

Storage Properties of Gamma-Irradiated Semi-dried Fish Varieties

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Several varieties of semi-dried unirradiated and irradiated (1&3 kGy) fish, namely, anchovies (*Stolephorus commersonii*), Bombay duck (*Harpodon nehereus*), shrimp (*Penaeus indicus*) and Vietnam scad (*Alepes mate*) were stored at ambient temperature (26°C). During the course of storage, quality characteristics such as total bacterial count (TBC), mould count and biochemical indices of freshness were studied. These studies indicated that initial TBC of semi-dried fish varied from 700-5400 cfu per g of fish, while mould count ranged from 27-1500 cfu per g. However, upon irradiation at 3 kGy, initial bacterial load was considerably reduced. Vietnam scad was not contaminated with mould after 3-5 months of storage at room temperature. Indices such as TVA and TVBN increased during storage at room temperature for both unirradiated and irradiated samples.

Semi-dried fish products are amongst the major seafood items transported to hinterland and exported to neighbouring countries. In spite of their good commercial potential, trade in semi-dried fish products sometimes suffers huge losses owing to spoilage of the commodity because of microbial contamination and insect infestation.

Irradiation of dried fish products is a reliable method of disinfestation (Daget, 1964) and reduction of microflora (Guevara *et al.*, 1989). Of different varieties of tropical fish, Bombay duck (*Harpodon nehereus*) is of particular importance as it makes up about 10-20% of the total Indian catch (CMFRI, 1966). Anchovies (*Stolephorus commersonii*) is another type of tiny fish of commercial importance. Our investigations encompass the radiation preservation of semi-dried fish varieties at ambient temperature and particular emphasis has been placed on the microbiological and biochemical status during storage. In these studies we have irradiated semi-dried Bombay duck (*Harpodon nehereus*), anchovies (*Stolephorus commersonii*), shrimps (*Penaeus*

indicus) and Vietnam scad (*Alepes mate*) with gamma radiation doses of 1 and 3 kGy and studied the shelf-life at ambient temperature (26°C).

Materials and Methods

Semi-dried fish such as anchovies (*Stolephorus commersonii*), Bombay duck (*Harpodon nehereus*) and shrimps (*Penaeus indicus*) were procured from the local market in Bombay, while samples of Vietnam scad were brought from Vietnam. Dried Vietnam scad contained 18% salt and 20-22% moisture, while semi-dried Bombay duck, shrimp and anchovies were reported to contain 5-7% salt and 20% moisture (Solanki & Shankar, 1987).

Semi-dried fish were packed in polyethylene bags (200 gauge) in 25 gm quantity. One set of packets were maintained without gamma radiation treatment, while the other two sets were exposed to gamma radiation doses of 1 and 3 kGy at ambient temperature in a ⁶⁰Co package irradiator (dose rate, 0.05 kGy/min) at Food Irradiation and Processing Laboratory, BARC. After treatment, non-irradiated and

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irradiated packets containing semi-dried fish were maintained at ambient temperature (26°C).

At 0, 1 and 2 months of storage, duplicate samples were withdrawn and a 10% homogenate was prepared in sterile physiological saline using Sorvall Omnimixer (5000 rpm). Appropriate dilutions of homogenates were plated on plate count agar for TBC and potato dextrose agar for mould count. After 2-3 days of incubation at 30°C colony counts were made.

Total volatile acids (TVA): To 30 ml of 10% of fish homogenate 5 ml sulphuric acid (1 N) and 5 ml phosphotungstic acid (15%) were added. After 15 min, the slurry was filtered through Whatman No. 1 filter paper. TVA in the filtrate was determined as per the method described by Venugopal *et al.* (1981). Volume of 0.01 N NaOH required to neutralise acids of 100 g of fish was expressed as TVA number.

Total volatile bases (TVBN) were estimated by the Conway microdiffusion procedure in a TCA (5%) extract of the fish homogenate (10%) as per Farber & Ferrow (1956).

Results and Discussion

During storage of semi-dried non-irradiated and irradiated (3 kGy) Vietnam scad (Table 1), products did not have any

Table 1. Storage properties of semi-dried Vietnam scad (*Alepes mate*)

Dose kGy	Storage period, months							
	1				2			
	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg%	TVA No.	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg%	TVA No.
0	2.6x10 ³	0	-	-	2.81x10 ³	0	151.2	48
3	40	0	-	-	20	0	134.4	32

moulds even after ambient storage of 3 months, probably due to the high salt content (18%). Initial bacterial count of 2.6 x 10³ per g increased steadily to 10⁵ per g during 4 months of storage at room temperature. A radiation dose of 3 kGy resulted about 2 log cycle reduction in initial bacterial count. However, on storage for 4 months TBC of irradiated samples, increased to 2 x 10⁴ per g. Biochemical indices such as TVA and TVBN increased in both control and irradiated samples.

Tables 2 and 3 incorporate data on quality of semi-dried non-irradiated and irradiated (1 & 3 kGy) Indian fish varieties during storage for 0, 1 and 2 months at room temperature. The Indian semi-dried fish were found to be contaminated with 100-1000 moulds/g. However, gamma radiation (3 kGy) completely eliminated moulds except in the case of semi-dried Bombay duck. Under commercial conditions, Indian semi-dried fish exhibited initial total bacterial count of 500-700 cfu/g. However, gamma irradiation at 3 kGy doses inactivated bacteria by 2 log cycles. TVA and TVBN in both irradiated and non-irradiated samples increased during ambient temperature storage.

Irradiation of food items upto an overall average dose of 10 kGy has been cleared by WHO/FAO/IAEA as wholesome and nutritionally and toxicologically safe for

Table 2. Storage properties of Indian semi-dried Anchovies (*Stolephorus commersonii*)

Dose kGy	Storage Period, months							
	0				1			
	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg%	TVA No.	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg%	TVA No.
0	5.4x10 ²	1.18x10 ²	28.0	40	4.2x10 ³	1.86x10 ²	37.8	64
1	60	0	28.0	32	2.3x10 ²	1	28.0	40
3	0	0	28.0	24	0	2	25.2	56

Table 3. Storage properties of Bombay duck (*Harpodon nehereus*)

Dose kCy	0				Storage period, months				2			
	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg %	TVA No.	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg %	TVA No.	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg %	TVA No.
0	7x10 ²	1.58x10 ³	47.6	96	4.9x10 ²	9x10 ²	364	120	2x10 ³	2x10 ³	593.6	424
1	2x10 ³	16	50.4	120	2.5x10 ²	3	336	104	1x10 ³	80	583.4	504
3	20	1	44.8	104	20	9	364	176	1x10 ³	80	593.4	400

Table 4. Storage properties of semi-dried shrimps (*Penaeus indicus*)

Dose kCy	0				Storage period, months				2			
	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg %	TVA No.	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg %	TVA No.	TBC g ⁻¹	Mould count g ⁻¹	TVBN, mg %	TVA No.
0	27.1x10 ³	27	18.48	120	5.5x10 ³	28	154	112	2x10 ⁵	9x10 ²	246.4	168
1	10	1	16.80	64	3.1x10 ²	0	112	112	2x10 ³	30	246.4	200
3	0	1	16.80	56	0	1	112	128	1x10 ⁴	10	224.0	200

human consumption (WHO, 1981; Brinolfsson, 1986; Farkas, 1989). Gamma irradiation has been recommended to disinfect as well as to decontaminate dried fish. In our laboratory, dehydro irradiation process involving a combination of heat and gamma radiation has been developed for Bombay duck, shrimps and white pomfret for prolonged stability of dried fish products at ambient temperature (Gore *et al.*, 1970; Doke *et al.*, 1978; Agarwal *et al.*, 1972). The data presented on bacterial load and the biochemical parameters revealed that gamma radiation could effectively reduce initial bacterial contamination and mould count, thus facilitating extension in storage stability of these products.

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