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Effects of Electron Beam Application on Microbiological and Organoleptic Parameters of Chilled Turkey

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The radiation processing of food products is one of the most effective and universal technologies for extending the shelf life of meat and meat products during storage [1-4]. More than 1.3 million tons of various agricultural and food products, including meat, are irradiated annually in the world [5,6].
Currently, it has become a priority to optimize the exposure parameters, such as radiation source, energy of ionizing particles, and irradiation technique for treatment of meat and poultry.
The aim of this study was to investigate the impact of various irradiation parameters on microbiological and organoleptic properties of chilled turkey.
The experiment used three types of chilled turkey samples. The first type was 0.5 ml minced turkey homogenate in 2 ml Eppendorf tubes which were used to estimate microbiological parameters of minced turkey. The second type was thin slices of turkey (weight (40 ± 5) g, width (2.8 ± 0.2) cm, length (12 ± 0.5) cm and thickness (6 ± 1) mm) in vacuum bags which were used to estimate organoleptic parameters, such as the changes in taste, odor, and texture of chilled turkey after irradiation. The third type was turkey cubes (weight (0.3 ± 0.05) g, size (6 ± 0.3) mm) in 2 ml Eppendorf tubes used to estimate the dose rate influence on microbiological parameters of minced turkey.
Samples were treated by 1 MeV electrons using the industrial electron accelerator UELR-1-25-T-001. The samples were irradiated in the range of doses from 0.25 kGy to 10 kGy. The dose rate was varied by modifying beam current from 60 nA to 6 μA. Computer simulation using GEANT4 code was performed to estimate the dose absorbed in samples of turkey, taking into account the technical properties of the accelerator. Each time during irradiation the total charge absorbed by the plate was monitored to determine the required dose of irradiation. The dose is proportional to the charge absorbed by the plate.
It was found that 1 MeV accelerated electron irradiation with the doses over 1 kGy reduced bacterial content in minced turkey 100 times compared with non-irradiated samples. At the dose of 6 kGy complete sterilization of the product was observed. However, doses exceeding 2 kGy had a significant impact on organoleptic properties of treated turkey meat. Therefore, a dose range of 1 kGy to 2 kGy is found to be most efficient for treatment of this type of product.
The study of the dose rate showed the nonlinear dependence of the number of viable cells in chilled turkey irradiated with low-energy accelerated electrons in the range from 0.25 kGy to 3 kGy on the dose rate. Irradiation with the doses up to 1 kGy ensured a more significant reduction in bacterial content in turkey meat treated with the dose rate 1 Gy/sec and 10 Gy/sec. In contrast, irradiation with the dose range of 2 kGy to 3 kGy enabled a more considerable decrease in the amount of pathogens at the dose rate of 100 Gy/sec.
As a result of this study, 1 kGy to 2 kGy at the dose rate from 1 Gy/sec to 10 Gy/ were selected for eliminatihg of pathogens and preserving organoleptic properties of chilled turkey.

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