Volume 4, Issue 2

www.agriallis.com

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine

Article Id
AL04114

NEOTERIC TECHNOLOGIES IN FISH PROCESSING AND FISHERY PRODUCTS: A REVIEW

[1]Tameshwar*, and [2]Devati

tameshwar400@gmail.com

[1]Karnataka Veterinary, Animal and Fisheries Sciences University, College of Fisheries Mangalore – 575002, India

[2]Institute of Fisheries Post Graduate Studies, Tamil Nadu Dr. J. Jayalalithaa Fisheries University (TNJFU-OMR Campus), Vaniyanchavadi, Chennai- 603103, India

Fish is the cheapest source of animal protein constitutes a major share in the global food basket. World fish production sector facings the challenges to boost the production to alleviate the hunger and mal nutrition in the future. From the post-harvest handling, to the transportation of fish, through the processing line packaging and storage certainly require a proper care, in order to maintain the quality and nutritional attributes and preventing post-harvest losses. During the year 2018 about 88 percent (156 million tonnes) of world fish production was utilized for direct human consumption. The remaining 12 percent (22 million tonnes) was used for non-food purposes, of which 82 percent (or 18 million tonnes) was used to produce fishmeal and fish oil. The proportion of fish used for direct human consumption has increased significantly from 67 percent in the 1960s. Live, fresh or chilled fish still represented the largest share (44 percent) of fish utilized for direct human consumption as being often the most preferred and highly priced form of fish. It was followed by frozen (35 percent), prepared and preserved fish (11 percent) and cured at 10 percent. (FAO, 2020). Few of the emerging technologies that have application in fish processing are High Pressure Processing, Irradiation, Microwave Processing, Radio frequency, Ultrasound, etc. Packaging technologies like Modified Atmosphere, active and intelligent packaging also plays an important role in fish preservation (Fellows, 2000; Da-Wen, 2005).

High Pressure Processing

High pressure processing is an effective methods for preservation of foods. In which the food is placed in a pressure vessel which is capable to sustain the required pressure and the food is submerged in a liquid, which acts as the pressure transmitting medium, such as water, castor oil, ethanol or glycol etc. These liquids protect the inner vessel surface from corrosion. HPP preserving food by combining elevated pressures (up to 900 Mpa or good atmosphere) and moderate tem (up to 120 ^{o}C) over a short period. So many advantages in this technology like uniform pressure, minimum heat, minimum damage to food and properties of foods. Effects of HPP on microorganisms shown that fungi showed highest sensitivity at 300 Mpa to 400 Mpa fungi showed highest sensitivity to HPP followed by gram bacteria. HPP treatment of 250 Mpa and 200 Mpa enhanced shelf life of Indian white prawns (H. Milne Edwards, 1837) and yellowfin tuna chunks respectively (Hugas *et.al*. 2002, Hogan *et.al*. 2005).

Irradiation

It is a physical treatment that consists of exposing foods to the direct action of electronic, electromagnetic rays to assume the innocuity of foods and to prolong the shelf life (Doyle, 1999). Irradiation of food can control insect infestation, reduce the number of pathogenic microorganisms and delay or eliminate natural biological processes such as ripening, germination or sprouting in fresh food. (Ahn *et al*. 2006) Three types of ionizing radiations are used to process products. Gamma rays, x-rays and accelerated electrons (Lecroix, 2005). Three types of ionizing radiation are used in commercial radiation to process products such as foods and medical and pharmaceutical devices (International Atomic Energy Agency (IAEA), radiation from high-energy gamma rays, X-rays, and accelerated electrons (Lacroix, 2005). Gamma rays, which are produced by radioactive substances (called radioisotopes). The approved sources of gamma rays for food irradiation are the radionuclides cobalt-60 (60Co; the most common) and cesium-137 (137Cs). They contain energy levels of 1.17 MeV and 1.33 MeV (60Co) and 0.662 MeV (137Cs). Electron beams, which are produced in accelerators, such as in a linear accelerator (linac) or a Van de Graaff generator at nearly the speed of light. Maximum quantum energy is not to exceed 10 MeV. X-rays or decelerating rays, which can be likewise produced in accelerators. Maximum quantum energy of the electrons is not to exceed 5 MeV**.** Irradiation doses of 2 kGy to 7 kGy can reduce important food pathogens such as Salmonella, Listeria, and Vibrio spp., as well as many fish spoilers' microorganisms such as *Pseudomonadaceae* and *Enterobacteriaceae* that can be significantly decreased in number (Lacroix, 2005)

Microwave Processing

The applications of microwave heating on different fish preservation methods include drying, pasteurization, sterilization, thawing, tempering, baking etc. Microwaves are electromagnetic waves whose frequency varies within 300 MHz to 300 GHz. Microwave heating is caused by the ability of the materials to absorb microwave energy and convert it into heat. Microwave heating of food materials mainly occurs due to dipolar and ionic mechanisms. Water content in the food material causes dielectric heating due to the dipolar nature of water.Microwave drying has advantage of fast drying rates and improving the quality of product. In microwave drying, due to volumetric heating, the vapors are generated inside and an internal pressure gradient is developed which forces the water outside. Thus shrinkage of food materials is prevented in microwave drying. One of the disadvantages of microwave drying is that excessive temperature along the corner or edges of food products results in scorching and production of off-flavors especially during final stages of drying. Microwave combined with other drying methods such as air drying or infrared or vacuum drying or freezedrying gave better drying characteristics compared to their respective drying methods or microwave drying alone (Chandrasekaran *et al*., 2013).

Radio Frequency

Radiofrequency heating refers to the use of electromagnetic waves of certain frequencies to generate heat in the material. Radiofrequency heating can be performed in any of the 3 frequencies (13.56 MHz ± 6.68 kHz; 27.12 MHz ± 160 kHz and 40.68 MHz ± 20 kHz). The advantages of RF heating are increased heating and processing speed, improved product quality and yield because of uniform heating, usage of only 1/3 of the floor space of conventional heating units, instant on/off and temperature change and higher energy savings up to 60 % to 70 %. Another important advantage claimed for RF heating is its ‘self-limiting’ property, which controls the consumption of RF energy according to the workload.

Ultrasound

Ultrasound (US) is defined as waves of a mechanical nature that require an elastic medium to propagate (Mason, 2002 andLempriere, 2013). Sounds and ultrasounds differ in frequency: sound waves propagate at frequencies audible to the human ear (from 16 Hz to 16–20 kHz), while US waves propagate at frequencies greater than 20 kHz (upper limit of audibility for the human ear) up to frequencies of 10 MHz, which then proceeds to the so-called hypersonic region.Ultrasonic waves at this range are capable of causing physical, mechanical, or chemical changes inthe material leading to disrupting the physical integrity, acceleration of certain chemical reactions through generation of immense pressure, shear, and temperature gradient in the medium. Ultrasonic has been successfully used to inactivate *Salmonella* spp., *E. coli*, *L. monocytogenes*, *S. aureus* and other pathogens (Awad *et al*., 2012).This technique has potential advantages over other techniques including freedom from radiation hazards, which may appear in some of the existing non-destructive methods.

Retort Pouch Processing

As in canning, retort pouch food is sterilized after packing, but the sterilizing procedure differs. The pouches are processed in an overpressure retort. The time and temperature will be standardized depending on the product. With the availability of retort pouches, it can function as an excellent import substitute for metallic cans. Besides, cost reduction retort pouch packages have unique advantages like boil in bag facility, ease of opening, reduced weightand do not require refrigeration for storage. Processed food products can be kept for long periods at ambient temperature. The energy saving is more in processing in flexible pouches compared to cans. On a comparison, oftotal costs, including energy, warehousing and shipping, the pouch looks even more favorable. There is 30 % to40 % reduction in processing time compared to cans, solids fill is greater per unit, empty warehousing is 85 %smaller and weight of the empty package is substantially smaller.

Bio Preservation

Bacteriocins are a heterogeneous group of antibacterial proteins that vary in spectrum of activity, mode of action, molecular weight, genetic origin and biochemical properties various spices and essential oils have preservative properties and have been used to extend the storage life of fish and fishery products. Natural compounds such as essential oils, chitosan, nisin and lysozyme, bacteriocins have been investigated toreplace chemical preservatives and to obtain green label products (Stiles and Hastings, 1991).

Active and Intelligent Packaging

- **Active packaging (AP)**

Active packaging is defined by European regulation (EC) No 450/2009, AP systems are designed to "*deliberately incorporate components that would release or absorb* *substances into or from the packaged food or the environment surrounding the food*.” Active packaging materials are thereby “*intended to extend the shelf-life or to maintain or improve the condition of packaged food*.” Although extensive research on AP technologies is being undertaken, many of these technologies have not yet been implemented successfully in commercial food packaging systems. Some of the active packaging systems include; Oxygen scavengers; Carbon dioxide emitters; Moisture regulators; Antimicrobial packaging, Antioxidant release; Release or absorption of flavors and odors; Carbon dioxide scavenger and Activepackaging systems with dual functionality (combination of oxygen scavengers with carbon dioxide and/or antimicrobial/antioxidant substances). Other active packaging systems that are expected to find increased attention in the future include colour-containing films, light-absorbing or regulating systems, subsectors formicrowave heating, gas permeable/breathable films, anti-fogging films, and insecticides repellant package (Labuza and Breene, 1989).

- **Intelligent packaging**

Intelligent packaging also known as smart packaging, senses some properties of the food it encloses orthe environment in which it is kept and informs the manufacturer, retailer and consumer of the state of these properties. Intelligent packaging has been defined as ‘Packaging systems which monitor the condition of packaged foods to provide information about the quality of the packaged food during transport and storage. These include Time temperature indicators, Leakage indicator, Freshness indicator, etc. Active andante lligent packaging systems contribute to the improvement of food safety and extend the shelf-life of the packagedfoods. However these are evolving technologies in the seafood area and many of these systems are in thedevelopmental stage (Kerry *et al*., 2006).

Conclusion

Aquatic foods can help with food and nutritional security, product diversity, value addition, increasing exports, and minimizing post-harvest losses, all of which can contribute to global economic growth and hunger reduction. Consumers prefer high-quality processed foods with little nutritional characteristics alterations. Recent thermal and non-thermal processing technologies will aid in increasing the shelf life of fish, maintaining nutritional characteristics, increasing convenience, reducing waste, facilitating exports and imports, and, most importantly, increasing economic value.

References

Ahn, D. U., Lee, E. J., Mendonca, A., 2006. Meat Decontamination by Irradiation in *"Advanced Technologies for Meat Processing"*. In: Nollet,L. M. L., Toldra, F. (Eds.).

Da-Wen, S., 2005. Emerging Technologies for Food Processing. Elsevier Academic Press. UK.

Doyle, M. E., 1999. Food Irradiation. Madison: University of Wisconsin, Food Research Institute.

FAO. 2020. *The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome.*

FELLOWS, P., (2000). Food Processing Technology: Principles and Practice, II ed, CRC, New York.

Kerry, J. P., O'grady, M. N., Hogan, S. A., (2006). Past, Current and Potential Utilization of Active and Intelligent Packaging Systems for Meat and Muscle-Based Products: A Review. *Meat Science* **74**: 113–130.

Labuza, T., Breene, W., (1989). Applications of Active Packaging for Improvement of Shelf-Life and Nutritional Quality of Fresh and Extended Shelf-Life Foods. *Journal of Food Processing and Preservation*. **13**: 1–89.

Lacroix, M., (2005). Irradiation of Food in *"Emerging Technologies for Food Processing"*. In: Sun, D. W. (Ed.). *Elsevier Academic Press*. SanDiego, California, USA. p. 353–386.

Lempriere B.M., (2013). Ultrasound and Elastic Waves: Frequently Asked Questions. Elsevier; San Diego, CA, USA.

Mason T.J., Peters D., (2002). Practical Sonochemistry: Power Ultrasound Uses and Applications. Wood head publishing; Sawston, Cambridge, UK.

Stiles, M. E., Hastings, J. W., (1991). Bacteriocin Production by Lactic Acid Bacteria: Potential for Use in Meat Preservation. *Trends in FoodScience & Technology* **2**: 247−251.