

Paradigm Shift in Processing Technologies and Quality concerns in Fisheries

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Local Points at a Glance: The authors favour the readership by telling them about emergence of processing technologies like high pressure pulse light, pulse electric field, radio frequency heating, irradiation processing etc.

The seafood industry plays an important role in the economic and social wellbeing of nations across the world. Besides contributing to a major occupation of a large section of the population, it contributes to feeding of a significant part of the world's population with a low cost but highly nutritious food. Over a period of time the aforesaid simple business of small timers has evolved into a more lucrative and trade-oriented industry, providing employment to millions of people around the world. This traditional livelihood business has transformed into a sector, contributing to the food and nutritional security of the country, besides contributing to the economy and providing employment opportunity.

Fish is changing into the most preferred animal protein due to its high content of easily digestible protein and the presence of omega 3 fatty acid content. The world per capita consumption of fish has increased from 9.9 kg in 1960s to over 16 kg in 2005. The human population explosion demanded increases in the production and aquaculture provided the much needed thrust to it in recent time. The much debated stagnation in fish production from marine sector augmented the aquaculture production to satisfy the requirements in a large way.

More than 37% of the fish and fishery products enter the international trade and more than 190 countries in the world engage in International trade of fish and its products. As far as India is concerned EU, USA and Japan are the major markets and the demand for them is on the

increase. The export of marine products from India reached an all-time high of 18,856 crores in Indian rupees with a total quantity of 9,28,215 tonnes (MPEDA, 2013) with an overall growth of 7.68% in quantity. South East Asia was the largest buyer of Indian marine products, followed by EU, USA, Japan and Middle East.

The fishing industry in India is traditionally export-oriented but of late, increase in price realisation is seen in the domestic market. However, quality of the product sold in the domestic market is a concern and in this context much is needed to be addressed. Another important factor is the shift in the consumer acceptance from traditional chilled/ frozen products to value-added products. Even minor value addition as ready to cook products fetches appreciable demand from among the domestic consumers. The Central Institute of Fisheries Technology has made considerable advance on the utilisation of many varieties of fish and shellfish. Pioneering work on the harvest and post-harvest front was initiated by CIFRI in the country during 1960s, which paved way for the future developments in both the harvest and post - harvest areas. The institute, in the past 55 years of its existence, has provided the much needed impetus for the fisheries development in the country.

Emerging technologies in fish processing

Seafood is a highly perishable commodity and needs to be processed into products which can be stored or

processed subsequently or consumed at a later stage. Though fish undergo changes post mortem due to chemical processes taking place in fish or due to microbial action during storage, technologies exist that can take care of spoilage to a large extent. Chilling of fish is one of the earliest technologies for the preservation of fish. The increase in shelf life of the product from initial catch to its spoilage determines its value as far as commercial application is concerned. As consumers' preference has been changing, technologies as well as different products have come in to the market to quench the consumer requirement. The consumer now understands the finer attributes of quality such as texture, flavour, colour etc., and therefore the responsibility of the processor rests on the creation of acceptable characteristics in the products in order to increase its acceptability and in turn garner profitability for the business. There are a number of emerging technologies which have been tried at different levels of adaptation across the world or are at different levels of research and development and waiting for adaption in the sector. Some of the technologies which received the attention of food manufacturers include high pressure processing, pulse light technology, pulsed electric field, microwave processing, radio frequency, microwave, irradiation etc.

High pressure processing is a technique for extending the shelf life of products with minimal or no heat treatment but is effective in protecting the attributes of the fish. The technology, first commercialised in 1992 in Japan, has been

tried for a variety of food products. In this process, the pressure is uniformly transmitted throughout the product which affects the covalent bonds of food, while retaining the other attributes. The possibility of extending shelf life of the product for longer periods without compromising the freshness and quality of the food is the main advantage of the process. There are reports available on the use of high pressure processing for destruction of micro-organisms, to alter functional properties of fish-based products such as surimi and for the formation of heat induced gels from fish. Pressure shift freezing and pressure assisted thawing are the two other applications of high pressure techniques. The research at CIFT, Cochin, clearly indicates increased shelf life of fish and shell fish as well improvements in the functional properties of surimi gels when this technique was used. The equipment procured under the NAIP assisted project 'Studies on high pressure processing on high value perishable commodities' clearly demonstrated the extension of chilled stored shelf life of pressure treated shrimps (*L.vannamei*) up to 30 days. Similarly 50% extension of shelf life of tuna chunks stored in ice compared to controlled samples too was demonstrated.

Pulse light is another non-thermal technology finding application in food processing. The technique, approved by the USFDA under 21CFR 179.41, employs pulses of light i.e., high peak pulses of broad spectrum white light in short bursts, which inactivate micro-organisms on food surfaces as well as food contact surfaces and packaging materials by the action of the ultra-violet light of the spectrum. Research work has demonstrated reduction in the load of species of *Listeria*, salmonella, pseudomonas, staphylococcus, *E.coli* etc. and has contributed to extension of shelf life of fish and shellfish. It was reported that shrimp treated with pulse light demonstrated a higher shelf life of 7 days in edible condition in chilled storage compared to that of simply chilled shrimp. The green technology which uses minimum energy is a quick process in controlling microbial growth and is considered as a safe technology for food applications. However, low penetration of light in fish meat products and the effect of light on lipids are some of the intriguing problems associated with pulse light technology. The machine procured at CIFT, Cochin under the project "A value chain on Oceanic Tuna Fisheries in Lakshadweep Sea" has demonstrated

encouraging results on *Etroplus suratensis* in extending the shelf life of the product. Similarly, pulse treated tuna product, masmin, demonstrated a 0.7 log reduction in fungus. Challenge studies with tuna homogenate showed a reduction of almost 3 log reduction in *E.coli* 0157 H7 showing the usefulness of the technology for fish preservation.

Pulse Electric Field: In high intensity pulse electric field, food is placed between 2 electrodes where pulses of high voltage are applied. The treatment is conducted either at ambient, or sub or above ambient temperatures for a short period of time (less than 1sec). This is a non-thermal technology where heating of food is minimum and is reported to be superior to traditional heat applications as the detrimental changes in physical and sensor attributes of the food is avoided (Ziang *et al.*, 1995).

There are reports indicating the application of PEF for extending the shelf life of bread, milk, fruit juices etc. This could be an important future technology for preserving fish or shell-fish based liquid food such as soups with minimum loss of characteristics such as flavour, nutritional value etc.

Microwaves are used at domestic levels for cooking of food but their application for commercial purposes for preservation of food such as cooking, drying, pasteurisation and preservation of food materials, is an important area of the future. The importance of microwaves is due to its ability to reach high heating rates, uniform heating, and safe handling, besides easy operation and low maintenance. The possibility of changes in flavour or sensory attributes of food is also reported to be minimum compared to conventional cooking process (Vadivambal & Jayas, 2010). Microwaves are type of electromagnetic waves with frequency in the range 300 MHz to 300 GHz. Domestic microwave appliances operate generally at a frequency of 2.45 GHz, while industrial microwave systems operate at frequencies of 915 MHz and 2.45 GHz (Datta & Anantheswaran, 2000). Microwave heating of food materials is caused by the dipolar and ionic mechanisms, in which the food material absorbs the microwaves and convert to heat. The presence of water results in dielectric heating due to the dipolar nature of water. The major problem however is the non-uniform distribution of heat leading to uneven distribution of temperature resulting in

the partial control of microbes (Vadivambal & Jayas, 2010). But in selected food applications such as bacon cooking as well as sausage cooking, microwaves have shown their useful applications. There is a growing demand for the use of microwaves in the applications for ready-to-eat products packed in microwaveable packaging materials.

Radio frequency heating, like microwaves is a dielectric heating has a potential for fast heating solid or semi-solid food. According to electromagnetic compatibility regulations, the industrial, scientific and medical bands of radio frequency are limited to 13.56, 27.12, and 40.68 MHz. The deeper depths of RF energy penetration in foods and the simple uniform field patterns, compared to the complex non-uniform standing wave patterns in a microwave oven, make RF heating more suitable for processing of large food trays (Zhao and others 2000; Wang and others 2003). This is being extensively used for thawing of frozen fish products which takes lesser time compared to conventional thawing.

The **irradiation** process has been approved by the Food and Agriculture Organization (FAO), the World Health Organization (WHO), the International Atomic Energy Agency (IAEA) and the *Codex Alimentarius Commission*. In India, about 20 commodities have been approved for processing by this method. Irradiation processing of food involves the controlled application of energy from ionising radiations such as gamma rays, electrons, and X-rays for food preservation. It works by disrupting the biological processes that lead to decay. Control of insect infestation, reducing the numbers of pathogenic or spoilage micro-organisms and delay or elimination of natural biological processes such as ripening, germination, or sprouting in fresh food are some of the characteristics of radiation that find application in food industry. Like all preservation methods, irradiation should supplement rather than replace good food hygiene, handling, and preparation practices.

Irradiation, though it causes alterations in the case of micro-organisms, do not cause change in nutritional parameters. Gamma irradiation has been considered as an interesting method of preservation to extend the shelf life of fish and also to reduce qualitatively and quantitatively the microbial population in fish and fish

products. Irradiation doses of 2-7 kGy can reduce important food pathogens such as Salmonella, Listeria, and *Vibrio* spp., as well as many fish-specific spoilers Pseudomonaceae and Enterobacteriaceae that can be significantly decreased. Studies have shown that frozen tuna loins (of *Thunnus obesus*) packed in polyethylene PE bags and irradiated by an X-ray machine at a dose of 2.2 kGy, showed higher keeping quality than unirradiated samples. BARC, Mumbai has done some pioneering works in the irradiation of fish. Consumers have their own understanding on the consumption of irradiated products, and consumer sensitisation programmes have not been extensively taken up by the industry till date.

Quality Assurance and Trade

Seafood is an important commodity for trade and India exports over nine lakh tons of seafood worth over Rs.19,000 crores. Since the demand of seafood is on the increase world over and as it is one of the highly traded commodity across the world, concerns are raised by the consumers regarding how safe it is for consumption. Sanitary and Phytosanitary agreement signed in Marrakesh on 15 April 1994 and the General Agreement on Tariffs and Trade (GATT 1994) along with the establishment of World Trade Organization on 1 January 1995 sets out the basic rules for food safety and animal and plant health standards.

The production of fish and shell fish depends on the water ecosystem, and the environmental and pollution issues associated with the water bodies have direct impact on the quality of the seafood with special reference to hazard aspect. A hazard is a biological, chemical or physical agent that is reasonably likely to cause illness or injury in the absence of its control. The hazards associated with concerns on fish and fish products, is increasing in both number and level due to the awareness of consumers on the health impact of hazards and therefore has become a major concern as far as trade is concerned.

The key issues to ensuring fish and shell fish quality are fish health and environmental monitoring, whether it is sourced from aquaculture or from the marine waters. As far as aquaculture is concerned control and sensible management of environment and fish health programme should be made available in line with the scientific

development to the farmers. In the marine sector many persistent organic pollutants such as polychloro biphenyls (PCB) and dioxins, which tend to accumulate in the organic matter and into the animals along the food chains leading to health concerns. Therefore, periodic assessment of the seafood quality based on chemical residues is essential to protect the consumers and to provide reassurance and competitive advantage to the export market. Traceability is the much talked about method in the food industry which requires every food operator to have system and procedure for tracking all the inputs entering the food system.

A chain of potential risks follows from the fish catch to the processing facility as well as from the processing facility to the retailers or consumers directly. Product handling in the process causes concerns to consumers as well as to the authorities. The chemical hazards in fish and shell fish mainly include heavy metal residues, pesticide residues, antibiotic residues and a few others like persistent organic pollutants such as PCBs and Dioxins. The levels of these hazards keep on decreasing and few of them, particularly antibiotic residues, have been banned for their presence in the edible portion meant for human consumption. The list also includes certain biogenic amines including histamines as well as toxins from shell fish origin, namely ciguatera, Paralytic Shellfish poisoning (PSP) and Diarrhetic Shellfish Poisoning (PSP). The microbial hazards include certain viruses such as norovirus and bacteria such as *Vibrio parahaemolyticus*. Therefore the shellfish sector has a serious challenge of maintaining product quality and safety, as a result of the harmful algal blooms leading to biotoxins in edible portion and water quality in shellfish growing areas. Incidences of pathogens such as *Vibrio* in shell fishes particularly in raw oysters, as well as metals like mercury in fish, cadmium in cephalopods and additives beyond limits as well as adulterants in feed and other contamination related to industrial pollution put pressure on the consumers. In addition, additives which are banned for use in fish, wild or farmed, cause major concern in the trade. Presence of residue levels of formaldehyde in fish as well as presence of residue levels of dyes such as malachite green are major problems in fish in other countries. This calls for a closer look in to the quality system so that such banned items do not enter the food system.

Causes of Export rejection from India

The major importing countries, namely the EU and USA, have their controls on imports. The Operational and Administrative System for Import Support system (OASIS) of USA and the Rapid Alert System for Food and Feed (RASFF) of EU control the import in respective countries. On an average there are about 380 rejections of fish and fishery products by EU during the period from 2002 to 2008. India's rejection figure from EU was about 37 for the period from 2002 to 2008, almost one tenth of the total rejections. For the same period the average rejections from USA is about 1850, almost six times higher.

The analysis of the cause of rejection from EU showed that maximum rejection from third world countries were noticed for the presence of banned veterinary drug residues (28%) followed by microbiological contaminants, heavy metals and other reasons. Rejections on the grounds of organoleptic reasons indicated limitations in the quality control in the exporting countries. For USA, filth or unsanitary conditions contributed to over 49% of the rejection, followed by Microbiological reasons, labelling issues etc. The pattern of rejections definitely showed concern on the quality control system in the exporting countries.

Mitigation measures

Good manufacturing and good hygiene practices are important practices for the countries and the immediate requirement is to develop a good hygienic environment for production and processing of seafood. According to FAO, quality Assurance refers to "all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality". Preventive strategies based on thorough analysis of prevailing conditions are much more likely to provide an assurance of fish quality. Implementation of Hazard Analysis Critical Control Point (HACCP) along with GMP and GHP provide safe guards against the potential hazards which are likely to interfere with the production system leading to safe fish for human consumption. Post-harvest handling must therefore be optimised, and quality assurance systems are a way to reduce post-harvest losses and maximise the value of the catch.

With diversification in the product and process regime, proper and scientific knowledge will be a requirement for increased understanding and for

mitigation strategies for new emerging pathogens as well as the chemical contaminants and additives that go in to the production line in order to protect the health of the consumer across the world.

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MATSYA MELA - 2014 SHIMOGA, KARNATAKA

In order to popularise the activities of fisheries, and to create awareness among all the stake holders under one umbrella, the State Department of Fisheries, Govt of Karnataka, had organised a three day (15th Feb to 17th Feb 2014) Zonal level Matsya Mela - 2014 karnataka, at Shimoga, (Matsya Kashi), which is almost at center of the State, and wherein most of the Inland fisheries activities are concentrated. Regional Zone of Shimoga, at the fringe of Western Ghats, harnesses the major faunal and floral biotome of the State, particularly 60-80 varieties of aquarium fishes which are exported from Tunga river alone.

Matsyamela 2014 was the grand fisheries event and was inaugurated by Honourable Speaker of the State Upper House, Mr. D H Shankara murthy. Other chief guests on the dais were honourable Director of Fisheries Mr. H S Veerappagowda, Mrs Surekha Muralidar, Mr. Viswanatha Kashi, and public representatives from the various organisations of Shimoga. The inaugural function was presided by Mr. Prasanna Kumar, Honourable member of

Legislative Assembly, Shimoga.

Inaugurating the Matsyamela the speaker pressed the need to conserve the healthy ecosystem of the natural water bodies, keeping in view the restoration of rich native eco-biota and insisted efforts to be made to keep the environment intact for the future generations. The local MLA promised the fisherfolk that the present government is keen in implementing the various socio-economic upliftment programmes. During the inaugural function various informative brochures were-released. Director of Fisheries gave a call to all the stakeholders of the fisheries, that the sincere efforts of the State department should be well utilized for the overall development of fisheries.

An aquarium gallery, where more than 80 varieties of aquarium fishes were displayed in various sizes of aquaria, including moulded ones was the main attraction and for impressive turn out of the event. There were 20 different stalls, represented by the Academic Institutions, Extension services, Fish

farmers Associations, Commercial Entrepreneurs(from the field of Fish Feeds, Fisheries Infrastructures, Fisheries Requisites), which were also the center of attraction for not only the farmers but also for the public including children. There was also Fresh Fish sale outlet setup at the event.

A food gallery, which was again at the center stage of the matsyamela, with participations from the Karnataka Fisheries Development Corporation, Fish Farmers Associations, Fisheries Co-operative Societies etc., served the public with various delicacies.



A view of the inaugural event



Dr. C. V. Vasudevappa is appointed as the First Vice-Chancellor of the University of Agricultural and Horticultural Sciences Shimoga. Karnataka

The Governor of Karnataka and Chancellor of the Universities in Karnataka has appointed Dr. C. V. Vasudevappa, Dean of Post Graduate studies, UAS Bangalore as the first Vice-Chancellor of the University of Agricultural and Horticultural sciences, Shimoga, for a period of four years from the date of assumption of office or till he attains the age of 67 years, whichever is earlier.

Dr. Vasudevappa hails from Issur, shikaripura Taluk, Shimoga District. He was a student of the College of Fisheries Mangalore and had received his BFSc degree in 1974 and MFSc in 1977. Later, he received his doctoral degree PhD.

from the University of Science and Technology, Kochi. During his education he was a recipient of Govt of India scholarship and ICAR junior and senior fellowships.

Dr. Vasudevappa had the privilege to serve as chairperson for 6 committees and he was member of 20 National and International Committees besides being member of several Educational committees. He had undergone intensive training on application of qualitative genetics for aquaculture, at ICLARM, Manila, Philippines. He participated in 14 international and 62 national seminars and workshops and in 46 training programmes as resource person.



Dr.C.Vasudevappa

His vast experience will enable him to establish unique educational and research faculties in the newly formed University of Agricultural and Horticultural Sciences, Shimoga. *Fishing Chimes* wishes him all the best in his present position.

