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BONE-IN PORK LOINS: MODIFIED ATMOSPHERE PACKAGING TO EXTEND SHELFLIFE

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Summary

Modified atmosphere packaging with 100% carbon dioxide was used to investigate changes in daily gas composition, as well as the influence of fat trim level and location of loin in the box on shelflife characteristics. Length of storage was the primary factor influencing shelflife of whole loins and their retail chops. Although microbial qualities was acceptable in loins stored up to d 19, sirloin and blade discoloration was obvious at 11-13 d. Storage for more than 11 d reduced the display life of retail chops to 1-2 d. Shelflife characteristics of bone-in pork loins were superior with this packaging system compared to more traditional systems.

(Key Words: Pork, Packaging, CO_2, Shelflife, Color.)

Introduction

Modified atmosphere packaging (MAP) is a packaging system in which the normal atmosphere in the package is removed and replaced with gases that help extend shelflife of meat. Carbon dioxide is the most commonly used gas in the United States because of its anti-microbial properties. If not used properly, carbon dioxide in MAP can cause undesirable meat discoloration even though bacterial growth is controlled. However, the causes of this problem are not fully known. For example, will trimming pork loins to 0 to 1/4 in. fat affect MAP shelflife? Thus, this experiment was conducted to determine the effects of subcutaneous fat trim level, location of the loin in the box, and daily gas changes in MAP on shelflife of bone-in loins and retail chops.

Procedures

Paired pork loins (110 pairs) were obtained from a commercial pork plant. Subcutaneous fat of one loin of each pair was trimmed to 1/4 in., whereas fat on the companion loin was trimmed to 1/8 in. Loins were weighed to calculate weight losses. Bone, fat, sirloin, and blade color were evaluated, and bone bacterial counts were taken. Five loins of the same trim level were then packaged in a box containing a MAP plastic bag. Loins were oriented with two in the top layer, one in the middle, and two in the bottom layer locations. The five companion loins of the second trim level were packaged in another box with the same location orientation, thus, creating a set of paired boxes. All bags were evacuated of air and flushed with 100% carbon dioxide. Initial gas composition was determined on all boxes using a gas analyzer, and the boxes were shipped to Kansas State University where they were stored up to 19 d at 33°F.

During storage (3-19 d), oxygen and carbon dioxide levels were determined daily. Two sets of paired boxes were opened on d 3, 4, 5, 6, 7, 9, 11, 13, 15, 17, and 19 of MAP for evaluation of shelflife characteristics. Loins were evaluated for weight loss; discoloration of bone, fat, and blade and sirloin lean surfaces; off-odors; and microbial quality. Rib and sirloin chops were removed to determine display color stability. Chops were individually placed in styrofoam trays overwraped with PVC, and displayed for three d at 38°F under 100 ft-candles of "natural" fluorescent lighting.

Results and Discussion

Length of MAP storage was the primary factor influencing gas composition and shelflife characteristics of whole loins and their retail chops. Carbon dioxide concentration (Fig. 1) was lower at d 3 of MAP and continued to decrease through d 19. Oxygen concentration (Fig. 1) was higher at d 3, decreased through d 15, and then increased through d 19. The initial rapid change in gas composition (d 3) was due to the absorption of carbon dioxide into the meat surface. Whole loin weight loss (data not shown) increased with increasing lengths of MAP storage from 1.7% at d 3 to 4.3% at d 19. Off-odors were not detectable through 7 d of MAP and had only a slight intensity at d 19.

Microbial counts increased with increasing storage, but at d 19, counts were still acceptable (log 4.5), and loins were free from spoilage. More importantly, the microbial counts through 9 d of MAP were lower than initial counts (pre-packaging). This reduction was due to the bacteriostatic action of carbon dioxide. The increase in counts above initial levels may have been due to the simultaneous decrease in carbon dioxide concentration or the adaptation of the microflora to the carbon dioxide environment.

Discoloration was the limiting factor in the shelflife of the whole loins. Bone discoloration increased with increasing length of MAP storage, with the most rapid increase at d 5. However, even after 19 d of storage, discoloration of bone surfaces was still at an acceptable level. Blade and sirloin lean discoloration (Fig. 3) increased rapidly between 5 and 7 d of MAP and continued to increase through 19 d. Discoloration was obvious and probably objectionable between d 9 and 11 for the sirloin lean and at 13 d for the blade lean. Longissimus (loin eye) muscles discolored less during display than the sirloin and tenderloin muscles. Discoloration of the muscles increased as display time increased. Storage in MAP for 13 d or more reduced the display life of longissimus muscles from 3 to 2 d. Eleven d in MAP reduced display life for the sirloin and tenderloin muscles to 1 d.

Level of fat trim and location of loins in the box had negligible effects on most wholesale loin or retail chop characteristics. However, loins in the middle and bottom location trimmed to 1/8 in. had greater ($P<.05$) discoloration of the fat than their counterparts trimmed to 1/4 in. Discoloration of fat did not differ between loins in the top location.

Conclusions

Packaging pork loins in 100% carbon dioxide produces a dynamic gas environment, which can extend the microbial shelflife of bone-in pork loins up to 19 d. However, discoloration of the whole loin lean surface will result in discrimination between 11-13 d of MAP. Initial color of retail chops from loins stored 19 d in MAP is acceptable, but chops will have only 1 to 2 d of display life after MAP storage of 11 d.

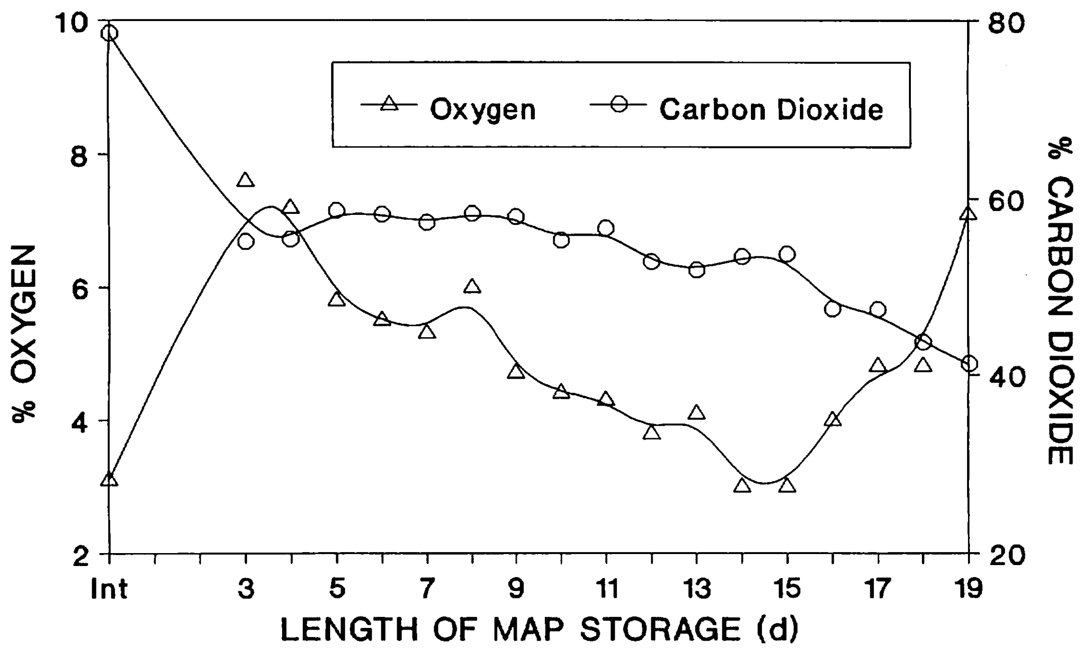

Figure 1. Changes in gas composition.

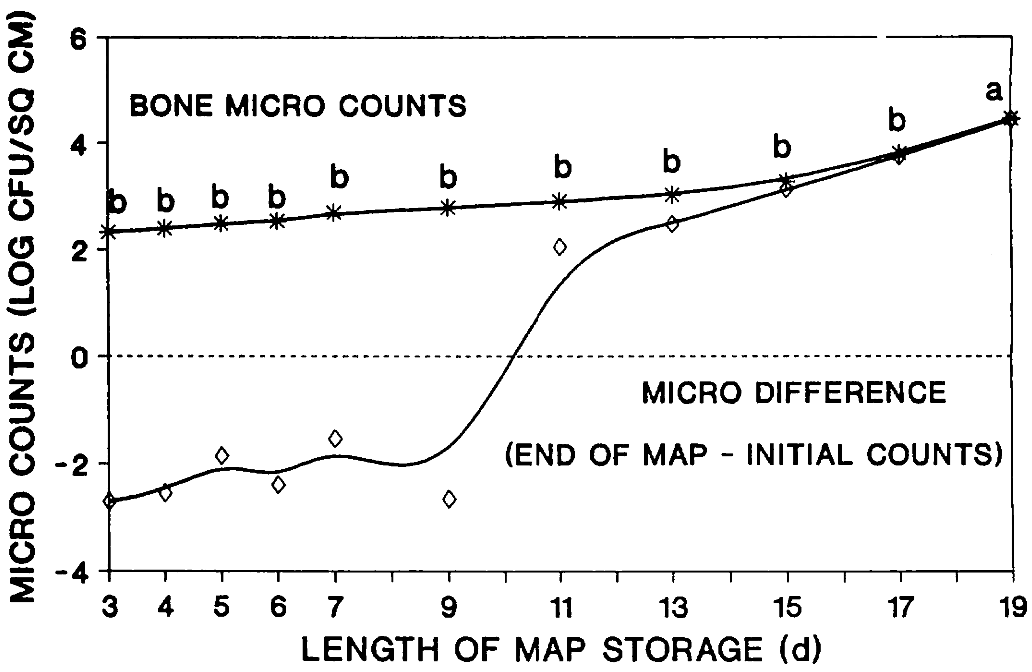

Figure 2. Microbial growth.

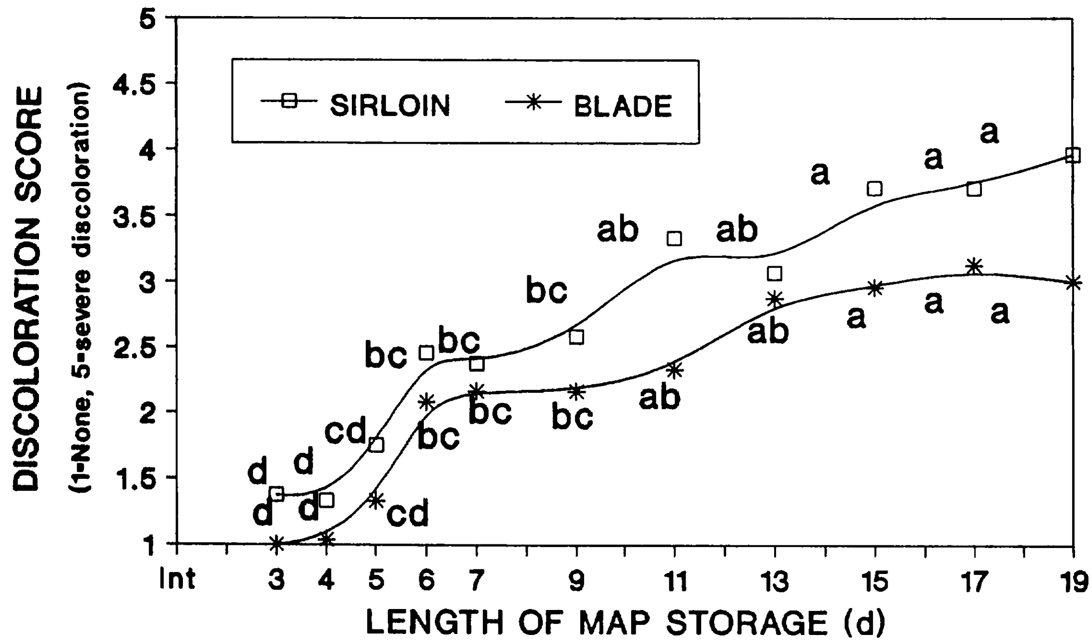

Figure 3. Whole loin discoloration.