



मत्स्य प्रौद्योगिकी समाचार Fish Technology Newsletter

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Contents

News from the Research Front	1
Publications	14
Training Programmes	15
Outreach Programmes	16
Exhibitions	17
Workshops and Seminars	18
Consultancies	26
Awards and Recognitions	28
Celebrations	29
Post Graduate Research	30
Personnel News	30
Personalia	36

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News from the Research Front

Pulsed Light Technology

Pulsed light technology, an emerging non-thermal technology for decontamination of food surfaces and food packages, is consisting of short time high-peak pulses of broad-spectrum white light. High intensity light is a synonymous term with pulsed UV light, pulsed light, broad spectrum white light and near infrared light. Pulse light technology is an alternative preservation technique to thermal treatment for killing microorganisms using short time high frequency of intense broad spectrum, rich UV light, which is the portion of the electromagnetic spectrum corresponding to the band between 200-280nm. Pulsed light is produced using technologies that multiply power many fold. It is used for the rapid inactivation of microorganisms on food surfaces, equipment, and food packaging materials.

The use of pulse light for the inactivation of microorganisms was initiated in Japan in the late 1970s. Later extensive work was done to sterilize pharmaceutical products. However, the technology was adopted by the food industry in 1996, only when Food and Drug Administration Authority approved the use of pulsed light technology for production, processing and handling of foods.

Electromagnetic energy is accumulated in a capacitor within fractions of a second and then released in the form of light within a short time (nanoseconds to milliseconds),

Blower: Purify the air inside the sterilization unit and a cooling effect for the lamp. Will increase the life of lamp.

Sterilization unit: The sample is placed below the Xenon lamp inside this chamber for treatment.



Pulse generator: Electrical energy is converted to short duration pulses of broad spectrum white light (200-1100 nm)

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resulting in an amplification of power with a minimum of additional energy consumption. Equipment used to produce pulse light is made up of one or more adjustable xenon lamp units, a power unit, and a high voltage connection that allows the transfer of a high current electrical pulse. As the current passes through the gas chamber of the lamp unit, a short, intense burst of light is emitted. The light produced by the lamp includes broad spectrum wavelengths from UV to near infrared. The wavelength distribution ranges from 100 to 1,100 nm: UV (100–400 nm), visible light (400–700 nm), and infrared (700–1,100 nm). Many fluids, such as water, have a high degree of transparency to a broad range of wavelengths including visible and UV light, while other liquids, such as sugar solutions and wines, exhibit a more limited transparency. Increasing the amount of solids will diminish the intensity of penetration of the UV radiation. The lethal effect of pulse light can be attributed to the rich broad spectrum UV content, its short duration, high peak power and the ability to regulate both the pulse duration and the frequency output of the flash lamp. The primary cell target of pulse light is nucleic acid. The effectiveness of pulsed light treatment depends upon several factors such as intensity, treatment time, food temperature and type of microorganism. Light pulses have the ability to inactivate enzymes in food as well. Pulse light treatment of 30J/cm² does not cause any loss of proteins, riboflavin and ascorbic acid in frankfurters and riboflavin content in beef, chicken and fish. The colour and shear force values did not show any significant change in catfish treated with 2-4 pulses of 2.5-5 J/cm².

Packaging plays an important role in the preservation, transporting and marketing of the products. Suitable packaging materials are to be selected for packaging of animal products for pulse light treatment. Pulsed light can be used to inactivate microorganisms on the surface of food packaging materials, and potentially on the surface of products packaged in UV transparent materials. The use of pulsed light could lead to a reduction in the need for preservatives or chemical sterilizing agents. Chemical surface sterilizers such as hydrogen peroxide, propylene oxide or per-acetic acid may leave a residue or require time to reduce to an acceptable level. But pulsed light has the advantage of not leaving undesirable residue after treatment.

Pulse light is a novel non-thermal technology to inactivate pathogenic and spoilage microorganism on foods. This method can be used for surface sterilization of foods such as baked goods, seafood, meat, fruits and vegetables. Many research findings have shown that this can be used for the reduction of microbial load of *Listeria monocytogenes*, *Salmonella enteritidis*, *Pseudomonas*

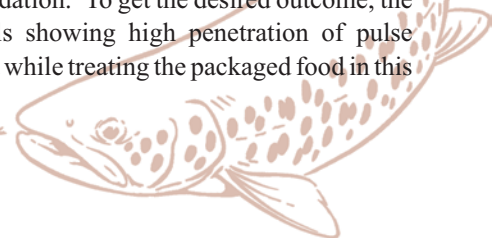
aeruginosa, *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli* etc. Many researches have shown extended shelf life in shrimp treated with pulsed light. Shrimp treated with pulsed light and stored at refrigerated condition for seven days remained edible, whereas untreated shrimp showed extensive microbial degradation and were discoloured, foul smelling and not edible. Pulsed light was able to reduce the psychrotroph and Coliform population on the surface of summer flounder fillets. The sensory attributes indicate that fillets remained acceptable even after 15 days of refrigerated storage. There have been findings that indicate 1 log reduction of *Escherichia coli* O157:H7 or *L. monocytogenes* on salmon fillets, when pulsed light treatment of 5.6 J/cm² per pulse could be achieved after 60 sec. treatment at 8cm distance which was done without affecting the quality. Studies conducted at McGill University, Canada show promise for pulsed light treatment for cold smoked vacuum packed salmon to control *L. monocytogenes* and *Clostridium botulinum* A and E.

Although majority of studies are related to microbial reduction in dairy products, vegetables and fruits, there are limited studies about effectiveness of pulsed light on fish micro flora and shelf life. Studies need to be conducted to assess the effects of pulse light treatments on food properties beyond safety and spoilage. There is a need for optimizing the critical process factors to achieve the target inactivation level for specific food applications without affecting quality. Pulsed light equipment with good penetration and short treatment time need to be designed for commercial purposes. In addition, the applicability of pulsed light treatments on an industrial scale needs to be compared with other non-thermal or conventional thermal processes.

Merits and Demerits

Merits: The inactivation of microbes by pulse light is a very fast process and cause a rapid disinfection in a very short period. It is a green technology as the consumption of energy is very less during its application. It has been proven as a safe technology for living beings and their environment without producing harmful residuals, chemicals and toxic byproducts in the pulse light treated foods. It does not affect the nutritional and sensory qualities of the products. The concerns of ionized radicals and radioactive byproducts in foods by consumers are removed in pulse light due to its non-ionizing spectrum.

Demerits: Pulse light application in meat industry has some constraints as it has low penetration power and chances of lipid oxidation. To get the desired outcome, the packaging materials showing high penetration of pulse light should be used while treating the packaged food in this





method. The limited control of food heating still remains the main concern in pulse light technology. Sample heating is perhaps the most important limiting factor of pulse light for practical applications.

Contributions from CIFT

Central Institute of Fisheries Technology (CIFT), Cochin under the NAIP sub project “A value chain on oceanic tuna fisheries in Lakshadweep sea” procured a pulsed light preservation machine (RC-847). Extensive work was done on standardization and studies are being conducted on shelf life extension of chilled fish.

Some of the salient achievements

Pulsed light treatment done on Pearlsplit (*Etroplus suratensis*) for 12 sec. with a total energy of 25 J/cm² showed a bacterial reduction of 2.6 log cfu/ml. The biochemical and sensory parameters were superior for pulsed treated samples. The storage study indicated a shelf life extension of six days for pulsed treated Pearlsplit fillets when compared to control.

Pulse treatment was done in Yellowfin tuna (*Thunnus albacares*) steaks packed in 12μ polyester/300 gauge low-density polyethylene laminate, 300 gauge polyethylene and 300 gauge cast polypropylene respectively. Cast polypropylene was found to give maximum bacterial reduction. Yellowfin tuna steaks were packed in cast polypropylene pouches and pulsed treatment for different time duration were given. Pulse treatment for 6 sec. with an energy output of 11.5 J/cm² with a bacterial reduction of 1.83 log cfu/g was found to be acceptable microbiologically and with regard to sensory attributes.

Yellowfin tuna steaks were dip treated in 2% sodium acetate, 2% potassium sorbate and a combination of 2% sodium acetate-potassium sorbate solution. Samples were packed in 300 gauge cast polypropylene pouches and pulsed for 6 sec. The textural properties were better for pulsed light treated samples. The sensory and L*a*b* colour values of tuna steaks of pulse treated samples were better than dip and pulsed treated combinations. Shelf life extension of 13 days for pulsed treated and pulsed-dip combinations was obtained. However organoleptically the pulse treated samples were rated superior.

Conclusion

The research data available in the scientific literature clearly demonstrate the potential of pulsed light technology to inactivate pathogenic and spoilage microorganisms in food products or in food-contact materials. It remains one of the least-studied emerging technologies and much work still needs to be done in this area. Besides microbial-inactivation studies, systematic work is also necessary to investigate the impact of pulsed-light treatments on the nutritional and sensory properties of the treated foods. A detailed study on the effect of pulsed light for shelf life extension is not available at present. Studies done in fish are very little and thus a detailed work on fish preservation with pulsed light treatment is necessary. There is a need for optimizing the critical process factors to achieve the target inactivation level for specific food applications without affecting quality. Pulsed light equipment with good penetration and short treatment times need to be designed for commercial purposes. In addition, the applicability of pulsed light treatments on an industrial scale needs to be compared with other non-thermal or conventional thermal processes.

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UHMWPE - The Strongest Fibre Enters the Fisheries Sector of India

The introduction of synthetic fibres has greatly influenced the efficiency and durability of fishing gear and also eased out the physical strain on the fishermen. In India, till 1950s, the basic materials used for fishing gear fabrication were natural fibres such as cotton, sisal and hemp for the webbing; and coir and jute for the ropes. By 1950s polyamide (PA) multifilament was introduced followed by high density polyethylene (PE) twisted monofilament and PA monofilament. Rope material was replaced by PE and polypropylene (PP).

In the fishing industry elsewhere, aramid fibres like Kevlar was a later introduction while the latest introduction to this sector is the ultra high molecular weight polyethylene (UHMWPE) fibres, also termed as high modulus polyethylene (HMPE) or high performance polyethylene (HPPE). The UHMWPE fibres made its impact on operation of purse seines, trawl nets and cages in the waters of New Zealand, Australia and North America (Anon, 2009a; Anon, 2009b). However, in the Indian fishing and culture industry, it is yet to be tested and proved for its suitability.

