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Effects of Irradiation Source and Dose Level on Oxidative Stability of Ground Pork

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Objectives

Irradiation is well-known for its sterilization impacts on meat products. However, some oxidation related quality defects have been identified as one of major problems associated with irradiated meat products. While various irradiation source and/or dose level could result in different extents of oxidation, little information is available on how different irradiation sources and dose levels affect antioxidant enzyme activities and subsequent oxidative stability of meat products. Therefore, the objective of this study was to determine the effects of irradiation source/dose level on endogenous antioxidant enzyme activity and lipid oxidation of ground pork.

Materials and Methods

Pork ham muscles (*M. biceps femoris, semitendinosus* and *semimembranosus*) from 6 carcasses at 1 d postmortem were trimmed, ground, and divided into 7 groups. The irradiation treatments, comprised of 3 irradiation sources (γ-ray, electron-beam (e-beam) and X-ray) and 2 irradiation dose levels (3 and 7 kGy) with non-irradiated control, were randomly assigned to the ground pork groups. Ground pork in vacuum-packaged bags was irradiated at target dose levels with each ionizing source at the ambient temperature (22°C). Catalase (CAT), glutathione peroxidase (GSH-Px), and superoxide dismutase (SOD) activities were determined on the day of irradiation. To determine lipid oxidative stability, conjugated diene (CD), peroxide value (POV) and 2-thiobarbituric acid reactive substances (TBARS) were measured during 20 d of refrigerated storage (4°C). The experimental design was completely randomized block with 3 independent replicates. The ANOVA procedure was performed on all the variables measured using the GLM procedure with SPSS. When significant differences were found ($P < 0.05$), Duncan's multiple-range test was used to separate the mean differences between treatments.

Results

The ground pork irradiated with X-ray showed lower POV but higher TBARS values compared to the ground pork assigned to other irradiation sources ($P < 0.05$). X-ray irradiation significantly decreased total SOD activities as compared to the other irradiation sources. Regarding the impact of irradiation dose level, ground pork irradiated at 7 kGy had higher CD and TBARS values than that irradiated at 3 kGy. E-beam irradiation at 7 kGy significantly decreased CAT activity when compared to non-irradiated control. GSH-Px was unaffected by either irradiation source or dose level ($P > 0.05$).

Conclusion

The results from the present study suggest that the extent of lipid oxidation in ground pork induced by irradiation could be dependent on irradiation source/dose level. The decrease in total SOD activity in X-ray irradiated ground pork could result in accelerated formation of secondary oxidation products such as malondialdehyde. Further studies to develop a practical strategy to minimize irradiation-induced oxidative quality defects of meat products (e.g., incorporation of antioxidants or different packaging conditions) would be warranted.