The Third Symposium

Sustainable technologies for food processing and preservation

# Abstracts

# Program for 4th December 2019

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| **09:00 am- 09:30 am** | **Registration** |
| **Session I** | **Inaugural Session** |
| **09:30 am – 11:00 am** | **Watering of Plant**<br><br>**Felicitation**<br><br>**Welcome (5 Min)**<br>Professor Nutan Kaushik, DG, AFAF, *AMITY University*<br><br>**About ReFood Project (15 Min)**<br>Dr. Kristina Widell, Senior Research Scientist, *SINTEF, Norway and* Dr. Marit Aursand, *SINTEF, Norway*<br><br>**Remarks by (10 Min)**<br>Dr. Dhrubjyoti Chattopadhyay, Vice Chancellor, *Amity University Kolkata*<br><br>**Remarks by (10 Min)**<br>Dr. W.Selvamurthy, President,ASTIF & DG, ADSI, *Amity University*<br><br>**Keynote: Cold-chain for market expansion (30 Min)**<br>Mr. Shri Pawanexh Kohli, CEO, *National Centre for Cold-chain Development*<br><br>**Vote of Thanks (5 Min)**<br>Dr. Rama Ranjan Bhattacharjee, *Amity University Kolkata* |
| **11:00 am – 11:15 am** | **Tea Break** |
| **Session II** | **Cold Chain Management (10 Min each)** |
| **11:15 am – 12:30 pm** | **Temperature/Time and quality parameters in the cold chain of fruit**<br>Professor Trygve Eikevik, *NTNU*<br><br>**Improvement of Surimi supply chain in India-Value stream mapping and compensatory refrigeration system**<br>Dr. Souvik Bhattacharya, Vice Chancellor, *BITS Pilani and* Mr. Abdullah & Mr.Santosh, Research Scholar, BITS Pilani<br><br>**Eco-friendly cooling technology in India**<br>Dr. Simarpreet Singh, Director, *Eco REFTEC Pvt Ltd*<br><br>**Renewable-energy based decentralized post-harvest cold storage solution**<br>Mr. Alok Nikhade, Thermal Lead, *Ecofrost Technologies Pvt Ltd*<br><br>**Use of Hydrocarbons as an environmentally friendly working fluid**<br>Mr. Ehsan Allymehr, Research Scholar, *NTNU*<br><br>**Studies on a $CO_2$ based summer air conditioning system with single and multiple expansion valves**<br>Mr. Mihir, Research Scholar, *IIT Kharagpur* |

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| **Session III** | **Utilization of Rest Raw Materials (10 Min each)** |
| **12:30 pm - 1:00 pm** | **New technologies and new species for better utilization of marine bio resources**<br>Dr. Rasa Slizyte, Senior Research Scientist, *SINTEF Ocean, Norway*<br><br>**Nutritional Profiling of *Hibiscus* population from Meghalya**<br>Dr. Nutan Kaushik, Director General, AFAF, *AMITY University Noida* and Sengnolotha Marak, Research Scholar, *Amity University Noida*<br><br>**Strategic involvement of students in bioeconomy challenges in the food sector**<br>Dr. Eva Falch, Ass. Professor and Vice Dean Innovation, *NTNU, Norway*<br><br>**Valorization of Surimi industry rest raw material**<br>Ms. Asha Kumari and Ms. Khushboo, Research Scholars, *Amity University Noida* |
| **01:00 pm – 02:30 pm** | **Lunch Break and Poster Session** |
| **Session IV** | **Bio-Sensors (10 Min each)** |
| **02:30 pm – 03:00 pm** | **Sensors for the detection of Food Borne Pathogens**<br>Dr. Swati Jain*,* Asst. Professor*, Amity University Noida*<br><br>**Food Safety Risk Analysis, specific to fish and Marine products**<br>Dr. Alok Srivastava*, Chief Scientist, CFTRI, India*<br><br>**Printable conducting ink to detect unwanted VOCs in food**<br>Dr. Rama Ranjan Bhattacharjee*, Amity University Kolkata* |
| **Session V** | **Food Regulations** |
| **03:00 pm – 03:30 pm** | **Multi-response method for the determination of 150 pesticide residues in packaged drinking water by chromatographic techniques**<br>Dr. Debdutta Mishra, *Deputy Director, Central Food Laboratory, FSSAI*<br><br>**FSSAI- Streamlining Food Safety Ecosystem in India**<br>Col pramod Shahaji Dahitule, *FSSAI* |
| **Session VI** | **Indo – Norway Funding Opportunity** |
| **03:30 pm – 04:00 pm** | Dr. Amit Parikh, Scientist E, *Department of Biotechnology, Govt. of India**<br><br>Dr. Sivaji Chadaram, Scientist F, *Department of Science and Technology, Govt. of India** |
| **04:00 pm – 04:45 pm** | **Group Discussion – New Collaborations** |
| **04:45 pm – 05:15 pm** | **Short presentations from Group Discussions (5 Min each)**<br>Group representatives |
| **05:15 pm – 05:30 pm** | **Conclusion**<br>Professor Nutan Kaushik, DG, AFAF, *AMITY University Noida* and Professor Ramgopal, *IIT Kharagpur* |
| **05:30 pm** | **Tea** |
| **7:00 pm** | **Dinner (By Invitation) at 6 Ballygunge, New Town, Kolkata** |

## Program for 5th December

| Time | Activities |
|---|---|
| 09:10 am | Departure from Amity Kolkata for Industry Visit |
| 10:30 am | Industry Visit Starts |
| 12:30 pm | Departure from Industry to Amity Kolkata |
| 13:00 pm | Lunch at Oh Calcutta |
| 14:30 pm | ReValue Project Meeting at Amity Kolkata |
| 17:00 pm | High Tea |
| 17:30 pm | Departure |

## Contents

# SESSION II

# Cold Chain Management

# Studies on a CO2 based Summer Air Conditioning System with Single and Multiple Expansion Valves

**Mihir M. Hazarika [a], Maddali Ramgopal [b], Souvik Bhattacharyya [c]**

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## Abstract

The primary objective of this study is to analyse the performance of a transcritical CO2 based summer air-conditioning unit. For this purpose, numerical models are developed to design and develop a fully instrumented test-rig for CO2 based air-conditioning unit. Fin-and-tube heat exchangers with spiral fins have been designed to use as gas cooler and evaporator for the proposed CO2 cycle. To analyse the behaviour of the transcritical CO2 system with single expansion valve, a system simulation model is developed and simulations are carried out to investigate the effects of important operating parameters on the performance of the system. It is found that for a given operating condition, there is an optimum charge at which the maximum COP of the system is obtained. For such a system, the performance varies significantly with the ambient temperature for a given total charge and room air specifications. Results show that for each 10K increase in the ambient temperature, the system COP decreases by about 24%. Air flow rate through the gas cooler also affects the gas cooler pressure and system performance significantly.

System simulations are also carried out to analyse the performance characteristics of two configurations of the proposed CO2 system – one with single-stage expansion and the other with two-stage expansion. It is observed that for a given internal volume and operating conditions, there is an optimum charge at which COP is maximum for single-stage expansion. However, for two-stage expansion, maximum COP is maintained over a range of refrigerant charge. This study also presents the effect of ambient temperature on the performance of both configurations with single-stage as well as two-stage expansion. Results show that both configurations can effectively track the optimum performance at different ambient temperatures with optimum charge maintained in the respective configurations. The optimum charge is smaller for two-stage expansion.

Experimental studies are also carried out and the experimental results are compared with the results obtained from numerical simulations. It is observed that numerical results are in good agreement with experimentally determined quantities.

***Key words*:** CO2, transcritical cycle, system simulation, two-stage expansion, refrigerant charge.

# Temperature/Time and Quality Parameters in the Cold Chain of Fruit

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**ABSTRACT**

Fruits are highly influenced by the ambient temperature at the harvesting periode and should be cooled as quickly as possible after harvesting to avoid loss of shelf life. Even a short period in the harvesting process without chilling will reduce the shelf life with weeks. Fruits like apples should be transported as short as possible before the chilling, and one option is to do the chilling directly at the field in a special chilling device, made to be moved between the fields in the harvesting period. The transport of fruits should be in refrigerated trucks. Transport of the apples over distance (one or two days) without chilling can reduce the shelf life with more than 30%. If arranged in a centralized system, the apples can be cooled in a separate cooling tunnel before entering the cold storage. To enhance the shelf life the most efficient way is to store the apples in a modified atmosphere with control of the temperature, humidity, $CO_2$ and methane.

# Use of Hydrocarbons as an Environmentally Friendly Working Fluid

**Ehsan Allymehr** [a]

[a] **Norwegian University of science and technology**

## Abstract

While hydrocarbons were used as refrigerants in the first generation of working fluids, the problems raised by its flammability and subsequent rise of CFCs caused the natural refrigerants including hydrocarbons to be put out of use. CFCs were later banned because of their strong contribution to the Ozone layer depletion and were replaced by HFCs which in turn are being phased out because of their great contribution to the global warming. Thus, new refrigeration systems are being developed by using natural refrigerants and providing practical solutions by modifying the mechanical aspects of system. The main challenge with the use of hydrocarbons as working fluid remains to be the flammability, this risk can be mitigated by minimizing refrigerant charge in the system, this can be done most effectively by reducing the volume of the heat exchangers by means of more efficient heat transfer and more advanced materials.

# Renewable Energy Based Decentralized Post-harvest Cold Storage Solution

**Alok Nikhade**

Thermal Lead, Eco REFTEC Pvt Ltd

**Abstract**

India, according to a report published in 2016, had a capacity of 30 million tons of cold storage in over 7000 cold storage units. This number was projected to increase to 70 million tons in 2020 and 200 million tons by 2030. The electrical load catering to the power demands of cold storage today is 1.2 GW, accounting for 0.5% of total installed capacity. Most of this power requirement is fulfilled through generation from conventional sources of electricity generation.

Considering that over 40% of the post-harvest produce is getting wasted due to lack of cold chain elements in the country, the number of cold storages is bound to increase, further straining the limited energy resources available. An approach to solve the energy issue pertaining to cold storage operation would be to develop renewable-energy based cold storages at each collection node of this cold chain.

Ecozen solutions address this problem of energy disconnect by developing solar-energy based micro cold storage, 'Ecofrost'. Ecofrost Micro Cold Storage, with a capacity of 5 tons, is an optimal cold storage solution for small scale farmers and agricultural businessmen. Ecofrost derives the energy required to drive its refrigeration system with the help of an array of solar photovoltaic panels. Ecofrost MCS is designed to be stand-alone cold storage, operating on solar PV energy, able to perform load extensive pre-cooling as well as low energy holding operations efficiently.

The specific energy consumption for chilled cold storages operating within the temperature range of 0 to 10 degrees for the pull-down period comes out to be 47.7-63.5 kWh/m3/year for pre-cooling load and 46.1-62.7 kWh/m3/year for holding load in Indian scenario. This way each installation of Ecofrost in India ensures annual savings of 2530 kWh of electricity consumption from conventional resources.

The challenge to the execution of renewable energy, for off-grid applications such as this, is the intermittent nature of source of power, which may not synchronize with the cooling load schedule. This brings up the necessity of a bank of energy which may conserve the surge of electrical power availability and the frequent inoperability of the compressor in a vapor compression refrigeration system. A cold latent thermal energy storage is a perfect solution when coupled with cooling capacity control algorithms. Ecofrost implements this as a heat exchanger without secondary refrigerant, thus meeting the cooling load schedule without continuous availability of electricity or losses associated with the secondary circuit.

The compressor in this refrigeration system is the major power-consuming component in the refrigeration system. Thus, the performance of any refrigeration system is governed by the capacities and efficiencies of the compressor. Variable speed compression provides

modulations in the refrigeration capacity at constant temperature conditions based on the refrigeration requirements sensed in the room. By closely following the heat load inside any closed room and consuming only the required power as compared to fixed speed compressors which would consume nearly the rated power under all conditions, refrigeration systems using variable speed compressors are able to achieve higher coefficient of performance.

Using speed variability provides an additional advantage in the case of Ecofrost. The nature of input power to the compressor in case of Ecofrost is intermittent because of use of solar energy. In cases when the power available is low because of poor solar radiation, a fixed speed compressor might fail to operate because the power available is insufficient to start the compressor. To overcome this problem, a storage bank would be needed between the power source and consumption points, further reducing system efficiency. Variable speed compressor, on the other hand, holds capability to consume a wide range of input powers for every temperature condition. The compressor selection and motor drive control with Ecofrost offer a span of 1x-2.9x input power capacity variation throughout the day to ensure a superior utilization of available solar PV power with a leaner installed infrastructure. This capability of variable speed operation characteristics makes the compressor a better fit for solar energy and other renewable energy-based applications. There are applications of this technological evolution in the distributed network of perishable commodities which makes this a promising domain for continuous research and development.

# SESSION III

# Utilization of Rest Raw Materials

# New Technologies and New Species for Better Utilization of Marine Bio- resources

**Rasa Slizyte**

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**Abstract**

Every year the world's fisheries wastes more than 20 million tons of marine materials including “non-target” species, fish processing wastes and by-products. In the European Union those discards make up to total of ca. 5.2 million tons each year. Some countries have traditionally been utilising significant parts of the marine rest raw materials (MRRM), mainly as silage, which is often processed into animal feed. Only a small fraction of the MRRM is used for human consumption or other value added applications. In other countries, due to the lack of specialised infrastructure, the MRRM are wasted or sent directly for animal feed without any attempt to recover the valuable components. For instance, cut-offs of fish are wasted or sold for low value uses, such as the production of biogas, fuel or mink feed. Furthermore, thousands of tonnes of fish are discarded within European waters, due to low commercial value of the catches, lack of quality or suitable infrastructure. New European directives introduce significant changes to these discarding practises. It will therefore be a challenge for the industry to develop methods to turn fish viscera and skin, currently considered as undesirable raw materials for hydrolysis and human consumption, into profitable products. Traditional processing technologies (e.g. thermal extraction, hydrolysis, silage) for fish rest raw materials that contain significant amounts of oils, usually aims at high amounts of oil or maximised solubilisation of proteins, with either the proteins or the oil considered as secondary products. Due to lower yields and insufficient quality, the proteins or the oil are considered as secondary products. Salmon rest raw materials like skins, backbones and viscera contained significant amounts of both lipids and proteins, which could be extracted and used as valuable ingredients in several applications. A new approach for traditional hydrolysis of fish rest raw materials containing significant amounts of oils will be presented. The basis of several stage processing is the mild thermal separation of oil prior to hydrolysis and further processing of the de-fatted rest raw material. The oil obtained by thermal separation shows significantly higher quality compared to oil separated during hydrolysis with addition of commercial enzymes. The protein changes during the thermal separation step does not affect the hydrolysis of the proteins by the added proteases. The third stage of the processing covers further extraction of valuable components like gelatine, phospholipids, nucleic acids and calcium. Therefore, the three stage processing where oil is separated using mild heating during the first step look very promising both with regard to economical (up till 85% of oil from raw material is separated before hydrolysis) and quality aspects (oil contained low amount of free fatty acids and were not oxidised).

The ongoing growth of global population has fundamental impacts on food sources. Here the key challenge is to increase food production with less input of scarce or non-renewable resources in order to supply the increasing demand. It is therefore important to capture and reuse nutrients and organic materials such as proteins and lipids that are in high demand. Secondary bio-production on the side streams from land-based aquaculture, food

production and forestry sectors to generate high value raw materials for feed has an enormous potential to improve sustainability of both agriculture and aquaculture.

There are a number of low trophic organisms that feed on organic material, which is considered as waste or co-streams from several industries. Both polychaetes and crustaceans can produce ω-3 LC-PUFA de novo and can be cultivated using different co-streams from bio-based industries, such as sludge from aquaculture and forestry, in addition to seaweeds and fish feed. Cultivated biomass have an interesting chemical composition where the lipid, mainly composed of phospholipids, is probably one of the most interesting fractions, followed by proteins with favourable amino acid profiles, carotenoids and other antioxidants, vitamins and minerals. This makes them a valuable biomass, which can be used to production of marine ingredients for both food and feed markets.

Circular bioeconomy leads to increased resource efficiency and more profitable food and bio-based production, where innovative processing of raw materials, products and technologies are in focus. SINTEF Ocean is involved in many interdisciplinary projects with a bio-economic perspective, focusing on utilisation of new marine resources, more gentle and more profitable processing technologies by covering whole value chain.

**Keywords:** salmon, rest raw materials, oil, protein, gelatine, jellyfish, gammaridae, polychaetes

# Nutritional Profiling of *Hibiscus sabdariffa* Population from Garo Hill Districts of Meghalaya

**Sengnolotha Marak** [a], Nutan Kaushik [a], Eva Falch[b], Alexander Dikiy [b], Elena Shumilina [b *]

[a] Amity University Uttar Pradesh, Noida

[b] Norwegian University of Science and Technology (NTNU), Norway

**Abstract**

Plants are widely used as drugs, cosmetics and food additives. The quality and safety of herbal material is under the constant attention of the authorities, since the quality might vary due to the different harvesting locations and time, inaccurate collection or different plants processing. Therefore, the assessment of herbal material composition and its changes upon different processing has both scientific and applied value. *Hibiscus sabdariffa* commonly known as Roselle. This plant is extensively grown in tropics including India, where its consumption exceeds 600MT (dry weight) per year. The aim of the study was to identify and quantify the therapeutically and industrially valuable compounds in dry calyx of *H.sabdariffa*. The calyx were collected from different districts of Garo Hills, Meghalaya. Two drying process: Shade Dry (SD) and Tray Dry (TD) were employed. The physicochemical parameters of the dry calyxes' powders were assessed for all samples. In addition, the metabolic profiling of all samples was carried out using NMR spectroscopy. Thirty-two $^{1}$H NMR spectra were binned into 331 buckets. ANOVA analysis determined the 255 buckets which values significantly differ in SD and TD samples ($p<0.05$). The following Principal Component Analysis showed a good SD and TD clustering so indicating that the metabolic composition of two groups is statistically different. While TD group generally allowed the extraction of more metabolites, SD group has a higher concentration of only few of them. Application of the quantitative NMR spectroscopy allowed to determine the variability of seven main polar metabolites: Hibiscus acid, Fructose, Glucose, Betaine, GABA, Succinate and Acetate in the dry powder of *H. sabdariffa* calyx. The obtained results will be presented.

# Valorization of Rest Raw Material Obtained from Surimi Industry

**Khushboo[1],** Asha Kumari[1], Nutan Kaushik[1], Rasa Slizyte[2], Kristina Norne Widell[2]

1. Amity University Uttar Pradesh, Noida
2. SINTEF Ocean, Trondheim, Norway

## Abstract

A large amount of rest raw material (RRM) is annually produced during manufacturing of Surimi which is usually utilized for production of low- value products such as silage, animal feed etc. RRM obtained from Surimi industry majorly involves head and viscera, skin and bones, refiner waste and wash water which is rich in protein with excellent amino acid profile and omega- 3 fatty acid. Valorization of by-products obtained from Surimi manufacturing is a global priority to acknowledge environmental and socioeconomic challenges. Conversion of RRM by utilizing biotechnological methods into high value food products is a potential alternative to reduce environmental pollution and economic investment associated with post processing of these by-products. Application of enzymatic hydrolysis was studied for production of functional and bioactive peptides from RRM. Enzymatic hydrolysis has higher applicability in comparison to other methods employed in the food and pharmaceutical industries because of it is milder processing parameters and subsequently minimal effects on product quality and lower toxic chemicals residues in the final product. This protein hydrolysate is characterized on the basis of their chemical composition, stability, degree of hydrolysis, molecular weight distribution, and nutritional value, functional and bioactive properties. Four different types of commercial enzymes (alcalase, papain, bromolein, and trypsin) and endogenous enzymes were used for enzymatic hydrolysis of RRM. Bromolein and papain combination depicted most promising results on account of degree of hydrolysis, essential amino acid content and antioxidant activity.

Apart from solid rest raw material like head and viscera, skin and bones etc Surimi Industry also produces a large amount of wash water with high concentration of soluble proteins. Method of isoelectric precipitation using organic acid was examined for extraction of soluble protein from wash water. The process indicated positive results with a removal upto more than 85% of soluble protein. Both the process involved in treatment of RRM promoted application of green technology in RRM processing with production of high value products which can be potentially employed in food and pharmaceutical industries.

Keywords: Surimi, Rest Raw Material, Enzymatic hydrolysis, Wash water, Iso-electric Precipitation

# SESSION IV

# Bio-Sensors

# Printable conducting Ink to Detect Unwanted VOCs in Food

**Rama Ranjan Bhattacharjee**
Amity University, Kolkata

**Abstract**

Currently, there is no nanomaterial in the market that can be used as an active component to fabricate flexible hand-held sensors that can detect volatile organic compounds (VOCs) in snacks or packaged food. Changes in concentration of VOCs emitted from food items can provide valuable information about its contamination. There are a few gadgets available like the well-established methods to assess rancidity in potato crisps such as the rancimat or the acid degree value. These are time-consuming and labor-intensive methods and cannot be performed at any given site. Methods like e-noses based on mass spectrometry or gas sensors have been reported. But the methods are expensive and cannot be easily implemented.

In the present work, we modify conducting polymer like polypyrrole (PPy) with conducting carbon quantum dots (CQDs) by a unique surface confined catalytic process. The synthesis method will be scalable to any extent depending on the amount of ink to be prepared per batch. The CQD-PPy dispersion in water is converted into ink without any external additive, and it forms stable printed impression on flexible substrates like printed circuit board (PCB). The PCB has been incorporated into a hand held device that will be used to sense VOCs in food items.

# Food Safety Risk Analysis, Specific to Fish and Marine products

**Dr Alok Kumar Srivastava**
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## Abstract

India, being signatory to World Trade Organization (WTO), is strengthening its regulatory framework in harmony with Sanitary and Phytosanitary Measures, Technical Barrier to Trade (TBT) agreements and CODEX standards to achieve logical balance between human health protection and trade facilitation. Changing food technologies, international trade and many other factors have introduced new hazards into food chain. High foodborne illness and emergence of new hazards continue to pose demanding and challenging food safety ecosystem in protecting public health. Food Chain, consisting of processing, service and export units are increasingly recognizing the relevance of food safety standards. Food Safety and Standards Authority of India (FSSAI) is strengthening comprehensive scientific collaboration on Risk Analysis (links between food hazards and actual risks to human health) comprising of hazard identification, hazard characterization, exposure assessment through Total Diet Survey (TDS) and other means to arrive at Risk Characterization and Risk Management towards decision-making on appropriate control measures, through standardization and advisories.

Considering the importance of consumption of fish and fishery products to human health and also the trade potential, FSSAI in recent past has focused its safety paradigm. Section 2.6 of Food Safety and Standards (Food Product Standards and Food Additives) Regulation 2011 has dealt different categories of fish and marine products, their processing and preservation technologies in detail. Regulation standardizes different quality and safety parameters including Total Volatile Base Nitrogen (TVBN), histamine etc. Category 9 of Food Categorization System (FCS) of Regulation has detailed the permitted additives for fish and fishery products including molluscs and crustacean. Greater emphasis is accorded to safety parameters including implementation of Maximum Residue Limits (MRL) of heavy metals, pesticides, Polychlorinated biphenyls (PCB), Polycyclic Aromatic Hydrocarbons (PAH) and anti-biotic and pharmacologically active substances specific to groups of fish and marine products. Table 1 A of **Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011 specifies the Hygiene specific microbiological requirements and Table 1 B details the safety specific microbiological requirements. In order to address the unintended usage of formalin, recent advisory of FSSAI has also specified the naturally occurring limit of formaldehyde in freshwater fish (4ppm) and brackish water / marine origin (100ppm).** Considering the importance of shared responsibility, wide participation of stakeholders makes the food safety ecosystem more robust and effective in safeguarding the human health and facilitation of food trade.

# SESSION-V

# Food Regulations

# FSSAI - Streamlining Food Safety Ecosystem in India

**Col Pramod Shahaji Dahitule**

***Food Safety and Standards Authority of India (FSSAI), Kolkata Regional Office, Benfish Tower, 6th floor, 31 G N Block, Sector-V, Salt Lake, Kolkata-700091.***

**Abstract**

The Food Safety and Standards Act (FSSA), 2006 came into force from 2011 and replaced multiple food laws, standard setting bodies and enforcement agencies with one integrated food law. Food Safety and Standards Authority of India (FSSAI) under the Union Health ministry is creating an ecosystem for safe and nutritious food engaging stakeholders from every corner of the society viz., responsible citizen, food businesses and the regulator. FSSAI is enabling shift from curative to preventive health care. As a part of the 10 goals set by FSSAI, RUCO (Repurpose Used Cooking Oil) is has enabled the collection and conversion of Used Cooking Oil to biodiesel. FSSAI is committed to reducing the industrially produced trans fatty acids to less than 2% by the year 2022 in a phased manner. Eat Right India Movement promotes the Eat Healthy, Eat Safe, Eat Fortified, No Food Waste and to build trust in food that people get in the market through common food testing. FSSAI has formulated several food standards including Standards for Health supplements and Nutraceuticals are specified under Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, Functional Food, and Novel Food) Regulations, 2016. The Food Fortification Resource Centre (FFRC) is a Resource and Support Centre created to promote large-scale fortification of food across India. FSSAI is creating an ecosystem of food safety mitras who will help FBOs with licensing and registration, training and auditing hygiene at different institutions such as schools, colleges and corporate campuses. In order to strengthen and develop a robust Food Testing Laboratory network in the country, FSSAI has formulated a scheme for Strengthening of Food Testing Laboratories (SoFTeL) in the country. International Training Center on Food Safety and Applied Nutrition (ITC-FSAN) has been built in collaboration with Global Food Safety Partnership (GFSP) of the world bank and Export Inspection Council (EIC) for hands on training on food analysis. FSSAI's own two referral food laboratories, National Food Laboratory, Ghaziabad and National Food Laboratory, Kolkata are being renovated with world class facilities. Indian Food Laboratory Network (InFoLNet) has been established as a digital solution to connect all food labs in the country to a centralised lab management system. FSSAI has established the Food Safety Knowledge Assimilation Network (FSKAN), a system of network of organizations/ Institutions/ Universities under its mandate as specified in Section 16, 3(e) of the Food Safety and Standards Act, 2006 to establish functional links between the regulators, experts and other sectors to ensure effective cross-sectoral collaboration through sponsored agreements/ grants for R&D or specified studies/ surveys etc.

Keywords: FSSA, FSSAI, RUCO, Trans Fat, FFRC, Swasth Bharat Yatra, SoFTeL, ITC-FSAN, InFoLNet Food Safety Mitra, FSKAN

# POSTER SESSION

# Bio-conversion of Fish Industry Rest Raw Materials into Bio-fertilizer

**Asha Kumari**[1], Nutan Kaushik[1], Rasa Slizyte2, Khushboo1, Sancharini Das[1]

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2. **SINTEF Ocean, Norway**

## Abstract

Global fishconsumption has been increaseddue to its good health benefits. But at the same times large amounts of Rest Raw Materials (RRM) are generated during fish processing which account for approximately 50% of total fish production (Rajeswari et al., 2018).These RRM have high impact on the environment and public health due to the release of organic and inorganic compounds. Therefore, proper fish RRM management aids in eliminating harmful effects on environment such as groundwater and surface water pollution through the leaching of its high nutritive content (Gao et al., 2010). The RRM from fish processing industries consists of head, viscera, skin, scales, bones and other body parts which are rich in different plant nutritive element and free from hazardous contaminants and pathogens (Rajeswari et al., 2018). Conventionally these RRM can be used for production of high-proteinmeals, animal feeds and Compost (Kim et al., 2010). These wastes could be converted into bio- compost through bioconversion process by using microorganisms such as *Lactobacillus* spp. and *Bacillus* spp.which is used in organic farming (Gennadievich et al., 2009; Kim et al., 2010). Composting is a biotechnological process by which different microorganism used to convert complex organic matter into simpler nutrients. Composting of fish RRM is a relatively new, practical and an eco-friendly alternative to fish RRM disposal. The microorganism convert fish RRM intobio-fertilizer which may be suitable for farming as theycause mineralization by their metabolic activity,so that plants can uptake the mineralseffortlessly and stabilizesagricultural productionThis Bio- fertilizer from fish RRM is a complete fertilizer as it contains all theessential minerals needed for plant growth and can be used as cost effective, aneco-friendly product for organic agriculture productions.

**Keywords:**Fish RRM, Bio-composting, *Lactobacillus* spp.,*Bacillus*spp, organic farming

# Process for Removal of Soluble Protein from Meat and Seafood Industry Wash Water and Utilization of Precipitated Protein

**Khushboo[1],** Asha Kumari[1], Dr. Nutan Kaushik[1], Dr. Kristina Norne Widell[2]

1. **Amity University Uttar Pradesh, Noida**
2. **SINTEF Ocean, Trondheim, Norway**

## Abstract

Production and subsequent processing of large amount of food grade meant and seafood products generates huge quantity of by-products. Apart from solid rest raw material like head and viscera, skin and bones etc this industry also produces a large amount of wash water with high concentration of soluble proteins. Discarding of this wash water poses serious biological threats, high disposal cost and loss of valuable components. We have developed a protocol for removal of soluble protein from meat and seafood industry wash water using isoelectric precipitation. Wash water was treated with 0.1 N and 1 N lactic acid to obtain a pH ranging 2-6 for a time period of 30-360 min at a temperature range of 4-25 degree Celsius. The process indicated positive results with a removal upto more than 85% of soluble protein. Precipitated protein can be further utilized for nutrient fortification of food and feed products and treated water can be re-used in the industry.

**Keywords:** Seafood Industry, Meat Industry, Soluble protein, Isoelectric Precipitation, Lactic Acid, Wash Water

# Functionalized Polymeric Magnetic Nanoparticle Assisted SERS Immunosensor for the Sensitive Detection of *S. typhimurium*

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**Abstract**

The quest for detecting bacteria has gained momentum in food and beverage industry for preventing spoilage of products to maintain requisite quality. This work describes the development of a SERS immunosensor for the detection of model pathogen, *Salmonella typhimurium* using strategically synthesized size controlled functionalized polymeric magnetic nanoparticles (FPMNPs) working as effective immunomagnetic separator.

The synthesized probe contains surface diketonic functionalities which covalently link with amino groups of antibodies against *Salmonella* common structural antigen (CSA-1-Ab) and hence specifically captured the target bacteria. Magnetic core of nanoparticles facilitated easy separation of target bacteria from the milieu of non-specific molecules. Gold nanoparticles (GNPs) modified with CSA-1-Ab and external Raman reporter molecules (RRM) were used as signal probes. We compared the signalling attributes of 4-mercapto benzoic acid (MBA) and 5,5′-dithiobis(succinimidyl-2-nitrobenzoate) (DSNB) as RRMs. Capture and signal probes sandwich the target bacteria upon its addition, generating Raman signal from the 'hot-spots' created by signal probe. Under optimal conditions, the SERS intensities of MBA and DSNB at 1588 and 1336 $cm^{-1}$ respectively were used to measure the concentration of the pathogen in the range of $10^1$-$10^7$ cells $mL^{-1}$. Limit of detection (LOD) of MBA and DSNB based immunosensor was measured as 100 cells $mL^{-1}$, and 10 cells $mL^{-1}$ respectively. Moreover, appreciable recovery (82–114%) was recorded for sensing method for different spiked food products. Thus, the developed magnetically assisted SERS immunosensor is sensitive, specific and has strong potential to be used for detecting contamination in food samples in field conditions.

# Influence of Thermal Properties of Brown Seaweeds (Saccharina latissima) on Atmospheric Freeze-drying Process in Fluidized Bed

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**Abstract**

Study explains the influence of thermal properties on the atmospheric freeze-drying process of brown seaweeds in fluidized bed, especially on fluidization, that is important for efficient and rapid drying. Two different types of raw materials (washed and raw) were investigated using differential scanning calorimetry technique. Raw seaweeds contained high amount of salts and water soluble fraction on the surface, that influences significantly the amount of unfrozen water at low temperatures (up to 11.6 % w.b. at -25.0 °C), while washed seaweeds showed almost complete freezing without significant depressing of freezing point. The diagram that shows the amount of ice with respect to temperature and total moisture content was obtained. The efficient drying process can be obtained using washed seaweeds, which do not contain water-soluble elements on the surface, while raw seaweeds showed agglomeration of particles during drying, due to significant depression of freezing point.

**Keywords:** Seaweeds, ice content, atmospheric freeze-drying, ufreezable water, glass transition

# First CO2 Refrigeration and Hot Water System with Ejector in India

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**Abstract**

This work presents a pilot-project for a R744 refrigeration system with combined hot water and thermal storage, as well as ejectors support. The goal of the project is to install such a system for a school kitchen of the Akshaya Patra Foundation in Bangalore, India. Today, Akshaya Patra is the world's largest (not-for-profit run) Mid-Day Meal Program serving wholesome food every school day to over 1.76 million children from 15,024 schools across 12 states in India. The objective of the project is to demonstrate feasibility of integrated CO2 chiller technology to replace current HCFC units and in addition to provide hot water, and to prove the viability for large scale adoption of the technology.

# Development of a Combined Absorption-Compression Heat Pump Test Facility at High Temperature Operation

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**Abstract**

The present work deals with the analysis of the current requirements and opportunities of the development of a combined absorption-compression heat pump (CACHP) test facility at high temperature operation. The CACHP system combines the technologies of an absorption and vapour compression heat pump with a mixture of ammonia and water as refrigerant. The functionality of this process was already been proven in the industrial sector using standard components In recent years, several studies have investigated the CACHP system to identify challenges and opportunities to increase the achievable temperature range and optimize process performance. The compressor and the absorber were identified as critical components for increasing the achievable temperature level. For this purpose, this study investigates the currently available solutions of the critical main components for use in the development of a planned CACHP test facility that can be used for experimental investigations and increases the achievable sink outlet temperature on the secondary side up to 140 °C to 180 °C.

**Keywords:** Industrial High Temperature Heat Pump, Combined Absorption-Compression Heat Pump, Ammonia-Water Mixture

# EVALUATING THE APPLICABILITY OF ENZYMATICALLY EXTRACTED SOLUBLE DIETARY FIBRE FROM MUSTARD DE-OILED SEED MEALS FOR FUNCTIONAL FOOD DEVELOPMENT TO AMELIORATE DYSBIOSIS.

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## Abstract

Mustard is a commonly grown food crop used for the production of mustard oil in India. India produces 5.7 million tonnes of mustard seeds per annum, out of which West Bengal contributes 6% of the total cultivation. Mustard oil production in our country accounts for the generation of 3.01 million tonnes of de-oiled seed meals annually. In spite of its high protein, carbohydrate and fibre content, these de-oiled counterparts receive much less importance. Only a minute proportion is used as manure and animal feed while the major portion is disposed of as wastage. This study aims to utilise the waste products of edible oil industry for development of functional foods.

Soluble dietary fibre (SDF) has been enzymatically extracted from the de-oiled mustard meal by using the enzymes α-amylase, protease and amyloglucosidase respectively. This was followed by an evaluation of the various anti-oxidative and prebiotic activities of the mustard SDF. The functional properties like- water solubility, water holding capacity, fat absorption capacity, emulsifying activity, were analysed in order to find out its applicability as a food ingredient.

The functional, anti-oxidative and prebiotic activities of the extracted SDF have been found to be satisfactory in comparison to other dietary fibre. SDF has been proven to possess prebiotic properties i.e.- they selectively facilitate growth of probiotic bacteria, promoting host health. In-fact, mustard SDF had shown better prebiotic activity, in combination with *Lactobacillus casei* and *Lactobacillus plantarum* compared to the commercially available prebiotic inulin.

With possession of such attributes, the enzymatically extracted soluble fibre is a promising functional food ingredient and could be used for development of a synbiotic food product that could be directed for targeting dysbiosis (undesirable alterations in the taxonomical composition and metagenomic functions of the gut microbiota) and restoring the normal gut equilibrium. Procuring SDF from edible oil industry waste will help to develop functional food at low cost and will also ensure complete waste utilisation as well as reduction.

**Keywords:** soluble dietary fibre, prebiotic activity, functional properties, dysbiosis, waste utilisation.

# A Study On Characterization and Bioactivity Of Polyphenols Extracted From Some Indigenous Edible Flowers

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## Abstract

**Introduction :** Oxidative stress is the primary etiological factor for causing inflammatory diseases like atherosclerosis, diabetes, cancer, neurodegenerative diseases etc. Due to profound antioxidant anti-inflammatory, antiproliferative characteristics, plant polyphenols have been found to be effective against such chronic diseases. Flavonoids , a class of polyphenols have far-reaching effects against CVD as these are potent inhibitors of LDL oxidation and endothelial dysfunction.

**Objectives :** The main objectives of this study were to quantify the polyphenol and flavonoid present in the locally available edible flower like Dregea volubilis, Sesbania grandiflora (white variety), Sesbania grandiflora (pink variety), Cucurbita maxima.

**Materials and methods: T**he *in vitro* antioxidant activity were by assessed by TROLOX, ABTS, and DPPH radical scavenging activity. The specific polyphenol constituents were identified by HPLC chromatogram. Also the oxidation inhibitory effect of polyphenol extracts were measured using lecithin liposome and lipid emulsion system following which DNA damage protection assay was carried out.

**Findings :** Polyphenol and flavonoid contents were found maximum in Dregea volubilis extract and lowest in Cucurbita maxima extract. Methanolic extract of Dregea volubilis showed maximum Total Antioxidant Capacity expressed as m mole of TROLOX , ABTS+, DPPH radical scavenging activity as well as maximum inhibition of liposome and lipid emulsion peroxidation. Dregea volubilis extract also showed considerable inhibitory effect against LDL oxidation and liver cell DNA damage induced by hydrogen peroxide. HPLC chromatogram of all the flower extracts revealed that myricetin in Cucurbita maxima , rutin in Sesbania grandiflora, and guaicol in Dregea volubilis are the major flavonoids.

**Conclusion :** In this comparative study Dregea volubilis was found to show maximum antioxidant activity. It is also evident that the health promoting attributes of these edible flower extracts are due to content and composition of flavonoids. Exploration of such varieties of locally available flora and fauna can be a great source of novel nutraceuticals which can be used by the food and pharmaceutical industries as prebiotic, food preservatives and so on. Thus further screening of such herbal plant nutraceuticals and its prebiotic and preservative potential could be the next step towards commercialisation. This approach can be effective to bring a healthy and sustainable change in the food system preventing consequence of many chronic diseases.

**Key words** : oxidative stress, LDL oxidation, Dregea volubilis, flavonoids,guaicol, novel nutraceuticals

# Systematizing Sesame Lignans Rich Nanoemulsion against Sepsis: Shifting to a New Paradigm

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## Abstract

Neo-age nano-scale researches have reformed the field of therapeutic nutrition through different miniature forms with natural resources. Edible biopolymers have emerged as potential delivery vehicle for a huge number of nutraceuticals to prevent various clinical disorders. The prime objective of our present study is to fabricate soya-phospholipid based nanoemulsion for the delivery of sesame lignans and to apply it effectively in the treatment of sepsis. The successful preparation of oil-in-water nanoemulsion was made possible by low energy technique- solvent evaporation. To validate the stability of sesame oil nanoemulsion formulation morphology and particle size distribution of the nano-emulsion formulations were studied thoroughly. Further the *in vivo* and *in vitro* bioavailability of sesame oil nanoemulsion was assessed through time-gradient dependent study. The bioactivity of sesame oil nanoemulsion against lipopolysaccharide-induced sepsis was examined in *in vivo* rat model to determine the anti-oxidative and anti-inflammatory potential of this novel formulation. The stable nanoemulsion has shown mean droplet size in the range of 100-200 nm with a polydispersity index $\leq 0.3$. The bioavailability analysis parameters have revealed that the nanoemulsion has significantly enhanced the absorption of sesame oil compared to the conventional emulsion system. Histological sections of tissues along with the biochemical oxidative stress and inflammatory markers have proved superior therapeutic efficacy of sesame oil nanoemulsion than conventional emulsion. Improved bioavailability and enhanced bioactivity is achieved in nanoemulsion system due to its very small particle size and inherent higher surface to volume ratio compared to conventional emulsion.

**Keywords**: phospholipid, nano-emulsion, stability, bioavailability, sepsis, bioactivity

# Partial Substitution of Fish Meal with Oil Seed Cake for Cultivating Fish in a Cost Effective Manner

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## Abstract

Fish is a much favored ingredient of Bengali cuisine. It is not only loved because of its texture, taste, flavor, tenderness of flesh or easy digestibility but also preferred because of its high Biological Value of protein in terms of essential amino acids. Fish meal is extensively used as fish feed due to diverse reasons including its high protein content, more specifically its excellent amino acid composition, better digestibility and lack of anti nutrient factors. Apart from having all this beneficial facts the major problem is the static production of fish meal which in turn causes the reduce availability and high costing of fish feed that ultimately increases the production price and eventually raise the market value of the fish and make them unavailable to common people, despites being nutritionally sound. Therefore, the over dependence on fish meal can directly affect the issues related with supply, price, quality fluctuation and sustainability. Thus it is necessary to adopt an alternative intensive farming practice, in terms of identification, development and utilization of alternatives to fish meal to overcome this situation. One factor that can be considered in production costs and increase profitability of producers is the utilization of fish feed with low levels of fish meal and high levels of inexpensive, high quality plant protein sources namely ground nut cake, coconut cake, sunflower cake for optimizing the feeding formulas.

**Key words :** Fish meal, Value added product, Fish feed, Biological Value, Nutrition security, Affordability.

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# Making Edibles out of Wastes for Ensuring Nutrition Security

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## Abstract

About 1.3 billion tons of food in the form of fruits, bakery, bread, vegetables, dairy and animal products are lost every year through food supply chain worldwide (FAO 2012). Extensive works have been carried out to convert these food wastes to generate biofuel and like but these have certain public and environmental health issues. On the other hand, food waste is a rich source of various nutrients such as protein, carbohydrate, oil, mineral, and fat that can be used in a wide range of enzymatic and microbial processes. An attempt, in this backdrop, has been undertaken to highlight the conversion of food wastes to edible items through various food processing methods. It has been found that waste from almost all food items are being subjected to various methods of food processing resulting improvement in nutritional contents and decreasing anti-nutritional factors. It may be mentioned that nutrition security which a component of SDGs, can be achieved through novel approaches of food processing thus making edibles from waste; however challenges like high cost, control of process condition and low-quality end products need to addressed.

**Keywords:** bioactive compounds, fermentation, food waste, malnutrition, sustainability

# Multi-residue Method for the Determination of 123 Pesticide Residues in Packaged Drinking Water by Solid-phase Extraction/ Liquid Chromatography-Tandem Mass Spectrometry

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**Abstract**

A multi-residue method was developed for the determination of 123 pesticide residues in Packaged Drinking Water using solid-phase extraction (SPE), and liquid chromatography-tandem mass spectrometry (LC-MS-MS). The method development was based on an appraisal of the characteristics of LC-MS-MS for 123 pesticides as well as the efficiency of extraction and purification by SPE cartridges from packaged drinking water. Samples were first concentrated using Waters Oasis prime HLB (N-Vinylpyrrolidone DVB copolymer) cartridges stacked in vacuum manifold. Pesticides were eluted with methanol, and the eluates were directly injected to LCMSMS. The limit of quantitation for the method was 0.025 and the range of testing was from 0.025 to 1 ng $g^{-1}$ depending on each pesticide analyte. At the four fortification levels of 0.025–1 ng $g^{-1}$, the average recovery rates were between 90 and 120%, among which 113 pesticides had recovery rates of 70–120% and 10 pesticides had recovery rates of 59–70%. There were 123 pesticides with a relative standard deviation below 20%.

Keywords: Pesticide multi-residue analysis, liquid chromatography-tandem mass spectrometry (LC-MS-MS), packaged drinking water, SPE.

# Properties of Hydrolysates Made from Stored Heads of Farmed Trout (*Oncorhynchus mykiss*)

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## Abstract

The global demand of proteins are increasing. The fish processing industry is a large source of food waste such as head, backbone and skin, which have high content of food-grade proteins. Today, most of these rest raw material are used for feed and pet food. To be able to meet the increasing demand of proteins, there is a need to utilise more of the rest raw material for human consumption. Fish protein hydrolysates is a suitable method for this purpose. Industry might meet difficulties processing all rest raw material when fresh. Therefore, there is a need of knowledge about quality and properties of hydrolysates when using rest raw material of lower quality.

Heads of trout were collected the same day as slaughtered, minced and frozen at -80 degrees until hydrolysis. Minced heads were thawed and divided into three experimental groups. One of the groups were immediately hydrolysed after thawing (control). To simulate the use of fish that was not fresh, oxidation was induced at two different levels in two of the groups before hydrolysis. Enzymes used in the hydrolysis was papain and bromelain, at a concentration of 0.05 % of each. Temperature was 50 degrees, and the hydrolysis lasted for one hour.

The results showed that the protein hydrolysate made of stored heads had lower solubility, but also a higher proportion of peptides and proteins with a molecular weight below 2000Da. Use of stored heads did not affect the total amino acid distribution.
Hydrolysates made of stored heads of trout may have a potential for human consumption, but further studies are needed.

# Increased Utilisation and Value Creation from white Fish Rest Raw Materials

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**Abstract**

*The recently funded research project, SUPREME will address the challenges of the Norwegian whitefish sector and develop concepts and solutions for increased utilization of rest raw materials (RRM). The sea-going fishing vessels accounts for 86 % of the unutilized whitefish RRM in Norway. Thus, to achieve maximum utilization, the processing solutions need to be flexible, compact and adapted to demanding on-board conditions. This project will focus on solving the technical problems related to on-board handling, preservation and logistics of RRM. This will be done to develop optimized technological solutions for processing of RRM that are suitable for on-board conditions.*

The Norwegian fisheries industry produces around 340 000 tons of whitefish rest raw materials (RRM) each year. Marine RRM is a high value raw material rich in proteins, lipids and other important components (calcium, phosphorus, etc.) and can be used to produce ingredients for food and feed. However, in 2018 approximately 166 000 tons of whitefish RRM was discarded and not utilized, resulting in a significant loss in potential value creation from already harvested resources.

The quality of ingredients (eq. oils and proteins) produced from RRM depend upon sorting, storage and handling practices of the RRM. Marine RRM are especially vulnerable when it comes to spoilage and degradation, and prolonged storage of RRM gives increased concentration of free fatty acids (FFA), increased oxidation and reduction in the molecular weight of proteins leading to the degradation and quality loss. To utilize a higher amount of the RRM generated by the sea-going vessels, the RRM needs to *be preserved by thermal and/or chemical methods* in order to increase their shelf life or *be processed into semi-manufactures or ingredients on board*. However, application of these technological solutions is costly and, if there are no obvious economic incentives to increase the use of RRM, it is difficult to encourage value creation.

In Norway, international guidelines about reuse of RRM from discard and bycatch of fish entered into force in March 2011. Inefficient use of RRM in whitefish supply chains not only contributes to an adverse environmental impact on living resources, but also on the environment due to dumping of RRM. The logistic solutions should secure the volumes needed for industry scale systems in a way that secures the quality of the RRM and the profitability. In addition, the environmental impacts from transport should not outplay the benefits from improved resource utilization.

During on board production of (frozen) HG fish or fillets, the resulting RRM accounts for respectively 30% and more than 60% of the round weight of the fish. To increase the resource efficiency, whitefish RRM should be processed into valuable ingredients as oil, protein, gelatin and minerals for human consumption, pet-food and livestock- or fish feed. Acid-hydrolysis (silage), traditional fish oil- and meal production, and enzymatic hydrolysis are among the technological solutions for utilization of RRM. Today, all the mentioned technologies are being tested and evaluated for implementation on the fishing vessels. However, they are all facing several challenges and limitations and need further research and development. To establish successful market penetration and meet the customers' requirements, the technological solutions need to be adapted and optimized in accordance to raw material composition and process conditions and be suitable for on board processing conditions.

**SUPREME –** Sustainable production of ingredients from whitefish rest raw materials project runs for 4 years (2019 – 2022) and is funded by The Research Council of Norway (NRC, project number 294539). FOR MORE INFORMATION about the project and ongoing activities check out the following:

Website https://www.sintef.no/projectweb/supreme/

Facebook https://www.facebook.com/SUPREMEProsjekt/

Instagram supreme_project #supremeprosjekt

*Keywords*: Rest raw material, Whitefish, Handling, Preservation, Bio-processing, Mapping, Logistics management, Pilot demonstration

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