ICAR- CIFT INTERVENTION IN MARINE NUTRACEUTICAL SECTOR

Dr. George Ninan
Director
Central Institute of Fisheries Technology (CIFT), Kochi-29

Introduction

Marine ecosystems have a high diversity of living organisms compared to terrestrial ecosystems providing numerous resources for human nutrition and health. Marine resources have received great attention recently; research on marine-derived molecules has discovered new bioactive compounds with important properties increasing their applicability as nutraceuticals in the food and supplement industries. During the past several years, an array of biologically active molecules has been extracted/isolated and purified from numerous sources of marine origin with the aid of distinct techniques and methodologies for newer applications. ICAR - Central Institute of Fisheries Technology (ICAR-CIFT) set up in 1957 is the only national center in the country where research in all disciplines relating to fishing and fish processing is undertaken. The institute started functioning at Cochin in 1957 with three Research centers function at Veraval (Gujarat), Visakhapatnam (Andhra Pradesh) and Mumbai (Maharashtra). Realising the paramount significance of marine nutraceuticals, ICAR-CIFT is working in the various research arenas staring from the harvest aspects of marine resources, designing and development of energy efficient fishing systems for responsible fishing and sustainable management, other basic and strategic research in fishing and processing, development of implements and machinery for fishing and fish processing etc. Some of the notable contributions from ICAR-CIFT in the marine nutraceutical sector is briefed below:

Chitosan

Chitosan is a linear polysaccharide composed of randomly distributed β-(1-4)-linked D-glucosamine (deacetylated unit) and N-acetyl-D-glucosamine (acetylated unit). It has a number of commercial and possible biomedical uses. Chitosan is produced commercially by deacetylation of chitin. Chitin (C8H13O5N)n is a long-chain polymer of a N-acetylglucosamine, a derivative of glucose, and it is found in many places throughout the natural world. It is the main component of the cell walls of fungi, the exoskeletons of arthropods, such as crustaceans (like the crab, lobster and shrimp) and the insects, including ants, beetles and butterflies, the radula of mollusks and the beaks of the cephalopods, including squid and octopuses. ICAR-CIFT has developed a method for the extraction of chitin from shrimp shell waste The wet prawn shell collected from the peeling

centers is initially converted in to chitin which is then converted to chitosan by a chemical process deacetylation. Then the alkali free dried and powdered chitosan can be bagged in polythene lined HDPE (high density polythene) woven sacks.

Technology Benefits:

- Chitosan find various industrial applications like, biotechnology, food processing, pharmacy and medicine.
- Boiler chicks diet with chitin was found to improve the feed efficiency, resulting in about 10-12% weight gain in the birds compared to a chitin free diet
- Use of chitin for the production of Glucosamine hydrochloride finds applications in antibiotics and baby food formulations.
- Chitosan can be used as sizing material for textiles
- It can be used as a water/ wine clarifying agent and also in the preparation of cosmetics and pharmaceuticals etc.
- Recent studies have shown the effectiveness of Chitosan (in the form of microfined powder) impregnated gauze and film for treatment of chronic wounds and external ulcers and to arrest/ minimize bleeding in brain surgery.

Glucosamine hydrochloride

ICAR-CIFT has developed a method for preparation of glucosamine from the shells of shrimp, lobster, or crab. Glucosamine is also fight joint inflammation and inhibit the production of enzymes that destroy cartilage. It plays a major role in lubricating joints, increasing their mobility and strengthening of cartilage. Glucosamine is commonly used in the treatment of osteoarthritis.

Collagen Chitosan Membrane for Plastic surgery and Dentistry

ICAR-CIFT has developed a Collagen chitosan membrane derived from collagen of fish air bladder and chitosan from prawn shell is intended to be used as an artificial space making barrier over periodontal bony defects- specifically in infrabony 2-3 walled defects and grade II furcation defects in dentistry and as covering membrane preventing fluid loss and blood loss in burns/wounds during healing. It finds applications in plastic surgery also. Collagen-Chitosan films are flexible, tough, transparent, clear and oxygen permeable with good tensile strength.

Development of a seaweed NutraDrink:

Based on a novel solvent free extraction of sulphated polysaccharide and phenolics from seaweed, a nutraceutical drink (NutraDrink) was developed. A macroporous adsorbent resin was used to selectively remove the compounds responsible for seaweed off-smell.

Iron-Calcium-Fortified-Fish Soup Powder (FSP)

FSP was developed with the objective of addressing micronutrient malnutrition with special reference to improving iron levels in vulnerable population. Intervention among adolescent girls of West Jaintia Hills District, Meghalaya using fortified FSP showed promising trends in blood hemoglobin levels.

Chitosan based vitamin microparticles

Microencapsulation of thiamine and pyridoxine Vitamin B1 and Vitamin B6 were encapsulated with vanillic acid grafted chitosan and subsequently spray dried. The wall material was synthesized following optimized protocol, starting with 20 g of chitosan and 20 g of vanillic acid to obtain microparticles of encapsulated thiamine and pyridoxine. Dietary supplementation of Thiamine - pyridoxine-vanillic acid-grafted chitosan is an effective means to prevent cardiovascular disease.

Fish oil Powder

A stable fish oil powder was developed using emulsion and encapsulation technology. Cardioprotective effect of encapsulated fish oil powder was stablished in cardiomyoblast cell lines.

Fish oil rich in PUFA supplementation effects the mRNA and protein expression of enzymes of lipid metabolism. Fish consumption has been associated with several health benefits as demonstrated by epidemiological studies worldwide. The positive effects are thought to be due to the predominance of n-3 PUFA in fish. To elucidate the possible mechanisms of action, we used RNA expression studies for determining the level of expression of four genes in liver of wistar strain rats namely acetyl co a carboxylase (ACC), fatty acid synthase (FAS) and steroyl Co A desaturase-1 (SCD-1) in response to feeding fish oil. Using western blotting technique the levels of ACC, FAS and SCD-1 enzymes expressed in the liver were determined.

Development of a co-delivery system of Betalain and PUFA

Multiple emulsification and microencapsulation followed by spray drying was adopted to prepare stable PUFA. Microencapsulation is one of the promising methods that can minimize oxidative deterioration of ω-3 oils by converting into a stable free-flowing powder.

Development of stable squalene powder

Microencapsulation of squalene with maltodextrin and whey protein isolate gave an encapsulation efficiency of 96% and oxidative stability of more than four months. Wall material optimization for squalene encapsulation led to the development of stable emulsion of chitosan (CS) and whey protein isolate as the emulsifier. Cakes fortified with squalene microencapsulated with chitosan-whey protein complex had superior oxidative stability and textural quality.

Fucoxanthin

Supercritical fluid extraction of Fucoxanthin and lipid from brown seaweed Sargassum sp. Fucoxanthin content in the extract was determined by HPLC and found to be 1.5 mg/g of the extract. The extract was also found to be rich in different saturated and unsaturated fatty acids. Since fucoxanthin and seaweed lipids are known to possess bioactivities, the extract could potentially be used as nutraceutical supplement.

Seaweed based dietary fibre

Dietary fibre from *G.edulis, S.wightii* and *U.lactuca* extracted under optimized conditions were analysed for their physicochemical and functional properties like FT- IR analysis, hydration properties (water holding capacity and swelling capacity), oil holding capacity and antioxidant properties (total phenolic content, DPPH free radical scavenging activity and reducing power assay).

Nutraceutical potential of seaweeds

Nine tropical potentially edible seaweeds from Phaeophyta and Chlorophyta were studied for their nutritional composition, mineral content and nutraceutical potential. The seaweeds considered for the studies were green (Ulva reticulata, Valoniopsis sp., Boodlea composita, Caulerapa sertularioides) and brown (Sargassum johnstonii, Padina gymnospora, Padina tetrastromatica, Cystoseira indica, Dictyopteris australis). Acetone and chloroform extracts of Ulva lactuca showed antibacterial activity towards Salmonella typhimurium, Morganella morganii, E.coli, Listeria monocytogenes and Staphylococcus aureus.

Proteoglycans

ICAR-CIFT has Extracted, purified and characterized proteoglycans from *E. brucus*. Cytotoxic effect of proteoglycans from E. brucus against He La (Breast cancer) cell lines was elucidated.

Myctophids

Myctophid biochemical database was developed. Biochemical and nutritional evaluation of mycotphid fishes was carried out. Fatty acid profiles of Myctophid fishes were profiled and

compared. Fatty acid profile of Myctophid fishes were compared with common food fishes. Myctophid fishes were found to be rich in omega-3 Polyunsaturated Fatty Acid such as DHA. Myctophid fishes were solar dried and dried fishes were subjected to Supercritical Fluid Extraction for fatty acid extraction.

Conclusion

Marine Biomolecules have the potential to be used in a broad spectrum of products such as: food, biofuels, chemicals, cosmetics, medicines, etc. ICAR-CIFT is working on the novel frontiers of marine biomolecules research starting from developing sustainable extraction protocols for obtaining marine bioactives, structural elucidation, their detailed in vivo and in-vitro bioactivities and finally commercialization of these technologies. However, promotion of marine Biomolecules as nutraceuticals is still needed by generating consumer awareness for the acceptance of products even on a regional basis. Presently, the Institute is working towards the Comprehensive utilization of Marine Biomolecules by applying biorefinery approach in line with the UNs Sustainable development goals.