VARIATION OF BACTERIAL LOAD AND FATTY ACIDS OF GAMMA IRRADIATED YELLOWFIN TUNA (*Thunnus albacares)*

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Introduction

The interest on food quality has contributed to guide consumers' choice toward fishery products which are considered to be of high nutritional value and capable of influencing human health in a positive way [1]. In recent years, consumers are eating more raw fish products such as sushi, sashimi and surimi. However, raw fish products contain many food borne pathogenic microorganisms.

Fresh tuna fillets are highly perishable products. It is one of the highly demanding export products in Sri Lanka. However, quality deterioration during processing causes limited shelf-life and economic loss. Therefore it is a requirement to develop new technologies and efficient preservation methods which lead shelf-life extension of the product.

Food irradiation is considered as a 'technological saviour' in finding suitable solution for the problems caused by pathogens in food. Therefore, introduction of irradiated foods would become an important attribute to public health and it can be regarded as a useful tool to attain food security in the 21st century. It is considered to be an alternative method for food preservation, in order to prevent food spoilage, insect infestation and also reduce the microbial load [2].

The aim of the present study was therefore to evaluate the effect of gamma irradiation on microbial and chemical quality of yellowfin tuna (*Thunnus albacares*) fish fillets.

Materials and Methods

Fish Samples

Fresh yellowfin tuna used in this experiment were collected from landing sites of Kalpitiya coast, 2015 and were degutted, deheaded and filleted and packed in labeled sealed polythene bags and kept on ice box at a temperature below 4˚C. Then divided into four lots: non-irradiated (control) and irradiated (5,7 and 10 kGy).

Gamma Irradiation

Samples were irradiated at 5,7 and 10 kGy doses using Cobalt 60 source at Sri Lanka Gamma Center, Atomic Energy Authority of Sri Lanka, Biyagama. The absorbed dose was monitored with dosimeters (Harwell perspex-Amber 3042) with Polymethyl methacrylate. After irradiation, the samples were stored in freezer (-18 ˚C) until used.

Total Plate Count (TPC)

Five replicates from each treatment, un-irradiated and irradiated, were taken for the test. Serial dilutions were performed for all the samples using 10 g portion from each sample homogenizing with Maximum Recovery Diluent (Himedia) in sterile bags. Pour plate method was used and the samples were plated on Plate count agar (Himedia). Plates were incubated at 37 ± 1 ˚C for 48 hours [3].

Free Fatty Acid Value (FFA)
Free fatty acid values were determined according to the method describe in AOAC method [4].

Peroxide Value (PV)
The peroxide values of fish oil were determined according to AOAC method [5].

Fatty acid Composition
Fatty acid composition was determined by gas chromatography. The fatty acids were converted to fatty acid methyl esters (FAME) , which were analyzed by using a Agilent 7890B gas chromatograph equipped with a DB WAX (Agilent 122-7032) capillary column (30 m x 250 µm id., 0.25 µm film thickness) and flame ionization detector (FID). The injector and the detector temperatures were 240˚C and 250 ˚C respectively. The operating conditions for gas chromatography as follows: initial oven temperature, 160 ˚C for 10 minutes, rising to 190 ˚C at 3 ˚C/min and hold for 5 minutes, rising to 230 ˚C at 8 ˚C/min and a final hold time of 12 minutes. Flow rate was 25 mL/min. The carrier gas was Helium. The eluted peaks were identified by comparing with standards (Qualimix, Larodane fine Chemicals, Sweden).

Results and Discussion
Total Plate Count (TPC) given in Figure 1 shows that maximum bacterial load was found in control fillets. The bacterial load was reduced with the irradiation. The bacterial load of control sample was maximum (3.152×10^4 cfu/g) followed by 5 kGy irradiated fishes (2.48×10^2cfu/g). At 7 and 10 kGy irradiation samples showed sterilized conditions resulting significant reduction in bacterial growth.

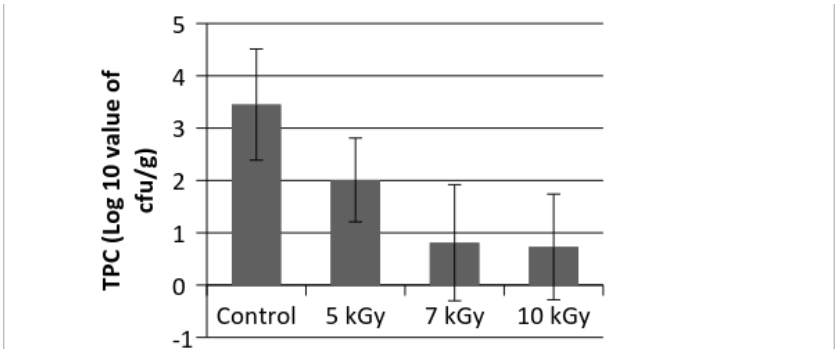

Figure 1. Effect of different doses of radiation on bacterial count (Mean ± standard deviation)

The Free Fatty Acid (FFA) value shows (Figure 2) the levels of quality and freshness of oil. It is the indication of lipid hydrolysis. Non-irradiated samples showed 61.23%

while 5,7 and 10 kGy samples showed 15.67, 16.26 and 68.32% respectively. Total saturated fatty acid showed maximum percentage in 5 kGy irradiated fillets while minimum percentage showed in non-irradiated samples.

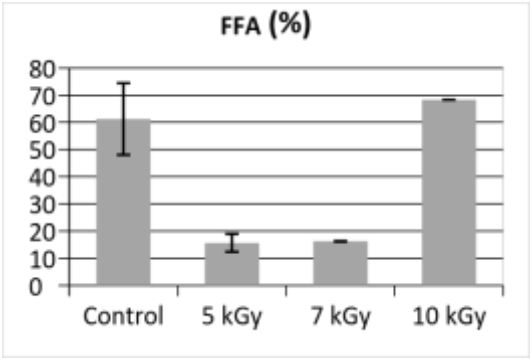

Figure 2. FFA (%) of Tuna fish fillets with different doses of irradiation (Mean ± SD**)**

Peroxide value of non-irradiated fillets showed (Figure 3) significantly higher amount than irradiated samples. It doesn't show any significant difference with the increment of irradiation dose. All irradiated samples showed significant reduction in peroxide value with the control samples. The results revealed that the irradiation reduces the auto- oxidation of fish lipids but it does not depend on irradiation dose

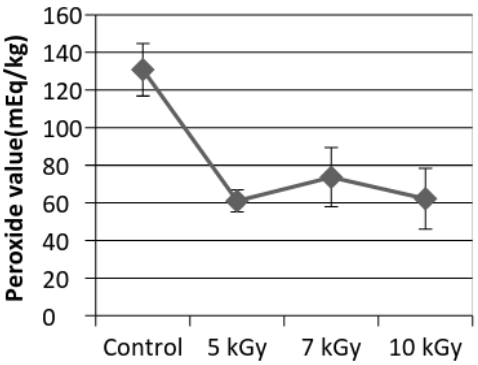

Figure 3. Effect of different doses on Peroxide Value of fish fillets (Mean ±SD)

Total monounsaturated fats were increased with the irradiation when the polyunsaturated fats showed reduction with the irradiation. In the 7 kGy irradiated samples showed sudden reduction in total unsaturated fats while 10 kGy irradiated samples showed highest per cent of total unsaturated fats. Control samples showed highest per cent of omega 3 fatty acids and omega 6 fatty acids showed reduction with the irradiation.

Table 1. Fatty acid composition of non-irradiated and irradiated fish fillets

Fatty Acid (%)	Control	Irradiation Dose (kGy)		
		5	7	10
Total Saturated fatty acid	23.9	27.5	27.4	23.9
Total monounsaturated fatty acid	20.7	21.0	28.4	23.5
Total Polyunsaturated fatty acid	50.7	48.3	38.4	48.1
Total unsaturated fatty acid	71.4	69.4	66.8	71.7
Omega 3 fatty acid	39.0	37.2	29.6	37.1
Omega 6 fatty acid	7.7	7.1	6.0	6.8
Total Omega fatty acids	46.8	44.3	35.6	43.9
Unidentified	4.5	3.0	5.2	4.3

n=2

Effect of gamma irradiation on nutritional components in cultured sea bass was investigated by Ozden and Erkan [8]. Some essential amino acids were significantly increased after irradiation of sea bass. The fatty acid composition had differences between control and irradiated samples. The content of polyunsaturated fatty acids (PUFA) in the muscle of non-irradiated, 2.5 and 5 kGy irradiated sea bass were 26.66, 30.66, and 30.15%, respectively. Ozden and Erkan [8] also showed that there is an increase in ω6 and ω3 fatty acids in sea bass during the irradiation.

Conclusions and Recommendations

The results show that irradiation has significantly reduced the bacterial load which extends the shelf life of tuna fish fillets. Lipid oxidation was also reduced with the irradiation and FFA and fatty acid composition of the samples were not comprehensible.

Gamma irradiation can be applied to enhance the shelf-life of fish product, and this technology can be used to prepare better commercial products from the tuna fish fillets.

Acknowledgement

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