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Effects of modified atmosphere packaging and carcass chill rate on pork loins

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EFFECTS OF MODIFIED ATMOSPHERE PACKAGING AND CARCASS CHILL RATE ON PORK LOINS¹

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Summary

Use of 10% oxygen in a modified gas atmosphere package resulted in more off-odor, higher microbial counts, and a less desirably colored loin and loin chops. Furthermore, it reduced chop display life and is not recommended.

(Key Words: Pork, Shelflife, Packaging, Quality, Oxygen.)

Introduction

Modified gas atmosphere packaging offers a longer product life for fresh pork cuts, including loins. Use of 100% carbon dioxide is common but may cause suboptimal loin appearance. Low oxygen levels in the gas mix may reduce this problem, but green discoloration of retail chops may result.

This study investigated use of various carbon dioxide/nitrogen gas mixes plus one with 10% oxygen on loin and retail chop color, weight loss, aroma and storage, and/or display life for both conventionally and ultra-chilled pork sides.

Experimental Procedures

Twenty conventionally slaughtered pork carcasses were split, and sides were assigned to either conventional chill at 34°F or ultra chill at -30°F with rapid air movement for 1 h. Then temperature equilibration was allowed at 34°F, and both sides were cut at 24 ± 2 h postmortem.

At cutting, loins were divided into five sections, each covering a three-vertebrae part of the loin, and closely trimmed of fat (overtrimmed) to maximize muscle exposure. Because loin sections vary anatomically, sections were assigned to packaging treatments so that each anatomical loin section was assigned equally to each treatment.

Immediately after cutting and trimming, loin pieces were placed in a gas barrier film bag, which was flushed and then filled with the appropriate gas mixture using a Corr-Vac Mark III snorkel-type packager, or vacuum packaged and stored at 34 to 40°F. The four gas

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packaging treatments included the following proportions (%) of carbon dioxide (CO₂), nitrogen (N), and oxygen (O₂), respectively, in the gas mixture: 100, 0, 0; 50, 50, 0; 25, 75, 0; and 25, 65, 10. Packages were monitored for percentage CO₂ and O₂ during storage.

Loins from 10 carcasses were stored for 22 d and those from the other 10 carcasses for 14 d before opening; evaluating aroma, purge loss; and microbial standard plate count; and preparing chops for retail display.

Retail chops (1 in. thick) from each loin section were individually placed on a tray, over-wrapped with oxygen permeable polyvinylchloride film, and placed under standardized display temperature and lighting. Color was evaluated by a color scoring panel and also instrumentally before display (d 0) and after 1, 2 and 3 d of display. At the end of the 5-d display, product aroma, standard plate count, and display weight loss (or gain) were determined.

Results and Discussion

Ultra-chill versus conventional chill reduced carcass shrink but did not result in other differences. Differences between 14 and 22 d of storage of loin pieces in modified gas atmospheres were not consistent. Therefore, data were combined (Table 1).

Oxygen in the treatments with only CO₂/N in the gas mix remained below 0.3%. All gas packages were double-flushed, i.e., a vacuum, flush, vacuum, fill cycle. The treatment with 10% O₂ initially had 9.5% O₂, which gradually was reduced to below 6% as O₂ was used for muscle metabolism.

Weight loss for loin pieces in 100% CO₂ was greater than for those in vacuum packages, which lost slightly more weight during 3-d display than the other treatments.

Off-odor for loins immediately after the modified atmosphere (gas) package was opened was greatest for the two treatments with 25% CO₂ and least for those with 100 or 50% CO₂. This odor dissipated 15 min after the package was opened, but the treatment with 10% O₂ still had slightly more off-odor. This treatment and vacuum packaged showed most off odor after a 3-d display. A higher microbial count for the 10% O₂ treatment was related to the greater off-odor.

Average loin color for the 10% O₂ treatment tended to be less desirable ($P < .05$) at 15 min after opening gas packs. Discoloration score showed a rather general off-color for the treatment with 10% O₂. Color evaluation of chops before display and after 1 or 3 d of display showed least desirably colored chops when 10% O₂ was added to the gas mix. When 100% CO₂ was used, the loin was more discolored than for other gas atmospheres 15 min after the package was opened, but the chop appearance was equal or superior to that of chops in other treatments.

Table 1. Loin Gas Packaging Effects on Loin and Chop Traits (Chill and Storage Treatments Combined)

Trait	100% CO ₂	50% CO ₂ 50% N ₂	25% CO ₂ 75% N ₂	25% CO ₂ 65% N ₂	Vacuum
				10% O ₂	
Weight loss, %					
Loins	4.3 ^a	3.8 ^{ab}	3.8 ^{ab}	3.9 ^{ab}	3.2 ^b
Chops (3 d)	2.6 ^{ab}	2.5 ^{ab}	2.5 ^b	2.5 ^{ab}	2.7 ^a
Off-odor ^c					
Loins, 0 min	1.0 ^c	1.1 ^c	2.1 ^a	2.2 ^a	1.5 ^b
Loins, 15 min	1.0 ^b	1.0 ^b	1.0 ^b	1.3 ^a	1.0 ^b
Chops (3 d)	1.7 ^c	1.9 ^{bc}	2.1 ^b	3.2 ^a	2.9 ^a
Microbial					
CFU/cm ² , log	3.3 ^b	3.7 ^b	4.1 ^b	5.1 ^a	3.9 ^b
Color ^f					
Loin, 15 min	2.6	2.5	2.1	3.7	2.2
Chops, d 0	1.25 ^b	1.22 ^b	1.28 ^b	1.37 ^a	1.28 ^b
Chops, d 3	3.40 ^{ab}	3.32 ^b	3.32 ^b	3.45 ^a	3.34 ^b
Color, Worst Spot ^f					
Chops, d 0	1.26 ^a	1.22 ^a	1.28 ^a	2.50 ^b	1.34 ^a
Chops, d 1	2.17 ^a	2.06 ^a	1.94 ^a	3.03 ^b	2.09 ^a
Chops, d 3	3.47 ^a	3.40 ^a	3.37 ^a	4.11 ^b	3.49 ^a
Discoloration ^g					
Loin, 15 min	3.2 ^b	2.6 ^c	1.9 ^d	4.7 ^a	1.9 ^d
Chops, d 0	1.0 ^b	1.0 ^b	1.0 ^b	1.6 ^a	1.1 ^b
Chops, d 1	1.4 ^b	1.3 ^b	1.1 ^b	1.9 ^a	1.2 ^b
Chops, d 3	3.5 ^c	3.6 ^{bc}	3.5 ^c	3.9 ^a	3.7 ^b

^{a-d}Means in same row with same or no superscript letter are not different (P>.05).

^cOff-odor scale: 1 = none, 2 = slight, 3 = small, 4 = moderate, 5 = extreme.

^fColor scale: 1 = bright pink, 3 = slightly gray or tan, 5 = extremely gray or tan.

^gDiscoloration scale: 1 = none, 2 = slight (0-10%), 3 = small (11-20%), 4 = moderate (21-60%) and 5 = severe (>60%).