The Food Tech Times

YOUR FOOD TECHNOLOGY COMPANION

COCHIN CHAPTER • QUARTERLY NEWSLETTER •OCT-DEC 2023 • ISSUE 09

Seafood: The Wealth from the depth

Celebrating 10th Successful Year

of

Association of Food Scientists & Technologists (India)
Cochin Chapter

- Articles by experts
- Activities of AFSTI Cochin chapter
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FOOD ENTREPRENEURS CONCLAVE (FECO 2.0)

FECO

by

Celebrating 10th Successful Year

AFSTI Cochin Chapter

Association of Food Scientists & Technologists (India), Cochin Chapter

&

Department of Food Science & Technology, KUFOS

On 30/11/2023 @ Kerala University of Fisheries & Ocean Studies, Kochi

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The Food Tech Times

A Newsletter by AFST(I) Cochin Chapter

Contents Page No.

From Editor's desk

Dr. Abhilash Sasidharan

Editor, The Food Tech Times

Seafood, including fish and shellfish, plays a significant role in our diets and ecosystems, holding immense importance for human health, the environment, and the global economy. Seafood is a rich source of essential nutrients such as high-quality protein, omega-3 fatty acids, vitamins (like B12, D), and minerals (such as iodine, selenium, and zinc). These nutrients are crucial for maintaining good health, aiding in the development of the brain, heart, and immune system, and reducing the risk of chronic diseases. Regular consumption of seafood is associated with reduced risk factors for heart disease. Omega-3 fatty acids in fish can lower triglycerides, reduce blood pressure, and decrease the likelihood of blood clot formation, thus promoting cardiovascular health. Omega-3s, particularly DHA (docosahexaenoic acid), are essential for brain development in infants and cognitive function in adults. Including seafood in the diet during pregnancy and early childhood is recommended to support optimal brain growth and function. The seafood industry is a significant contributor to the global economy, providing livelihoods for millions of people, including fishermen, processors, and restaurant workers. It represents a major export and trade commodity in many countries, contributing to economic growth and stability. Sustainable fishing and aquaculture practices are vital to maintaining seafood stocks for future generations. Overfishing and destructive fishing methods can deplete fish populations and harm ocean ecosystems. By promoting sustainable practices, we can ensure a continued supply of seafood. Seafood consumption helps maintain the balance of marine ecosystems. Predatory fish control the populations of smaller species, preventing overpopulation and promoting biodiversity. A healthy marine ecosystem benefits not only seafood production but also the entire environment. Seafood is an integral part of the culinary traditions of many cultures around the world. It often represents cultural identity and heritage, with various recipes and preparation methods passed down through generations. Seafood offers a wide variety of options, from white fish like cod and haddock to oily fish like salmon and mackerel, as well as shellfish such as shrimp, crab, and oysters. This diversity allows for a range of flavors and cooking methods, catering to different preferences and dietary needs. Seafood can be a reliable source of food, especially in coastal regions where it may be more accessible than other forms of protein. It can help address food security issues by providing a consistent source of nutrition. Fish and shellfish are often more efficient at converting feed into protein compared to land animals, reducing greenhouse gas emissions associated with meat production. Sustainable aquaculture practices can have a smaller environmental footprint compared to traditional livestock farming. Seafood is celebrated for its unique flavors and textures, making it a versatile ingredient in various cuisines. It can be grilled, baked, fried, steamed, or served raw in dishes like sushi and sashimi. In conclusion, seafood is more than just a delicious addition to our diets. It is a vital source of nutrition, a driver of economic growth, and a cornerstone of cultural and culinary traditions. To ensure its continued importance, it is crucial that we promote sustainable practices in harvesting and consuming seafood, safeguarding both our health and the health of the oceans on which we depend. This edition of The Food Tech Times brings you the significance of seafood under the theme Seafood: The wealth from the depth.

"If we wipe out the fish, the oceans are going to die. If the oceans die, we die."

– Paul Watson

The Food Tech Times

AFST(I) Cochin Chapter

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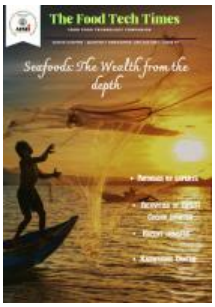

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About AFST(I) Cochin Chapter.....

AFST(I) is the largest professional body of Indian food scientists and technologists and during the past 8 years, the Chapter has made significant contributions to the academic and industrial community of food science and technology.

The continuing pandemic situation has affected several activities of the association. However routine activities of the Association were carried out without fail. Since the situation is easing out Cochin chapter can also venture out carefully into newer activities.

In 2016 Cochin Chapter of AFST(I) conducted "Food Entrepreneur's Conclave" in association with the Kerala University of Fisheries & Ocean Studies (KUFOS), Kochi. Prof (Dr) A Ramachandran, Vice Chancellor, KUFOS inaugurated the programme. Mr. James Joseph the techie turned entrepreneur and Founder, Jackfruit365.com made a presentation on his experience in jackfruit utilisation. Smt. Omana Muraleedharan who has come up with a prawn based snack, 'Prawnoes'. Described her experience in launching the first prawn flavoured ready to eat snack food. K.Aravindakshan, Deputy General Manager , KSIDC, Kochi, Vikas Temani , Strategic Growth Areas, Synthite Industries Ltd, Ernakulam, Baiju, Nedumkery, Founder and Chairman, Agropark and Technolodge ,Piravom ,T.Johnson , Entrepreneur Consultant, Food Processing Technologies, Dr.C O Mohan, Sr.Scientist, ,Central Institute of Fisheries Technology, Kochi and Dr.Satyen Kumar Panda, Sr.Scientist ,Quality Assurance & Management Division, CIFT, were the resource persons in the Conclave. Conclave was attended by 158 registered participants. In 2017 AFST (I) Cochin Chapter, KUFOS and Bakers Association Kerala (BAKE) jointly organised Trainers' Training Workshop for Bakery Professionals at KUFOS which was held as part of the Diamond Jubilee Celebrations of AFST (I). Prof (Dr). A .Ramachandran, Vice Chancellor of KUFOS, inaugurated the workshop. Dr VM Victor George Registrar, KUFOS, P M Sankaran, President Indian Bakers Federation, Dr K Gopakumar Former Deputy Director General, ICAR also spoke on the occasion. Classes were conducted by eminent Resource Persons in the field . They include Reshmi Rajan, Nodal Food Safety Officer Govt of Kerala, Rachel Jacob ,Former GM Quality Control ,Modern Food Industry Ltd, Dr C.P.S .Menon, formerly with Britannia Industries. Selected experts from the bakery industry also shared their success experience in the sector. The workshop was attended by about 90 participants for whom it was a great occasion to clarify their apprehensions and doubts.

AFST(I) Cochin chapter regularly observed World Food Day every year by organizing workshops, meeting, training sessions and Quiz Programmes by associating with leading academic institutions. In 2019 a workshop on "Prospects & challenges of Catering Industry in Kerala" was conducted. The function was inaugurated by Dr A Ramachandran – Vice chancellor, KUFOS . Mr V K Varghese having astounding experience in food catering industry also shared his experience. Lectures were given by Mr Jacob Thomas (Asst Commissioner –Food Safety Ernakulam), Mr Biju P Abraham (MIE, General Manager), Dr Bhadran A (Former Government Analyst- Regional Laboratory, Kakkanad) and Dr P E Doles (FSSAI, Kochi). Other institutions with which the Chapter associated in celebrating World Food Day are IGNOU Regional Centre, Kaloor ,St Theresa's College, SH College ,Thevara, and St Gits College, Kottayam.

AFSTI Cochin Chapter conducted several FOSTAC Food Safety Supervisor training on Advanced manufacturing (Level 2) . Two batches of two day FoSTaC Level 3 (Special) training on Milk and milk products were organised by KUFOS ,Panangad and AFST(I) Cochin Chapter at the University campus in 2018. Late Job Elias , National Trainer provided the training. Dr. C T Chacko, Former Managing Director, Kerala Livestock Development Board guided the participants through cattle rearing issues. In the coming years our Association can take up more activities supporting food entrepreneurs and student community in the discipline of Food Technology.

About the Newsletter.....

The Association of Food Scientists and Technologists (India), Cochin Chapter is coming up with a newsletter titled “The Food Tech Times”. The newsletter is intending to provide information regarding the activities of the chapter, achievements of the members, remembering the pioneers of the food industry that inspires our journey forward, and also valuable and informative articles from eminent experts from the field.

We have also strived to make the newsletter student friendly by including student articles and information that could be utilized by the student community to fuel their academic as well as professional endeavors.

The 9th edition of our newsletter especially focuses on the theme "Seafood: The Wealth from the depth" so that the readers can get acquainted with or gain more knowledge on science behind the seafood processing, products, its nutritional value, byproducts and various factors.

Wish you all a very happy reading!!!

SEAFOOD NUTRITION

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Seafood has held a special place in the culinary world for centuries, revered for its exquisite flavors and versatility. Beyond its delicious taste, seafood offers a treasure trove of essential nutrients that contribute to a healthy diet. It is a healthful choice for people of all age groups.

PROTEIN POWERHOUSE

One of the primary reasons' seafood is celebrated is its high protein content. Fish, in particular, is an excellent source of lean, high-quality protein which includes all the essential amino acids and easily digested protein because it has less connective tissue so fish muscle is so fragile .For the elderly who may have difficulty chewing or digesting their food, seafood can be a good choice to help them obtain their daily protein needs Protein is essential for the growth, repair, and maintenance of tissues in our body, making seafood an ideal choice for individuals looking to build and maintain muscle mass.

FAT

The fats found in the seafoods are oils. Studies show that seafood eating can decrease the risk of stroke, heart attack, hypertension and obesity. Seafood is low in saturated fat and higher in "heart healthful" omega-3 fatty acids along with polyunsaturated fat. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are the most important omega-3 fatty acids in seafood. All seafood such as salmon, sardines, and mackerel contain omega-3 fatty acids and rich sources of EPA and DHA. These fatty acids help lower blood pressure and heart rate, improve cardiovascular function, reducing inflammation, and improving blood vessel function. Farm-raised seafood can have an equal or even higher amount of omega-3 fatty acids than wild-caught seafood.

VITAMINS AND MINERALS

Seafood contain niacin, vitamin B6, vitamin E, vitamin B12, thiamin, riboflavin, zinc, phosphorus, magnesium, iron, copper, potassium and selenium are the essential vitamins and minerals. In addition, oily fish have generous amounts of vitamins A and D, while fish with bones remaining, such as canned salmon and sardines, are good sources of bone-building calcium. Fish, especially marine fish, are a dietary source of iodine. Fish is high in iodine and selenium which are nutrients with important roles in the nervous system, brain function, the immune system and metabolism.

- **PREGNANCY AND LACTATION**

During foetal growth and development, as well as in early infancy and childhood, the nutritional value of seafood is very important. For pregnant women, lactating mothers and women of childbearing age, eating seafood is important because it supplies DHA that is beneficial for the brain and visual development of infants.

EXAMPLES

1. Pedvey or Indian Oil Sardines are known to be a rich source of proteins, vitamins, and minerals. They help in making your bones stronger, prevent inflammation and relieve stress.
2. Carpo fish, Rohu is enriched with a handsome amount of protein. Packed with Omega 3 fatty acids and vitamins A, B, and C
3. Surmai or King Mackerel is very high in protein, vitamins, and minerals.
4. The protein found in Indian salmon or Rawas helps the body maintain a healthy metabolism which promotes weight loss.
5. Katla fish is enriched with proteins and vitamins. It is low in calories.
6. Indian butter fish, Pomfret or Paplet is delicious in taste, this fish is rich in protein and has a tremendous amount of omega 3 fatty acids.
7. Indian Mackerel or Bangda is rich in Omega 3 and Selenium which is great for your cardiovascular health. It helps lower blood pressure, enhances eyesight and reduces cholesterol.

REFERENCE
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- Malden C. and A.L. Yaktine, eds. "Seafood Choices: Balancing Benefits and Risks." Washington, D.C.: National Academies Press.

SEAFOOD AND HUMAN HEALTH

Dr. T.K. Srinivasa Gopal

Former Director

Central Institute of Fisheries Technology Cochin-29, India

Over one billion people rely on fish as their primary source of animal protein. It constitutes over 14-16 % of the total animal protein consumed world- wide. It is estimated that around 60 percent of people in many developing countries depend on fish for over 30 percent of their animal protein supplies, while almost 80 percent in most developed countries obtain less than 20 percent of their animal protein from fish. Fish and fishery products form a substantial part of human diet, both of poor and wealthy. However, with the increased awareness of the health benefits of eating fish and the ensuing rise in fish prices, these figures are rapidly changing.

Overview of health benefits of eating sea foods has long been recognized as nutritious. Seafood is an excellent resource for proteins, vitamins, trace elements and polyunsaturated fat (omega-3 fatty acids). Seafood is comparatively less expensive protein source available. Health benefits related to fish consumption are due to the presence of proteins, unsaturated essential fatty acids, minerals and vitamins. The polyunsaturated fatty acids (PUFA), especially ω-3 PUFA in fish are known for their hypocholestermic activity. These nutritional qualities have stimulated increasing demand for fish, worldwide.

Fish is highly tasty and easily digested and it is consumed as food all over the world, with other sea foods it provides the world's prime source of protein. Interest in seafood intake has increased markedly over the past two decades, largely due to their health significance. Fish and fishery products form an important food component for a large section of world population. Seafood serves as a rich source of polyunsaturated fatty acids [PUFAS], especially omega-3 PUFAS, minerals and vitamins. Beneficial effects of seafood consumption in the prevention of various diseases/disorders have also been well established. These benefits have been linked to not only to the presence of well-known long chain highly polyunsaturated omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA, but also attributed to various other bioactive molecules such as taurine, glutamine, peptides, squalene, collagen, gelatin, marine saccharides, vitamins, biominerals etc. Fish and shell fish in particular have been acknowledged for being a high protein, low calorie food. In recent years, the importance of fish in the diet has extended from its image as a cornerstone of healthy diet to more specialized roles such as disease prevention.

Though there is a growing awareness of the beneficial role of fish and other marine foods in human nutrition, particularly the importance of seafood in lowering the risk of major nutrition related chronic diseases, the basic information available in this regard is relatively scanty. The following are some of the interesting aspects of seafood in human health management.

MARINE LIPIDS

PUFA

Fish and fish oils contain very-long chain and highly unsaturated n-3 PUFA such as eicosapentaenoic acid and docosahexaenoic acid. Fish oils reduce the synthesis of chylomicrons by the intestine and/or increase their removal from circulation, thus decreasing postprandial lipemia. EPA and DHA constitute 70-75% of total PUFA. Marine organisms accumulate this through their food chain. EPA and DHA play a major role in maintaining health by regulating the lipid metabolism. They exert hypolipidemic activity by decreasing cholesterol, triglycerides, LDL and VLDL-cholesterol in the systemic circulation. Interestingly, the hypolipidemic property of fish oil is stronger on hyperlipidemic patients than on normal subjects (Harris, 1989). Cholesterol concentration in plasma has been decreased by fish oil supplementation and by n-3 PUFA in patients with type V hyperlipidemia, who do not tolerate any other type of dietary. Also they are capable of elevating HDL-cholesterol, which lowers the rate of coronary heart diseae and reduces the risk of atherosclerosis and stroke. Accumulation of cholesterol along with a depot of other metabolic materials on and in the vessel walls surrounding the heart is described as atherosclerosis. Stroke refers to blockage of blood flow to a part of the Brain. It was suggested 37 years ago that the low occurrence of fatal coronary heart disease in Inuits (Eskimos) could be related to their high intake of marine n–3 PUFA (10-14g/day). This ecological study was the basis for the hypothesis that consumption of marine n–3 PUFA could protect against coronary heart disease. Recently, in a large prospective randomized clinical trial of 11,324 patients with recent myocardial infarction, administration of 850 mg EPA plus DHA daily, in

addition to pharmacological treatment, led to a 45% reduction in mortality at 42 months. Marine n- 3PUFA also regulate prostaglandin metabolism. They also have influence on kidney function by modulating the retention of water and removal of excess sodium.

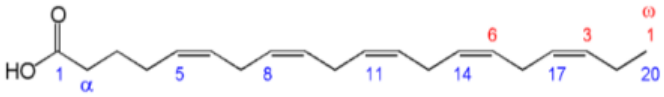

Fig 1 Chemical structure of eicosapentaenoic acid (EPA)

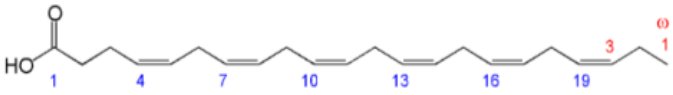

Fig 2 Chemical structure of docosahexaenoic acid (DHA)

Though etiology of cancer is uncertain, complex and multifactorial, 35% of all cancer is related to the way we eat. Many trials using fish oil or PUFAs from fish oil as diet shows promising results in the area of cancer treatment. It is well evident from experimental and clinical investigations that consumption of EPA and DHA are beneficial in alleviating a wide range of cancers. In rats, linoleic acid, a precursor of arachidonic acid in tissues, increases the size and number of tumours whereas EPA and DHA decrease both. It is suggested that the potential of n-3 fatty acids to prevent recurrence and metastases of mammary cancer when used in adjuvant therapy is associated with a (n-6) to (n-3) ratio <2:1. In humans, dietary (n-3) fatty acid treatment offers possibilities in malignant diseases. Intake of n-3 FA also reduces the activities of cartilage destroying enzymes responsible for joint destruction in rheumatoid arthritis. Impaired insulin production and/or function leading to impaired glucose metabolism are characteristic of adult onset Type -II diabetes. Excess weight can be controlled with diet and exercise. Diet containing n-3 FA will allow tissue to more efficiently absorb and metabolize glucose in the absence of insulin. PUFA deficiency reverses alcohol-related mitochondrial dysfunction via an increase in phospholipid arachidonic over linoleic ratio, which raises cytochrome oxidase activity. Liver disease must be one of the major causes of PUFA deficiency because long chain PUFA biosynthesis mostly occurs in the liver. PUFA deficiency is a well-established feature of advanced cirrhosis mainly in plasma, erythrocytes and platelets. PUFA deficiency decreases the fluidity of cell membranes and impairs their biological functions.

PUFA deficiency is related to a number of diseases like Alzheimer's disease, Parkinson's disease, hypertension, inflammatory and auto-immune disorders, depression, schizophrenia, multiple sclerosis etc. Indeed, deficits in the peripheral amounts of PUFA have been described in subjects suffering from neurological and psychiatric disorders. The diseases such as Asthma, diabetes, psoriasis, thyrotoxicosis, multiple sclerosis etc. can be moderated by consumption of marine n-3 PUFA. DHA is critical to normal eye and vision development Along with another fatty acid called linoleic acid it makes it makes > 1/3rd of fatty acid in Human brain and retina. DHA also increases memory power. A person can expect good health if he or she consumes 0.5-1g of PUFA/day.

SQUALENE

Squalene, an isoprenoid molecule present in shark liver oil in higher quantities, has been reported to possess antilipidemic, antioxidant and membrane stabilizing properties. The liver is the main location of lipid storage and high content of low-density squalene which (specific gravity 0.86 at 25 °C) is supposed to offer hydrostatic lift and facilitate the shark to maintain neutral buoyancy. In human beings, it is directly involved in the lipid metabolism not only as a precursor molecule of cholesterol biosynthesis, but also as a feedback inhibitor of HMG CoA reductase in regulating cholesterol metabolism. Squalene has been shown to suppress the growth of tumor and that exposure to squalene over a period of time was reported to inactivate carcinogenic substances. Squalene also plays a role in enhancing health through its part in the building blocks of hormones and cholesterol and as anti-oxidant. In humans, squalene is useful to enhance the effects of some cholesterol-lowering drugs. The combination of pravastatin and squalene has been shown to be very effective in reducing total and LDL-cholesterol and increasing HDL-cholesterol.

Table 1 The level of squalene content in different oils

Oil	mg/100g
Olive oil	37
Rice bran oil	332
Arachis oil	28
Cod liver oil	31
Seal oil	35
Butter	7
Coconut oil	2

Squalene revitalizes weakened body cells and helps to revive cell generation. Its chief attribute is the protection of cells from oxidation reactions. The human body has about six billion oxygen reliant cells. Oxygenation to the cells promotes good health to the most basic level of life. Squalene helps to clean, purify, and detoxify the blood from toxins, facilitating circulation. It cleanses the gastrointestinal tract and kidneys, causing better bowel movement and urination. Many diseases are cured if the blood is purified,by supplementing squalene.

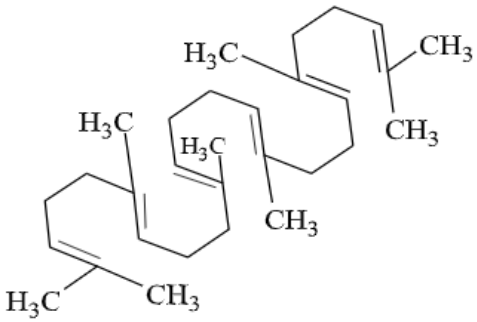

Fig 3 Structure of squalene

As squalene prevents cellular damage, healthy cells are produced, which are linked together with lipoproteins, later forms lipofuscin, an anti-aging substance. It prevents the formation of harmful lipid peroxide, which destroys various kinds of vitamins. Squalene carries oxygen in the cellular level, causing further improvement in organ function through cellular metabolism, preventing the acidotic cell syndrome where cells become acidic, deteriorate and die due to lack of oxygen. There is a

significant relationship between the degree of one's health and the amount of oxygen consumption by body cells. In today's polluted environment, lack of exercise and poor lifestyle, squalene gives a beneficial source of oxygen for our body.

Squalene's terpene gives a sterilizing effect, combating the growth of various microorganisms such as coliform Bacilli, dysentery Bacilli, Micrococcus pyocynanel, Staphylococcus, hemolytic streptococcus, and Candida albicans. Squalene naturally increases male potency and vitality through a better body. It also helps regulate the female menstrual cycle and improves irregular and abnormal cycles. Squalene is used as bactericide, intermediate in the manufacture of pharmaceuticals, organic coloring matter, rubber chemicals, aromatics and surface-active agents. Squalene is now extensively used as an additive in pharmaceutical preparations and certain foodstuffs. A health food called squalene powder is popular. It is prepared by adding proteins, carbohydrates, flavoring agents etc. to squalene. This is soluble in water and stable during storage.

Squalene is now used as an immunoprotector. Squalene reduces various aches and pains, helps body organ such as the kidney, liver and gallbladder and digestive system to function properly, helps hemorrhoids to shrink and curb obesity. It also acts as relaxant, giving added vigor and vitality without the hyper-activity associated with other food supplements, generates hair and smoothens skin. It exhibits penetrating action with immediate effect on topical applications and helps to prevent various kinds of disease and speeds up the healing process in most conditions of ill health.

FISH PROTEINS

Fish proteins are incorporated as a protein supplement in human diet. High content of highly digestible protein, available lysine, methionine and cysteine and minerals makes fish protein a highly nutritious product. Fish proteins lessen the risk of microalbuminuria. It improves blood lipid profile of animals and human. Fish protein powder is used to formulate infant foods, soups and protein containing beverages to enhance their protein content & nutritive value. It is also used as milk replacer. Fish protein hydrolysate has inhibitory effect on both lipoxigenase and cyclooxygenase. It is exerting synergistic effect when used with synthetic antioxidants.

Fish protein hydrolysate contains some important bioactive peptide fraction like gastrin, calcitonin gene related peptides (CGRP) and some growth promoting peptides which play a key role in our metabolic path ways. Fish protein hydrolysate suppresses both hypertension & atherogenesis.

Along with fish oils, proteins in fish are also having positive role in reducing blood cholesterol. Recent studies have shown that fish proteins have a clear protective effect in diabetic renal diseases. Fish proteins are having high biological value, as they contain all essential amino acids in the right proportion. Plant proteins, although rich in certain essential amino acids do not always offer all essential amino acids in a single given food. Legumes lack methionine, while grains lack lysine. Fish protein is also an excellent source of lysine as well as the sulphur-containing amino acids, methionine and cysteine. Amino acid scores of fish protein compare well with the FAO reference pattern. In the studies conducted in the Central Institute of Fisheries Technology, Kochi, it was seen that the amino acid composition of the protein is crucial in determining its hypocholesterolemic properties. The alanine/proline ratio in a protein was found to be the significant factor determining its hypocholesterolemic properties.

Protein content of fish muscle ranges between 16 and 20% depending on the species of the animal, the nutritional condition, and the type of muscle. Protein from fish is easily digested, with most species showing a protein digestibility greater than 90%. The chemical score or amino acid score compares a food's amino acid pattern to that of whole egg protein. The chemical score of finfish is 70, an indication of its high quality, beef is 69 and cow's milk is 60. The protein efficiency ratio (PER) another measure of protein quality of fish is around 3.5, which is much higher than beef (2.30) and milk proteins (2.5) and close to that of egg (3.92). Fish is a good dietary source of taurine, a non-protein amino acid with multiple functions like neurotransmission in the brain, stabilization of cell membranes and in the transport of ions such as sodium, potassium, calcium and magnesium. Nutritional quality of protein is generally determined by factors like essential amino acid composition, digestibility and biological value. Fish protein is rated high in all the above qualities and is considered as a good dietary protein in all respects.

COLLAGEN

In fish, collagen is a major fraction of connective tissues such as skin, bone, tendon, the vascular system of animals and the connective tissue sheaths surrounding muscle. Collagen is the fibrous protein that contributes to the unique physiological functions of connective tissues in skin, tendons, bones, cartilage and others. Collagen contents vary considerably with fish species, age and season. Nevertheless, collagen obtained from different species and habitats might be different in terms of molecular compositions and properties. It is possessing properties like abundance, biocompatibility, non antigenic and non-toxic nature, strength, biodegradability etc-tremendous applications in different fields. It is widely used in the production of anti-thrombogenic surfaces, burn cover dressings & controlled drug delivery systems. It is also used as a bone filling material. Premature ageing of skin due to hyperglycemia attack in diabetic patients can be cured using collagen. Surgical sutures are prepared from fish gut collagen. Collagen-chitosan membrane is used as a barrier device for guided tissue regeneration in human periodontal infrabony and furcation defects.

TAURINE

Taurine is one of the most common sulfur-containing amino acids found rich in seafood. This non-protein amino acid is present in high concentration in most of the tissues, amounting to about 50-60% of the total free amino acid pool. Though taurine is found in significant concentrations in all

animal products, fish are good sources of taurine. Table 2 shows the level of taurine content present in some seafood.

Table 2 Levels of taurine content in various seafood

Food	Taurine content
Conch (*Strombus gigas*)	850
Ink fish	672
Blood Clam	617
Clam	496
Shellfish	332
Crab	278
Prawn	143
Sole	256
Crucial carp	205
Silver carp	90
Hairtail fish	56
Yellow croaker	88
Eel	91

Values are mg/100g edible portion.

In plant kingdom, taurine occurs in traces, averaging ~0.01 ¤mol/g fresh wt of green tissue. This is <1% of the content of the most abundant free amino acids. Taurine is a conditionally essential amino acid involved in a large number of metabolic processes. Its function in the body has been long underestimated. In recent years it has become clear that taurine is a very important amino acid in the visual pathways, the brain and nervous system, cardiac function, and it is a conjugator of bile acids hence performs key functions in cholesterol metabolism.

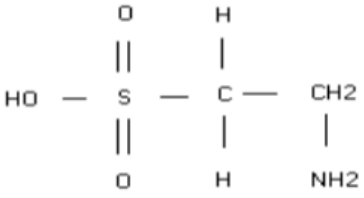

Fig 4 Structure of Taurine

Basically, its function is to facilitate the passage of sodium, potassium, calcium and magnesium ions into and out of cells, and to stabilize the structural and functional integrity of cell membranes. It is involved in detoxification of xenobiotics and also essentially required for efficient fat absorption and solubilization. The requirement of this free amino acid is absolutely indispensable in prenatal and infant development. Though absence of taurine does not result in immediate deficiency and disease, long-term deprivation can cause a multitude of health problems. One is not stumbling into the abyss of teleology in thinking that a compound conserved so strongly and present in such high amounts is exhibiting functions that are advantageous to the life forms containing it. The anitlipidemic and cholesterol-lowering action of taurine lie in its ability to promote the degradation of potentially detrimental cholesterol to relatively harmless bile acids. Taurine supplementation reduces the deleterious action of diabetes on amino acid transport systems, which results in alteration of the cellular amino acid balance. It has also been found as an effective in correcting the antioxidative imbalances that produce diabetic cataracts. Taurine prevents diabetic nephropathy, which is the leading cause of end-stage renal disease occurrring in over half of Type 1 diabetics.

Taurine and to a lesser extent glycine are the major amino acids associated with the removal of toxic chemicals and metabolites from the body. Low taurine levels appear to be a major factor in the chemically sensitive individuals, particularly to chemicals such as chlorine, chlorite (bleach), aldehydes, alcohols, petroleum solvents and ammonia. Recent research studies have shown that taurine neutralizes reactive hypochlorous acid, which is generated during oxidative neutrophil burst, and forms a stable neutral taurochloramine compound.

Taurine can increase cell viability, which is an important alternate protective mechanism to offer protection against free radical damage. The antioxidant property of taurine inhibits neutrophil burst and subsequent oxidative stress, which can result in reperfusion injury to heart tissue. Taurine is able to prevent the inactivation of super oxide dismutase by hydrogen peroxide. It also acts as an antioxidant by preventing changes in the levels of non-enzymatic free radical scavengers. Tonicity (synonymous with osmolarity) is a term that describes the status of cell fluid volume in relation to its external medium. Taurine has an important role in maintaining the delicate balance of tonicity in every cell in the body. Taurine, as an important amino acid osmolyte, helps to regulate osmolarity without causing additional perturbations of cellular tonicity.

Taurine is necessary for the proper function of the kidney and acts as an organic osmolyte. Absence of taurine results in diminished renal function such that the process of excretion of unwanted substances from the blood is grossly impaired. Taurine has been shown to regulate osmotic pressure in the cell, maintain homeostasis of intracellular ions, inhibit phosphorylation of membrane proteins, and prevent lipid peroxidation. As an osmotic regulator, it has been suggested that taurine, along with glutamic acid, is instrumental in the transport of metabolically-generated water from the brain. Taurine acts as an antioxidizing agent and a membrane stabilizer to maintain the functions of membrane-bound protein enzymes. It is of particular value to the preservation of erythrocytes.

BETAINE

Betaine (trimethylglycine or glycine betaine) is a non-toxic amino acid derivative which is produced by a wide variety of organisms (bacteria, plants, invertebrates, and mammals). In recent years, as the market for functional ingredients and foods has grown, betaine has been actively investigated for its health-promoting potential. The principle role for betaine in plants and microorganisms is to protect cells against osmotic inactivation. Exposure to drought, high salinity, or temperature stress triggers betaine synthesis in mitochondria, which results in its accumulation in the cells. Betaine is a compatible osmolyte that increases the water retention of cells, replaces inorganic salts, and protects intracellular enzymes against osmotically induced or temperature-induced inactivation. Betaine also helps maintain intercellular osmolarity and protects proteins from becoming denatured. High levels of betaine are found in animal products, especially shellfish, and in some plants, specifically members of the beet family (e.g.beetroot and spinach), and grain. Table 3 shows the level of betaine content present in some of the seafood items.

Table 3 Betaine content (µg/g) in different seafood

Serial No	Seafood	betaine
1	Clams	2500
2	Shrimp	2190
3	Cod	25
4	Groper	12
5	Monkfish	500
6	Mussel	1630
7	Perch	26
8	Salmon	19
9	Tuna	<10

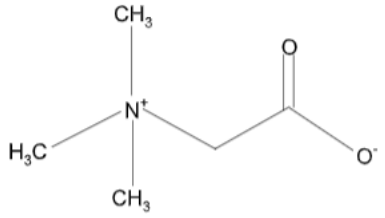

Fig 5 Chemical structure of betaine

Betaine has long been considered beneficial to the blood, and the digestive system. It has been regarded as a laxative; a cure for bad breathes, coughs and headaches; and even as an aphrodisiac. Betaine is a major water-soluble component in fruits of Lycium chinense, which has long been used as tea or a traditional oriental medicine for the treatment of hepatic disorders in Korea and Southeast Asia. Betaine functions very closely with choline, folic acid, vitamin B12, and a form of the amino acid methionine known as S-adenosylmethionine (SAM). All of these compounds function as "methyl donors." They carry and donate methyl molecules to facilitate necessary chemical processes. The donation of methyl groups by betaine is very important to proper liver function, cellular replication, and detoxification reactions. Betaine can act as an osmolyte in vertebrate species and as a methyl donor, thus partly reducing the requirements for other methyl donors (e.g., methionine, choline).

CHITIN AND CHITOSAN

Chitin and chitosan are the most abundant polysaccharide in nature, after cellulose. Chitin is long and unbranched homopolymer, it form a major part of cell wall of crustaceans (shrimp, crab, lobster, krill, and squid), insects, fungi, annelids, molluscus and coelenterates. Structurally, it is poly (N-acetyl-2-amino-2-deoxy-D-glycopyranose) in which the N-acetyl-2-amino-2-deoxy-D-glycopyranose units are linked by (1-4) β bonds. Among several sources, the exoskeleton of crustaceans consists of 15% to 20 % chitin of dry weight.

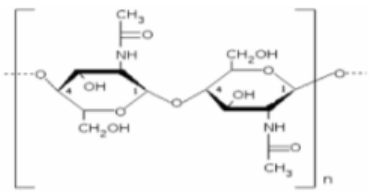

Fig 6 Structure of chitin

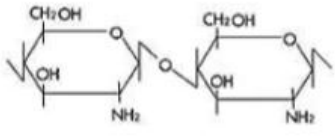

Fig 7 Structure of chitosan

Applications in food and nutrition

NAG moiety present in human milk promotes the growth of bifidobacteria-produces lactase required for digestion of milk lactose. Cow's milk contains limited amount of NAG moiety-some infants fed on cow's milk may have indigestion. Chitosan supplementation helps to overcome lactose intolerance in humans and animals by changing micro flora of gut. Chitosan has hypolipidemic and hypocholesterolemic activity. Chitosan has antioxidant properties and its incorporation is beneficial as a potential natural antioxidant for stabilizing lipid-containing foods. The antimicrobial efficacy of chitosan in lipid emulsions as well as in aqueous solutions is very much effective in producing formulations with improved activity in terms of reducing the number of microorganisms.

Medical and Pharmaceutical Applications of Chitin and Chitosan

Partially deacetylated chitin like 6-0-carboxymethyl chitin, which is readily soluble in water and remarkably higher susceptibility by lysozyme than chitin and chitosan can be fabricated into gels & films as self-regulated drug delivery system. Floating and swelling properties of chitosan in acidic medium are used for the preparation of chitosan granules with internal cavities for sustained release of drugs. Chitin and chitosan are useful for enhancement of dissolution properties of poorly soluble drugs such as grisefulvin, phenytoin, flufenamic acid and indomethacin. Chitin and chitosan can be used as a substitute for the widely used microcrystalline cellulose (MCC) in tablet preparation. Albumin blended chitosan membrane can be used for haemodialysis. Chitin powder can be used for wound dressing. Chitosan can be used for the treatment of burns. Chitosan forms a tough, water absorbent and biocompatible film on the burn. It provides a cool & pleasant soothing effect when applied in open wounds. Chitosan film has oxygen permeability sufficient to prevent oxygen deprivation of tissues. It is slowly degraded by enzymes and film need not be removed periodically from wound.

In ophthalmology

Chitosan is used for making ideal contact lens. It has all the characteristics required such as optically clear, mechanically stable, sufficient optical correction, gas particularly oxygen permeability, wettability and immunologically compatible. Antimicrobial and wound healing property of chitosan along with excellent film forming capability make chitosan suitable for ocular bandage lens.

In dentistry

Chitosan could be used as a transparent membrane or as a thin powder soaked in antibiotic solution. Accelerates wound healing, promoted regular fibrin formation & favored the epithelialisation. Also used for the treatment of gingivectomy.

Nutritional and phrmacological properties of chitosan

Chitosan is currently the focus of much medical research, as it is a polyglucosamine (the second-most-common dietary fiber, after cellulose). Studies have shown that chitosan has the following properties:

- As a soluble dietary fiber, it increases gastrointestinal lumen viscosity and slows down the emptying of the stomach.
- It alters bile acid composition, increasing the excretion of sterols and reducing the digestibility of ileal fats. It is unclear how chitosan does this, but the currently favored hypotheses involve the increase of intestinal viscosity or bile acid-binding capacity.
- Chitosan is relatively insoluble in water, but can be dissolved by dilute acids, which would make it a highly-viscuous dietary fiber. Such fibers might inhibit the uptake of dietary lipids by increasing the thickness of the boundary layer of the intestinal lumen, which has been observed in animal experiments.

GELATIN

Fish gelatin is not a complete protein source because it is deficient in tryptophan and low in methionine content. Gelatin contains 18 of the 20 amino acids, which include 8 of the 9 essential amino acids. High levels of glycine, proline and hydroxyproline are present. The digestibility is excellent and it is often used in feeding invalids and the high level of lysine (4 %) is noteworthy. Gelatin is considered as a fully digestible food material with an energy value ranging from 350-450 kcal per 100g. Studies have shown that the consumption of 7 to 10 g/day can significantly improve nail growth rate and strength and it also promotes hair growth. Gelatin has also been shown to benefit arthritis sufferers in a large proportion of cases. The amino acid composition of gelatin has a positive effect on the bones and joints.

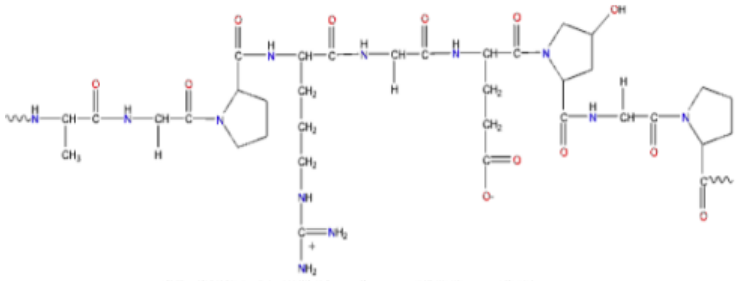

Fig 8 Typical structure of fish gelatin

CHONDROITIN SULFATE

Chondroitin sulfate obtained from shark cartilage is used for the treatment of arthritis. It is part of a large protein molecule (proteoglycan) that gives cartilage elasticity. Shark corneas have been used for human corneal transplants.

GLUCOSAMINE

On hydrolysis of chitin with concentrated acids under drastic conditions gives relatively pure amino sugar D-glucosamine. Glucosamine, which occurs naturally in the body, plays a key role in the construction of cartilage - the tough connective tissue that cushions the joints. Glucosamine stimulates the production of glycosaminoglycans (the key structural components of cartilage) as well as the incorporation of sulfur into cartilage. Sulfur is necessary for making and repairing cartilage. Glucosamine is effective for easing osteoarthritis pain, aiding in the rehabilitation of cartilage, renewing synovial fluid, and repairing joints that have been damaged from osteoarthritis. It possesses excellent antiulcer property.

AMINO ACIDS

Fish contain all the essential amino acids in required proportion and hence have a high nutritional value. Non-protein amino acid taurine is found to be rich in free amino acid pool- beneficial in treating heart disorders. Fish is an excellent source of sulphur containing amino acids cysteine and methionine. Histidine content is high in proteins of mackerel.

VITAMINS

In general, both water soluble and fat-soluble vitamins are present in fish. Fish meat is a good source of B vitamins (red meat > white meat). Fish liver, eggs, milt and skin are good sources of B1, riboflavin, pyridoxine, folic acid, biotin and B12- Hence it is involved in prevention of various anemias including pernicious anemia. Fat soluble vitamins A, D, K and E are present in fish in varying amounts-often in higher concentrations than in land animals. The amount of vitamins and minerals is species-specific and can vary with season. Fatty or semi fatty fishes are excellent sources of vitamin D. Hence it plays an important role in calcium and phosphorous metabolism. Anti-hemorrhage factor Vitamin-K is also present in fish. In fish flesh Vitamin E occurs as a-tocopherol, a potent antioxidant Vitamin involved in counteraction of free radical mediated oxidative damage to the cell membranes. Large quantity of vitamin E (500-3000) is present in liver and body oils. Hepatic reserves of Vitamin A is much greater compared to mammals and birds. Liver oils from shark and Tuna are rich in Vitamin A & D. The flesh of lean white fish, such as cod, haddock, and pollock, contains from 25 to 50 IU of vitamin A per 100 g, while in the fatty species such as herring, there is from 100 to about 4500 IU of this vitamin in 100 g of meat. The content of vitamin D in sardines and pilchards and in tuna is in the range of 530 to 5400 and 700 to 2000 IU per 100 g, respectively. The contents of vitamin E in the edible parts of fish and marine invertebrates range from about 0.2 to 270 mg/100 g.

MINERALS

Fish is a good source of almost all the minerals present in seawater. The total content of minerals in the raw flesh of fish and aquatic invertebrates is in the range of 0.6 to 1.5% of wet weight. Fish and shellfish are valuable sources of Ca & P, also contains Fe, Cu, Se. Fish calcium powder prepared from back bone of tuna can be used to combat calcium deficiency in diet, particularly of children. Calcium deficiency can lead to bone failure and spine curvature in children. Salt water fish have high content of iodine-good for brain and hyroid function. Sodium content is low – makes it suitable for low sodium diets. Certain seafoods such as snails and tuna are good source of the macro mineral magnesium, which contributes to hardness of bone and acts as co factor for certain enzymes important in nerve & muscle function. Crustaceans and shellfish are richest source of Cu-essential for normal blood formation, maintenance of blood vessels, tendons and bones and health of central nervous system. Salt-water fish are rich in iodine. The iodine in marine fish ranges from 300-3000 ¤g/kg. Seafood, especially tuna, is an important source of the essential antioxidant trace element selenium, which provides protection against heavy metal poisonings and a variety of carcinogens. Functioning cooperatively with vitamin E, selenium is also a vital factor in protection of lipids from oxidation as part of the enzyme glutathione peroxidase, which detoxifies products of rancid fat. The carbohydrate content of finfish is insignificant, but certain shellfish store some of their energy reserves as glycogen, which contributes to the characteristic sweet taste of these products.

In conclusion, marine organisms are potential sources of variety of compounds with varied biomedical and pharmaceutical and nutraceutical applications. Yet there is little has been explored in this aspect. Further researches have to be carried out to utilize the wealth of Ocean for the welfare of mankind.

Importance of Histamine Analysis in Seafood and the Need for Rapid Technologies

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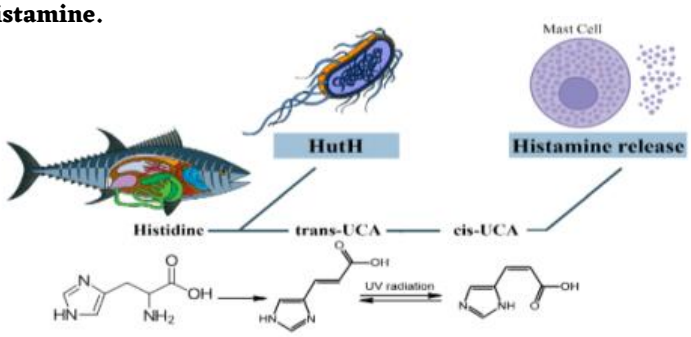
Healthy oceans are always a source of livelihood and food for billions of people. Considering the nutritional properties of seafood , multifold increase in desire to purchase seafood is seen in recent years. The projections according to "the state of world Fisheries and aquaculture 2022" by FAO show growth of 14% by 2030. Considering all these aspects , the quality of the seafood and safety of the consumers becomes critically important aspect. The quality and safety are interlinked. Few important quality parameters are Histamine , Marine biotoxins like domoic acids, Pathogens like Listeria and Salmonella, drug residues like chloramphenicol and chemicals like sulfites. Of these , Histamine is one of the critical quality parameters for seafood. High levels of histamine may develop in a variety of fish species as they decompose. These species include tuna, mahi-mahi, marlin, bluefish, sardines, anchovy, bonito, herring, and mackerel. Ingestion of histamine may cause scombroid poisoning in humans, which may lead to a variety of symptoms, including rash, nausea, vomiting, diarrhea, hypotension, palpitations, and muscle weakness.

Paralysis and death have also been reported in cases of scombroid poisoning. The consumption of fish and fish products containing high levels of histamine may cause scombrotoxin fish poisoning (SFP), also called histamine poisoning.

Formation of Histamine in seafood:

Histamine is a toxic metabolite produced by histamine-producing bacteria during spoilage and fermentation of fish and fish products. Many histamine producing bacteria are part of the natural microflora of the skin, gills and gut of freshly caught fish. Histidine decarboxylase (HDC) enzymes, synthesized by histamine-producing bacteria when they multiply, convert the amino acid histidine that are naturally present in fish into histamine. Histidine from different fish species can be found in food products initially or may be naturally released because of proteolysis induced by the processing of food or storage conditions. The L-histidine decarboxylase found in E. coli, Proteus, Klebsiella, and Morganella morganii turns the histidine of fish tissues into histamine.



The level of histamine in fish and fish products mainly depends on 1) species of fish - Seafoods like mackerel, sardine, tuna and anchovy naturally contain high amount of histidine. 2) Time-temperature control - In the absence of proper time-temperature control such as refrigeration and freezing, formation of histamine may occur at any point throughout the supply chain.

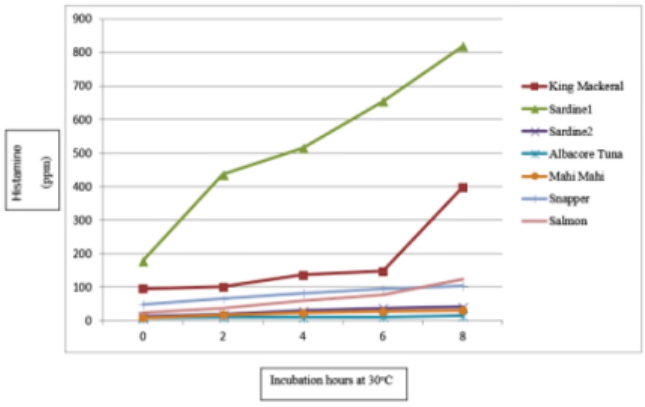


Figure 2: Change of histamine levels over the incubation time for various fresh fish samples.

Figure 3: Trend of histamine formation over a period of 6 days in tuna sample

Regulations and control –

The Food and Drug Administration has established a 50-ppm upper limit (defect action level) for histamine in seafood. Food safety standards Authority of India has established different histamine levels depending upon the Raw (100mg/kg) and processed(200mg/kg) seafood products as well as fish species which are more potential to cause histamine food poisoning. A sampling plan prescribes n: Number of units comprising the sample c: Maximum allowable number of defective sample units m: Acceptable level in a sample M: Specified level when exceeded in one or more samples would cause the lot to be rejected.

Analyzing Histamine in seafoods –

Measurement of histamine levels in seafood is an important part of the seafood industry's Hazard Analysis Critical Control Point (HACCP) programs. The analytical method specified by FDA for determination of histamine levels in seafood is AOAC Official Method 977.13, a fluorometric method. Other quantitative analytical methods for histamine include gas chromatography, high-performance liquid chromatography, high-performance thin layer chromatography, and capillary electrophoresis. Semi-quantitative methods include immune-enzymatic kits, colorimetry, thin-layer chromatography, and enzymatic methods. Several test kits for rapid determination— both quantitative and qualitative (pass/fail)—have also been developed.

Neogen Technologies for Histamine testing in seafood-

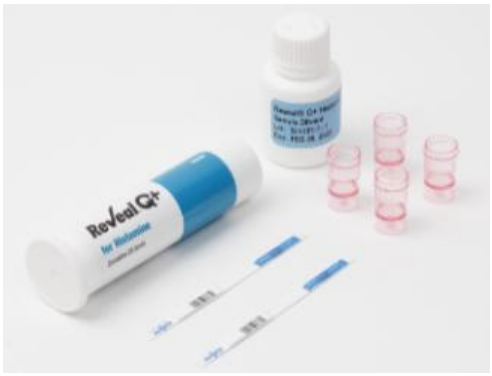
In view of labor intensive and considering the use of hazardous materials that need special handling and disposal for official method, Neogen has developed multiple rapid technologies for determining histamine in seafoods. The advantages can reduce testing time by as much as 75% and eliminate these chemical disposal concerns for some of the world's largest tuna processors.

Available options –

1) Lateral Flow Technology - The principle behind the LFA is simple: a liquid sample extract containing Histamine moves without the assistance of external forces (capillary action) through various zones of polymeric strips, on which molecules that can interact with the analyte are attached.

- **Reveal® for Histamine is a single-step lateral flow assay based on a competitive immunoassay format intended for the visual screening of histamine at 500PPM level in scrombroid species of fish, such as tuna and mahi-mahi.**

- **Reveal® Q+ for Histamine is an innovative lateral flow assay for the quantitative (1.5–40ppm) testing of histamine in scombroid species of fish and fish meal. The assay is read on the Raptor® or Raptor Solo Platform.**



2) ELISA Technology – ELISA (which stands for enzyme-linked immunosorbent assay) is a technique to detect the presence of Histamine antigens in the samples. An ELISA, like other types of immunoassays, relies on antibodies to detect a target antigen using highly specific antibody-antigen interactions.

- **Veratox® for Histamine is a competitive direct ELISA intended for the quantitative analysis of histamine in scombroid species of fish, such as tuna, bluefish, and mahi-mahi, and in fishmeal.**

Neogen technologies are verified and approved by AOAC RI. The AOAC validation studies were performed on fresh, naturally contaminated fishes, as well as canned and pouched products. The test uses a uniquely simple water extraction process and returns results in the range of 2.5 to 50 parts per million. The study showed a 95.4% recovery rate of spiked samples, when directly compared to the AOAC official fluorometric method, and no cross-reactivity to all other commonly occurring biogenic amines.

Way forward :

Monitoring and controlling histamine levels is a crucial step from the consumer safety perspective. Advantages of rapid screening methods are multiple – field suitability , easy to perform , quick results, minimum training required. Multiple validated and approved technologies are available in the market. In India , Food safety standards Authority is supporting and promoting the use of rapid or screening methods by approving these technologies under special approval schemes to ensure maximum sample analysis , controlling the outbreaks of histamine poisoning, and ultimately ensuring consumer safety. The Reveal for histamine lateral flow kit is presently the simplest and most rapid means of classifying fish samples for levels of histamine.

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To know more on seafood testing, contact:

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Extraction of astaxanthin from crustacean waste using supercritical fluid extraction

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Introduction

Astaxanthin (3,3′-dihydroxy-β, β′-carotene-4,4′-dione) is a xanthophyll carotenoid, consists of a hydroxy and one keto functional group at each end of the polyene chain, and soluble in fat. It has both lipophilic and hydrophilic properties. The major source of astaxanthin is the marine origins including algae, salmon, trout, krill, and crustaceans. Astaxanthin is the principal carotenoid compound present in the carapace of crustaceans and exists in both free and esterified forms. It is mainly present in crustacean tissues, cuticles, hemolymphs, and eggs. The composition and rigid structure of the crustacean exoskeleton constitutes a critical bottleneck for astaxanthin recovery from this waste. On the contrary, astaxanthin is highly sensitive to temperature, light, and pH. So, the major challenge is to extract the astaxanthin without affecting its biological function. It has a wide range of biofunctional properties that helps to improve the functions of the immune system including anti-aging, regenerating skeletal muscles, reducing blood sugar and blood pressure, antioxidant activity, anti-inflammatory, anti-microbial, anti-cancer, etc (Ambati et al., 2014). Astaxanthin is used as a preferred pigment in aquaculture feeds (Kittikaiwan et al, 2007).

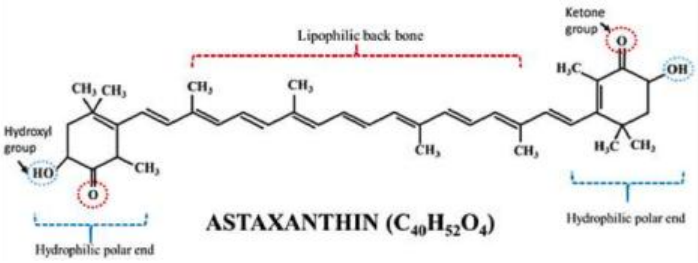

Fig.1. Chemical Structure of Astaxanthin (adopted from Singh et al., 2021)

Supercritical fluid extraction (SFE) is falls under green technology and mainly used for separating one component from another using supercritical fluids as the extracting solvent. A supercritical fluid can be defined as a form of matter in which the liquid and gaseous phases are indistinguishable. Supercritical fluids have properties between gas and liquid. The most popular SFE solvent is carbon dioxide. It is inexpensive, non-flammable, relatively nontoxic, low critical temperature, and commercially available even at high purity.The instrumentation required to perform a successful SFE (Fig.2). The main components of SFE include a pump, extraction chamber, recovery chamber, and a collection device. The mixture to be separated is placed in the extraction chamber and put in contact with the supercritical fluid the material to be extracted swept from the extraction chamber to the recovery chamber. SFE helps us to reduce the consumption of the extraction solvent and the usage of non-hazardous substances. This article discuss the the extraction process for astaxanthin by SFE method.

Fig.2. SFE instrument

Astaxanthin extraction by supercritical fluid method

SFE method for isolation of carotenoids from crustaceans showed in the mainly from crayfish waste reduced solvent usage and handling times and provided quite clean extracts in a single step. It increased the solvent polarity, extraction rate, and efficiency (Lopez et al.,2004). Astaxanthin and lipids were extracted from the Atlantic shrimp waste (Pandalus borealis) using supercritical carbon dioxide (SC-CO_2). The lipid content 0.12 mg/gCO_2 and astaxanthin content 0.4µg/gCO was found at 50°C with 30 MPa and (Ahmadkelayeh et al., 2022). An intensification strategy integrating microwave pretreatment with SFE is proposed by (Nune et al., 2021) for the first time, to enhance the astaxanthin recovery from crab processing waste and to improve astaxanthin concentration in the final extract/product.Microwave pre-treatment condition 140 °C and 300 W, for 90 s time was provided before SFE. SFE condition were achieved at 500 bar, 40 °C, and 13 wt % ethanol as a co-solvent. Ahmadkelayeh et al (2020) found improvements in this process, while using oils as green co-solvent in supercritical CO_2 extraction, and achieved a higher recovery of polar carotenoids and lipids. However, developing new strategies in supercritical fluid extraction, using cost-effective green co-solvents to augment the production of astaxanthin and lipids from natural sources for large-scale industrial applications, is still in its infancy. In 2020, Aneesh et al. proposed an integrated biorefinery method for SFE of astaxanthin-rich oil with consecutive

protein and chitosan extraction from Ridgeback shrimp processing discards. Charest et al.(2001) reported that astaxanthin was extracted from crawfish shells using supercritical CO_2 and ethanol as a cosolvent. They found that supercritical CO_2 extraction with 10% ethanol was more effective than without ethanol in extracting astaxanthin and that the presence of moisture enhanced astaxanthin extraction. The combined effect of temperature and moisture had a significant effect. Temperature alone caused no significant increase in astaxanthin extraction.

According to Mezzomo et al. (2013), the mass transfer rate of the process was impacted by the moisture content of the raw material and the CO_2 flow rate variables in the kinetic investigation of SFE from pink prawn processing residue. Chandra Roy et al. (2020) extracted astaxanthin-rich oil from shrimp (Penaeus monodon) waste and mackerel (Scomberomous niphonius) skin using concurrent supercritical CO_2 extraction. The extracted mixed oil showed higher antioxidant activity, better stability, and bio-potentiality. It also revealed that fish skin oil can acts as an entrainer during the supercritical extraction of astaxanthin from prawn shells.

Sl.No	Raw material used	Parameter (Temperature & Pressure)	Yield of Astaxanthin	Reference
1	Atlantic shrimp waste (*Pandalus borealis*)	50°C & 30 MPa	0.4µg/gCO_2	Ahmadkelayeh *et al.*, 2022
2	crab processing waste	40°C & 500 bar	5.17µg/g dry residue	Nune et al 2006
3	*Litopenaeus vannamei*	50°C & 150, 200 bar	5.2±0.8 %	Correa et al. (2012)
4	Krill	45 °C &25 MPa	8.62±0.31 mg/100 g	Nihari *et al* 2012
5	Crab (*Callinectes sapidus*) wastes	55°C & 320 bar	30.53ppm	Felix *et al.*, 2001

Extraction of astaxanthin from different crustaceans sources using SFE

Andrea et al. (2010) reported that the astaxanthin extraction yields increased considerably with increasing the proportion of ethanol/CO_2 mixture when the percentage of cosolvent was increased from 5% to 15%, reaching maximum recoveries of 93.8% and 65.2% for the lipids and astaxanthin, respectively. The maximum astaxanthin concentration in the extract was achieved when an ethanol percentage of 5% (m/m) was used. Correa et al. (2012) found that the supercritical extraction experiments showed the highest extraction rates for Litopenaeus vannamei for the first extraction at 150 and 200 bar. It was found that the yield (5.2±0.8 %) was higher in the presence of ethanol acting as a co-solvent at the temperature 50°C, the results also showed a higher concentration of carotenoids in the extracts obtained using ethanol as a co-solvent and that astaxanthin always appears in greater among carotenoid. In krill, higher yield of astaxanthin was 8.62±0.31 mg/100g was found in the SFE extraction (25 MPa, 45 °C 2.5h) than in the organic solvent extraction process (Nihari et al 2012). Similarly, astaxanthin was extracted from the crab (Callinectes sapidus) wastes by SFE using ethanol as a cosolvent. According to the study, it is possible to achieve yields of about 40% within the range of conditions used. The sample load and pressure had a statistically significant effect on astaxanthin extraction yields which was 30.53ppm (Felix et al., 2001). In 2016, Shazana et al. found the potential of SFE of astaxanthin from shrimp waste to be further developed for pilot-scale production. Within the explored experimental region, the best extraction condition of supercritical CO_2 with 15% (v/v) ethanol at 215.68 bar, 56.88°C and 1.89 ml/min, which allowed recovery of 58.50 ± 2.62 µg/g astaxanthin yield and 12.20 ± 4.16 µg/g free astaxanthin content for 120 min extraction time.

Conclusion

The SFE is an effective way to extract astaxanthin, it has the ability to control temperature and pressure, less use of chemicals, higher extraction yield, and shorter extraction time. The SFE method helps to control analytical costs in terms of solvent usage and disposal, consumable expenditure and administration overheads. Extraction of astaxanthin using SFE from crustacean byproducts shows better yield in a short period of time. Moreover, it helps to extract natural astaxanthin with a higher yield from the crustacean byproducts. Marine crustacean waste are promising alternative source of astaxanthin, a highly demanded carotenoid with strong antioxidant capacity currently used for nutraceutical and functional food formulation.

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NAVIGATING THE BLUE REVOLUTION: SUSTAINABLE SEAFOOD FOR A GREENER FUTURE

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Introduction

For millions of people around the world, seafood provides a significant source of protein. Because it recognizes and rewards sustainable fishing methods, choosing sustainable seafood is crucial. In turn, this promotes communities, food security, and thriving, healthy oceans. Seafood that has been harvested or raised (also known as aquaculture) with little negative impact on the environment and society is considered sustainable. When carried out properly, sustainable seafood sourcing avoids overfishing, reduces unintended effects on other ocean creatures and ecosystems, recognizes and safeguards crucial fish habitats, and considers the social and economic effects on the communities from which the seafood is derived. Seafood that has been caught sustainably guarantees that there will be plenty of fish in the sea in the now and the future. Seafood is the most widely traded food product in the world and sustains billions of people. Wild-caught and farmed seafood is a key source of animal protein for more than 3 billion people worldwide.

The environment has historically been greatly impacted by the seafood business. According to estimates from the United Nations Food and Agricultural Organization, 85% of marine fish populations are either overfished or completely exploited. Like this, a lot of fisheries throughout the world discard more fish than they keep. Bycatch, or the accidental capture of non-target species, is detrimental to many species. The degradation of coastal environments is a result of pollution from poorly managed and unsustainable fish farms, commonly known as aquaculture.

To conserve maritime environments, the species that live there, and the communities that rely on seafood for their livelihoods and food security, WWF works across the entire supply chain. Our objective is for both wild-caught and farmed seafood to be obtained with no negative environmental effects while yet supplying future demand from a population that is expanding at an ever-increasing rate.

WWF aims to raise companies' knowledge of and preference for buying seafood that has been produced responsibly to make sure you have the greatest environmental options for seafood at your neighbourhood grocery store or restaurant. By collaborating with the processing and retail industries to give environmentally friendly options, WWF contributes to making significant and long-lasting improvements in the health of the world's seas.

Evolution of the sustainable seafood movement

The movement for sustainable seafood had its start in the 1990s as people became more aware of the value of preserving a source of wild food, excellent jobs, and healthy oceans. A major turning point in the development of the MSC was the collapse of the Grand Banks cod fishery in Canada in 1992. When the cod fishery was permanently shut down, more than 35,000 fishermen and plant workers from more than 400 coastal communities lost their employment almost immediately. In response, the World Wildlife Fund (WWF) and Unilever, a multinational consumer goods corporation and the largest consumer of cod at the time of the collapse, started a project that would result in a scientifically-driven standard to define sustainable fishing and ultimately lead to the establishment of the MSC.

The MSC, which was established in 1997, established the first and most well-known certification for wild, sustainable seafood. Twenty years later, we have witnessed personally the power of progress. Over 10 million tons of seafood are produced by sustainable fisheries that have earned MSC certification worldwide.

How can I tell if the fish I am eating is sustainable?

All you need to do is search for the MSC blue fish tick when purchasing or eating seafood. This certification demonstrates that the seafood can be linked to thriving fish populations that have been caught ethically.

In Australia and New Zealand, there are more than 500 goods marked with the MSC blue fish check. Many well-known brands and merchants sell sustainable seafood.

Goals of Sustainable Seafood

- Environmental sustainability

Seafood that is obtained sustainably for the environment and other wildlife, whether it comes from the wild or from aquaculture, supports robust and healthy ocean ecosystems. Fishing gear has little effect on habitat and other wildlife, and stocks of wild-caught seafood are well-managed and not overfished.

Fish and other seafood farming, or aquaculture, has a lot of potential as a response to the mounting demands on our ocean resources. When best practices are followed, it is possible to farm seafood with as little negative environmental impact as possible. These activities reduce wild fish being used as feed, disease, pollution, and habitat destruction.

▫ **Social Responsibility**

Fair and secure working conditions are guaranteed for those who produce our seafood thanks to sustainable seafood. Retailers, producers, and suppliers of seafood are obligated to abide by international labour regulations that are intended to stop violations of human rights such forced labour, human trafficking, and dangerous child labour. Many companies see the value of learning more about socially responsible seafood production and locating potential hotspots for human rights violations in their supply chains.

Better seafood options

To move the seafood industry toward sustainability, according to WWF, certification programs - the Marine Stewardship Council (MSC) for wild-caught seafood and the Aquaculture Stewardship Council (ASC) for farmed seafood are essential. By urging businesses to only purchase seafood from fisheries and farms that are properly managed and that bear the MSC and ASC designations, WWF is committed to enhancing the sustainability of seafood. The WWF assists industry in contributing to the solution by involving participants from all points along the seafood value chain, including fishermen, farmers, and processors as well as merchants, retailers, and restaurants. Through this partnership, WWF promotes significant and long-lasting improvements in the condition of the oceans around the world, making sustainable seafood more readily available.

WHAT THE WWF IS DOING?

▫ **Wild-caught Seafood**

85 percent of the world's fisheries are either overfished or completely exploited. According to WWF, protecting maritime environments and supporting ethical fishing practices are crucial for both people and animals. To safeguard our seafood supply and guarantee that the interwoven web of underwater species will continue to thrive in the future, WWF collaborate with industry along the full value chain, from the ocean to the table.

▫ **Farmed Seafood**

Humans consume about half of the seafood from farms. Aquaculture, another name for seafood farming, is the world's fastest-growing food production method. The WWF aims to reduce production's harmful effects on the environment and society, including the overuse of antibiotics and pesticides as well as the frequent fish escapes that compromise genetic diversity and spread illness.

Status of India in the sustainability of seafood

The most recent survey found that 91% of India's marine fish stock was in good condition. Findings with the potential to strengthen India's position at the World Trade Organization and have a favourable effect on the nation's seafood trade. A report supporting India's stance before the World Trade Organization claims that the country's marine fish population is robust and sustainable.

According to the research done by the ICAR-Central Marine Fisheries Research Institute (CMFRI), 91.1% of the 135 fish populations evaluated in 2022 were found to be in good health. The results represent an important step in the nation's attempts to keep its marine fisheries sustainable. The report, titled "Marine Fish Stock Status of India 2022," also emphasized the decline in unethical behaviour, with only 4.4% of the stocks experiencing overfishing.

The report was made public by Parshottam Rupala, the Union Minister for Fisheries and Animal Husbandry, during the eighth Sagar Parikrama phase in the southern districts of Tamil Nadu.

According to a news release, CMFRI Director A. Gopalakrishnan stated that these findings will support India's position at the World Trade Organization (WTO) and would be expected to improve the nation's negotiating position internationally.

Sustainable Seafood Network of India (SSNI)

A registered trust called Sustainable Seafood Network of India is demanded to bring people and organizations together to pursue common goals that cannot be undertaken in individual capacities. This network will share sustainable seafood information, coordinate related activities, and join forces for those activities that call for coordinated efforts.

The network's objectives are: -

▫ **To communicate with and have an impact on local government and other government line**

agencies, you need to become known as a reliable common platform at the national level.

▫ **Create connections with stakeholders, government organizations that deal with development, and other organizations to mobilize resources and funding for development.**

▫ **Enhance FIP governance and management, and encourage a national culture of openness, responsibility, and good governance.**

▫ **Contribute to the creation and execution of initiatives assisting fisheries striving for sustainability.**

▫ **Oversee and keep an eye on fisheries that are striving for sustainability.**

▫ **Work together with many stakeholders, NGOs, and funding organizations.**

▫ **Give the fishing community instruction, education, and data-based knowledge to aid and support fishermen with resources.**

▫ **Sustainability capacity-building initiatives in partnership with Fisheries University.**

Need for FIP

The development of a plan to enhance a particular fishery by considering better policies and management over a certain time is made possible by fishers, seafood buyers, and suppliers participating in Fishery Improvement Projects. Participating in a FIP (Fishery Improvement Projects) gives farmers and processors access to markets that seek environmental and sustainability credentials. A FIP's objective is to increase a fishery's sustainability and move toward Marine Stewardship Council (MSC) certification. To achieve the strict requirements of international fishery sustainability standards, fisheries require a high level of organization and finance. A FIP offers a place to start when organizing fishery participants to eventually gain certification to global sustainability criteria for fisheries.

Conclusion

To protect the health of our seas and provide a reliable food supply for future generations, the significance of sustainable seafood cannot be stressed. Sustainable seafood production practices put the welfare of consumers, fishing communities' livelihoods, and marine ecosystems first. We can significantly contribute to the preservation of the world's seas and the variety of animals that call them home by selecting sustainable seafood selections. It is essential for people, companies, and governments to work together in the following ways to promote sustainable seafood:

1. **Support sustainable fishing practices: Encourage the adoption of responsible fishing techniques, such as carefully managed fisheries, little bycatch, and minimal damage on marine environments.**
2. **Transparency and traceability: Encourage seafood labelling and traceability systems that let customers make knowledgeable decisions and hold companies responsible for their origin.**
3. **Sustainable aquaculture: Environmentally friendly aquaculture practices that lessen the strain on wild fish populations and guarantee the humane treatment of farmed seafood should be invested in and supported.**
4. **Conservation and regulation: Promote strict laws and rules that enforce sustainable fishing methods, save threatened species, and stop illegal, unreported, and unregulated (IUU) fishing.**
5. **Consumer education: Inform customers about the significance of sustainably caught fish and how to make ethical decisions when buying seafood products.**
6. **Collaboration: Encourage cooperation between governmental entities, environmental groups, fisheries, and the seafood sector to find sustainable solutions.**

In conclusion, adopting sustainable seafood practices is not only morally required but also a crucial step in protecting the environment and the long-term sustainability of our global seafood supply. We can all help to ensure that our seas are healthy in the long run and that there will be an abundance of seafood for future generations by making thoughtful decisions, promoting sustainable initiatives, and speaking out for responsible legislation.

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- **What is sustainable seafood? | Seafood basics | Seafood Watch**

SEA CUCUMBER WONDERS: From Delicacy to Conservation Challenges

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For fisheries enthusiasts, the term "sea cucumber" is not new; it resonates through news, books, and firsthand experiences. To the uninitiated, seacucumbers may sound like a marine vegetable, but for us, these fascinating organisms are marine invertebrates, coming under the class Holothuroidea, with a leathery skin and an elongated body often found in benthic areas and deep seas, worldwide.

In South Asia, sea cucumbers are not typically consumed, but they are harvested for the East Asian market, where they are revered as a delicacy, known as bêche-de-mer (cured sea cucumber). In India, the industry predominantly revolves around one species, *Holothuria scabra*, found in the Gulf of Mannar, Palk Bay, Andaman and Nicobar Islands, Lakshadweep, and the Gulf of Kutch.

Fig.1: *Holothuria scabra*

This culinary delight is enjoyed in both fresh and dried form and are frequently incorporated into traditional Chinese medicine. Although there has been a historical trend of low bêche-de-mer exports, a notable increase in trade has recently occurred due to the rising demand.

However, the accessibility of harvesting slow-moving sea cucumbers have resulted in overexploitation, leading India to impose a ban on sea cucumber fishing in 2001. Sri Lanka, also recognized the need for conservation, and attempted to restrict the trade through a permit system covering collection, processing, transportation, and exportation.

Sea cucumbers are rich in Vitamin A, B1, B2, B3, and essential minerals like calcium, magnesium, iron, and zinc. The bioactive compounds in sea cucumber are mainly attributed to its unique biological and pharmacological activities, including anti-angiogenic, anticancer, anticoagulant, anti-hypertension, anti-inflammatory, antimicrobial, antioxidant, antithrombotic, antitumor, and wound healing properties, are attributed to various bioactive compounds. The bioactive compounds like triterpene glycosides (saponins), chondroitin sulfates, glycosaminoglycan (GAGs), sulfated polysaccharides, sterols (glycosides and sulfates), phenolics, cerberosides, lectins, peptides, glycoprotein, glycosphingolipids, and essential fatty acids are linked to its therapeutic activity.

Fig 2: Processed sea cucumbers, known as bêche de mer, are a popular delicacy in East Asia and an ingredient used in traditional Chinese medicine, making them an expensive commodity. Source: OceansAsia.

East Asians incorporate sea cucumbers into salads, soups, and various dishes, appreciating not only their unique taste and texture but also the associated health benefits. However, conservation efforts are crucial, as sea cucumbers play a vital role in the marine ecosystem.

Sea cucumbers, distributed across all oceans, live near corals, rocks or seaweeds in warm shallow waters. Their activities aid in nutrient cycling, reduce organic loads, redistribute surface sediment, and enhance benthic habitats. Many species of sea cucumbers burrow in the sea bed, acting as bioremediators by increasing seawater alkalinity, thus supporting the survival of coral reefs.

While sea cucumbers serve as food for other species and engage in complex symbiotic relationships, overexploitation poses threats to sediment health, nutrient recycling, biodiversity of associated symbionts, and the transfer of organic matter through detritus to higher trophic levels. Therefore, the culinary and medicinal value of sea cucumbers goes hand in hand with the necessity for sustainable harvesting and conservation. As we savor the wonders of sea cucumbers, let us also recognize our responsibility to protect these marine guardians and ensure the health of our oceans.

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APPLICATION OF CHITOOLIGOSACCHARIDE CONJUGATES

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Introduction

Chitin, a naturally occurring polymer, is synthesized by a vast array of organisms and is recognized as the second most found biopolymer in nature, following cellulose (Kaczmarek, M. B., et al., 2019). Chitin is a linear polysaccharide composed of N-acetyl-D-glucosamine (GlcNAc) residues linked together by β (1-4) bonds and is frequently regarded as the second most prevalent polysaccharide in the natural world, following cellulose. Its primary role is as a structural element in the cell walls of yeast and fungi, as well as in the exoskeletons of insects and arthropods, such as, lobsters, crabs and shrimps. Numerous studies have demonstrated its useful properties, leading to its wide-ranging applications in the fields of food industry, agriculture, wastewater treatment, textile industry, microbiology, nanotechnology, chemistry, material science, tissue engineering, and drug delivery. Its application in the food and pharmaceutical sectors is restricted due to its limited solubility. Chitosan can be obtained through the partial deacetylation of chitin and is a heteropolymer consisting of GlcNAc and D-glucosamine (GlcN) residues. In contrast to chitin, chitosan exhibits solubility in weakly acidic aqueous solutions.

Chitooligosaccharides

Chitooligosaccharides (COS), are degradation products of chitosan with a degree of polymerization (DP) less than 20 and an average molecular weight of less than 3900 Da (Li et al., 2016). COS are generally soluble in water and partially soluble in methanol and dimethyl sulfoxide, making them more accessible for various applications in agriculture, food, cosmetics, and the pharmaceutical industry. They possess distinct properties such as antibacterial, antifungal, anti-inflammatory, and antioxidant activities. To overcome the solubility issue associated with chitin and chitosan, Chitooligosaccharides have been employed in many of the applications. Chitooligosaccharide (COS) conjugates refer to molecules or compounds in which chitooligosaccharides are chemically attached or combined with other substances, such as drugs, polymers, proteins, or nanoparticles. These conjugates are created to harness the unique properties of chitooligosaccharides, which include biocompatibility, biodegradability, and bioactivity, for various applications in fields like medicine, agriculture, and biotechnology. COS conjugates can be designed to improve drug delivery, enhance the solubility of certain compounds, or offer targeted delivery of bioactive substances, among other purposes.

COS blends can be generated from chitosan through various physical techniques, such as hydrothermal processing (Sato et al.,2003), microwave treatment, ultrasonication (Wu et al.,2008) and exposure to gamma-rays (Yoksan et al., 2004). Alternatively, chemical processes involving acids [Domard et al.,1992; Einbu et al.,1992) hydrogen peroxide (Lin et al., 2009) or sodium nitrate (Morris et al., 2007) can also produce COS. Among the chemical methods for breaking down chitosan (Mittal et al., 2022; Vo et al., 2017; Atasoy et al., 2019; Quideau et al., 2011), acid hydrolysis is likely the most widely recognized.

In this review, we offer an outline of several of the most encouraging applications of COS conjugates. Additionally, we present an account of the current understanding of COS conjugates, their characteristics, and their utilization across diverse domains.

Potential applications of COS-PPN conjugates

A research study was aimed to synthesise and evaluate conjugates of chitosan oligosaccharides (COS) with a range of naturally occurring phenolic antioxidants, which are frequently found in plants, including catechin (CAT), epigallocatechin gallate (EGCG), gallic acid (GAL), caffeine (CAF), and ferulic acid (FER), was investigated. Using the ascorbate (AsA) and hydrogen peroxide (H_2O_2) redox pair system, the researchers were able to create an effective synthesis strategy for these COS-phenolic conjugates. They next used Fourier- transform infrared (FTIR), nuclear magnetic resonance (NMR) and UV-visible spectroscopy to thoroughly characterize the synthesized COS-phenolic conjugates in order to verify the conjugation. They also evaluated the COS conjugate antibacterial and antioxidant qualities. Finally, the study looked at the inhibitory effects of COS and its polyphenol conjugates on pancreatic lipase, α-amylase, and α-glucosidase (Mittal et al., 2022).

Chitooligosaccharides in wound healing process (Matica et al., 2023)

Antioxidant activity of COS-PPN conjugates

COS-PPN Conjugates have been extensively used in many foods and pharma applications because of their antioxidant properties. It retards the oxidation of protein, lipids, DNA etc. by interrupting the oxidative propagation chain reaction (Atasoy et al., 2019).

Some antioxidants namely secondary antioxidants scavenge some metal peroxidants thus lower oxidation in lipids. When COS is conjugated with PPNS it causes increment in antioxidant activity of biomolecule in process system thus shows an improved efficiency of radical scavenging activity (Quideau et al.,2011). Pasanphan and Chirachanchai (2008) utilized the carbodiimide method to create a conjugate of chitosan and gallic acid, resulting in an enhanced ability to scavenge free radicals and -OH radicals. Likewise, Cho et al. (2011) documented an elevation in the DPPH-radical scavenging capabilities of the CS-gallic acid conjugate. The antioxidant impact of gallate chitooligosaccharides was assessed in mouse macrophage RAW264.7 cells by Ngo et al. (2011). They found that gallic acid (G-COS) could scavenge cellular radicals

in RAW264.7 cells and inhibit oxidative damage to lipids, proteins, and DNA. They also inferred that G-COS could reduce the expression and activation of NF-B and raise intracellular antioxidant enzyme levels (SOD and GSH) in RAW264.7 cells that had been exposed to oxidative stress.

Antimicrobial activity of COS-PPN conjugates

Although Chitosan has a variety of functions, its antimicrobial activities have garnered significant attention in recent years. Since CS's weak antimicrobial properties are most likely caused by its low solubility, CS has been combined with a number of phenolic compounds to increase its antimicrobial activity. Chitooligosaccharides could be conjugated with biomolecules in order to improve antimicrobial properties. The antioxidant activity of many COS derivatives was investigated by Eom et al. (2012) their research revealed that protocatechuic acid conjugated COSs and caffeic acid conjugated COSs exhibited the greatest antioxidant activity out of all the PA-c-COSs synthesised.

Pharmaceutical application of COS-PPN conjugates

The antioxidant and anti-inflammatory activities of gallic acid-conjugated COS were evaluated in human lung epithelial A549 cells. The conjugate COS and Gallate were found to have an exceptionally high capacity to scavenge DPPH radicals and to provide protection against H 2 O 2 - induced damage to DNA. This study found that the addition of gallic acid to COS improved its antioxidant and anti-inflammatory properties. Results suggested that gallate-COS could be a useful prophylactic against inflammation of the lungs and lung cancer caused by free radicals. The capacity of Chitooligosaccharide to scavenge free radicals was investigated both in vitro and in vivo using a high-fat diet mice model. Strong antioxidant qualities of COS were found to be able to protect animals from oxidative stress (Vo et al., 2017). In a study Salicylic acid and COS conjugates improved the oxidized alginate-gelatin hydrogel's capacity to heal wounds. The COS conjugate enhanced collagen proliferation at the wound sites, resulting in faster healing (Oh et al., 2021).

COS have the capacity to effectively manage hypertension by suppressing the activity of renin and angiotensin-converting enzyme (ACE). COS acts as an ACE inhibitor by specifically targeting the positively charged active site of ACE, which contains hydrogen-bond acceptors and relies on zinc as a cofactor. A study conducted by Hong et al. (2005) revealed that among various COS derivatives with different degrees of polymerization, the chitotriose derivative with a degree of polymerization (DP) equal to 3 exhibited the most potent ACE inhibitory activity. Furthermore, research has indicated an inverse relationship between the degree of deacetylation (DD) and the ACE inhibitory activity of COS and its derivatives (Huang et al., 2005; Hong et al., 1998). Because hydrogen bonds develop to facilitate COS binding, the aminoethyl-conjugated COS showed improved ACE inhibitory activity (Ngo et al., 2008).

Application as Edible coatings of COS-PPN conjugates

The use of CS-PPN conjugate edible coatings for the preservation of different food items has drawn a lot of attention nowadays. The goal of edible coatings is to create natural layers on product surfaces that increase shelf life by preventing weight loss, slowing respiration, halting microbial development, and oxidizing lipids. Fruit preservation has been achieved with the application of CS-PPN coating (Liu et al., 2017; Dehghani et al., 2016), on a variety of fruits, including, peach fruit (Jiao et al., 2019) pineapple (Jing et al., 2019), and king oyster mushroom (Liu et al.,2016).

Wu et al. (2016) CS-gallic acid conjugate to coat silver pomfret (Pampus argentus) and quality parameters were observed for 15 days at 4°C. The CS-gallic acid conjugate coating significantly decreased the production of volatile bases, lipid oxidation products, and microbiological spoilage across all coated samples. Additionally, the fish freshness was preserved, by its increased water-holding capacity and decreased ATP decomposition (K value). As a result, silver pomfret sensory qualities and shelf life were extended by 3 to 6 days. In another study, the pork meat had a shelf life of six days, but the CS-gallic acid conjugate, which was made with recombinant laccase isolated from B. vallismortis fmb-103, increased it to 18 days at 4°C (Zheng et al., 2018).

Application as Bioactive films of COS-PPN conjugates

Due to their numerous advantages, including non-toxicity, antimicrobial, antioxidant, biodegradability, biocompatibility, and the capacity to form films, CS-PPN conjugates are frequently used in the production of bioactive edible films (Kerch., (2015) which enhance the quality and prolong the shelf life of most of the perishable food products. Concurrently, the issues related to the application of chemical preservatives can be mitigated. When peanut powder was packaged in CS-gallic acid conjugate bags as opposed to polyethylene and CS bags, Schreiber et al. (2013) found reductions in TBARS, PV, and conjugated trienes.

β-secretase (BACE) inhibitory activity of COS-PPN conjugates

BACE - β-site amyloid precursor protein (APP)-cleaving enzyme is a crucial component in reducing Aβ amyloid peptide levels in Alzheimer's disease (AD) as it initiates the initial step in Aβ production. Eom et al. (2013) synthesized eight different types of chitooligosaccharides (COS) linked to phenolic acids, using hydroxyl benzoic acid and hydroxyl cinnamic acid. These COS variations contained different types of substitution groups, including p-hydroxyl, 3,4-dihydroxyl, 3-methoxyl-4-hydroxyl, and 3,5-dimethoxyl-4-hydroxy groups. The study examined the inhibitory effects of these COS derivatives on β-site amyloid precursor protein (APP)-cleaving enzyme (BACE). The study found that these derivatives demonstrated significant inhibitory activity against BACE. Among these derivatives, Caffeic acid- conjugated COS (CFA-COS) was further analyzed to determine its mode of BACE inhibition, which was found to be non-competitive. The findings of this study suggested that CFA-COS derivatives hold promise as innovative BACE inhibitors for reducing the risk of Alzheimer's disease (Eom et al., 2021).

Anti-inflammatory effect of COS-PPN conjugates

To enhance the combined benefits of unripe apple polyphenols (APP) and chitooligosaccharides (COS), scientists used a spray-drying method to create microcapsules called apple polyphenols-chitooligosaccharides (APCM). They examined how APCM influenced the release of polyphenols in a simulated gastrointestinal digestion model and assessed its anti-inflammatory properties against LPS-induced RAW264.7 cells. APCM notably suppressed the production of nitric oxide (NO) and TNF-α, while simultaneously increasing the production of the cytokine IL-10 as the concentration rose. These findings suggest that APCM can mitigate inflammation by reducing the production of pro- inflammatory cytokines like TNF-α and by promoting the production of anti-inflammatory cytokines such as IL-10. These findings support the application of conventional medicine to treat inflammatory disorders with scientific validity (Rana et al., 2021).

Propionibacterium acnes plays a significant role in the development of acne-related inflammation and can compromise the body ability to defend against oxidative stress. To tackle this issue, antibiotics such as tetracyclines, azelaic acid, macrolides, and erythromycin are commonly used to manage microbial proliferation and mitigate inflammation. However, these antibiotic treatments often entail adverse effects like cytotoxicity, allergies, and gastrointestinal disturbances. Consequently, recent research has shifted its focus towards the development of alternative antimicrobial materials. In this particular study, researchers chemically linked chitooligosaccharide (COS) with gallic acid (GA) using a hydrogen peroxide-mediated approach, and they assessed the resulting compounds antioxidant and antimicrobial properties. Subsequently, they developed a polyvinyl alcohol hydrogel containing GA-conjugated COS (GA-COS) for the treatment of acne. GA-COS, particularly when within the molecular weight range of 5-10 kDa, exhibited outstanding antioxidant capabilities and demonstrated more potent antimicrobial effects against P. acnes in comparison to COS alone. Furthermore, the polyvinyl alcohol hydrogel containing GA-COS not only inhibited the generation of reactive oxygen species within cells but also exhibited superior antimicrobial properties when compared to control treatments (Park et al., 2018).

Conclusion

In both medicine and food, COS biomolecule conjugates have the potential to provide sustainable and innovative solutions that address various health and safety concerns. Their versatility and biocompatibility make them a promising candidate for a wide range of applications, contributing to advancements in healthcare and food technology. However, further research and development are needed to optimize their efficacy and safety for specific applications.

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Unlocking the Potential: Exploring the Value of Fish By-Product

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INTRODUCTION:

Fish by-products are substances made from the leftovers from fish processing operations as well as the raw material itself and are not intended for human consumption. The fish products that are considered primary are those that are intended for human consumption, while the rest waste or inedible parts are the by-products. By-products are significant both economically and nutritionally. By transforming fish waste and otherwise unusable fish into Fish in general is a cold-blooded aquatic organism that breathes with gills and swims with fins; they are categorized as Finfish and Shellfish. Finfish are cold-blooded aquatic vertebrates that have gills, fins with rays, and scales covering the body. Shellfish are cold-blooded aquatic invertebrates that have gills, various types of locomotory organs and a shell/exoskeleton covering the body. They include crustaceans and molluscs.

Fishery products are made from a wide range of aquatic species. Typically, only the most appetizing and detachable parts of the carcass are saved for human consumption. A significant portion of the tissues, many of which are rich in protein and attractive from a nutritional standpoint, are wasted as a result of this process. The recovery of these waste materials and their subsequent processing into byproducts are the topics covered in this article.

1.FISHMEAL:

Fishmeal is an unrivaled component of feed because it offers high-quality protein and high concentrations of lysine, methionine, and cysteine, three important amino acids that animal systems cannot generate. Additionally, it is a good source of B-group vitamins like riboflavin, niacin, pantothenic acid, and cyanocobalamin (B12). Fishmeal is high in minerals such as calcium, phosphorus, copper, and iron, along with some other trace elements. Fishmeal is a naturally occurring, well-balanced source of high protein that is used in pet food, diets for farmed fish, and as a high protein supplement during critical phases of the life cycles of pigs and poultry.

It is made by cooking, pressing, drying, and grinding fish skeletal remains and adherent proteinaceous tissues from fileting and canning operations, or by processing whole miscellaneous fish primarily caught along with prawns, such as Jew fish, sole, silver-bellies, and ribbonfish. Due to changes in the raw materials utilized, the processing techniques used, and the environmental conditions used, fish meal composition varies greatly (Miles & Chapman, 2006). Fishes with higher fat content like anchovies, sardines, herring, menhaden etc. are traditionally used as raw materials to manufacture fishmeal.

Its nutritional content is about; Protein: 50-70%; Fat: 05-10%; Ash:12-33%; moisture, 06-10%. Fish meal is rich in all the essential amino acids, B- group vitamins and minerals particularly phosphorus and calcium (Mohanty, 2020).

Dry rendering, also known as dry reduction, is a method of producing fishmeal from non-oily fish such as silver bellies, jew fish, ribbonfish, sole, anchovies, and shark carcasses, fish offal, and fileting waste. For small amount of raw materials, they are sun dried to a moisture content of 10% and ground, while in case of large scale production, first the raw materials are coarsely ground then which is then fed into cooker-drier which is a steam-jacketed vessel equipped with power driven stirring system. The product is dried in the cooker-drier with continuous stirring under atmospheric pressure or partial vacuum, if it contains desirable oil it is subjected to hydraulic press for oil extraction which is then ground to required size and bagged (Barlow & Windsor,1984).

Wet rendering, also known as wet reduction, is done for producing fish meal from high fat fishes like menhaden, herring, sardine, etc. Fishes are first coarsely ground and subjected to heating under live steam, and then pressed for extraction of oil and water. The solid residue after extraction is called the press cake, is then fluffed out and dried to a moisture level of 10%, which is then finally ground and packed.

2.FISH OIL:

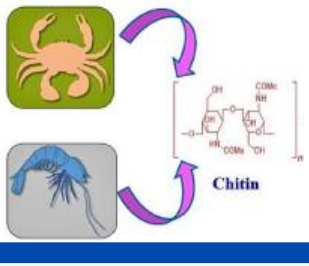
Fish oil is extracted from fatty tissues of the fishes. It is a mixture of triglycerides containing cholesterols, other alcohols, pigments, vitamins, glycerides, ethers and fatty alcohols. Fish oil can be extracted from whole fish and liver (Mohanty, 2020). Fish oil extracted from both resources has industrial and medicinal uses. It is recommended for a healthy diet because it contains the omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Simopoulos et al., 1986). Fish oils are required to be added in minute quantities for optimum health benefit, cellular metabolism and normal physiological functions. National and International health authorities have set up recommendations of daily fish oil intake due to the immense health potential it carries. Small, bony, oily fish, such as anchovies, herring, capelin, and menhaden, for which there is little demand for human food, are processed to make fishmeal and fish oil. A minor portion is produced from fish offal, trimmings, and other wastes, primarily from fileting and canning edible fish such as tuna, cod, haddock, hake, and pollock. The raw material is typically prepared by cooking, pressing, drying, and grinding. The liquor, which is a mixture of fish oil, water, and soluble protein, is removed using pressing. The oil is separated from the liquor using a centrifuge, and it is frequently refined before being delivered to storage tanks. When oil is stored, great care is taken to maintain quality. Fishmeal is made by drying and grinding the solids. This typically contains 6 to 10% fish oil, although it might be higher or lower. The majority of fish oil is used in fish feed, and there is a growing market for fish oil in functional foods and human nutritional supplements.

3. FISH SILAGE:

Fish waste can be conserved and converted into useful feed for animals or fertilizer for crop production by employing the method of fish silage. As a result, the fish wastes can be transformed into a product with a high value both from an economic and nutritional point of view. It is economically not possible to set up a fish meal plant for small scale industries in such a case, fish silage technology is very efficient in processing the fish waste. Fish silage is a technology that can be used to preserve fish and parts of it that do not end up as human food. Fish silage can be made from spoiled fish, sub-utilized species, by-products from marine fish, commercial fish waste and industrial residues from the fileting industry (Disney & Tatterson, 1977). Fish silage can be used as a valuable feed input for aquaculture, or for the production of poultry, pork, or other livestock. It can also be used as natural fertilizer for the production of crops. Fish silage is made by adding preservative to the minced fish waste or minced whole fish that is not suitable for human consumption. The preservative is usually an organic acid like formic acid. It is produced by treating whole or parts of fish with acid, usually formic or mineral acid, followed by liquefaction brought by naturally present proteolytic enzymes in the fish and is accelerated by reducing the pH below 4.5 (Tatterson & Windsor,1974; Backhoff ,1976; Raa & Gildberg, 1982; Lindgern & Pleje, 1983; Hall et al.,1985). Also biological fermentation using lactic starter cultures and fermentable sugars can be done for silage production (El-Mehdi,1982; Raa and Gildberg, 1982). To prevent survival of pathogenic bacteria a maximum pH of 4 is suggested to be maintained in the final product (Tatterson, 1976 and 1982).

4. CHITIN:

Chitin is a naturally occurring and second most abundant polysaccharide. It is mainly found in crustacean shells (shrimp and crab). Chitosan is obtained by removing the acetyl group from chitin through chemical treatments such as deacetylation (Mohanty, 2020). Both chitin and chitosan offer a unique set of physicochemical and biological characteristics, such as biocompatibility, biodegradability, nontoxicity, physiological inertness, immunological activity, antibacterial properties, wound-healing activity, heavy metal ions chelation, gel-forming properties and affinity to protein. Due to this property their applications are widely distributed in many fields, such as wastewater treatment, biotechnology, medical and pharmaceutical, food industry, agriculture, cosmetics and pulp and paper industries. The general method of preparation of chitosan from fish scale comprises demineralisation, decolourisation and deacetylation. Raw fish scales are first washed thoroughly with water, dried in the oven and soaked in 1% HCL solution for 36 hours. It is then washed, dried in the oven and kept in 2N NaOH solution for 36 hours for demineralization (Mohanty, B., 2020). Fish scales are then kept in Potassium permanganate solution (having composition 1g of KMnO4 in 100ml water) for 1 hour, followed by keeping it in Oxalic acid (having composition 1g of Oxalic acid in 100ml water) for the process of decolourization of the experimental sample. Chitin is the resultant product which is then further treated with 50% w/v NaOH for the process of deacetylation resulting in chitosan as the end product.



5. ISINGLASS:

The basic material used to make isinglass is air bladder, sometimes referred to as fish maws and typically found in dry form and is usually made from bladders of catfish, carps, eels, polynemids, sciaenids, sea bass, etc. (Mohanty, B., 2020). The most important product made from bladder is likely isinglass, which is mostly used to clarify alcoholic beverages. Due to the high collagen content, the swim bladder of sturgeons is used for production of isinglass (Koochekian et al., 2006), usually dried sturgeon fish air bladders are used for preparing isinglass, first dried air bladders are obtained and soaked for several hours, (usually 24hours) so that they absorb water and becomes soft and spongy in texture, then these soaked bladders are cut into small pieces and made into small thin strips by by rolling them in between water cooled iron rollers. They are further compressed by ribbon rollers into ribbons about 0.4mm thick.

These ribbons are air dried and rolled into coils. This final product is isinglass. It has various applications such as, clarifying agent for beer, cider, vinegar, etc., used as a substitute for gelatin, can be used as adhesive paste, Isinglass dissolved in acetic acid forms a strong cement base useful in glass or pottery and more.

6. FISH PROTEIN CONCENTRATE:

Fish protein concentrates (FPC's) are defined as those products obtained from fish in which the protein is more concentrated than the original raw material Its sensory attribute may range from light-colored, bland powders to dark powders having intensely fishy tastes, or they may be pastes with a similar wide range of colors and tastes. Fish protein concentrate contains about 75 to 95% high - quality protein and usually play important roles to improve cardiovascular and other associated health conditions (Torris et al., 2018). It can be processed through various ways;

- **Viobin process:**

In viobin process the fish is ground and suspended in ethylenedichloride , using indirect steam the mixture is then brought to boil. Ethylene chloride and water form an azeotropic mixture with boiling at 70.5 °C. On condensation the azeotropic distillate separates into two layers. The solvent layer is pumped back into the vessel to carry off more water. Boiling is continued till the water content becomes zero. The residue containing solvent and lipids are then filtered and washed twice or more with fresh solvent to remove all the adhering lipids. Then finally the vessel is flushed with dry steam to remove any traces of solvent. This dry product is then milled, packed and stored under ambient temperature (Akhade et al., 2016)

- **Canadian process:**

It is done in 2 stages, in the first stage the fish is ground and suspended in water acidified with phosphoric acid (pH 5.5). It is then cooked for 30 minutes at 70 - 80°C with constant stirring. The cooked mass is then filtered and the residue obtained is repeatedly washed with hot water until it is practically odorless. In the second stage the residues obtained after stage 1 are suspended in isopropyl alcohol

and refluxed for 15 minutes. It is done to reduce the amount of water and oil from the residue. The residue is further repeatedly treated with successive batches of solvent till the desired quality is achieved. This final residue is then pressed and obtained as press cake which is then dried and milled (Akhade et al., 2016).

7. FISH PROTEIN HYDROLYSATES:

Fish protein hydrolysates (FPH) is a by-product made from fish or fish material by protein hydrolysate, FPH is a mixture of broken proteins. Proteins derived from fish are exceptionally nutritionally superior and sustain nutritional balance of essential amino acids when compared to plants and all other animal sources (Ghaly et al., 2013). FPH can be produced in two forms, liquid and dried, but dried FPH is most preferred due to its longer shelf-life, easier storage and transportation. FPH has improved functional properties and bioactive properties such as anti-oxidative properties and it is also recently used as cryoprotectants for frozen fish products. It has a huge potential use as a protein source for human consumption, but dehydration of liquid FPH into dried FPH demands high energy requirements and consequently is very costly. Different types of hydrolysis are done;

- Acid Hydrolysis:

Hydrochloric acid and in some cases Sulphuric acids are used for the acid hydrolysis process. It is done at elevated temperature and high pressure. The solution is neutralized to a pH of 6.0 to 7.0 after hydrolysis which is then condensed and dried further. It is a cost effective and simple process, thus considered important at the industrial level, but during acid hydrolysis important amino acids, such as tryptophan, methionine, cysteine is normally lost and asparagine and glutamine are converted into aspartic acid and glutamic acid (Thakar, P. N., Patel, J. R., and Joshi, N. S., 1991)

- Alkaline Hydrolysis:

Sodium hydroxide is mainly used in the alkali hydrolysis process, wide-water soluble polypeptides are easily broken and further reduced at a slower pace into basic compounds. A high pH of 12.5 at 95 degrees Celsius for 20 minutes is used in small-scale batch systems. The main drawback in this process is the development of low amino acid content hydrolysates such as lysine, arginine, serine, threonine, isoleucine and residues such as lanthionine and lysinoalanine. They are accepted as good quality food supplements for human consumption (Mackie, I M., Jan 1982).

8. AMBERGRIS:

Ambergris is a solid waxy substance originating in the intestine of the sperm whale (Physeter macrocephalus). Fresh ambergris is black and soft in appearance and has a foul odour, which is excreted by the whales through their mouth, when it is too large to pass through the digestive system, thus it is also said to be the vomit of the sperm whale. It is utilized for medicines, potions and as a spice. It was utilized and suggested by medieval apothecaries for its healing powers and the perfumers for its scent. Thus it is mostly used in the field of medical for treating general weakness, epilepsy, typhoid, fever, hysteria and other nervous disorders, in combination with other medicinal herbs and important ingredient for the production of much fragrant perfumes (Romero, 2006).

9. PEARL ESSENCE:

Pearl essence is a suspension of guanine crystals in water or an organic solvent. Guanine is a lustrous material found in the scales and epidermal layers of fishes like oil sardine mackeral, Caspian roach, Pelecus cultratus, carp bleak, ribbon fish, etc,. (Manda Mhatre, Yojana Muniv and Rani Thakre., 2022). A French man Jaquin, in 1956 coined the method of processing artificial pearls with the help of pearl essence. For its preparation freshly removed scales are firstvwashed to remove any foreign materials, which can be then preserved in 10-15% brine. Then the brine is drained off and the scales are covered with muslin cloth bags and squeezed, it is to be ensured that the scales are not allowed to dry. The compressed mass can be stored at 0 degrees Celsius (Mhatre, Muniv and Thakre, 2022). Pearl essence can be made in either aqueous suspension or non-aqueous suspension. In aqueous suspension the washed scales are agitated with minimum quantity of water containing little ammonia, then it is screened to remove the scales, then the liquor is allowed to settle in a cool atmosphere where guanine settles and supernatant is decanted and replaced with fresh batch of water containing little ammonia. This step is repeated until well purified guanine crystals are obtained. In non-aqueous suspension guanine is suspended in organic solvents such as acetone, amyl acetate, chloroform and carbon tetrachloride. Its most important use is in the manufacture of artificial pearls, and used as a spray or dip to give a lustrous appearance in various applications like shoes, finishing of textiles, jewelry box, etc.

10.GELATIN:

Currently, the use of animal waste as an alternative source of gelatin is being extensively researched, with one example being the usage of fish waste, which consists of fish skin and bones. One alternate source of the basic materials used to make gelatin is the waste of fish skin and bones. Utilizing fish skin waste as the raw material for gelatin can increase the economic value of fish skin waste that hasn't been used to its full potential. It can also solve the halal problem of gelatin products that cause many issues for the general public whose religion forbids the consumption of some types of animals, such as pigs and cows. Additionally, using fishing waste-derived gelatin can prevent the Bovine Spongiform Encephalopathy (BSE) disease. Gelatin extraction can be done by acid or alkali treatment to give type A and type B gelatins, respectively (Veis, 1964, Ward and Courts, 1977). Most adopted method was treating with mild to harsh acidic treatment (Songchotikunpan et al.,2008). Alkaline process involves the usage of strong alkali treatment, in this process, small particles are soaked in lime solution at 15-20 degrees Celsius. After incubation time, the material is washed with water keeping the pH around 10, then the solution is filtered and mixed with 5% solution of hydrochloric acid (HCl) to lower the pH and then freeze dried (Tavakolipour, 2011).

CONCLUSION:

As mentioned above one of the major problems faced by various countries in the current scenario is waste disposal, the rate of waste generation is unbearably higher than the rate of waste disposal, due to which they may be accumulated and cause various distresses, and one of the major sector producing high amounts of waste is Food sector like agriculture, fish, poultry cattle farming and etc,. One of the best ways to control waste management is by converting the waste substances into useful products, thereby reducing the need to dispose of waste and benefiting people by modifying them and adding value to satisfy various needs.

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MARINE ORIGINS OF BIOACTIVE MOLECULES

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Marine ecosystem is dynamic and home to an assortment of aquatic plants and animals. A vast reservoir of bioactive substances which sustain biological activity exists in sea, with millions of bioactive chemicals and secondary metabolites originating from marine invertebrates like sea slugs, sponges, mollusks, bryozoans, and tunicates, among many other marine creatures (Suleria et al., 2015) . Marine organisms could serve as valuable resources for the discovery of novel compounds exerting biological activities and beneficial effects to the human population. This paper brief about the functional active compounds such lipids, polysaccharides, probiotics, and prebiotics derived from marine habitat.

Marine algae

Marine algae are basically classified into two groups, which include macroalgae and microalgae. The micro algae are found in bentheic and littoral environments as well as in the ocean as phytoplankton. The macroalgae, or seaweeds, are found in the littoral zone.Microalgae are abundant in nutrients, including astaxanthin, polysaccharides, polyunsaturated fatty acids, β-carotene, and vitamins C, A, E, H, B1, B2, B6, and B12. Macro algae, often known as seaweeds, are categorized into three main groups: brown algae (phaeophyta), green algae (chlorophyta), red algae (rhodophyta), and blue-green algae (cyanophyta). Phycocolloids (agar and carrageenan) and minerals, as well as proteins, furanone, polyunsaturated fatty acids, L-α kainic acid, pigments, phenotics, phlorotannins, and pigments are some of the distinctive nutritional and medicinal qualities found in macro algae (Suleria et al., 2015) . Seaweeds are mostly consumed by humans and animals for their nutritional value, including vitamins, minerals, and polysaccharides, as well as for their beneficial properties. Seaweeds are mostly consumed by humans and animals for their nutritional value, including vitamins, minerals, and polysaccharides, as well as for their beneficial properties (Samarathunga, Wijesekara and Jayasinghe, 2023) .

Marine lipids

Marine ecosystem-derived lipids are harbor to variety of compounds that are superior in terms of nutrition, such as PUFA and antioxidants (Cretton et al., 2022) . Marine lipids are mainly composed of wax esters, phospholipids, sterols, triacylglycerols, and the metabolic products of these substances. These lipids are originated from marine animal sources and plant sources like algae. Various lipid compounds from marine sources include Eicosapentaenoic acid, Docosahexaenoic acid, Arachidonic acid, Alpha-Linolenic acid, Microcolin-A, Okadaic acid, Alpha-amino-butyric acid, Brassicasterol and stingmasterol (Muralidhar, Karthireddy and Lingam, 2017) .

Marine polysaccharides

Marine polysaccharides are a family of long-chain polymers made of glycoside linkages connecting several monosaccharide molecules that are generated from marine organisms (De Jesus Raposo, De Morais and De Morais, 2015) . Based on the source of origin these marine polysaccharides can be classified into marine plant polysaccharide, marine animal polysaccharide and marine microbial polysaccharide (Wang et al., 2018) . Marine polysaccharides can be used in the development of marine drugs, functional foods and to improve food characteristics. Additionally, marine polysaccharides hold significant potential as a prebiotic and for fostering the development of probiotics and also help in regulating dysbiosis and protect the intestinal barrier (Ou et al., 2022) . Many studies have been conducted on marine polysaccharides as potential medicinal agents for the treatment of different illnesses. Several medicinal benefits, including anti-inflammatory, anti-viral, and anti-cancer properties, have been shown for the polysaccharides fucoidan, carrageenan, alginate, and chitosan (Lee et al., 2017) .

Marine probiotics

Marine environments abode of microbial diverse population which can be useful in the development of probiotics that are both safe and effective. WHO defines probiotics are live microbial supplements when administered in adequate amounts exhibit health beneficial effects. Probiotics can be isolated from marine animal-associated bactericidal strains. One of the most effective tools for combating pathogen infections is the ribosomally synthesised antibiotic peptide known as bacteriocin (Desriac et al., 2010) . Various strains of marine probiotic bacteria include Bifidobacterium (*B. longum, B. infantis, B. breve, B. adolescentis*), Leuconostoc spp. (Ln. lactis, *Ln. mesenteroides subsp. Cremoris, Ln. mesenteroides subsp. dextranicum*), and Streptococcus spp. (*S. salivarius subsp. thermophiles*) Lactobacillus (*L. casei, L. acidophilus, L. rhamnosus GG, L. johnsonii La-1*) (Muralidhar, Karthireddy and Lingam, 2017) . Numerous novel functional food items incorporate probiotics as a key ingredient. Probiotics, particularly Lactobacillus and Bifidobacterium, may help avoid lactose intolerance and treat diarrhea (Kim, Bhatnagar and Kang, 2012) .

In comparison to terrestrial ecosystems, marine ecosystems are home to a more extensive array of life forms including algae, fishes, crustaceans and other organisms, which offers a wealth of nutrients for human sustenance and health. Numerous marine bioactive compounds have been identified to date, but their applications in various fields are still in its infancy. The application of these bioactive substances derived from marine sources needs more research, notwithstanding all of their intriguing qualities and health-related potential. More research needs to be done on humans to determine the toxicity and bioavailability of some of these compounds in particular.

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Recent activities of the AFST(I) Cochin Chapter

World Food Day celebration

The chapter in association with Nirmala College, Chalakudy conducted national seminar in commemoration of World Food Day 2023 titled 'EL ALIMENTO'.

Ms.Daly Sajeev , Vice Chairperson of Nirmala Institutions delivered the Precedential address. Dr.D.D. Nambudiri, President of the chapter delivered an address highlighting the theme of World Food Day 2023 .
"Water is Life, Water is Food. Leave No One Behind"

He highlighted the critical importance of water and risk of diminishing supply of fresh water . He also drew attention to the fact of mindless pollution of water sources and the impending catastrophe that we would be facing unless we take corrective action here and now.
Dr.Anilakumar , former Associate Director, DFRL delivered the inaugural address . He distressed the importance of conserving our water sources and preventing reckless pollution .

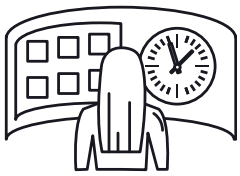
Dr.B.Jacob, Vice President , AFST(I) Cochin in his felicitation address mentioned that future wars would be 'water wars' as the world would face acute shortage of drinking water . He said that the Sanskrit language has 'Jeevanam' a synonym for water which means water sustains life .

Food stalls were put up by the students at the best stalls awarded prizes.

Mahadeva College , Vaikom

The College which has been closely associating with AFST(I) Cochin Chapter organized competition among the students for new food products from indigenous fruits and vegetables . They put up stalls displaying innovative products and the best stall was awarded prize by our chapter .

Sri. P.G.M.Nair , the Managing Director of Mahadeva College appreciated the contribution and support from our chapter in emphasizing the importance of innovation in food processing and product development .



Recent Updates...

FSSAI withdraws order to declare 'best before date' on loose sweets

The Food Safety and Standards Authority of India (FSSAI) has withdrawn a September 2020 order that made it mandatory to declare ‘Best Before’ date on containers and trays of non-packaged loose sweets. The directive for withdrawal was issued on November 7, 2023, barely days before Diwali.
It said now, considering that the Food Safety Standards (Packaging and Labelling) Regulations 2011 have been superseded by the Food Safety and Standards (Labelling and Display) Regulations 2020, the said directive has been reviewed and it is observed that the same requires further deliberations by the concerned scientific panel regarding the declaration of date marking on non-packaged or loose food products.

Indian seafood industry worried as US takes aim at shrimp import from India

The country’s seafood sector has expressed concern at a proposal by Louisiana senator Bill Cassidy to constitute the India Shrimp Tariff Act to levy duty on shrimp imports from India.
The proposal made in the last week of September has found support from the Southern Shrimp Alliance (SSA), an organisation of shrimp fishermen, shrimp processors and other members of the industry in that country’s eight warm water shrimp producing states of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina and Texas.
Frozen shrimp comprises nearly 70 percent of seafood export from India, which reached a record $8.09 billion in FY23. The US is currently the largest market for Indian seafood, mainly shrimp. The SSA website says that in the proposed India Shrimp Tariff Act, Cassidy has pointed out that imports of Indian aquaculture shrimp that he alleges is highly subsidised account for 40 percent of the volume of all shrimp imports into the country.

India's seafood exports touch all-time high in 2022-23

India's seafood exports, both in terms of volume and value, achieved an all-time high in 2022-23. It shipped 1.7 million tonnes of seafood worth Rs 63,969.14 crore ($8.09 billion) during the financial year, growing 26.73 per cent in quantity terms and 4.31 per cent in value terms over 2021-22. According to a press statement from the Ministry of Commerce & Industry, Frozen shrimp remained the major export item in terms of both quantity and value while USA and China turned out to be the major importers of India's seafood.
Frozen shrimp, which earned Rs 43,135.58 crore ($5481.63 million), retained its position as the most significant item in the basket of seafood exports, accounting for a share of 40.98 per cent in quantity and 67.72 per cent of the total dollar earnings. In rupee terms, shrimp exports during the period increased by 1.01 per cent.

Biofortified seeds with focus on nutrition, food security in works

India has begun work on development of biofortified seeds for pulses, wheat, mustard and millets as well as fruits and vegetables to up the nutrient content to a desired level, a move aimed at ensuring nutrition and food security, a senior government official told ET on the condition of anonymity.
According to the official, the effort is also to improve India's ranking on the Global Hunger Index where the low ranking for India is not because of low availability of food but for the low nutritional value of exix=sting crops that results in malnutrition in India's newborn children and females.

Growing demand to help Indian food, beverage packaging industry to reach USD 86 bn by 2029'

The Indian food and beverage packaging industry that is growing by 14.8 per cent annually is expected to reach USD 86 billion in 2029, following rapid urbanisation, rising disposable incomes and evolving consumption patterns, All India Food Processors Association.
"Post-Covid-19, the demand for natural food ingredients has surged. FSSAI's new regulations for nutraceuticals and organic foods are driving growth in the sector. Packaging has evolved from protection to marketing and sustainability. Trends like natural, organic, vegan, and GI-tagged products are reshaping the landscape," All India Food Processors Association, Western Region, chairman Prabodh Halde said in a statement on the last day of the Food Ingredients (Fi India) and ProPak India.
The organised packaged ingredients market is valued at about Rs 20,000 crore annually, indicating a shift from loose to packaged products, he stated at the 17th edition of Food Ingredients (Fi India) and the 5th edition of ProPak India, organised by Informa Markets in India from August 17-19.

Food processing sector to generate 9 million jobs by 2024

India’s food processing sector is expected to generate 9 million jobs by 2024 and by 2030, India’s household consumption would quadruple, making it the world’s fifth-largest consumer of food and food technology, said Mr. Prabodh Halde, chairman, All India Food Processors’ Association (AIFPA) Western Region at the 17th edition of ANUTEC - International FoodTec India, co-located with ANUFOOD India and PackEx India held in Mumbai. He said this emerging sector, which had attracted $4.18 billion in foreign direct investments (2014-2020), is poised for significant growth.
“The sector significantly contributes to India’s economy, accounting for 13% of exports and 6% of industrial investment. With a market size of $1.3 billion, the thriving Indian gourmet food sector sustains an impressive 20% Compound Annual Growth Rate (CAGR),” he said.
He said India’s food processing sector was aiming to double its GDP contribution from 8% to 20% by 2030.

Consumers and food vendors urged to immediately stop using newspapers for packing, serving and storing food items

Consumers and food vendors across the country have been urged to immediately stop using newspapers for packing, serving, and storing food items. The Food Safety and Standards Authority of India (FSSAI) on Wednesday issued this directive, expressing concern over the health hazards associated with the use of newspapers for wrapping or packaging food.
The CEO of FSSAI, G. Kamala Vardhana Rao, said that there are significant health risks associated with this practice, and the move seeks to alert consumers, food vendors and other stakeholders of the dangers.
“The ink used in newspapers contains various bioactive materials with known negative health effects, which can contaminate food and lead to health issues when ingested,” he said. He also noted that printing inks may contain chemicals, including lead and heavy metals that can leach into the food, posing serious health risks over time. The FSSAI added that newspapers are often subjected to various environmental conditions during distribution, making them susceptible to contamination by bacteria, viruses or other pathogens that may transfer to the food, potentially causing food-borne illnesses. The authority has notified the Food Safety and Standards (Packaging) Regulations, 2018, which strictly prohibits the use of newspapers or similar materials for storing and wrapping food. According to this regulation, newspapers should not be used to wrap, cover or serve food, nor should they be used to absorb excess oil from fried food.

1.'Rashtriya Gokul Mission' is associated with which Union Ministry?
[A] Ministry of Agriculture and Family Welfare
[B] Ministry of MSME
[C] Ministry of Women and Child Development
[D] Ministry of Fisheries, Animal Husbandry and Dairying

2. Mhadei Wildlife Sanctuary (WLS) is located in which state?
[A] Odisha
[B] Bihar
[C] Sikkim
[D] Goa

3.Which city is the host India-US 2+2 meeting in 2023?
[A] New Delhi
[B] Chennai
[C] New York
[D] Chicago

4.Which Indian city has been added to the 'UNESCO Creative Cities Network', in Literature' category?
[A] Madurai
[B] Kozhikode
[C] Mysuru
[D] Kurnool

5.'Kepler-385', which was seen in the news, is a?
[A] Asteroid
[B] Seven-planet System
[C] Satellite
[D] Star

6.'M-Kavach 2' is a bot removal tool developed by which institution?
[A] NIC
[B] C-DAC
[C] HAL
[D] EIL

7.Which entertainment channel collaborated with the Ministry of Women and Child Development to support the Beti Bachao, Beti Padhao initiative?
[A] Sony
[B] Star
[C] COLORS
[D] Zee

8.When is 'National Cancer Awareness Day' observed?
[A] November 3
[B] November 5
[C] November 7
[D] November 9

9.When is the 'National Education Day' celebrated every year in India?
[A] November 9
[B] November 11
[C] November 13
[D] November 15

10.When is the 'World Diabetes Day' observed?
[A] September 14
[B] October 14
[C] November 14
[D] December 14

11."Innovation Handshake" agenda, is associated with which two countries?
[A] China and US
[B] US and India
[C] India and China
[D] India and Pakistan

12.Kashmir saffron has bloomed for the first time in which state/UT in 2023?
[A] Uttarakhand
[B] Kerala
[C] Himachal Pradesh
[D] Goa

13.Which state released an exclusive book on its snakes?
[A] Himachal Pradesh
[B] Madhya Pradesh
[C] Assam
[D] Kerala

14.'Sarige Suraksha Insurance Scheme' is implemented in which state/UT?
[A] Andhra Pradesh
[B] Karnataka
[C] Tamil Nadu
[D] Gujarat

15.Kangaroo care, which was seen in the news, is associated with which field?
[A] Defence
[B] Childcare
[C] Politics
[D] Animal Welfare

16.Which country has won the ODI Cricket World Cup Title for the most time, as of 2023?
[A] West Indies
[B] Australia
[C] India
[D] England

17.Who is the first Indian woman to receive the 'International Emmy Directorate Award'?
[A] Ekta Kapoor
[B] Zoya Akhtar
[C] Sudha Kongara
[D] Juhi Chawla

18.Which is the first cricket team to score more than 300 runs in a T20I?
[A] Nepal
[B] Bangladesh
[C] South Africa
[D] India

19.Neha Thakur, who secured a silver medal for India at Asian Games, plays which sports?
[A] Shooting
[B] Squash
[C] Sailing
[D] Boxing

20.Which country hosted the 'Annual IAEA General Conference' in 2023?
[A] India
[B] Austria
[C] Paris
[D] Rome

21.'DXN' is the code allotted to which Indian airport?
[A] Noida Airport
[B] Purandar Airport
[C] Utkela Airport
[D] Mopa Airport

22.Toto, a Sino-Tibetan language spoken by tribal Toto people, is written in which script?
[A] Hindi
[B] Bengali
[C] Marathi
[D] Tamil

23.Which is the second state after Bihar to conduct a caste survey?
[A] Rajasthan
[B] Madhya Pradesh
[C] Uttar Pradesh
[D] Uttarakhand

24.ISRO's Flight Test Vehicle Abort Mission-1 (TV-D1) is a crucial test for which mission?
[A] Aditya L-1
[B] Mangalyaan
[C] Chandrayaan-3
[D] Gaganyaan

FOOD TECHNOLOGY

1.Putrefaction is observed in...
[A] Fat
[B] Protein
[C] Starch
[D] All of the above

2. Thiamine is destroyed by.....
[A] Acetic acid
[B] Sulphur dioxide
[C] Sorbic acid
[D] Ethylene

3. Rind rot is observed in.....
[A] Raw milk
[B] Butter
[C] Evaporated milk
[D] Cheese

4. Wong's method is used in the estimation of.....
[A] Biotin
[B] Reducing sugar
[C] Iron
[D] Aflatoxin

5. Turkey X disease is due to.....
[A] Aflatoxin
[B] Islanditoxin
[C] Citrinin
[D] Moniliformin

6.Quality of sugar is determined by the process specified by.....
[A] ICMUSA
[B] IUCMSA
[C] ICUMSA
[D] ISUCMA

7 Sausage is a.....
[A] an emulsion
[B] a solution
[C] a precipitate
[D] None of the above

8. Poor quality of eggs float in water due to.....
[A] microbial spoilage
[B] increase in air cell
[C] decrease in air cell
[D] None of the above

9. EVOH stands for.....
[A] Ethylated Vinyl Alcohol
[B] Ethylene Vinyl Alcohol
[C] Ethyl Vinyl Alcohol
[D] Ethylidene Vinyl Alcohol

10. Section 101 of FSSA, 2006 deals with....
[A] Reward by state government
[B] Recovery of penalty
[C] Repeal and Savings
[D] Power to remove difficulties

11. Improvement notice can be issued to FBOs under which section....
[A] 28
[B] 29
[C] 30
[D] 31

12. GRAS means....
[A] Good product
[B] Genetically modified
[C] Generally recognized as Safe
[D] All of the above

13. Section 96 of FSSA, 2006 deals with.....
[A] Reward by state government
[B] Recovery of penalty
[C] Repeal and Savings
[D] Power to remove difficulties

14."Adjudication" in FSSA, 2006 is described in section....
[A] 68
[B] 70
[C] 72
[D] 74

15. Prebiotics are....
[A] Phytochemicals
[B] Nutrients
[C] Dietary supplements
[D] None of the above

16. Protocol for recall is given in....
[A] ISO 22000
[B] ISO 9001
[C] ISO 18000
[D] ISO 14001

17. Standards laid for product is given by....
[A] BIS
[B] ISO
[C] ISI
[D] WHO

18. FIFO is...
[A] First in Final Release
[B] First Leave First Out
[C] First In First Out
[D] None of the above

AFSTI Cochin Chapter

Association of Food Scientists & Technologists, India (Cochin Chapter)

Invites

Articles for its 10th edition Newsletter

The Food Tech Times

On the theme

"Food Side-stream Valorisation : A Path of Sustainability"

Instructions for the articles:

- The articles must be related to the topic mentioned above
- Give appropriate references.

Submit your articles to:

afsticochinnewsletter@gmail.com

Last date of submitting articles: 10 March 2024

Department of Food Science & Technology, KUFOS

&

AFST(I) Cochin Chapter

Presents

FOOD ENTREPRENEURS CONCLAVE (FECO) 2.0

Souvenir 2023

AFST(I) Cochin Chapter would bring out a souvenir to commemorate the decennial event, containing the proceedings & presentations from the seminar and also articles from experts in food science and Technology & industries. The souvenir will be in print and digital format.

Please send your articles & advertisements before the 15th December 2023.

Category	Advertisement Tariffs	
A	Souvenir Back cover advertisement	₹ 50000/-
B	Souvenir Front cover advertisement (Inside)	₹ 40000/-
C	Souvenir back cover advertisement (Inside)	₹ 30000/-
D	Full page advertisement (Inside)	₹ 10000/-

AFST(I) Cochin Chapter Souvenir

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Print area : 28×21 cm

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