Electron Beam Irradiation: A novel approach for shelf stable vacuum packed and chill stored Vannamei shrimp

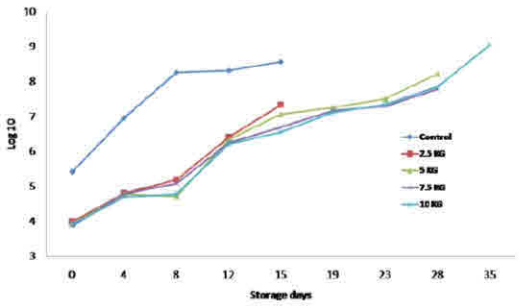
Microorganisms are key factors for seafood spoilage, particularly a few members of microbial community being responsible for major spoilage processes; referred to as Specific Spoilage Organisms (SSOs). Control of these SSOs would facilitate shelf life extension of the seafood products. Hydrogen sulphide (H_2S) forming bacteria like *Shewanella* sp., *Brochothrix thermosphacta, Pseudomonas* sp. and *Lactobacillus* sp. are among the main SSOs in seafoods. Various researches are being carried out to control these SSOs in fish/shrimp and fishery products. Electron Beam Irradiation (EBI) is a non-thermal processing technique, which is gaining much attention recently by food processors because of its antibacterial activity. Electron Beam (EB) is the flow of electrons with energy, and the energy is obtained as kinetic energy when the electron moves in a high electric field. Even though EBI is an ionizing radiation technique, it is different from the gamma irradiation wherein the latter employs emission of gamma rays from radioactive isotopes such as Cobalt-60 and Caesium-137 for irradiation; which are hazardous to handle and the processing technique is time consuming. The benefit of EB lies in its simplicity and since it is machine source, no hassles of source replenishment and disposal problems arise as well as also require less radiological safety precautions. But, on the other hand it has the disadvantage of poor penetration i.e., 5 MeV machine will penetrate upto 2.5 cms in unit density material and in addition it consumes high electric power and needs proper maintenance. The dose of EBI is measured in Kilo Gray (kGy). The fast dose delivery by EB machines make it economical to operate at higher throughputs. On account of its potential bactericidal effect, there are sufficient reports available on the reduction of pathogenic and spoilage bacteria in chicken and other meat products. However very scanty literature is available on its application in seafoods.

In the present study, an attempt was made to extend the shelf life of the shrimp by controlling the SSOs by EBI technique. For this, 16/20 grade headless shell-on Vannamei shrimp (*Litopenaeus vannamei*) was used. The Electron Beam treatment was carried out using 5Mev, 15 kV machine available with Electron Beam Processing Section of IRAD, BARC at BRIT-BARC Complex, Vashi (Fig.1). The Shrimp samples (3 cms thickness) were given treatment at melting ice temperature with 2.5, 5.0, 7.5 and 10 kGy of EBI. After the treatment, all the sample lots were chill stored at 4°C. One lot was untreated and kept as control for comparison.

Fig. 1. Electron Beam Processing Section of IRAD, BARC

Analysis of the effect of EBI on SSOs indicated that the *Pseudomonas* count for 2.5kGy treated samples had around 1 log reduction than control. Other EBI treated samples *viz.*, 5 kGy, 7.5 kGy and 10 kGy exhibited about 2 log lesser count compared to control. *B. thermosphacta* count was around 4 log for control, while it was 3 log for EBI treated ones. H_2S forming bacteria also indicated 1 log reduction when treated with doses *viz.*, 2.5, 5.0 and 7.5 kGy

compared to control; while treatment with 10 kGy resulted in 2 log reduction compared to control lots. In untreated samples (control), *Lactobacillus* count was 2 log on 0th day of storage. In case of treated samples, it reached 2 log count on 8, 15, 15 and 23 days of storage in 2.5, 5.0, 7.5 and 10kGy treated ones, respectively. In the present study, based on the psychrophilic count, control samples were rejected on 5th day (Fig. 2). However 2.5 and 5.0 kGy irradiated sample were rejected on 15th day whereas 7.5 kGy and 10 kGy treated samples had enhanced shelf stability with respect to microbial spoilage and were rejected on 19th day of chill storage.



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