THE MICROBIOLOGICAL QUALITY AND SHELF-LIFE OF THE IRRADIATED CHICKEN MEAT

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Abstract

Chicken breast and leg meats were packaged. Immediately after packaging, both sets of breast and leg meats were irradiated at 0,1,2,3,4 kGy. All the samples were stored at +8 °C and were analyzed for populations of mesophilic, total molds and yeasts, coliform bacteria, *E. coli*, *Salmonella* every 5 days for 20 days. By using a mesophilic population of 10^7 cells/g as a criteria for spoilage, fresh breast and leg meats receiving a dose of 0 kGy had shelf a life of 5 days with packaging. Both breast and leg meats that received a dose of 3.0 kGy had shelf lifes that were greater than 10 days at + 8 °C using packaging. This study showed that 1.0 kGy irradiation can inactivate 10^4 g /coliform bacteria and 10^3 g /*E. coli*. The shelf life of meat is largely dependent upon the level of microbiological contamination that occurs during processing especially in the slaughterhouse in Turkey. Irradiation has the potential to emerge as one of today's most significant food-preservation technologies.

1. Introduction

Irradiation as a method of meat preservation has excellent potential to improve meat safety and extend shelf life. In 1981, the use of irradiation was approved by the FAO/IAEA/WHO joint committee on the wholesomeness of irradiated food.

Food irradiation is a processing technology that has been shown to be a wholesome process by many scientific studies conducted worldwide during the past 50 years. Extensive research on the irradiation of fresh meat and poultry has been carried out since 1950s. Some of the benefits ascribed to this technology include improved shelf life, reduced use of chemicals as preservatives, reduced levels of pathogens in foods.

2. Materials and methods

The growth and plating media used in this study were Merck. They were prepared and sterilized at 121^0C for 15 min. The microbiological analyses were performed according to the Bacteriological Analytical Manual.

The experimental trials were carried out independently in triplicate and the mean values were presented.

2.1. Preparation of Material

Chicken breast and leg meat samples were purchased from different slaughter houses. Then, chicken breast and leg meat samples were packaged in polymeric bags. And the samples were divided into five groups. Four groups were irradiated at 1.0, 2.0, 3.0, 4.0 kGy respectively and the other group was not irradiated. All of them were stored at 8^0C for 15 days in the refrigerator. The microbiological analyses were done for every five day storage period.

2.2. Radiation source and radiation treatment of samples

Chicken breast and leg meat samples were irradiated at 0, 1.0, 2.0, 3.0, 4.0 kGy dose at room temperature. Irradiation processes were carried out by ISSLEDOVATELJ (Gamma-cell) with a dose rate 2.67 kGy/h at the Department of Food Irradiation and Sterilization of Ankara Nuclear Research Center in Agriculture and Animal Science of Turkish Atomic Energy Authority.

The operation of the facility is based on the use of gamma irradiation of radionuclide Co-60 which has 11 mm. diameter and 8 mm. height. The dimensions of the facility (without platform) are 2100 mm. in length, 1440 mm. in width and 3434 mm. in height. The construction of the facility provides reliable shielding from ionizing radiation.

2.3. Enumeration of total viable count

Non-irradiated and irradiated chicken breast and leg meat samples were prepared by mixing 25 g. of sample with 225 ml. of dilution solution. The dilution solution used was saline water with 0.1% peptone and 0.85% NaCl. Samples were homogenized and serial dilutions were made. Then the microbial counts were estimated by surface spreading on Plate Count Agar (PCA). Plates were incubated at 37°C for 48 h. The counts were determined as log cfu/g fresh weight.

2.4. Enumeration of total count of yeast and mold

Homogenized samples were diluted serially and then surface spreaded on Potato Dextrose Agar (PDA). Plates were incubated at 25°C for 7 days. The microbial counts were determined as log cfu/g fresh weight.

2.5. Enumeration of coliform and *E.coli*

All the homogenized samples were serially diluted. From all five consecutive dilutions (from 10^{-1} to 10^{-5}), 1 ml. was inoculated into triplicate tubes, containing Lauryl-Sulphate Tryptose Broth with MUG (LST+MUG) and then incubated at 37°C for 24-48 hours. Gas-positive tubes were examined for gas formation and fluorescence. Fluorescence was controlled with UV lamb (Merck, Germany). Three of the five consecutive dilutions were used for MPN enumeration.

2.6. Evaluation of the presence of *Salmonella* spp.

Aseptically 25 g. of irradiated and non-irradiated samples were placed into 225 ml. Buffered Peptone Water and incubated at 37°C for 24 hours and then inoculated to Tetrathionate and Rappaport Vassiliadis Soya Peptone Broth and incubated at 37°C for 24 hours after selective enrichment step, streaked on Rambach Agar and

Xylose Lysine Deoxycholate Agar. Plates were incubated at 37°C and examined after 24 hours and if necessary after another 24 hours in order to check for the possible presence of *Salmonella* spp. colonies.

3. Results and discussion

This study showed that 1.0 kGy irradiation can inactivate approximately 10^4 g /coliform bacteria and 10^3 g /*E. coli*. The results were calculated on logarithmic scale. The results were given in the Table 1 and Table 2.

Table 1. Microbiological analysis results of chicken leg meat

Day	Dose kGy	Coliform Bacteria Count (log MPN/g)	*E.coli* Count (log MPN /g)	Total Viable Count (log cfu/g)	Total Yeast and Molds (log cfu/g)
0	0	6,63	4,63	7,56	5,53
	1	2,60	2,60	3,23	3,30
	2	<0,48	<0,48	<2	<2
	3	<0,48	<0,48	<2	<2
	4	<0,48	<0,48	<2	<2
5	0	-	-	-	-
	1	3,87	3,87	8,61	5,49
	2	<0,48	<0,48	4,36	3,04
	3	<0,48	<0,48	<2	<2
	4	<0,48	<0,48	<2	<2
10	0	-	-	-	-
	1	-	-	-	-
	2	<0,48	<0,48	8,57	5,45
	3	<0,48	<0,48	4,40	3,32
	4	<0,48	<0,48	<2	<2

-: spoiled

By using a mesophilic populations of 10^7 cells/g as a criteria for spoilage, fresh breast and leg meats receiving a dose of 0 kGy had a shelf life of 5 days with packaging. Both breast and leg meats that received a dose of 3 kGy had shelf lifes that were greater than 10 days at + 8 °C using packaging.

According to Lee at all (1995), irradiation dose of as low as 1.0 kGy can prolonge the shelf life and retard the growth of pathogens at refrigeration temperatures. Similar results were obtained in this research. 1.0 kGy irradiation dose extended the shelf life of chicken breast and meat legs to five days at 8°C. The shelf life of chicken breast and meat legs will be much longer at 2 or 4°C than 8°C storage.

2.0 kGy irradiation dose extended the shelf life of chicken breast and meat legs to ten days at 8°C. Both breast and leg meats that received a dose of 3.0 kGy had shelf lifes that were greater than 10 days at + 8 °C using packaging. *E. coli* was completely eliminated with 2.0 kGy irradiation dose in the all of the samples. Thayer (1993) studied on "Extending Shelf Life of Poultry and Red Meat by Irradiation Processing" and his research demonstrated that ionizing radiation can inactivate parasites, eliminate or greatly reduce the populations of microbial pathogens, extend the shelf life .
Salmonella spp. was not detected in the irradiated and non- irradiated chicken breast and leg meats

Table 2. Microbiological analysis result of chicken breast

Day	Dose kGy	Coliform Bacteria Count (log MPN/g)	*E.coli* Count (log MPN /g)	Total Viable Count (log cfu/g)	Total Yeast and Molds (log cfu/g)
0	0	6,36	3,36	6,53	5,60
	1	3,30	2,95	3,15	3,30
	2	<0,48	<0,48	<2	<2
	3	<0,48	<0,48	<2	<2
	4	<0,48	<0,48	<2	<2
5	0	-	-	-	-
	1	2,97	2,36	7,60	5,48
	2	<0,48	<0,48	4,36	3,00
	3	<0,48	<0,48	<2	<2
	4	<0,48	<0,48	<2	<2
10	0	-	-	-	-
	1	-	-	-	-
	2	<0.48	<0,48	7,54	5,30
	3	<0,48	<0,48	3,30	3,30
	4	<0,48	<0,48	<2	<2

-: spoiled

4.Conclusion

This study showed that 1.0 kGy irradiation can inactivate 10^4 g /coliform bacteria and 10^3 g /*E. coli*. The shelf life of meat is largely dependent upon the level of microbiological contamination that occurs during processing especially in the slaughterhouse in Turkey. Irradiation has the potential to emerge as one of today's most significant food-preservation technologies.

Reference

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