done with commercial papain enzyme from papaya latex in the ratio 1:100 (E:B). Proximate analyses of the fish bone powder developed by two methods were conducted using standard methods. Enzyme extracted calcium powder exhibited maximum values for moisture and ash contents while protein and fat contents were higher for alkaline extracted bone powder. FTIR technique was used for characterizing the various functional groups present with in the fish bone powder. Calcium content of the pulverized tuna fish bone powder was analysed by Inductively coupled plasma mass spectrometry (ICP-MS) and calcium content was highest for alkaline extract. Yield of the bone powder via two methods of extraction resulted better yield for alkaline method. Better results were obtained for alkali extraction and so the same was used for the development of calcium fortified wheat pasta. Pasta was developed using extrusion technology by incorporating 5% calcium fortified with wheat flour. The proximate composition of the blended pasta extrudes, water activity, and cooking quality were analysed. The sensory attributes of pasta products like colour, aroma, taste, texture, appearance, and overall acceptability were evaluated by panellists. Addition of calcium powder showed increase in proximate constituents (protein, fiber, fat, and ash) except in the case of moisture. The protein content progressively increased from 10% in normal wheat flour pasta to 20.34% in calcium fortified wheat pasta while fat content increased by 2%.

Keywords: Fish bone powder, Calcium, Fortified pasta, Water activity, Cooking quality

FN12B3 **β -chitin and chitosan from Squid pen: effect of cold extraction
method on its characteristic properties****Sarika.K^{1*}, Ashish Kumar Jha¹ and Sreejith S¹**¹Veraval Research Centre of ICAR-CIFT

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Abstract

India being one of the global exporters of frozen squid items concurrently contribute to the generation of enormous quantity of squid pen as industrial processing waste, which are actually an untapped resource of bioactive compounds. Squid pen is having a unique composition of non-mineralized skeletal elements comprised of β -chitin and protein. The classification of α and β chitin is based on its crystalline structure. The occurrence of β -chitin is rare and squid pen being a potential source was taken for the extraction of chitin-chitosan. Pen waste collected from seafood industries was cleaned, dried, powdered and characterized before utilized for chitin extraction. The dried pen powder with a moisture content of 8.62% constitutes about 61.57 % protein, 28% chitin, 1.4 % fat and 0.3% ash. β -chitin extraction was tried out with both extraction methods like hot and cold at different time and temperature combinations. The cold extraction protocol with extended deproteinization step was found to have better results when compared to hot extraction. Deacetylation was done with varying alkali concentration and max degree of deacetylation (DDA) obtained was 73.21% at 50% NaOH concentration. Maximum yield of 32-34% chitin and 25-28% chitosan was observed and the obtained chitin and chitosan was characterized. XRD analysis exhibit three diffraction peaks at 8.5, 19.9 and 26.4 showed the crystalline nature of the polymer. The maximum peak was observed as 19.996° with high intensity and FWHM at 0.16. When compared FTIR results, similar peaks in squid pen chitosan with different functional groups of organic compounds such as out-of-plane, bending (557 cm⁻¹), C–O–C stretching (892 cm⁻¹), and CH₂ stretching (1161 cm⁻¹) was observed like in normal chitosan. Both squid pen chitin and chitosan powder were having the characteristic white colored without bleaching treatments along with good yield properties. Low mineral composition unlike in other shrimps and crab’s exoskeleton helped in removing the demineralization step, making the process less chemical usage and more economic.

Keywords: Squid pen chitosan, cold extraction, deacetylation, waste utilization, β chitin

FN14B4

Effect of ensilation of seaweed on its physical and nutritional composition

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Abstract

A study was conducted to analyse the effect of ensilation on dry seaweed powder. Fresh seaweed was collected from Veraval beach, brought to the laboratory in wet condition and was repeatedly washed with sea water and fresh water to clean the adhering sand and epiphytes. It was then dried under shade and pulverized. The powder was kept for ensilation. Ensilation was carried under anaerobic condition with two different solutions. Rice water and Lab serum solution which was made by adding rice water in milk and kept 3 days for fermentation, finally filterate was collected and used for ensilation seaweed. After ensilation of seaweed for 30 days it was characterized for pH, colour, proximate composition, energy value, TPC and total *Lactobacillus* count. The result of the study reveals that the ensilation decreases the PH of the fermented seaweed from 7 to 5. The colour indices viz. L*, a*, b* values were also decreased with ensilation. The protein content shows a significant increase with the ensilation. It has increased from 17 to 22% in both the solutions. There was no significant difference observed in ash content, crude fat and nitrogen free extract. The total *Lactobacillus* counts were 7.76 log cfu/g in seaweed silage prepared with Lab solution and 7.23 cfu/g in the seaweed silage prepared with rice water. The overall study shows that the ensilation of seaweed enhances the protein content.

Keywords: Seaweed, Ensilation, Proximate composition, Lab solution, Rice water, *Lactobacillus*

FN15B5

Effect of dietary protein and lipid sources on flesh quality parameter of striped catfish, *Pangasianodon hypophthalmus* (Sausage 1878)

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Abstract

This study was conducted to examine the effect of dietary protein and lipid sources on flesh quality parameters of striped catfish, *Pangasianodon hypophthalmus*. Nine practical diets were formulated with dietary protein levels (25%, 30%, and 35%) and lipid sources (Fish oil, Soybean oil and combination of fish oil and Soybean oil). The muscle total Saturated fatty acids (SFA) and Monounsaturated fatty acids (MUFA) were significantly ($P<0.05$) influenced by the dietary lipid sources. The n-6 class of muscle fatty acids were significantly ($P<0.05$) changed with changes in dietary lipid source, dietary protein levels and interactive effect of dietary protein and lipid sources. The muscle content of total n-3 fatty acids of different treatment group was significantly ($P<0.05$) affected by protein level and lipid source.

Keywords: *Pangasianodon Hypophthalmus*, Lipid source, Protein, Flesh quality

FN2AP1

Biochemical and nutritional analysis of 3d printed fish product developed through fortification with marine lipids

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Abstract

Three-dimensional (3D) printing of foods is an emerging innovative technology which is capable of fabricating novel foods in terms of aesthetics and functionality. In this study, fish products were printed by incorporating fish oil from Indian oil sardine. Canned fish mince (*Coryphina Hippurus*), a binder, corn flour and oil were the ingredients used in the base mix. The base mix after evaluating the initial quality parameters, was loaded to the 3D Food Printer and fish design developed through CAD software was printed. The printed product weight was 5g each. Mass flow rate was assessed while printing, and it was found to be 1.01g/minute. Printing precision was found to be 85%. After printing, the printed product was baked at 210°C for 15 minutes. Shrinkage of the printed product upon baking was 25%. The baked products along with the base mix were evaluated for various quality attributes. The protein and fat content of the baked product was 32.27% and 14.52% respectively. The energy value of the product was 247.7KJ/100 g of the product. The results of fatty acid analysis indicated that the fortified product had essential fatty acids like EPA and DHA at greater amounts. EPA and DHA content were increased from 0.723 and 6.324 of canned fish mince to 7.714 and 7.794 respectively, of the baked product.

FN4AP2

**Preparation and characterization of a novel edible seaweed laver
from *Ulva reticulata* (Forsskal, 1775)**

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Abstract

The growing interest in laver as a food product and as a source of substances beneficial to health has gained attention in food industry. Seaweed laver, a dried edible product developed from green seaweed *Ulva reticulata* and analyzed for its nutritional composition and spectral characteristics. *Ulva reticulata* were obtained from the Mandapam coast, Tamil Nadu, which contains $6.710 \pm 0.423\%$ of protein, $0.255 \pm 0.105\%$ of lipid, $4.195 \pm 0.215\%$ of moisture, $27.333 \pm 1.527\%$ of ash ($P < 0.05$). Laver was prepared from the seaweed along with seasonings for flavor enhancement. Protein and lipid content of the obtained laver were $4.154 \pm 0.075\%$ and $21.220 \pm 0.710\%$ ($P < 0.05$) respectively. Moisture and ash content of the product were $1.046 \pm 0.112\%$ and $15.399 \pm 1.264\%$ respectively ($P < 0.05$). Moreover, the thickness and weight of the developed laver were $0.284 \pm 0.045\text{mm}$ and 3gm respectively ($P < 0.05$). Color of the resulting laver was affected differently. The addition of seasonings lowers the greenness (a^* - value) of the developed laver. Tensile strength, WVTR and hardness (texture) of the laver were 2.34MPa , 2152gr/m^2 day and 0.98 ± 0.10 respectively. The functional groups and secondary structure of developed seaweed laver were observed by FTIR spectra. Thus, the seaweed laver could improvise the market value of seaweed and improves the utilization of natural resources available from the sea.

Keywords: Laver, Seaweed, *Ulva reticulata*, Nutritional composition, Color, FTIR

FN6AP3

Development of fish sausages from Daggertooth pike eel *Muraenesox cinereus* (Forsskal, 1775) and its quality characterization

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Abstract

Muraenesox cinereus is a high protein eel species with about 60 % yield of meat. Despite its nutritional value it is being considered as a low valued species and commonly discarded as wastes. This study developed 3 different sausages from the eel fillets with varying vegetable fat content (1% , 5 %,10 %) , dietary fibres and evaluated the nutritional (protein, fat , moisture, ash , carbohydrates and energy value) , physicochemical (weight loss, shrinkage, water holding capacity, texture, emulsion, colour and water activity), microbiological and sensory characteristics . The prepared sausage samples were excellent in its nutritional and physical characteristics. The commercial fish sausages available in the market were used as control. The sausage samples with 60% eel meat and 5% vegetable fat were found to have increased cooking yield, less fishy flavour and scored well for all the sensory parameters evaluated when compared with the control. Addition of egg white to this proportion increased the protein content and lightness value of the sausage, apart from high chewiness and springiness. Concerning the physicochemical aspects, the textural attributes like hardness, springiness, cohesiveness, chewiness and gumminess were found to be comparable with the commercially available sausages. Peroxide value, oxidative stability and overall homogeneous nature of the of the prepared sausage samples stored under 4 degree Celsius were conducted with ATR-FTIR spectroscopy. The results showed that the eel sausage is better value added product and can be used as a healthy alternative to the conventional meat sausages.

Keywords: Eel sausages, ATR-FTIR spectroscopy, Textural attributes

Extraction and physicochemical characterisation of gelatin from the skin of eel *Muraenesox cinereus* (Forsskal, 1775)

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Abstract

Gelatin is commercially made from skins and skeletons of cattle and pig by different extraction methods. Bovine spongiform encephalopathy and religious reasons limited the uses of the same for human applications. In this study gelatin was extracted from the skin of marine Daggertooth pike conger eel *Muraenesox cinereus* (Forsskal, 1775). The yield of the extracted gelatin was found to be 12-16%. The absorption bands of eel gelatin in Fourier Transform Infrared (FTIR) spectra were mainly situated in the amide band region (amide A amide B, amide I, amide II and amide III). The eel skin gelatin showed excellent functional properties with foaming expansion of 168.57%, foaming stability 108.57%, 87.14% at 30 min and 60 min respectively, emulsion activity index of 19.068 m²/g and emulsion stability index of 9.495min. The water holding and fat binding capacity and viscosity were also analysed. Water holding capacities were at the range of 6ml/g-8.5ml/g, Fat binding capacity within the range of 4.81ml/g-5.2ml/g and Viscosity of extracted gelatin was 7.7 cP. The colour of eel gelatin powder showed L* 82.20, a*1.18, b* 12.29 and gelatin gel had colour of L* 71.46, a* 1.80, b* 4.71. The eel skins had relatively high gel strength, melting point, water-holding and fat-binding capacities as compared with other fish species and could be recommended as potential replacements for mammalian gelatin in the food industry.

Keywords: Gelatin, Eel, FTIR, Functional property, Colour

FN8AP5**Production and optimization of Fish Protein Hydrolysate from discarded skin of eel *Muraenesox cinereus* (Forsskal, 1775) and its antioxidant potential****Priyadarshini M. and Radhika Rajasree S.R.,^{1*}***Fish byproducts Lab, Department of Fish Processing Technology,**Kerala University of Fisheries and Ocean Studies, Panangad, Kochi - 682 506, Kerala, India***Email: radhikarajasree@kufos.ac.in; +91-98409 27503***Abstract**

Due to increasing demand, there is a fervent need to utilize the low value and underutilized fish species for applications in food and nutraceutical industries. This study aimed to prepare fish protein hydrolysate from the discarded skin of dogtooth spike eel by enzymatic hydrolysis using enzyme papain. The biochemical and functional properties were also looked in to. The protein content of eel skin to protein hydrolysate were increased from $24.41 \pm 0.02\%$ to $86.71 \pm 0.34\%$ at the same time fat content shown a decrease from $5.53 \pm 0.01\%$ to $0.69 \pm 0.12\%$. The functional groups and secondary properties of protein hydrolysate were identified by Fourier-transform infrared spectroscopy shows peak at 3284 cm^{-1} , 1638.50 cm^{-1} and 1536 cm^{-1} due to presence of OH group, amide and aromatic groups. The colour of protein hydrolysate showed $L^*79 \pm 0.53$, $a^*2 \pm 0.31$ and $b^*21 \pm 0.65$. Production of protein hydrolysate was optimized by Response Surface Methodology based on combined effect of temperature, time and Enzyme/Substrate ratio. The influential parameters including temperature (45, 50 and 55 °C), time(60, 90 and 120 minutes) and Enzyme/substrate concentration(0.5, 1 and 1.5 %) on dependent variables including Degree of Hydrolysis, Protein content, peptide chain length & antioxidant property. The maximum Degree of Hydrolysis obtained from 45 °C, 90 min and 1.5% was $10.18 \pm 0.15\%$. The obtained protein hydrolysate has improved functional and bioactive properties, so it has potential application in food product development and nutritional supplements.

Keywords: *Muraenesox cinereus*, Eel skin, papain, enzymatic hydrolysis, protein content, Degree of Hydrolysis

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FN1BP1

Tuna, a major seafood industry in Androth, UT of Lakshadweep

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Abstract

Byproducts obtained from tuna fish processing are important bio-resources that are utilized for applications in food, health-care products, and pharmaceuticals or as specialty feeds for fish and other animals. A promising alternative use of tuna fish by-products is as functional food ingredients. Fish protein hydrolysate (FPH), which is obtained through hydrolysis of tuna waste is used as an ingredient in food industries to provide functional properties such as whipping, gelling and texturing properties. The present study aims to analyze the local use of tuna fish byproducts in Androth, one of the major tuna landing islands of Lakshadweep.



FN5BP2

Evaluation of Fourier Transform Infrared Spectroscopy as a tool for the evaluation of structural properties of protein hydrolysates

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Abstract

FTIR (Fourier Transform Infrared) spectroscopy technique is one of the earliest experimental methods for the determination of secondary structure estimation of proteins and polypeptides. This is because of the comprehensive structural information originated from FTIR spectra, in which the repetitive amino acid building blocks of proteins and peptides that impart nine characteristic amide bands such as amide A, B and I-VII. The amide I band (1600 – 1700 cm⁻¹) occurs primarily due to C=O stretching and C-N stretching vibrations, amide II band (1500 – 1550 cm⁻¹) is due to N-H bending and C-N stretching vibrations and amide III band (1200 – 1300 cm⁻¹) occurs because of C-N stretching and N-H deformation. The secondary structure of protein was usually based on the amide I band analysis because of its strong and intense absorption peaks. Enzymatic hydrolysis is a well-recognized potential method for the valorization of food processing by-products. The examining of the process is yet an important challenge because of the existing conventional analytical methods which are not simply appropriate to industrial start-ups. The effect of degree of hydrolysis on the secondary structure showed the higher intensities of beta turn and beta sheet and lesser peaks for alpha helices structural components implying the exposure of hydrophobic amino acid residues. The results of the study demonstrate the potential of using FTIR for monitoring the changes in the secondary structures taking place during protein hydrolysis and also paving the way for determination of these changes in other applications.

Keywords: FTIR absorption spectra; Degree of hydrolysis; enzymatic hydrolysis; secondary derivative structure

FN9BP3

Food applications of chitin nanomaterials derived from crustacean shell waste

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Abstract

The crustacean processing industry generates millions of tonnes of shell waste annually. These shell leftovers contain chitin, the primary structural component of crustacean shells, which is a valuable component. Chitin, however, has limited food applications due to its insoluble nature, but when downsized into chitin nanomaterials in the form of nanocrystals and nanofibers finds wide application in the food industry due to its unique characteristics, including its small size, solubility, low density, high surface area, superior chemical reactivity, low toxicity, biodegradability, biocompatibility, antioxidant activity, antimicrobial properties, and excellent mechanical performance. Currently, chitin nanomaterials are being used as solid particles to stabilize Pickering emulsions, as an additive to enhance the quality and shelf life of foods, as a reinforcing agent in biopolymer films of both natural and synthetic origin, saltiness enhancer, as starch retrogradation inhibitor, and as a dietary fiber. The application perspective of chitin nanomaterials is relatively new. Therefore, more research is needed to expand its applicability in food and other sectors such as agriculture, medicine, cosmetics, and so on.

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FN16BP4

SeaFox – a blend of seaweed and millet milk

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Abstract

The "Health mix" refers to a blend of natural multigrains, such as millets, cereals, pulses, whole grains, and nuts, etc. It boosts immunity and gives energy for activities & growth. Since health mix is in a powder form, the nutrients it contains can be easily ingested by the human body. Seaweed is an macroalgae source of food, feed, and medicine. Especially in other Asian nations, edible seaweeds were often eaten either fresh, dried, or as a component of prepared foods. However, in the South Asian region, this bountiful natural resource is still underutilized. Sea vegetables especially Seaweed are low in calories, high in vitamins, minerals, dietary fibre, and PUFA (40% of their dry mass). In light of contrast, the millets also known as Nutria-cereals, are a fantastic choice for preparing health mixes. In dry and semi-arid areas of Asia and Africa, foxtail millet—a minor millet—is a significant crop for food and fodder grains. Weaning and geriatric diets that are high in vitamins, fibre, and iron can be made by blending it with milk. As a result, combining seaweed with foxtail millet milk would provide a snack that is higher in fibre, minerals, and phytochemicals, and that may be used to treat type II diabetes, genetic problems, and celiac disease. To increase the shelf life of the developed seaweed infusion on foxtail millet, ensure its stability, and make it easier to store and transport, it must be dried into a powder form. This developed novel healthmix is super nutritious, shelf stable, functional food on its nature and completely vegan, thereby helps in alleviate the nutrient deficient cause on commercial health mix.

Keywords: Health mix, Foxtail millet, Seaweed, Weaning and geriatric foods



WORLD FOOD SAFETY DAY, 2023

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Sub-Theme 3: Food safety, standards, and risk assessment



FS1A1

Private Food Safety Standards in Kerala Seafood Export Supply Chain

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Abstract

The strengthening of food quality and safety standards and regulations post-WTO coupled with the proliferation of private food standards and certifications in the import markets of developed countries impacted the dynamics of the Indian seafood export supply chain. Kerala, which pioneered the expansion of seafood exports in India and whose seafood exports are dominated by frozen shrimp and cephalopods, is proactively involved in the implementation of private standards and certifications such as ISO 22000, FSSC 22000, BRC, IFS, and GSA-BAP in the seafood exporting sector, either singly or in combination. The private standards play an important role in food safety governance and determining market access in international trade. In recent years there has been an increase in seafood certification and consumer labels in the European retail market. The seafood processors in Kerala who have the key responsibility of ensuring food quality and safety are increasingly adopting these standards. About 45 percent of the seafood processing companies in Kerala have implemented the private/voluntary food safety standards such as ISO 22000, BRC, FSSC 22000, BAP, and IFS. The research survey was conducted based on a sample of 92 seafood-processing firms in Kerala to determine the factors (motivation, constraints, costs, and benefits) that influence the implementation of these standards by seafood exporters in Kerala. Despite the Global Food Safety Initiative (GFSI) benchmarking and harmonization of these standards, nearly 20% of seafood exporting companies have implemented multiple food safety management systems in Kerala which substantiates the inadequacy of the purpose of GFSI benchmarked standards. The survey also revealed that the implementation of private food safety standards has mainly benefitted the exporters of high-value processed seafood in Kerala while posing serious trade impediments to those firms that export low-value products. Hence there is a need to develop a national food quality and safety standard that can be harmonized with the private standards proliferating in the market so that the advantages can be utilized by producers and processors of all food types and food businesses in India.

FS4A2**Trace metal variability in different matrix along Mangaluru, Dakshina****Kannada****Bindu Sulochanan*, Veena Shettigar, Shrinath B, Nagaraj Sommaya Gond, Naveen****Raju K.G. Naik and Dharmaraju L.B**

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Abstract

Studies by researchers have indicated the presence of trace metal in various matrix water, sediment and tissue (fish/tissue) along Karnataka Coastline. The study from 2017-2022 in Mangaluru in sediment and tissue matrix ANOVA showed highly significant yearly variability ($P < 0.0001$) in the trace metal of sediment collected from River (0-5 m water depth), Near Shore (5-10 m water depth) and Sea (10-40 m water depth) in metals As, Cr Cd, Cu, Pb and Ni. The levels observed were within the effect range medium (ERM) specified by Canadian Environmental Quality Guidelines Canadian Council of Ministers of the Environment, 1999. The mean trace metal in sediment (mg per kg dry weight) was Hg (0.45 ± 0.16), As (0.33 ± 0.15), Cr (53.87 ± 3.10), Cd (2.04 ± 0.18), Cu (6.32 ± 0.73), Pb (37.29 ± 2.33) and Ni (15.93 ± 1.0). In muscle tissue of fin and shell fish during 2017 to 2021 from 1330 samples analysed, the order of trace metal Hg (mg per kg dry weight) in different groups was Pelagic (0.19 ± 0.091) > Demersal (0.17 ± 0.06) > Mollusk (0.09 ± 0.024) > Crustacean (0.06 ± 0.022), As (mg per kg dry weight) Mollusk (1.50 ± 0.20) > Crustacean (1.09 ± 0.16) > Demersal (0.86 ± 0.21) > Pelagic (0.36 ± 0.12), Cd (mg per kg dry weight) Mollusk (7.38 ± 1.62) > Crustacean (4.0 ± 1.06) > Pelagic (2.86 ± 0.52) > Demersal (1.19 ± 0.28), Cu (mg per kg dry weight) Crustacean (7.59 ± 1.37) > Pelagic (5.69 ± 0.69) > Mollusk (4.34 ± 0.75) > Demersal (3.02 ± 0.90), Pb (mg per kg dry weight) Mollusk (3.32 ± 0.40) > Crustacean (2.6 ± 0.45) > Pelagic (2.42 ± 0.44) > Demersal (2.24 ± 0.29) and Ni (mg per kg dry weight) Mollusk (7.53 ± 2.23) > Pelagic (6.36 ± 1.81) > Crustacean (2.91 ± 0.53) > Demersal (2.50 ± 0.50). ANOVA showed the metals As, Cd, Cu, Pb and Ni significantly different ($P < 0.001$) yearly in the different groups, while between groups significant difference was not observed in metals Hg, Cu, Pb and Ni. Though the levels observed are within the permissible limit of WHO standard 1987 for fish and seafood for on dry weight basis with changing land use pattern there is a need for constant monitoring along the coast. There needs to be a balance between trade and conservation, ports and special economic zones are the needed and hence sustainable development depends on the application of better scientific knowledge and adopting energy efficient infrastructure facilities. The economic security of the coastal community is depended on the transition of trace metal from one matrix to another in today's changing food consumption patterns. Hence, a more area based inter disciplinary approach taking into account the hydrology along with awareness may aid in better conservation and sustainable development of our ecosystem. The coastal areas are influenced by diverse anthropogenic activities and the interest of different sectors. Be it poisoning due to harmful algal blooms or trace metal residues better standards need to be adopted as more products are going to be utilized from the sea as food.

FS6A3

Untargeted lipidomics approach using liquid chromatography - Orbitrap high resolution mass spectrometry for shrimp Geographical authentication.

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Abstract

The global seafood trade traceability mechanism includes mandatory disclosure of species identity, production technique, and geographic origin. High resolution mass spectrometry based lipidomic fingerprinting and chemometrics is an emerging technique for authentication of seafood traceability. The study investigates lipidomic profiles based on liquid chromatography-Orbitrap high resolution mass spectrometry for authentication of *L. vannamei* from various geographical origins including Thailand, Vietnam, India, and Honduras. The Exploris-120 Q-Orbitrap with a heated electro spray ionisation (HESI) ion source hyphenated to a UPLC was utilised for the lipidomics profiling of the shrimp in both positive and negative mode. Progenesis Qi, MetaboAnalyst, and SIMCA applications were used to further analyse and build chemometric models. PCA, orthogonal partial least square discriminant analysis (OPLS-DA), and partial least square discriminant analysis (PLS-DA) models were developed for the authentication of geographical identity. The developed OPLS-DA ($R^2X=0.943$ and $Q^2=0.927$) and PLS-DA ($R^2X=0.913$ and $Q^2=0.928$) models showed good fitness and a correctness score of 100%. The effective phospholipid biomarkers for species differentiation includes PE (20:5/P-18.0), GPCCho (22:6/18.0), Ceramide (d18:1/16.0), GPETn (22:6/18:2), (19R)-25-Amino-22-hydroxy-22-oxido-17,21,23-trioxa-22 lamda-5-phosphapentacosan-19-yi palmitate. LC-HRMS based Lipidomic profiling is an advanced technique for authenticating seafood traceability with potential applications in food safety sector.

Keywords: Mass spectrometry, Untargeted-Lipidomics, Authentication, Food fraud, Chemometrics

FS7A4

**Development and validation of an analytical method to determine
Emamectin Benzoate as mixture of emamectin b1a and emamectin b1b in
fish using QTRAP Mass Spectrometry**

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Abstract

Emamectin benzoate (EB) is commonly used as an anti-parasitic agent in aquaculture. It is classified as a second generation foliar insecticide derivative of abamectin and contains a mixture of two avermectin homologues. In this study residue analysis of Emamectin benzoate in fish matrices (skin and muscle, liver, kidney, plasma, intestine) was developed using QuEChERS and QTRAP Liquid chromatography tandem mass spectrometry (LC-MS/MS). Good linearity with R² value > 0.99 observed in the range of 5 - 200 µg/mL for this analyte. The method is validated as per European Union 96/23/EC in terms of sensitivity, specificity, linearity, accuracy, precision, and reproducibility. LOD and LOQ established as per Eurachem guidelines and CC_α and CC_β was established as per EU 657 EC and calculated based on the Maximum Residue Limit (MRL). The prescribed limit of MRL should be less than 100 ppb in fish and fishery products. The developed extraction protocol was employed for the determination of emamectin in different fish species such as *Pangasianodon hypophthalmus*, *Oreochromis niloticus*, *Trachinotus blochii*, *Labeo rohita* and *Oncorhynchus mykiss* after feeding trails carried out in laboratory experimental models.

Keywords: Emamectin B1a, Emamectin B1b, Insecticide, LC-MS/MS, Validation, fish matrix

FS9A5

Verification studies on alternative rapid technique for enumeration of yeast and mold in two distinct food matrices.

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Abstract

Yeasts and molds are able to grow in a large variety of food including raw materials as well as processed products. They are responsible for visible or non-visible defects, such as off-odor and flavor, and lead to significant food waste and economic losses. FSSAI mandates the enumeration of yeast and mold as a hygiene indicator in microbiological criteria of quality for almost each and every food matrix. The current study is a compilation of two separate studies done on alternative Petrifilm Rapid Yeast and Mold (RYM) Count Pate method versus standard methods in spices and eggs powder samples. No significant statistical difference was observed between Petrifilm RYM Count with five spices matrices versus BAM Chapter 18 nor Petrifilm RYM Count with egg powder versus ISO661 method. The 3M Petrifilm RYM Plate method demonstrated reliability as a rapid alternative for the enumeration of yeast and mold in 48 hrs. at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ in spice matrices in comparison to egg powder enumeration of yeast and mold in 60 hrs at $28^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Petrifilm plates use less glassware and equipment and take up less lab bench and incubator space compared to the traditional methods, thereby providing a faster, easier route to results. Petrifilm plates are easy to read as the indicator dye components offer better contrast to facilitate and additionally delivered results in about half the time of traditional agar methods.

FS13A6

Virulence of *Escherichia coli* isolated from seafood

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Abstract

The microbiological quality and safety of seafood are gaining much importance day by day owing to increasing awareness of consumers regarding the potential health risk associated with the consumption of contaminated seafood. Seafood contamination with pathogenic *Escherichia coli* poses a potential health threat to consumers as different pathogroups can cause a wide spectrum of diseases in humans. The present study was conducted to investigate the prevalence of pathogenic *E. coli* in seafood in the landing centres and the retail markets in Mumbai and characterize them for their virulence genotypes. Multiple selective-enrichment-isolation protocols were used for the isolation of pathogenic *E. coli* from a total of 78 seafood samples. The recovered *E. coli* isolates were biochemically identified and the virulence genes associated with each pathogroup were screened by PCR. Among 78 samples, 55 samples comprised 29 finfish and 26 shellfish harboured pathogenic *E. coli*. Out of 639 *E. coli* isolates, 180 *E. coli* isolates were found potentially pathogenic which carries one or more virulence genes characteristic of pathogenic *E. coli*. The enterohemorrhagic *E. coli* (EHEC) group (118/180) was the predominant pathogroup, followed by enteropathogenic *E. coli* (EPEC) (25/180), enterotoxigenic *E. coli* (ETEC) (20/180), enteroaggregative *E. coli* (EAEC) (16/180) and enteroinvasive *E. coli* (EIEC) (1/180). The faecal contamination of seafood through land runoff or the direct discharge of untreated sewage into water bodies results in contamination of seafood with this pathogen. It is essential to develop strategies to avoid faecal contamination of seafood to make seafood safe for consumption.

Keywords: Seafood, Pathogenic *E. coli*, EHEC, EPEC, ETEC, EAEC and EIEC

FS14A7

Non-destructive freshness assessment of Indian Mackerel using Convolutional Neural Network

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Abstract

The study focuses on the development and implementation of an algorithm which is capable of grading the freshness of fish using Convolutional Neural Networks (CNNs). The variations in the eye region of fishes indicate different stages of edibility and spoilage of Indian Mackerel. These variations are interpreted using feature extraction by convolutional layers. The fresh fish samples were subjected to storage under iced Good Manufacturing Practice (GMP) conditions for 15 days. The K-value, psychrophilic count and data acquisition of fish samples were performed to obtain valid reference data for classification and algorithm development. The acquired image dataset was augmented by varying Hue, Saturation, Contrast, Blur, Brightness, Reflection and Gaussian Noise. The augmented dataset is used for training, optimization and regularization of the CNN model. The test images of Mackerel are then collected for performance evaluation of the resulting model in predicting the day of storage and grading the freshness of fish into Extremely Fresh, Fresh or Spoiled. The training, validation and test accuracies of the model are 84.5 %, 74.72 % and 74.28 % respectively. The methodology can be adapted to different fish species and can provide practical solutions to consumers for the freshness assessment of fish.

Keywords: Data Augmentation, Feature Extraction, K-value, Psychrophilic count, Deep learning.

FS16A8

Microbial changes of white snapper (*Macolor niger*) packed under different packaging conditions during chilled storage

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Abstract

Fresh fish of prime quality is more delicious, rich in essential dietary components and are mostly preferred. Quality of fish can be ascertained by different preservation techniques such as chilling, freezing, drying, canning and pickling. Among them, fish stored by chilling is highly essential for preventing early spoilage and also for enhancing shelf life of fresh fish. Microbial spoilage is one of the main reason for unacceptability of fish in chilled condition. It is necessary to enumerate microbial populations in ice stored fish to determine the species of bacteria which causes rapid spoilage of fresh fish. In this present study, bacterial enumeration was carried out during chilled storage of white snapper fish (*Macolor niger*) under different packaging atmosphere for a period of 16 days. Fresh fish steaks were washed in ice cold water and 100 g was packed in three different packaging conditions. First batch of fishes were packed in air packaging, second batch of steaks were packed under vacuum packaging conditions and the final batch of fillets were packed using oxygen scavenger. All the batch of packets were stored with subsequent layers of flake ice and kept under chilled conditions (2-4 °C). The following microbial parameters were enumerated: Aerobic plate count (APC), Psychrophilic count, Pseudomonas count, Brocothrix count, H₂S producing bacterial count, Lactobacillus count, Enterobacteriaceae count, *E. coli*/coliform count and *Staphylococcus aureus* count by following standard methods. Fish was found in fresh condition in the batch stored in Vacuum and oxygen scavenger packing conditions compared to normal air packed fish steaks up to 13 days for the microbial parameter *i.e.* APC, where FSSR limit of fresh chilled fish was 10⁷ CFU/g. Later on 16th day of storage the APC count exceeded over the limit prescribed for chill stored fish. Similarly, Psychrophilic count, Pseudomonas count, Brocothrix count and H₂S producing bacterial counts showed initial decreasing trend up to 2nd day of storage and there after increased significantly. All the four kinds of microbes played a significant role in fish spoilage with Psychrophilic bacteria being the dominant one. No significant change was noticed in other bacterial counts such as Lactobacillus count, Enterobacteriaceae count and coliform counts for all the samples. Microbes such as *E. coli* and *S. aureus* were completely absent in all types of samples indicating no contamination occurred during storage study. This study indicates that fish packed under Vacuum and with oxygen scavenger conditions were found fresh upto 13 days compared to only 9 days under normal air pack and Psychrophilic bacteria played a prominent role in fish spoilage followed by H₂S producing bacteria.

Keywords: Microbial quality, Chilled storage, Air packing, Vacuum packing, oxygen scavenger packing, Psychrophilic bacteria

FS19A9

**Screening and identification of allergens in giant freshwater prawn,
humpback nylon shrimp and green tiger prawn**

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Abstract

Food allergens are emerging as one of the important group of hazards in recent times due to its widespread occurrence among most countries and also have recently received increasing attention from the food industry, legislative and regulatory agencies. Food allergy is an adverse health effect arising from a specific immune response. Allergies due to fish and shellfish are common food allergies and in fact, occupy a place in the FAO classification of allergens. Seafood can cause immediate (type I) food hypersensitivity in sensitive individuals. A study was carried out to identify the allergic proteins in giant freshwater prawn (*Macrobrachium rosenbergii*), humpback nylon shrimp (*Heterocarpus gibbosus*) and green tiger prawn (*Penaeus semisulcatus*). Screened and identified the allergic proteins in raw and cooked form. Muscle proteins were profiled by SDS PAGE and identified immunoglobulin reacting proteins by immunoblotting. Tropomyosin of 37 kDa and hemocyanin of 75 kDa are identified as major allergens in raw and cooked extracts of *M. rosenbergii* and *P. semisulcatus* whereas tropomyosin of 37 kDa was identified as major allergen in *H. gibbosus*.

Keywords: Food allergy, allergen, shrimp, tropomyosin, hemocyanin

FS21A10**Migration study of packaging materials for assessing chemical contamination and safety of packaged takeaway food****^{a*}Remya S., K. Sathish Kumar^a, Mohan C.O^a, J. Bindu^a and Tanweer Alam^b**^aICAR-Central Institute of Fisheries Technology, Cochin-682 029, Kerala, India^bIndian Institute of Packaging, Andheri East, Mumbai, Maharashtra 400093, India

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Abstract

The rapid growth of food delivery services in India has led to an increase in the use of plastic packaging for takeaway food. But the use of plastic packaging materials has raised concerns about potential health risks associated with human exposure especially when used for hot filling applications. The chemical additives in plastic packaging materials such as phthalates and bisphenol A (BPA), which have been identified as endocrine disruptors, can be migrated into the food. High food temperatures can potentially exacerbate the health risks associated with plastic packaging materials. Hence, in the current study, packaging materials, both pouches and containers intended for packing freshly cooked takeaway food at high temperatures were collected from Kochi, Kerala, India for safety evaluation by migration study. The plastic food packaging materials collected were polypropylene pouches & containers, pouches of metalized polyester laminated with polypropylene (Silver pouch/Aluminium foil pouch/Foil pouch/Food parcel pouch) and low-density Polyethylene pouches. Initially, the packaging materials were identified using FTIR (Fourier-transform infrared spectroscopy) and DSC (Differential Scanning Calorimetry). The overall migration from the collected packaging materials into different food simulants was tested as per IS 9845. None of the packaging materials crossed the prescribed overall migration limit of 60 mg/kg or 10 mg/dm² for plastic and there was also no visible colour migration. Migration of bisphenol-A (BPA) was tested using HPLC and the leaching of heavy metals from packaging materials was checked by ICP-OES. GC-MS was used for testing Phthalic acid, bis(2-ethylhexyl) ester (DEHP). Distilled water was used as the food simulant. Migration of DEHP and BPA were not detected in any of the materials tested.

Keywords: Phthalates, Bisphenol A, FTIR, DSC, Specific migration

Sodium benzoate content of fish pickles marketed in India

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Abstract

Sodium benzoate (E211) is very commonly used preservative in acidic foods such as pickles, fruit juices, jams, jellies, carbonated drinks, to inhibit the growth of yeast, mold and many bacteria. The acceptable daily intake (ADI) fixed by the joint FAO/WHO expert committee on food additives (JECFA) for sodium benzoate is 0-5mg/Kg body weight and the maximum allowable limit fixed by European Union regulation is 0.1%. As per the Food Safety and Standards Authority of India, the maximum recommended level of sodium benzoate in fish pickle is 200mg/Kg. However this preservative can cause health risk to consumers due to its genotoxic and mutagenic effect if it exceeds the recommended limits. Hence a study was conducted to evaluate the level of preservative, sodium benzoate in commercially available fish pickles in India. Sixty-five samples were analyzed using high performance liquid chromatography (HPLC) and compared with the Indian regulation FSSR 2011. The mean concentration of sodium benzoate was found to be 895.09 ± 111.02 mg/Kg, which is more than the permissible level. This could be a risk factor for health of the consumers. Therefore, rigorous monitoring and awareness about the safe use of preservatives among different sectors are required to ensure food safety.

Keywords: Sodium benzoate, Fish pickle, Preservative, Food Safety

FS25A12

Efficacy of Carbon Nano dots from fish scales for ensuring hygiene and sanitation in fish/food contact surfaces

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Abstract

Carbon Nano dots (CND) were prepared from scale of fish rohu (*Labeo rohita*) by hydrothermal method. Carbon dots are an emerging type of nanomaterial for the identification and inactivation of various bacterial species. These materials are chemically stable, water-soluble, and have outstanding photoelectric characteristics. They are also less toxic and have increased biocompatibility. The antibacterial activity and minimum inhibitory concentration (MIC) of carbon nanodots prepared were evaluated on various microorganisms. The antibacterial activity of prepared carbon nanodots was determined by using the Kirby-Bauer well diffusion method, where it was evaluated by observing the inhibition test zone formed around the antibiotic well to determine if the microorganisms were susceptible to the carbon nanoparticles on the agar plate. The minimum inhibitory concentration needed to kill most viable microorganisms after 24 hours of incubation was also determined by using macrodilution and microdilution (ELISA test) methods. The efficiency and period of effectiveness of carbon nanodots as a sanitizing agent on different fish contact surfaces were also studied. The challenge study was conducted with faecal indicator organism *E. coli* (gram negative) and hygiene indicator organism *Staphylococcus aureus* (gram positive) on seven fish contact surfaces that are used in fish/food value chain. The matrices used were Glass, Aluminium, Stainless steel, Tile, Concrete, plastic and wood. The CNDs were found to be effective against both *E. coli* and *Staphylococcus aureus*. Gram-negative microorganisms are more susceptible to carbon nanodot than Gram-positive microorganisms, and the active concentrations are 30 $\mu\text{l/ml}$ and 40 $\mu\text{l/ml}$, respectively. Significant ($p < 0.05\%$) reduction in bacterial load on food contact surface revealed the possibility of utilizing CND from fish scales, as disinfectant on different matrices in fish handling and processing sector. The study has opened up the avenue for fish scales which are considered as waste.

Keywords: Carbon Nano dots, disinfectant, challenge study, fish contact surfaces

FS26A13**Biomonitoring of micropollutants from Black clams (*Villorita cyprinoides*)
in Vembanad estuary, India: Human Health Risk Assessment using an
untargeted metabolomics approach****Niladri Sekhar Chatterjee^{1*}, Nasreen Nazar^{1,2}, Satyen Kumar Panda¹, and Femeena
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Abstract

The propensity of estuarine bivalves to bioconcentrate micro-pollutants makes them an excellent indicator organism for detecting environmental pollution. Vembanad Estuary, a region on India's south-west coast is an ecologically sensitive biome and an important Ramsar site. This study investigates the presence of a diverse range of micro-pollutants in black clams (*Villorita cyprinoides*), which are collected from ten different sites in and around the Vembanad Estuary. A large scale multiresidue method involving GC-MS/MS and LC-MS/MS analyses determined the micropollutants in raw, depurated, and cooked samples of black clam. The result shows that, at least one of the targeted micropollutants is observed in 97.28% of raw samples and 83.2% of cooked samples. Some of the significant detections included biphenyl (87.25%, 5.079 - 271.871 ng/g), fluorene (64.94%, 5.05 - 114.72 ng/g), 2-phenyl phenol (43.43%, 5.10 - 72.08 ng/g), and bisphenol A (31.87%, 5.83 - 227.23 ng/g). The seasonal and spatial comparison done via PCA shows higher contamination during premonsoon. Based on these detected levels of micropollutants in cooked clams, human health risk assessment was performed using Estimated Daily Intake (EDI) and the Target Hazard Quotient (THQ). The results of the risk assessment study indicate significant human health risk as the cumulative Hazard Index (HI) value was determined to be more than 1. Further risk assessment was carried out in an environmental metabolomics approach. The environmentally relevant concentration of the detected PAHs in clams was induced in animal exposure tests for 60 days to imitate the true nature of exposures. A number of crucial biomarkers were discovered, including phospholipids, fatty acyls, sterol lipids, and amino acids. Purine metabolite suppression is tied closely to cell damage and DNA synthesis interference. Similarly, downregulation of aromatic amines involved in catecholamine synthesis could be linked to a disruption in the hormone production pathway. According to our research, long-term low-dose exposure may have an impact on a number of metabolic processes, including those for purine, phenylalanine, tyrosine, and cholesterol, which may result in metabolic disorders.

Keywords: Micropollutants, Environmental metabolomics, Purine metabolism, Risk assessment, Hazard Index

FS27A14

qPCR assay optimization and efficacy of dyes for detection of *Vibrio cholerae* in seafood

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Abstract

Seafood has gained importance in the recent years because of nutritional significance and high consumption by people across the globe. Safety of seafood is a major concern for the consumers as well as seafood processing industries. Among the pathogenic *Vibrio* species, *V. cholerae* is regarded as an important bacterial pathogen and its detection in seafood is a challenge. In this study, Real time PCR method was optimised for *V. cholerae* detection targeting *hlyA* gene (178 bp). The annealing temperature of 55 °C was found optimum for amplification and melt curve was constructed. Among 182 presumptive identified *V. cholerae* isolates, 38 isolates were confirmed as *V. cholerae*. The specificity of this method (exclusivity and inclusivity) was carried out against different ATCC bacterial strains. The efficacy of two dyes namely SYBR green and evagreen dye in qPCR assay resulted no significant differences between the two dyes but more specificity was found in case for evagreen. The Limit of detection of 1 CFU/g by Real time PCR was found in spiked shrimps and fish samples. This specific method can be adopted by testing laboratories for rapid detection of *V. cholerae* in seafood in reduced time to ensure seafood safety.

Keywords: *V. cholerae*, qPCR, *hlyA* gene, SYBR green dye, Amplification curve

FS28A15

Quality and safety assessment of salted dried fishes available in Saurashtra coast

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A study was conducted to evaluate the quality and safety of salted dried fishes available in the retail markets of Saurashtra coast. A total of sixty dried/salted and dried fish samples were collected from Veraval, Porbandar, Okha and Diu. The quality and safety was assessed using a set of microbial and biochemical parameters. The study found about 46.6% of the samples aerobic plate count was above the FSSR limit of 5 log cfu/g. Yeast and mold count of all samples above the acceptable limit (2.69 log cfu/g) except in Bombay duck. *E. coli* was detected in gold spotted anchovy and crocker but within the limits (20 cfu/g). *Salmonella* was not detected in any of the samples. Twenty one samples acid insoluble ash was above the limit (1%). The heavy metals such as As, Cd, Pb and Zn was also evaluated. Presence of As was observed in 25 salted dried fishes with maximum of 3.6 ppm. None of the samples crossed the limit of 76mg/kg (FSSR, 2011). Cd was detected in 23 samples out of 60 samples collected and about 20% of the samples Cd was above 0.3mg/kg. The Pb content crossed the limit of 0.3mg/kg (FSSR, 2011) was observed only in 2 samples. The study found that only 33.3% of the dried salted samples were complied as per FSSR 2011. This study highlights the importance of imposing stringent measures on hygiene and sanitary practices during processing and drying to ensure the safety of salted dried fishes in market.

Keywords: Dried fish, APC, Quality, Safety

FS28A16

Investigation of hemolysin genes in *Vibrio alginolyticus* isolates of seafood origin

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Abstract

Food-borne diseases are a widespread and growing public health problem. *Vibrio* is one of the most important food-borne pathogens causes very huge loss in fish harvesting sector. Next to *V. parahaemolyticus*, *V. alginolyticus* is having potential to cause disease which is more in marine aquaculture industry. This study was aimed to isolate *Vibrio alginolyticus* from seafood and coastal environments and to study the biochemical characteristics, thereby to determine the occurrence of *V. alginolyticus* in the sea food and marine environment. A total of 92 samples (Fish -42, shellfish -30, water -12 and sediment -8) were collected from aquaculture ponds, and hatcheries in and around the brackish water farms of Cochin areas. Molecular level screening was done by PCR using species specific collagenase gene, hemolysin genes (*tlh*, *trh*, and *tdh* genes of *V. parahaemolyticus*). Out of 68 isolates, only 16 isolates representing 16 samples were confirmed biochemically as *V. alginolyticus*. PCR assay targeting collagenase gene resulted in the amplification of expected amplicon size of 737 bp in 14 isolates. Out of the 14 *V. alginolyticus* isolates, *tlh* gene was detected in 9 isolates and one isolate was positive for *trh* gene in which amplicon size is above than the expected size of 500 bp. The amplification of *tlh* gene in *V. alginolyticus* may lead the inadequacy of the species-specific marker of *V. parahaemolyticus* in the event of surveillance of epidemiological investigations.

Keywords: *V. alginolyticus*, Hemolysin genes, PCR, Collagenase gene, Seafood

FS2B1

Aeromonas infections in Indian major carp, *Labeo rohita* from farm ponds of Andhra Pradesh, India: Antimicrobial resistance and possible health risk

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Abstract

Aeromonads are widely distributed in aquatic environment which is considered as important vehicle of Aeromonas infections to fish and humans. Aeromonads are etiological agents of major bacterial fish diseases like haemorrhagic septicaemia, skin ulcers, fin/tail rot and dropsy in fishes and some species causes gastroenteritis, septicaemia, peritonitis, meningitis and eye infections in humans also. In the present study Aeromonas species were isolated from diseased freshwater fish *Labeo rohita* collected from farm ponds of Andhra Pradesh, India. A Total of 11 Aeromonas spp. were isolated, of which *A. veronii* bv. *veronii* (35%) was most dominant species. Antimicrobial resistance and multiple antimicrobial resistance (MAR) of isolated Aeromonas spp. were tested against 17 antibiotics being frequently used for human diseases. The Antimicrobial resistance of all isolates have shown significantly high ($p < 0.05$) resistance (100%) to ampicillin, amoxyclave and oxytetracycline. The MAR index of Aeromonas spp. ranged from 0.18-0.76, which indicates origination of isolated Aeromonas spp. from high risk sources of human contamination. Some isolates of present study viz., *A. hydrophila*, *A. veronii* bv. *sobria*, *A. veronii* bv. *veronii*, *A. schubertii* and *A. jandaei* were found to be pathogenic to humans also. The results revealed the pathogenic potential of Aeromonas infections in freshwater fish culture with emerging threat to public health.

Keywords: *Labeo rohita*, *Aeromonas* species, Biochemical characterization, Antimicrobial resistance, Multiple antimicrobial resistance

FS3B2

Survival characteristics of *Salmonella enterica* on fish and shrimp at low temperature storage

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Abstract

Multiple reports have indicated the presence of *Salmonella* bacterium in exported seafood from India, making it obvious that the bacteria can survive low temperature storage. Fish (*Harpadon nehereus*) and shrimp (*Parapenaeopsis stylifera*) samples were spiked with two concentrations (8 log CFU/g and 4 log CFU/g) of *S. enterica* inoculum. They were subsequently stored in frozen ($-18\pm 2^{\circ}\text{C}$) and chilled conditions ($1\pm 2^{\circ}\text{C}$). Viability of the bacteria was estimated by surface plating method on selective agar plates. In fish and shrimp samples inoculated with 8 log CFU/g, viable counts could be recorded up to 90 days of frozen storage. While the fish samples inoculated with 4 log CFU/g, survivability was recorded for 60 days, meanwhile in shrimp samples, the bacteria survived only up to 15 days. *Salmonella* inoculated fish and shrimp samples were stored in chilled conditions and their viability was monitored for fifteen days. At an inoculation level of 8 log CFU/g, an overall reduction of average 2 log CFU/g was observed in fish and shrimp samples during the fifteen days of storage. Viable counts for samples inoculated with 4 log CFU/g, could be observed for 11 days in fish samples and for seven days in shrimp samples at chill storage. The observations made in this study, indicates that the survivability of *S. enterica* in low temperature storage is dependent on the food matrix, level of inoculation and the storage temperature.

FS15B3

**Bioaccumulation of microplastics in humans through seafood –
implications for food security**

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Abstract

Plastic had become the most ubiquitous man-made product in the environment due to the extensive use of their products in everyday life. Discarded fishing craft, plastic bags, food containers, and plastic drink bottles pollute the water ecosystem. Microplastics have a wide range of buoyancy due to their varying densities, rendering them widespread in water and soil. Due to the small size, microplastics are easily ingested by organisms and bioaccumulated to higher trophic levels through food chain. The ingestion of microplastics by organisms cause physical damage and also increases the risk of toxicity. Fish is a good source of animal protein as it has a higher satiety value than other proteins, the prevalence and ecotoxicological effects of microplastics in fish may influence aquatic food security. Most humans ingest a significant amount of microplastic and even Nano plastic particles through food, particularly through the consumption of fish and other seafood. This review main aim is to address the sources of microplastic pollution in India affect aquatic ecosystems and to discuss their ingestion by aquatic organisms and to evaluate the potential health concerns of biomagnification.

Keywords: Microplastics, Buoyancy, Toxicity, Bioaccumulation, Biomagnification

FS17B4

New insights into promising antibacterial activity of *Ulva lactuca* against *Pseudomonas aeruginosa*

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Abstract

The increasing evidences of resistance in bacteria against lifesaving antibiotics raised an urgent need to identify novel natural bioactive compounds with therapeutic potential. Seaweed, under the marine macroalgae category, offers a valuable source of bioactive compounds with nutritional and medicinal purposes. *Ulva lactuca*, green seaweed is well known for its wide range of bioactive compounds with anticoagulant, immunomodulation, antihyperlipidemic, anticancer, antiviral and antioxidant properties. Information on the antibacterial potential of *Ulva lactuca* is still limited. Therefore, the present study aimed to prepare hot water extract from green seaweed and to evaluate its antibacterial potency against Gram-negative and Gram-positive human and fish pathogenic bacteria *in-vitro*. *Vibrio parahaemolyticus* (ATCC® 17802™), *Klebsiella pneumonia* (ATCC® 700603™), *Edwardsiella tarda* (ATCC® 15947™), *Pseudomonas aeruginosa* (ATCC® 10145™), *Aeromonas hydrophila* (ATCC® 35654™), *Salmonella* Typhimurium (ATCC® 23564™), *Escherichia coli* (ATCC® 10536™), *Proteus mirabilis* (ATCC® 12453™), *Proteus vulgaris* (ATCC® 33420™), *Vibrio mimicus* (MTCC® 11435™), *Vibrio cholerae* 0139 (MTCC® 3904™), *Enterococcus faecalis* (ATCC® 29212™), *Listeria monocytogens* (ATCC® 19115™) and *Staphylococcus aureus* (ATCC® 29213™). *Pseudomonas aeruginosa* turned out to be the most susceptible to *Ulva lactuca* extract. The antibacterial effect was compared with 17 different clinically important antibiotics. MIC and MBC were determined and found that *Ulva lactuca* is a promising source of bioactive compound with significant antibacterial potential.

Keywords: Seaweed, Antibacterial activity, *Pseudomonas aeruginosa*

FS20B5

**Determining the factors affecting consumer willingness to pay for sea
food safety decisions in Texas, United States**

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Abstract

Food safety and consumer satisfaction have become one of the critical issues being discussed across the globe. The process of producing the food is changing and the demand for safe food is also increasing. These demands are challenging the food system to emphasize more on their needs and to meet their demands on healthy, safe, and environmentally sound food products. A study was conducted to evaluate the consumer perceptions on food safety issues and the factors affecting consumers' willingness to pay when the information on food safety changes in Texas. Texas was considered as the site of study due to its diversity and influx of population in recent years. To accomplish the objectives, focus group discussions were conducted to find out the baseline information. Using that baseline information, a survey was designed and implemented to collect the data. The major portion of the consumers were either neutral or disagreeing with the food safety issues which includes voluntary recalls after encountering food safety issues, same standards of farmers market and supermarket, protection from food borne illness, and same standard of farm fish and wild caught fish demonstrating a knowledge gap providing the spaces for policy recommendation. Multinomial logistic regression was conducted to identify the factors affecting consumers' willingness to pay under company recalled, United States Department for Agriculture (USDA) recalled, Hazard Analysis Critical Control Point (HACCP) controlled and blockchain technology controlled seafoods. It identified the education level and perception have positive impact consistently. Further consumers were willing to pay extra price for food safety was also found significant. However, the elderly consumers (50 and above) were not willing to pay for food safety decisions.

FS23B6

**Bacteriophages as biocontrol agents for augmenting Food safety:
Observations using Coliphage Cocktail for controlling Escherichia coli on
shrimp**

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Abstract

Lytic bacteriophages are viruses that specifically kill target bacteria and have been increasingly recognized as biocontrol agents for protecting the post-harvest quality and ensuring food safety. A coliphage cocktail was prepared using equal quantities of 10 phages that specifically target *E. coli*. Marine shrimp (headless, 10g) were spiked at three different concentrations of *E. coli* viz., 10,000 cfu/g (B1), 2,25,000 cfu/g (B2) and 4,46,000 cfu/g (B3). Control shrimp (C) were not spiked with *E. coli*. The ability of coliphage cocktail to reduce the *E. coli* counts was assessed by dipping three sets of spiked shrimp (B1, B2 and B3) in three Multiplicity of Infection (MOI) levels of coliphage cocktail viz., MOI-10, MOI-100 and MOI-1000. Control shrimp were not treated with bacteriophage cocktail. The *E. coli* counts in all the different groups of shrimps was tested after 10 min, 20 min and 30 min of exposure to coliphage cocktail. A reduction in *E. coli* counts was noticed in all the shrimp exposed to coliphage cocktail. The *E. coli* counts of B1-shrimp decreased by 54%, 80% and 86% after 10 min exposure to bacteriophage cocktail at MOI-10, MOI-100 and MOI-1000, respectively and at the same time the *E. coli* counts in control shrimp (C) increased by 290%. B2-shrimp the *E. coli* counts decrease by 83%, 91% and 94% after 10 min exposure to bacteriophage cocktail at MOI-10, MOI-100 and MOI-1000, respectively. Similarly in B3-shrimp the *E. coli* counts decrease by 86%, 92% and 95% after 10 min exposure to bacteriophage cocktail at MOI-10, MOI-100 and MOI-1000, respectively. Similar trends in decrease in *E. coli* counts was noticed in shrimp exposed to bacteriophage cocktail for 20 min and 30 min. The results indicate that coliphage cocktail could effectively reduce *E. coli* counts in shrimp meat.

Keywords: Bacteriophages, Coliphages, Cocktail, Biocontrol, *E. coli*

FS24B7**Incidence, antibiogram, biofilm forming ability of *Staphylococcus aureus* from farmed *Penaeus vannamei* shrimp and their response to plant essential oils****Ahamed Basha Kusunur^{1*}, Navya Gongada², and Madhusudana Rao Badireddy¹**¹Visakhapatnam Research Centre of ICAR-Central Institute of Fisheries Technology (ICAR-CIFT),
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Abstract

The presence of pathogens in food is a significant threat to public health across the globe. One of the major routes of spread and transfer of *Staphylococcus aureus* in fish and fishery products is through improper handling of fish in the fish supply chain. The present study investigated the incidence, antibiogram, biofilm forming ability of *S. aureus* isolated from farmed *Penaeus vannamei* shrimp and their response to plant essential oils was studied. A total of 26 presumptive Staphylococci isolates were isolated from *P. vannamei* shrimp samples (n=26) of which 6 isolates were confirmed as *S. aureus* (23%) based on the presence of *nuc* gene. Disc diffusion assay results showed 16.7% of *S. aureus* showed resistance to four antibiotics out of the 10 antibiotics tested and 33% of the *S. aureus* isolates showed resistance to three antibiotics. Maximum resistance was observed towards penicillin, oxacillin and ciprofloxacin. Microtiter plate biofilm assay showed that 66% of the *S. aureus* isolates are weak biofilm formers. The agar well diffusion test results performed with plant essential oils such as thyme, cinnamon, clove, and tea tree oils showed distinct antibacterial effect of the oils against antibiotic resistant and biofilm forming *S. aureus* isolates. Thyme oil and cinnamon oil (ZOI >18mm) yielded relatively larger lesser zone of inhibition (ZOI) against antibiotic resistant *S. aureus* compared to clove oil (ZOI: 6mm-12mm) and tea tree oil (ZOI: 9mm-18mm). The presence of antibiotic resistant and biofilm forming *S. aureus* in farmed shrimp indicates potential risk to shrimp handlers and consumers. Thyme oil can be potentially used as natural therapy for controlling AMR and antibiotic resistant and biofilm forming *S. aureus*.

Keywords: *Staphylococcus aureus*, Antibiogram, Biofilm, Essential oils, *Penaeus vannamei*, Shrimp.

FS5AP1**Rapid authentication of species identity of commercially important shrimps using a portable FT-NIR sensor combined with chemometric modeling****^{1*}Rajesh R., ¹Pranamyia, C.H., ¹Pankaj Kishore, ¹Satyen Kumar Panda¹ and Niladri Sekhar Chatterjee[#]**¹National Reference Laboratory, ICAR-Central Institute of Fisheries Technology, CIFT Junction, Matsyapuri P.O., Cochin, Kerala 682029, India*Presenting author: rajeshmidhuna12@gmail.com,#Corresponding author: niladri_icar@hotmail.com**Abstract**

Economically motivated mislabeling of species identity is a major economic and public health concern of the global seafood supply chain. Fast moving supply chain of perishable commodities necessitates rapid and field deployable screening tools for the detection of food fraud such as species substitution and mislabeling. Miniaturized versions of molecular spectroscopy sensors have been widely used for the qualitative analysis of various food matrices, particularly for ensuring food safety, traceability, and authenticity. The present study focuses on the applicability of a portable- FT-NIR spectroscopy sensor combined with chemometrics for the rapid detection of species substitution and mislabeling in commercially important species of shrimps namely *P. monodon*, *L. vannamei*, and *P. indicus*. A portable DLP-NIR sensor was employed to acquire the FT-NIR fingerprint of the shrimp species. A wavelength range of 900 to 1700 nm was used to gather about 250 spectral fingerprints. The spectral data were pre-processed and filtered with different spectral correction algorithm, and chemometric classification models were developed using SIMCA 14.0 software. The best performing OPLS-DA model showed excellent fitness ($R^2X= 0.99$, $R^2Y=0.846$) and predictability ($Q^2(\text{cum})= 0.713$). With an area under the curve (AUC) value of 1 for the optimized model, the ROC curve additionally demonstrated low chances of false positive prediction. The external validation set when fitted in the optimized OPLSDA MODEL, showed a classification accuracy from 97 to 100%, suggesting excellent performance. This research demonstrated that authentication based on portable FT-NIR sensors can be a cost-friendly and reliable method for the rapid and on-site detection of food fraud.

Keywords: NIR Sensor, Chemometrics, Seafood fraud, Species mislabeling, SIMCA

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FS8AP2

A random sample survey of aflatoxin M₁ in UHT processed milk using a commercially available quantitative Rapid Method

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Abstract

The present survey has been conducted to check the levels of Aflatoxin M₁ in different Brands of UHT processed milk from different cities in India to understand the effect UHT processing has on M₁ content. Rapid Lateral Flow technology kit (Neogen RQAFM₁) was applied to analyze AFM₁ in the samples. The results showed that aflatoxin M₁ was detected in all the UHT milk samples, the AFM₁ concentration ranged from 54.8 ng/L to 612.25 ng/L. 81.8% of analyzed samples showed AFM₁ concentration less than 500 ng/L of Food Safety Standards Authority of India (FSSAI) regulations for aflatoxin M₁ while 18.2% samples were found to be failing. This study discovers the fact that UHT treatment is not efficient to mitigate the issue of AFM₁ concentration in milk. UHT Milk is an important contributor to the dietary intake of AFM₁ in India and more efforts are required in terms of stringent monitoring and control at all levels. Traditional mycotoxin testing methods can be laborious and costly, which can lead to fewer samples being tested and ultimately less control over the presence of mycotoxins in food and feed products. However, emerging technologies such as rapid diagnostic tests, biosensors, and molecular methods are now available that offer faster and more cost-effective alternatives to traditional testing methods. These methods allow for quicker screening of large numbers of samples and provide highly accurate and reliable results in real-time. By adopting these technologies, it is possible to increase the frequency and scope of mycotoxin testing, which can lead to better control over the presence of mycotoxins in food and feed products. Ultimately, this can help to protect human and animal health, reduce economic losses, and enhance overall food safety and quality. It can also contribute to the efforts of FSSAI for ensuring safe milk.



FS10AP3

The estimation of Chloramphenicol and Nitrofurans metabolites in shrimp using microwave-assisted derivatization and LC-MS/MS

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Abstract

Antibiotics such as chloramphenicol (CAP) and nitrofurans (NFs) are banned antibiotics for production of food of animal origin. Hence, presence of CAP and NF metabolites are accurately screened and quantified in the aquaculture industry. At present the official methods recommend single residue methods which takes 18 h of derivatization time. In this study, a method has been optimised using microwave assisted extraction and derivatisation for simultaneous analysis of chloramphenicol and five marker metabolites of nitrofurans in LC-MS/MS. Using polarity switching, in MRM mode, Chloramphenicol and five nitrofurans metabolites including 3, 5-Dinitrosalicylic Acid Hydrazide are measured simultaneously using AB Sciex 6500 QTRAP mass spectrometer equipped with an electrospray ionisation source (ESI). The microwave derivatisation time was optimised with incurred samples and two hour derivatisation time was found to be optimum. Further, solid phase extraction (SPE) clean-up was established for removal of co-extractives. The correlation coefficient of matrix-extracted calibration standards were more than 0.99 for all NFs and CAP throughout this study. Recovery studies were performed for NFs at levels of 0.25, 0.5, and 0.75 µg/kg and for CAP at levels of 0.075, 0.15, and 0.225 µg/kg. Means, SDs, and RSDs for each of the NF metabolites and CAP were calculated using recoveries obtained from verification data. The mean recoveries overall ranged from 107.8 to 117.8%. Our research demonstrated that this method is efficient and time saving for the simultaneous determination of nitrofurans metabolites and chloramphenicol.

Keywords: LC-MS/MS, Chloramphenicol, Nitrofurans Metabolites, Antibiotics, Microwave Digestion, SPE

FS11AP4

Comparative evaluation of large volume injection and split less injection technique with conventional and high throughput SPE clean-up for GC/MS/MS analysis of persistent organic pollutants in aquaculture feed

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Abstract

The current study aims to develop sensitive and rapid multiresidue analytical methodologies for the simultaneous analysis of Organochlorine pesticides (OCPs), Polychlorinated Biphenyls (PCBs), and Polycyclic Aromatic Hydrocarbons (PAHs) in aquaculture feed. The study compares conventional solid phase extraction (SPE) clean up and high throughput SPE clean-up approaches and different injection techniques namely programmable temperature vaporizer-large volume injection (PTV-LVI) and Split-Split Less (SSL) injection in GC-MS/MS (EI) Quantification. The trace level quantification in MRM mode were performed using Thermo Scientific- TSQ 9000 Triple quadrupole mass spectrometer equipped with a Triplus RSH autosampler. A DB-5MS UI capillary column was used for chromatographic separation. For PTV-LVI the instrument was configured using a pre column connecting to the analytical column through a “T” joint. Effect of clean up using Oasis HLB Prime (Waters, 3cc) and Silica SPE cartridge (Waters, 6cc) was evaluated. Ethyl acetate was more suitable extraction solvent for QuEChERS based extraction, as the extract showed less matrix effect than Acetonitrile. Silica SPE cartridge provided better cleanup as evident from the total ion chromatograms (TIC). However, HLB prime cleanup was faster and consumed less solvents. Both the cleanup approach produced fairly comparable outcomes in terms of recovery and matrix effect. The performance of the optimized analytical methods was validated for trace level quantification as per SANTE/12682/2019 guideline. The results demonstrated good linearities for the target compounds in the range of 1.25–20 µg/Kg with the correlation coefficient (R^2) of ≥ 0.99 . Among the four combinations of PTV/SSL injection modes and Silica/HLB clean up methods, PTV/Silica achieved average recovery between 84.36-104.12%. Majority of analytes showed relative standard deviation of $\leq 20\%$. LOQ for PTV method range between 0.57-2.78 µg/Kg whereas SSL between 0.72-3.21 µg/Kg. The streamlined analytical method is found to be sensitive and accurate and can meet the demands for the quantitative analysis of these analytes in feed.

Keywords: Mass spectrometry, Persistent organic pollutants, Aqua feed, Solid Phase Extraction clean up, PTV-LVI/SSL modes

FS12AP5

**Benchmarking of a portable mass spectrometer with GC-MS/MS for
determination and uptake of Formaldehyde in fish and shrimp**

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Abstract

With the rapid growth of science and technology, portable mass spectrometers have become an essential part of analytical instruments for research due to the fewer complications in sample preparation and its portability. In this study we evaluate a portable mass spectrometer for analysis of formaldehyde with minimum or no sample preparation. Formaldehyde is a type of contaminant, which is added to fish to increase their shelf life. The consumption of fish containing formaldehyde is harmful to human health. The work further correlate the analysis result with portable mass spectrometer with that of a table top GC-MS/MS. The fish chunks were dipped into formaldehyde solutions of different concentrations. The samples were then directly analysed using the portable mass spectrometer. The experiments were repeated with different dipping times. All results from the dashboard were collected and a linearity graph was plotted. The actual concentration of formaldehyde absorbed by the fish tissue was analyzed using GC-MS/MS. Also, a correlation linearity graph was plotted using the results obtained from GC-MS/MS and the portable mass spectrometer. The mass spectrum of formaldehyde obtained from the portable mass spectrometer mainly contains peaks at the $m/z=28,29,30$ and 31 . Only $29,30$ and 31 gave good linearity (regression values ≥ 0.95). The correlation graph also has good linearity with the regression ≥ 0.95 . The limit of detection of the portable mass spectrometer was found to be 50 ppm. The GC-MS/MS results shows that when treated with 0.05 to 4% of formaldehyde solution, shrimp tissue absorbs formaldehyde in the range of 8 to 26% and fish tissue (tilapia) in the range of 6 to 13% . Regarding dipping time, there is not much variance in formaldehyde concentration.

Keywords: Portable mass spectrometer, GC-MS/MS, Formaldehyde, Adulteration, Electron impact spectra

FS18AP6

Formation of nucleotide degradation products in Indian mackerel and Indian oil sardine during temperature abused condition

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Abstract

Degradation of nucleotides is important in assessing the freshness of fish. Adenosine triphosphate (ATP) degrades into inosine-5-monophosphate (IMP) which contributes flavour of fresh fish via adenosine-5-diphosphate (ADP) and adenosine-5-monophosphate (AMP). The IMP further degrade and produce inosine (ino) and hypoxanthine (Hx) and further deteriorates the fish by producing xanthine and uric acid. The present study assesses the nucleotide degradation in two species of fishes, Indian mackerel and Indian oil sardine under temperature abused conditions to understand the progress of spoilage. Indian mackerel and Indian Oil sardine were collected in highly fresh conditions and evaluated for accumulation of hypoxanthine, a nucleotide degradation product as a quality index during storage at 25 and 37 °C. Samples were drawn at an interval of 1.5 hr during both the storage condition. In case of Mackerel, hypoxanthine (54.6 mg/Kg) accumulated more than inosine (7.8 mg/Kg) at 37 °C storage within 4.5 hours while at 25 °C storage, inosine (36.6 mg/Kg) accumulated more than hypoxanthine (20.9 mg/Kg) within 4.5 hours. Higher rate of degradation from inosine to hypoxanthine was observed at 37 °C. In case of sardine, inosine (33.88 mg/Kg) accumulated more than hypoxanthine (24.56 mg/Kg) at 25 °C storage and similarly inosine (42.5 mg/Kg) accumulated more than hypoxanthine (22.4 mg/Kg) at 37 °C storage within 4.5 hours.

Keywords: Spoilage, Hypoxanthine, Inosine, Indian mackerel and Indian oil sardine

FS30AP7

Occurrence of *Vibrio cholerae* O139 in seafood and its molecular characterization

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Abstract

Seafood acts as an important reservoir of *Vibrio cholerae*, an important pathogen causing cholera in humans. In the present study, the prevalence of *V. cholerae* in different seafoods were assessed. Conventional microbiological and molecular methods were carried out for the isolation of various biotypes of *V. Cholerae* from seafood. A total of 85 seafood samples fresh seafood samples comprising 71 samples from retail and landing centres and 14 samples of fishery products were assessed for the presence of *V. cholerae*. Biochemical and molecular tests confirmed the presence of *V. cholerae* O139 strain from seafood. Molecular characterization of virulence and regulatory gene specific PCR resulted the presence of *ompW*, *toxR*, *zot*, *ace*, *hly* and *ctx* genes in the isolates. The isolates were negative for O1 biotype *tcpA* gene. Further *ctx* specific PCR targeting *ctxA* and *ctxB* revealed that the isolate carry both the genes in its genome. However, the mismatch amplification mutation assay of *ctx* gene revealed the presence of El Tor specific *ctx* gene. In conclusion, the presence of pathogenic *V. cholerae* in fishery products which are stored under ice required a greater understanding of their distribution, survival and virulence mechanism. Post-harvest seafood monitoring programme demands an effective establishment of risk management program for its control.

Keywords: *V. cholerae*, *ompW*, *toxR*, *zot*, *ace*, *hly* and *ctx*, PCR, El Tor

FS31A17

EXTRACTION AND CHARACTERIZATION OF LIQUID SMOKE FROM LOCALLY AVAILABLE WOOD

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Abstract

Liquid smoke (LS) is generally obtained by the condensation of wood smoke produced by smoldering wood chips or sawdust. It has been produced on large scale and are widely used to enhance smoke flavour in food products. Liquid smoke has many benefits when it is compared to conventional smoking methods, since it is an indirect smoking method, convenient to use, lower PAH without compromising the flavour which will ensure the quality and safety of food products. In the present study is aimed to extract the liquid smoke from the saw dust of jack fruit and characterized their properties. For characterization- pH, Titratable acidity, Total carbonyl and total phenol content (TPC), Polycyclic aromatic hydrocarbons (PAHs) content and antioxidant properties like DPPH & FRAP were estimated. Carcinogenic PAHs such as dibenzo[*a, h*]anthracene, benzo[*a*]anthracene, benzo[*b*]fluoranthene, indeno[1,2,3-*c,d*]pyrene, benzo[*a*]pyrene were not detected in both liquids. Liquid smoke obtained from jack fruit sawdust showed low acidic pH (1.76 ± 0.01) than commercial LS (1.91 ± 0.11). The total carbonyl content of commercial LS ($2.84 \pm 0.19\%$) was higher than the jackfruit LS ($1.89 \pm 0.00\%$). Similarly, commercial LS (4224.05 ± 11.54 mg/L) showed high TPC than jackfruit LS ($3.94.05 \pm 55.07$ mg/L). In DPPH analysis, both LS showed better radical scavenging activity and there is no significant difference between jackfruit LS ($93.50 \pm 0.089\%$) and commercial LS ($94.95 \pm 0.00\%$) at 1% level. In FRAP analysis, commercial LS showed high antioxidant activity (219.75 ± 13.27 μ M/ml) and jackfruit LS (67.62 ± 0.66 μ M/ml). The study revealed that the jackfruit LS had comparable antioxidant properties with commercial LS and can be used as an effective food preservative / flavouring agent to ensure the quality and safety with low cost-effective method.

Keywords: Liquid smoke, phenol content, carbonyl content, Antioxidant, Polycyclic aromatic hydrocarbons

FS31A18

Microplastic contamination and its associated risks in fishery products

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Abstract

Microplastic contamination has developed into a serious problem with worldwide repercussions. This work highlights the frequently disregarded danger that microplastics represent to fish and fisheries products, which can also be detrimental to human health. Fish can consume microplastics because they are abundant in the ocean and other water environments. Once they enter the digestive tract, the microplastics are absorbed and induce oxidative stress, cytotoxicity, and tissue damage in the fish. Fish being a significant source of protein for humans, eating it and other related products may expose humans to microplastics and be harmful to their health. Currently, there is little information available about the harmful effects of microplastics on humans. Therefore, by providing in-depth insights into the sources, pathways, and effects of microplastic pollution, the work aims to empower individuals, communities, and policymakers with the knowledge necessary to make informed decisions and implement effective solutions.

Keywords: Microplastics; Seafood; Contamination; Cured fish; Shrimps

FP70BP3

Storage study of Analogue Shrimp Products from Lizard fish (*Saurida tumbil*) in Retortable Pouches

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Abstract

A ready to serve thermally processed analogue shrimp curry and masala have been developed using steam air and water immersion retort. The developed analogue shrimp products were subjected to various biochemical analysis, texture, colour and sensory properties of analogue shrimp products in retortable pouches processed by steam/ air and water immersion retort were determined. The commercial sterility results showed that there was a total absence of aerobic, anaerobic, mesophilic and thermophilic, as well as spore and non – spore forming bacteria in all the analogue shrimp curry and masala products were commercially sterile. Based on nutritional profile, texture, colour and sensory of analogue shrimp curry processed by steam air retort was good for human consumption.

Keywords : Biochemical, sterility, texture, colour, sensory, steam air, water immersion

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