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DISPLAY LIFE AND RELATED TRAITS OF LOW-DOSE IRRADIATED, BONELESS, PORK CHOPS

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Summary

Irradiation and vacuum-packaging caused a more intense and stable red color in boneless pork chops. Irradiation up to 2.5 kGy increased cooked internal redness in chilled chops. Oxidative rancidity was greater in aerobic packaging than vacuum-packaging and in irradiated aerobic packaged chops than controls. Irradiation of vacuum-packaged boneless pork chops has promising potential for market acceptance.

(Key Words: Irradiation, Color, Oxidation.)

Introduction

Recent events involving food-borne infections in meat products have increased consumer awareness of possible food contamination with pathogens, especially *Escherichia coli* O157:H7. Of surveyed consumers, 43% were very concerned with food safety. Irradiation is one possible method to increase meat safety, especially when combined with good manufacturing practices. The World Health Organization stated that no toxicological hazard resulted from consuming food irradiated with up to 10 kilograys (kGy). Historically, consumers have rejected irradiation, but several studies indicate that consumer attitudes toward irradiation are changing. Even though the effects of irradiation on the survival of microorganisms in food have been well studied, little is known about the effects of low-dose irradiation on meat quality. Meat quality ultimately will determine consumer acceptance. The objective of this study was to determine the effects of irradiation on color and display life of chilled and frozen boneless pork chops in two packaging systems.

Procedures

Nine center-cut boneless chops from each of 42 loins (NAMP #412B) per replication were cut 1.25 in thick. Loins were assigned randomly to temperature treatment and package type before cutting. Six chops per loin were randomly assigned to each of the six remaining treatments (irradiation). The remaining three chops per loin were assigned randomly to treatments to fulfill chop requirements. Individual loins and chops were tracked throughout the study. Only chops with NPPC color, firmness/wetness, and marbling scores of 2, 3, or 4; loin eyes of 4.5 to 6.5 in^2; and Minolta L* (lightness) values of 40 to 58 were used. Chops were either vacuum-packaged (VP) or packaged aerobically (AP). After packaging, chops were boxed and stored either frozen at 0 ± 3°F or chilled at 37 ± 3°F. Boxed products were stored for about 60 h and shipped with arrival within 24 h at either Iowa State University's Linear Accelerator Facility (electron beam, ISU, Ames, IA) or FOOD TECHnology Service, Inc. (Co^{60}, Mulberry, FL). After product temperature was stabilized overnight to either 0 or 37°F, chops were treated with either 0, 1.5, or 2.5 kGy (chilled) or 0, 2.5, or 3.85 kGy (frozen) of either nonradioactive electron beam (EB) or radioactive Co^{60}. After irradiation, products were stored overnight, returned to Kansas

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State University, and stored at either 0 ± 3 or 37 ± 3°F for about 60 h. Prior to broiling, frozen chops were thawed at 34 ± 2°F overnight.

Two chops for each treatment for each replicate were broiled to 165°C internally, as measured by thermocouples attached to a temperature recorder. Cooking loss percentage and cooked internal color traits were evaluated.

Remaining raw chops were displayed at either 0 ± 3 or 37 ± 3°F under 150 foot candles light intensity. After 0, 3, 7, 14, and 21 d display, duplicate chops were evaluated for total plate count (TPC) using standard procedures, a modified 2-thiobarbituric acid analysis (TBA) to assess oxidative rancidity, and instrumentally for color. Purge percentage was determined at day 0 only.

Results and Discussion

Chilled Boneless Pork Chops. Vacuum-packaged irradiated chops were redder (greater a*) than AP counterparts at 0, 3, 7, and 14 d (Figure 1). No redness difference was observed between packs for controls, except day 3 VP was higher than day 3 AP. Redness increased with greater irradiation dose at 3, 7, and 14 d for VP chops, but decreased from 0 to 1.5 kGy at 7 d and across all doses at 14 d for AP chops. No redness difference was observed across display days for all doses for VP chops. Yellowness (b*) increased with longer display for both package types. VP chops had more stable a*/b* (red/yellow) ratios across doses for all display days. By day 21, 2.5 kGy chops were becoming lighter and less red than on previous display days.

Cooking loss was not affected by dose, irradiation source, or package type. Purge was greater in VP than AP chops. Irradiation up to 2.5 kGy increased cooked internal redness (a*). Total plate counts (TPC) decreased from 0 to 2.5 kGy in both package types, but AP was greater than VP at all doses. Oxidative rancidity levels (TBA) did not differ between doses for VP for either irradiation source (Figure 2). However, TBA values increased from 0 to 1.5 kGy for electron beam (EB) AP and from 0 to 2.5 kGy for Co^{60} AP. TBA values for VP chops were stable across display days for both sources and all dose levels. AP chops had greater TBA values than VP at all display days for 1.5 and 2.5 kGy doses.

Frozen Boneless Pork Chops. No difference for redness (a* values) was observed between irradiation sources at all doses and display days for VP. VP chops were redder than AP for all doses and display days and both sources. By 21 d, irradiated chops were indicating a trend toward yellowness.

Purge was greater in VP chops than AP regardless of irradiation source. Irradiation did not affect cooked internal redness (a*). However, EB AP chops had greater internal redness (a* values) than EB VP and Co^{60} AP samples. Control samples had greater TPC than irradiated at 0, 7, and 14 d. TPC decreased from 0 to 7 d for 2.5 and 3.85 kGy chops. TBA values did not differ between doses for VP chops, but AP samples increased from 0 to 2.5 kGy (Figure 3). AP chops had greater TBA values than VP at 2.5 and 3.85 kGy. In addition, TBA increased from 0 to 14 d in AP, with no difference observed across display days for VP chops.

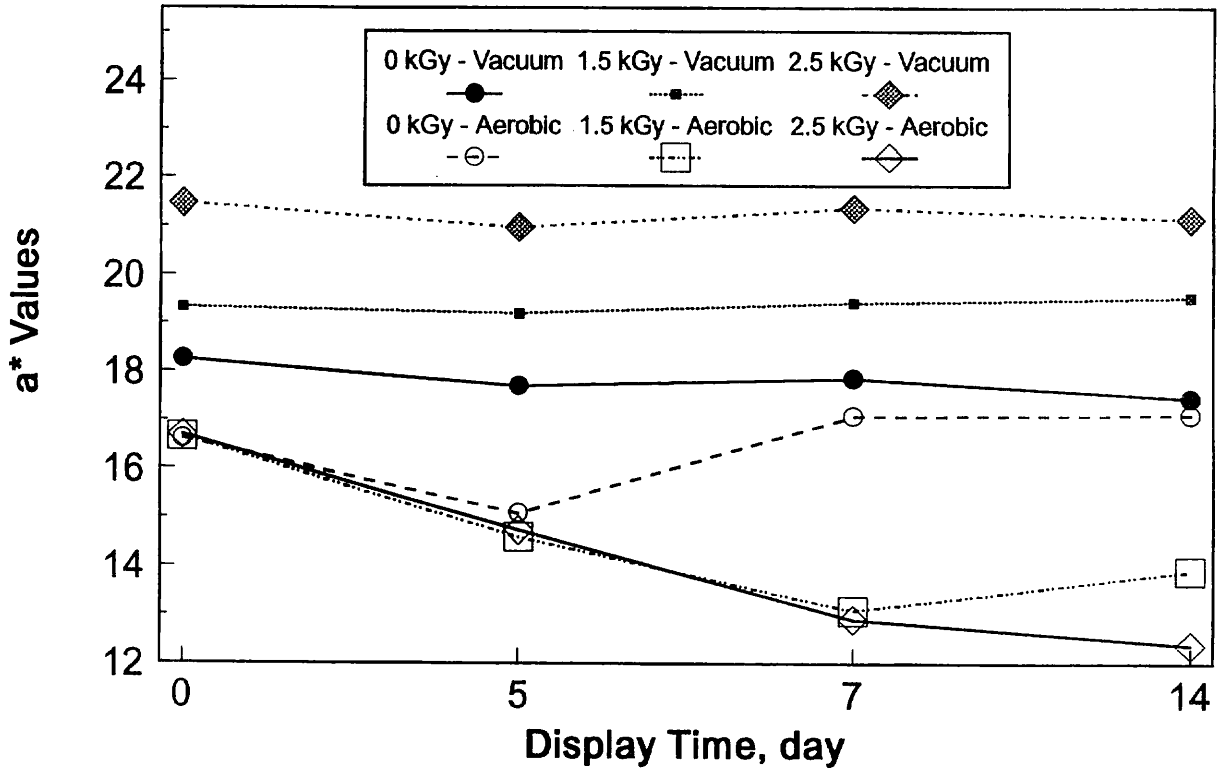

Figure 1. Comparison of Mean Values for Raw Redness (a* Values) across Days 0, 3, 7, and 14 for Package Type by Dose Level (SE = 0.6) in Chilled Boneless Pork Chops.

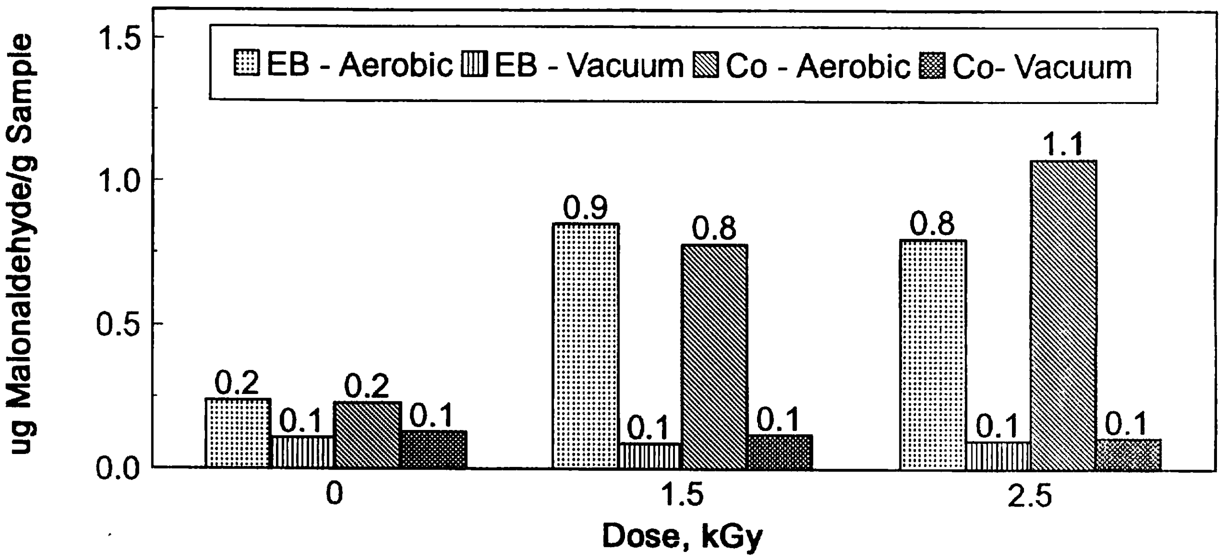

Figure 2. Comparison of Mean Values for Oxidative Rancidity Levels (TBA Values) across Dose Level for Irradiation Source by Package Type (SE = 0.1) in Chilled Boneless Pork Chops.

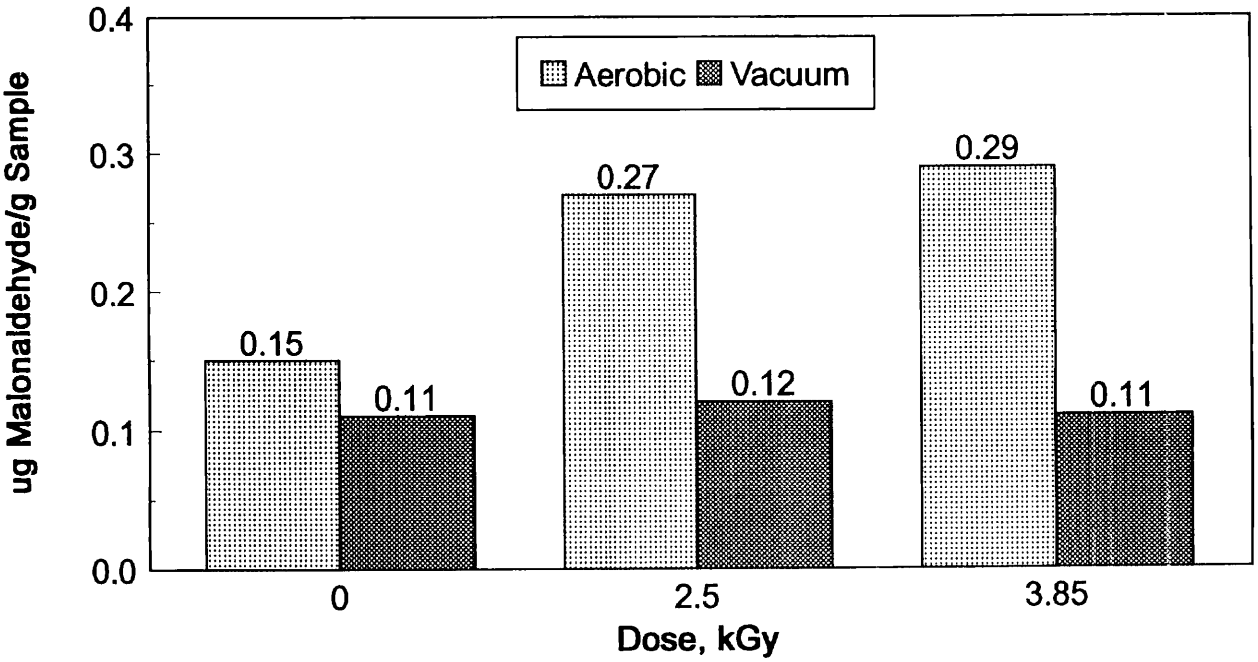

Figure 3. Comparison of Mean Values for Oxidative Rancidity Levels (TBA Values) across Dose Levels for Package Type (SE = 0.02) in Frozen Boneless Pork Chops.