

Post-Packaging Irradiation Combined with Modified Atmosphere Packaging for Control of Bacterial Pathogens on Meat Products

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Summary and Implication

Irradiation of ground beef in modified atmosphere packaging was compared with irradiation of ground beef in vacuum packaging for the inhibitory impact on *Escherichia coli O157:H7*. Recovery of surviving organisms showed that packaging systems did not alter the effects of irradiation for reduction of *E. coli O157:H7* in ground beef. Therefore, modified atmosphere packaging may be used to improve color of irradiated ground beef without affecting the inhibitory impact of irradiation.

Introduction

Irradiation and modified atmosphere packaging (MAP) are two hurdles used to control microbial growth in food products for improved food safety and shelf life. Many studies have shown that bacterial pathogens in fresh meat products are inactivated by irradiation. Packaging systems with CO₂ and N₂ have also been successfully used by many meat processors to achieve microbial control. However, meat quality changes caused by irradiation are still concern for consumer acceptance. The change of meat color from cherry red to brown is one of the major defects of fresh irradiated meat products, particularly beef. Research at Iowa State University has shown improved fresh meat color by flushing with carbon monoxide (CO) in MAP. The objective of this research was to combine irradiation with modified atmosphere packaging (CO and CO₂) for control of *E. coli O157:H7* in ground beef patties and to develop cherry red color for irradiated beef products. Comparison with irradiated products in vacuum packages was included as part of this study.

Materials and Methods

Fresh beef chuck roasts were purchased from a local grocery store and used for production of ground beef patties in the Iowa State Meat Laboratory Pilot Plant. Food grade 0.5% CO and 99.5% CO₂, packed in gas cylinders, was purchased from Linweld, Inc, Lincoln, NE 68508. A packaging machine with both vacuum and gas flush capabilities was used for packaging the patties. Five frozen

cultures of *E. coli O157:H7* (ATCC 35150, ATCC 43894, WS 3062, ATCC 43895 and WS 3331) were supplied by Food Safety Research Laboratory at Iowa State University. The cultures were combined and incubated at 37° C to reach 10⁸-10⁹ cfu/ml. Patties were inoculated with the 5-strain mixture at 5-log cfu per gram of ground beef. Individual beef patties (114 gram) were inoculated with one milliliter of the inoculant and packaged with vacuum or MAP. The MAP was done with 0.5% CO and 99.5% CO₂. Samples were subsequently irradiated with doses of 0.5, 1.0 and 1.5 kGy. Control samples were not irradiated. The enumeration of *E. coli O157:H7* survivors was conducted right after irradiation, 24 hours after irradiation, and 48 hours after irradiation. The experiment was repeated three times, D-values (dose required to inactivate 90% of the organisms), were calculated with Microsoft Excel and the data were analyzed with the Statistical Analysis (SAS) program.

Results and Discussion

There were no significant differences in D-values between vacuum packaging and MAP when compared at the same irradiation doses (Table 1). There were no significant differences in recovery of *E. coli O157:H7* from irradiation treatments after 0, 24 hour and 48 hour storage in either vacuum packaging or MAP. The average D-values for vacuum packages were 0.46, 0.45 and 0.47 after 0, 24 hour and 48 hour storage, respectively. The average D-values in MAP were 0.54, 0.50 and 0.48 after 0, 24 hour and 48 hour storage, respectively. The effects of irradiation on microbial recovery, meat color changes and other safety and quality parameters in the two packaging systems will be further evaluated during 12 weeks of refrigerated storage. However, it does not appear that the packaging environment affects the initial inhibitory impact of irradiation and, therefore, MAP may be used to counter some of the negative color effects of irradiation treatment of ground beef.]

Table 1. Counts of *E. coli* O157:H7 and D-values in ground beef patties packaged in vacuum and MAP prior to irradiation.

Irradiation dose(KGy)	Microbial count in Vacuum Packaging (Log cfu/g)			Microbial count in MAP with 0.5% CO and 99.5% CO ₂ (Log cfu/g)		
	0 hour	24 hours	48 hours	0 hours	24 hour	48 hour
0	5.6	5.7	5.7	5.6	5.8	5.6
0.5	4.7	4.6	4.6	4.6	4.5	4.6
1.0	3.5	3.5	3.3	3.5	3.7	3.5
1.5	2.4	2.4	2.6	2.9	2.7	2.5
D-Value	0.46	0.45	0.47	0.54	0.50	0.48