Irradiation Tecnology in Sea Products

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Introductıon

Food irradiation is a technology to protectfood quality, to providehygiene andto extendof shelf life. This technology is a physical practice such as pasteurization, canning and freezing methods carried out by utilizing the heat energy. The difference between the methods mentioned is that, the energy used in irradiation is not the heat energy but " ionizing energy" (TAEK, 2010).If properly applied, diverse food problems such as insect formation in seeds, sprouting of potatoes, early maturization of fruits and bacteria production are able to be prevented by irradiation. (IFAS, 2010). Several preservation technics such as freezing, smoking and heat treatment causes the loss in food.Studies are conducted concerning the utilization of new methods which will reduce losses in food production, increase shelf life and provide reliability. In this regard its popularity has increased due to the response to the expectations of irradiation applications (Korel and Orman, 2005).

In order to control hygienic quality of fish and fish products and to prolong the duration of protection, radiation has been legally allowed in Canada in 1973, Holland in 1976, Chile in 1982, Bangladesh in 1983,Brazil in 1985 and Thailand in 1986 (Öztaşıran et al.,1992; IAEA, 2010) Table 1.

Table 1. 15/11/2000 According to the legislation of the country on the irradiation doses can be applied to fishery products (IAEA, 2010).

Country	Product	Maxımum Dose (kGy)
Bangladesh	Fish	2.2
Brazıl	Fish	2
Chile	Fish	2.2
Costa Rica	Fish	2.2
Croatia	Dried fish	1-5-10
Cuba	Fish	3
France	Shrimp	5
Ghana	Fish	2-3-5
India	Fish	6
Indonesia	Dried fish	5
Korea	Fish powder	7
Mexico	Fish	2-3-5
Netherlands	Shrimp	4.5
Pakistan	Fish	3-5
South Africa	Fish	2
Thailand	Fish	2
Turkey	Fish	2-3-5
England	Fish products	3
Vietnam	Dried fish	1

*** Kilogray (kGy):** Irradiated foods that the average radiation energy absorbed per 1kg kilojoul are expressed as the amount.

Effect of qualıty and shelf-life of irradiatıon in sea products

Irradiation of fishery products is the process to kill harmful bacteria and other organisms by exposition to ionizing energy with the purpose to prolong shelf life of fishery products.Irradiation applications are utilized during the fisheries production and processing stages(Varlık et al., 2004). A radiation dose of 3-4 kGy can be applied to fish without a significant increase in temperature, and any negative effect on smell and taste during irradiation. Thus shelf life of product increases by 2-3 times(Mendes et al., 2005). İnactivation of enzymes is provided if a radiation dose of 10-1000 kGy is applied.Proteins in the structure of fish don't get harmed and enzymes remain active when an irradiation dose less than 10 kGy is applied(Varlık et al., 2004). In general the ideal dose for fish is stated to be as 2.2 kGy(URL1) Table 2.

Table 2. Applicable to fishery products of irradiation dose (Varlık *et al.*, 2004).

Applications	Doses of radiation dose / kGy
The killing of salmonella and parasites	0.2-3
Increasing resistance	1-3
Destruction of pathogenic microorganisms	1-7
Sterilization	30-50

In a study of fresh Atlantic horse mackerel (Trachurus trachurus) they were gamma irradiated at 1 and 3 kGy, and stored in ice for 23 days. Quality changes during ice storage at 0±1 ºC were monitored by sensory analysis. The control lot had a sensory shelf life of 8 days, whereas those of the irradiated lots were extended by 4 days(Mendes et al., 2005). Although irradiation of the fresh fish extends shelf life 1 week, researches showed that the shelf life of the fish kept in ice and irradiated for the distances as 1000 km is 2 week longer than the non-irradiated fish (Jean, 1990).In a study by which the influence of different doses of gamma rays and cold storage on microbiological, chemical and sensory characteristics of cultured sea bass was examined, the shelf life of sea bass stored in ice was found to be 13 days whereas it was 15 days for 2,5 kGy irradiated bass and 17 days for 5 kGy irradiated bass (Ozden et al., 2006). In a study with non-irradiated (control) and irradiated (2,5 kGy and 5 kGy) seabass and seabream the overall shelf life were found to be 13,15 and 17 days respectively. The overall shelf life of non-irradiated (control) and irradiated (2,5 kGy and 5 kGy) sea bass were found to be 9,13 and 17 days respectively(İnuğur, 2006).

Although TVB-N and TMA concentrations increased in all groups in mediterranean horse mackerel that was irradiated with a dose of 1 and 2 kGy during storage, the irradiated samples have less these values according to the control group (Mbarki et al., 2009).The name of study in 'shelf-lıfe extensıon and decontamınatıon of fısh fıllets (Trachurus pıcturatus murphyı and Mugıl cephalus) andshrımp taıls (*Penaeus vannameı*) ınoculated wıthtoxıgenıc Vıbrıo cholerae o1 el tor usıng gamma radıatıon', irradiation at medium doses (1.0 and 2.0 kGy) preserved the sensory attributes of fish fillets and shrimp tails and extended their acceptability in refrigerated storage (01ºC) to twice as long as non-irradiated samples (IAEA, 2001).

Changes in food caused by irradiation shows difference depending on many factors (radiation dose, type of food, packaging, processing conditions, etc.).The radiation dose of up to 10 kGy has been reported to remain relatively stable such as of macromolecules food components that make up protein, carbohydrate and fat.Some micromoleculs such as vitamins are very sensitive to irradiation (Ayhan, 1993), but it is reported that irradiated fish in appropriate doses is source of sufficient iodine, protein and vitamin B (URL1).

Irradiation of fish and fish products at very high doses has led to changes in the food structure.If administered dose is too high from requirement,the colour and the taste of the fish starts to change(İnuğur, 2006). In a study on semi-dried shrimp, it is determined that TBA values of the samples which were irradiated at 4 kGy dose are higher than that of irradiated at 2 kGy (IAEA, 2003). In a study in which the influence of during the cold-storage in bonito (Sarda Sarda) of gamma rays microbiological, biochemical and texture characteristics of the effect was examined, fresh bonito fillets were packed in aerobic conditions and were irradiated by irradiation doses 0, 1.5, 3, 4.5, 6 and 7.5 kGy. During the 21-days cold storage of fatty acids composition was associated with gamma irradiation and aerobic packaging, and was found to affect the oil profile significantly (Mbarki et al., 2008).

The polyethylene bags anchovy *(Engraulis encrasicholus)* samples were irradiated at 20 ºC, at 1, 2, 5, 10, 15, 20 and 25 kGy doses, after each irradiation they were determined with TBA test, irradiated and non-irradiated samples in the MA (malondialdehyde) content.

As a result, it was seen that fat oxidation is associated with environmental conditions and different doses of irradiation which is applied in fish rancidity (Tükenmez et al., 1997). However, during 293 daysat -18 ºC storage there was no significant impact of gamma irradiation (1 and 5 kGy) on patogonya tooth fish (Dissostichus eleginoides) fatty acid and phospholipid content (Principe et al., 2009). A significant nutritional impact of irradiation on polyunsaturated fatty acids (PUFA) is not observed (Mendes et al., 2005). In addition, if some cases of seafood radiation on the frozen occasion have been reported in to give better results (URL1).

Radiation of fish and fish products in very high doses cause changes in protein molecules(Varlık et al., 2004).However, in horse mackerel *(Trachurus trachurus)* of 1-10 kGy irradiation doses it has been reported that it doesn't have a significant effect on proteins (Silva et al., 2006). Above 10 kGy doses of irradiation on Tilapia (Tilapia nilotica x T. Aurea) it has been reported that some *amino* acids increased while some of them decreased.In the same study, on the Spanish mackerel (Scomberomorus commerson) dose of 10 kGy has led to the decrease of all amino acids (Al -Kahtanı et al., 1998). It is suggested that other preservation techniques should be used together to improve the efficiency of irradiation to increase the shelf life of products.

For this reason, several packaging systems such as vacuum and modified atmosphere packaging (MAP) and low-oxygen conducting plastic bags are used widely. It has been reported that use of irradiation and packaging technologies together will contribute to the flavour of the product (IAEA, 2003). On the basis of sensorial evaluation, a shelf life of 27-28 days was obtained for vacuum-packaged, salted sea bream irradiated at 1 or 3 kGy, compared to a shelf-life of 14-15 days forthe non-irradiated, salted sample (Choulira et al., 2004).

Effect of irradiation on microorganisms in sea products

In general, radiation sensitivity of microorganisms is related to the size of microorganisms and amount of water. Organismswhich havelarge DNA moleculesare affected byhigherdoses. For example, in high doses such as 10-45 kGy, bacteria and viruses are eliminated, pathogenic bacteria not spore forming between 1.5- 4.4 kGy moderate dose, parasites and insects lower than 0.1 kGy doses are eliminated. Gram-positives are more resistan-taccording tothe Gram-negative bacteria against the irradiation process. In general, spore forming organisms are more resistant than not spore forming ones.When comparing irradiation levels of mould and yeast, it is observed that irradiation level of yeast is higher than that of mould (Erkmen, 2010).

The sensitivity of several pathogenic bacteria and parasites to irradiation changes significantly according to the food product, environmental conditions, temperature, packa-ging environment and the duration of exposure to beam (Loaharanu, 1996).

Microbiologic safety of irradiated food features preference of this technology. This situation gains more importance especially in foods which are sensitive to microbiologic growth such as seafood and spices (Varlık et al., 2004). The irradiation technology is used to ensure the hygienic quality of several seafoods in Belgium and Netherlands (Loaharanu, 1990). There are different spoilage organisms for various fish products. Pseudomonas is a major cause of contamination for white meat fish and shrimp. Maximum doses that are applicable to fresh shrimp, sea fish and freshwater fish before sensory changes are perceived are2, 1-4, 1-3 kGy, and these doses also extend their shelf life by 5-14,18-38 and 13-20 days respectively (IAEA, 2003).

In a study of Mediterranean horse mackerel (*Trachurus mediterraneus*) was exposed to 1 and 2 kGy irradiation dose and stored in ice for 18 days. During the storage total amount of bacteria has been decreased efficiently by irradiation process (Mbarki *et al.*, 2009).

Homogenized samples of Sand mussel (*Mya arenaria*) exposed to ≤ 1kGyirradiation have been reported to have 100-1000 times less *E. Coli, Salmonella typhimurium, Staphylococcus aureus* and *Streptococcus faecalis* organisms (Harewood *et al.,* 1994).

Apart from fish, other seafood such as mussels, clams, shrimp and frog legs can be irradiated against bacteria that cause food-borne diseases, thus extending their shelf life.

For giving positive results in terms of taste and destroying E.*coli*and *Vibrio*species1 kGy irradiation dose is preferred for traditionally cooked seafoodsuch as oysters (URL1).

Conclusıon

The irradiation technology which is one of the edible seafood processing techniques is a technology that was researched and that is being researched of many seafood impact on the quality and shelf life. It contributes to the extension of the shelf life by eliminating microorganisms which exist in the fishery products. The ability of making irradiation in package maximize the reliability of the product from processing to consumption and is the biggest advantage according to the other processing methods. When the irradiation technology is applied in combination with the processing methods such as smoking, freezing etc.,much better results can be obtained.

. However, it creates different effects in every fish species or fishery products as in every food kinds. To take maximum advantage of the irradiation technology which has so many advantages according to the traditional methods, it is a fact that more comprehensive researches are needed in fish processing technology.

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