

Project Summary

Effect of Meat Packaging Technologies on the Safety and Spoilage- Indicating Characteristics of Ground Beef Phase 2: Spoilage Characteristics

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Phase 2: Spoilage Characteristics:

Project Summary

Background

Research is needed to provide the industry and government officials with scientific data regarding the spoilage characteristics of various packaging systems commonly used in the beef industry. The objective of this project was to determine the spoilage characteristics of carbon monoxide gas flush, hi-oxygen gas flush and rosemary oleoresin in modified atmosphere packaging of ground beef patties through affective and analytical sensory analysis.

Methodology

Coarse ground beef was obtained from a commercial processor, placed in a mixer and blended prior to a final grind. After the final grind, patties were formed (150 g) using a patty forming machine. Five packaging treatments were evaluated: 1) control (foam tray with film over-wrap); 2) high-oxygen (80% O₂ / 20% CO₂) modified atmosphere package (MAP); 3) high-oxygen MAP with added rosemary extract (Type HT-25 at 0.2%, Kalsec, Inc.); 4) low-oxygen carbon monoxide (0.4% CO, 30% CO₂, 69.6% N₂) MAP; and 5) low-oxygen carbon monoxide MAP with added rosemary extract. Rosemary extract was added to the coarse ground beef and mixed prior to a final grind. Beef patties were evaluated for changes in color and odor over time (0, 1, 3, 5, 7, 14 and 21 d) under simulated retail display conditions using coffin-style and multi-deck cases under continuous fluorescent lighting.

Trained panelists evaluated the color and surface discoloration of ground beef patties using a five-point, verbally anchored scale (1 = very bright red; 5 = very dark red or brown; 1 = no discoloration; 5 = severe discoloration, 61-100%). Consumer panelists were recruited from the surrounding area and asked to determine if the ground beef patties had good color (1 = very strongly agree; 7 = very strongly disagree) and how likely they would be to purchase (1 = definitely would purchase; 5 = definitely would not purchase) the package based on the color.

Odor panels were conducted on packages removed from the cases at each sampling interval. Trained panelists were asked to determine if an off-odor is present (1 = no off-odor; 5 = extreme off-odor) and to characterize the off-odor if present (1 = rancid; 2 = arid; 3 = sweet; 4 = sour; 5 = acid; and 6 = putrid). Consumer panelists were asked if the meat in the package smelled fresh (1 = very strongly agree, 7 = very strongly disagree) and how likely they would be to consume the meat (1 = definitely would consume; 5 = definitely would not consume) based upon the odor.

Total Aerobic Plate Counts (APC) were determined by plating on total plate count agar, lactobacilli were determined by plating on LBS agar and total coliforms were determined by plating on VRBA agar. The plates were incubated at 37 °C for 48 h. Total psychrophillic aerobic bacteria were determined by plating onto APC agar and incubating at 7 °C for 7 d.

Findings

There was a treatment by day of retail display interaction for trained panel color scores and percent surface discoloration scores. Results indicate the low-oxygen carbon monoxide gas flush had a

stabilizing effect on meat color after the formation of carboxymyoglobin. The carbon monoxide gas mixture was also effective at preventing the development of surface discoloration during retail display. There was a significant treatment by day of retail display interaction for both consumer responses to color. Consumer panel scores followed the same pattern as trained panel scores for meat color. Consumers in this study also ranked high-oxygen packages containing meat with rosemary extract to be more desirable at days 5 and 7 of display than high-oxygen packages containing meat without rosemary extract. After the development of carboxymyoglobin in packages containing carbon monoxide, consumers indicated they would purchase meat in these packages that had been displayed 21 days at 0-2 °C.

Results indicate that off-odors will develop in traditional and modified atmosphere packages over time. Traditional and high-oxygen packages develop off-odors earlier in the display period than packages containing carbon monoxide gas. Consumers indicated that beef patties packaged in an atmosphere containing carbon monoxide were more likely to smell fresh at 7, 14 and 21 days of display, but they would probably not consume these product after 14 days of display based upon the odor.

There was a significant packaging treatment by day of retail display interaction for psychrophillic aerobic bacteria counts and total coliforms. These results indicate that modified atmosphere packaging suppresses the growth of psychrophillic aerobic bacteria when compared to traditional packages exposed to air. Generally, traditional packages had significantly higher total plate counts and lactobacillus bacteria counts than modified atmosphere packages. These results indicate that total plate counts and lactobacillus bacteria increased as day of retail display increased for all packaging treatments.

Implications

This study demonstrated that meat color and package odor were very good indicators of spoilage in all packaging systems. Therefore, consumers can use color and odor as indicators of meat spoilage in traditional packages, high-oxygen modified atmosphere packages and low-oxygen modified atmosphere packages containing carbon monoxide gas.

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