

Electron beam irradiation: An alternative method to improve the dried fish product quality

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Fish and fishery products are important source of protein, fat, essential amino acids, minerals, vitamins and other nutrients. Drying is one of the oldest known methods of preservation of food. In India, consumption of dried fishes is about 32% of the total marine landings and about 17% of the total catch used for the production of dry fishes (Sheetal et al., 2017). Bombay duck (*Harpadon nehereus*) is one of the most abundant and preferable marine species in Maharashtra and Gujarat region (Chakrabarti, 2010). *Acetus* sp. form one of the primary dried food items preferred in north west coast of India. It contributes about 20% of marine shrimp landing and constitute seasonal fishery along the Maharashtra coast. *Acetus*, locally called Jawala in Maharashtra, caught as by-catch during trawling is discarded back to sea due to low price. *Acetus* is mostly consumed in dried forms (Jaiswar and Chakraborty, 2005). Electron beam irradiation (EBI) is a non-thermal processing technique gaining more attention by a food processor to improve the shelf-life and preserve its nutrient value. The advantage of the electron beam irradiation over gamma irradiation that it can be applied in a bidirectional manner in which the irradiation can come into contact with the food product from the top and bottom of the sample. This penetration can offer the advantage of a more uniform application of the irradiation, which can lead to a more effective elimination of bacteria, particularly on product surfaces (Lewis et al., 2002)

In the present study, quality of electron beam irradiated dried Bombay duck (*Harpadon nehereus*), dried Jawala shrimp (*Acetus* sp.) were studied. Samples were purchased from local fish market, packed in polyethylene pouches and exposure to electron beam irradiation in a linear EB RF accelerator (EB tech., BRIT, Navi Mumbai). The irradiation process parameters used include Energy 5 MeV; beam power 40 kW; beam current-0-4.5 mA; conveyer velocity of 10m/min; sample thickness 1-3cm. The doses of electron beam used were 0, 2.0 kGy, 4.0 kGy and 6kGy. All the samples were kept at room temperature. Biochemical and microbiological qualities were analyzed.

Proximate composition of dried Bombay duck and *Acetus* sp. are given in table 1. The moisture content is one of the important parameter which determines the quality of dried fishes. In general, the moisture content less than 15% in dried fish is recommended better for longer keeping quality. However, a reduction in moisture content of fresh fish by drying to 25% will stop bacterial growth and reduce autolytic activity. In the present study, Moisture content of dried Bombay duck ranged between 17.01-17.8%. Protein content ranged between 64.2 - 68.33%. Fat content varied from 3.84 - 4.57%. Ash content varied from 15.89 - 16.43%. There is no significant difference in the proximate composition of irradiated and non-irradiated samples.

Table 1: Proximate composition of electron beam irradiated dried Bombay duck and *Acetopus sp.*

Sample/Parameter	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Bombay duck				
Control	17.78±0.25	65.49±0.10	4.57±0.05	16.33±0.10
2.0kGy	17.66±0.20	64.2±0.05	4.28±0.04	16.43±.15
4.0kGy	17.52±0.15	64.51±0.02	4.26±0.10	16.27±0.25
6.0kGy	17.18±0.20	68.33±0.20	3.84±0.15	15.89±0.20
Acetopus sp.				
Control	17.77±0.30	66.76±0.10	3.10±0.30	12.80±0.10
2.0kGy	16.71±0.25	66.50±0.20	2.93±0.20	12.64±0.20
4.0kGy	16.92±0.20	65.80±0.08	2.96±0.15	12.69±0.25
6.0kGy	17.18±0.15	66.40±0.06	2.60±0.10	12.60±0.20

Biochemical quality of electron beam irradiated dried Bombay duck and *Acetopus sp.* are given in table 2. In the present study, control had higher TVB-N in both dried Bombay duck (217±1.50mg%) and dried acetopus sp. (260±1.40mg%) than irradiated one. Moreover, Peroxide value was higher in irradiated sample (3.02-3.74 milliequi.O₂/kg) than control in dried Bombay duck. Similar trend also observed for dried acetopus sp (control-3.62±0.02milliequi.O₂/kg; Irradiated- 5.13-7.55milliequi.O₂/kg). Sinduja et al. (2015) observed

significant reduction in TVB-N and TMA-N irradiated dried barracuda.

Microbial analysis of dried Bombay duck indicated that total bacterial count (3.8-3.3 log cfu/g) was lower in the irradiated sample than control (4.35 log cfu/g). Similar trend also observed for electron beam irradiated dried *Acetopus sp.* (Table 3). Sinduja et al. (2015) observed significant reduction in Total Plate Count (TPC) count in irradiated dried barracuda.

Table 2: Biochemical quality of electron beam irradiated dried Bombay duck and *Acetopus sp.*

Sample/Parameter	pH	TVB-N (mg%)	TMA-N (mg%)	PV (milli.eq.O ₂ /kg)	TBARS (mg MDA/kg)
Dried Bombay Duck					
Control	6.72±0.05	217±1.50	35±0.65	1.74±0.06	0.58±0.02
2.0kGy	6.57±0.02	196±0.90	30±0.80	3.51±0.15	0.77±0.01
4.0kGy	6.59±0.01	196±1.20	32±1.20	3.74±0.20	0.70±0.04
6.0kGy	6.62±0.02	195±0.85	30±0.80	3.02±0.50	0.79±0.02
Dried Acetopus sp.					
Control	7.7±0.01	260±1.40	42±1.20	3.62±0.02	0.59±0.01
2.0kGy	7.87±0.01	238±0.80	35±0.80	5.13±0.05	0.65±0.02
4.0kGy	7.82±0.02	225±2.20	28±0.95	5.40±0.01	0.76±0.02
6.0kGy	7.76±0.01	225±1.80	30±1.25	7.55±0.03	0.85±0.03

Table3: Microbial quality of dried Bombay duck and *Acetus sp.*

Sample/Parameter	TPC (log cfu/g)
Bombay duck	
Control	4.35 ±0.10
2.0kGy	3.80±0.05
4.0kGy	3.60±0.02
6.0kGy	3.30±0.06
<i>Acetus sp.</i>	
Control	4.10±0.04
2.0kGy	3.90±0.02
4.0kGy	3.80±0.01
6.0kGy	3.00±0.03

Organoleptic quality of the dried fish products were evaluated in terms of in color, odor, texture, insects' infestation, and overall quality. The color of dried Bombay duck was found to be whitish to yellowish. The color of dried *Acetus sp.* found to be brownish to reddish. Texture was firm and flexible in all samples. No insects' infestation was found in the

dried products. The overall acceptability of the products does not showed any significant difference between the samples. Results from the study suggested that electron beam irradiation can be used as an alternative method to improve the dried fish product quality during storage.

References:

- Chakrabarti, R. (2010) Improvement of cooking quality and gel formation capacity of Bombay duck (*Harpodonnetheus*) fish meat. *Journal of Food science and Technology*, 47(5), 534–540. DOI: 10.1007/s13197-010-0092-3
- Jaiswar A.K and Chakraborty S.K. 2005. *Acetus*, the preferred food of fishes along the northwest coast of India. *Indian journal of fisheries*, 52(2): 215-219
- Lewis, S.J., A. Velasquez and, V. Cuppett (2002). Effect of electron beam irradiation on poultry meat safety and quality. *Poultry sci.* 81(6):896-903.
- Sheetal B., Desai., A. Y., Tandel Rutvik kumar P., Tandel Jitendra kumar T. 2017. Production of different type of dry fish and its yield measurement at Veraval, Gujarat, India. *Research Journal of Recent Sciences*, 6(7):28-32.
- Sinduja Prakash, Saritha Kailasam & Jamila Patterson (2015) Effect of radiation on the nutritional and microbial qualities of salted and sun-dried Sharpfin barracuda (*Sphyraena acutipinnis*), *International Journal of Radiation Biology*, 91:7, 540-546, DOI: 10.3109/09553002.2015.1028596