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Color and Oxidative Stability of Goat Meat in Overwrap, Vacuum, and Nitrite-Embedded Packaging (#404)

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Introduction

Color is a major influence on consumer purchases of meat, particularly for goat meat, with preference for a lighter color. At this time, most goat meat is not sold in self-service retail display, which limits the shelf life and availability to many consumers, particularly those who purchase meat in large supermarket stores. This study investigated the color, lipid oxidation, and protein oxidation of goat M. Longissimus lumborum packaged in air-permeable, moisture-impermeable polyvinylchloride film, barrier vacuum pouches, and barrier vacuum pouches embedded with sodium nitrite crystals.

Methods

Boneless loins from 24 Savannah and Savannah-Kiko doe and wether kid goats were identified after slaughter and held in vacuum pouches for 7 days at 4°C to represent time from processing plant to the store. The loins were randomly assigned to three packaging treatments of overwrapping of polyvinylchloride film around a Styrofoam tray with an absorbent pad (OWP), vacuum packaging in nylon-polyethylene pouches (VAC), and vacuum packaging in barrier film with 145 mg/m^2 NO_2 (NO2), then cut into 1.9 cm thick M. Longissimus lumborum (LL) slices and two slices were placed into each package. Packages were randomly placed in a 4 vertical shelf retail self-service display case with 4°C and cool white fluorescent lights at 2,017 lumens 24 hours a day and rotated once per day during 12 days of retail display.

At 0, 3, 6, 9, or 12 days of retail display, 8 packages of each treatment were randomly selected for measurement of surface L*, a*, and b* on LL slices from each treatment with a spectrophotometer (aperture 10.32 mm, illumination type D65, optical geometry 45°, observer angle 2°). Three readings per location at three locations were averaged for a final color reading for each sample. After color measurement, samples were vacuum packaged in nylon-polyethylene vacuum pouches and stored at -20°C until analysis of oxidation.

Frozen samples were defrosted at 4°C overnight. Lipid oxidation was determined by aqueous acid extraction of thiobarbituric acid reactive substances (TBARS) and reported as malondialdehyde. Protein oxidation of LL muscles were determined after homogenization in phosphate buffer and protein precipitation with 10% trichloroacetic acid followed by addition of 10 mM 2,4-dinitrophenylhydrzine (DNPH) and overnight holding. Ethanol/ethyl acetate solution was added in successive washing cycles with pellet dissolution with 6 M guanidine-HCl in 20 mM phosphate buffer (pH 6.5). A plate reader measured the absorbance at 280 nm and 370 nm. The amount of hydrolyzed protein was calculated as $C_{hydrazone}/C_{Protein}$ = A370/ 22000M-1Mcm-1*(A280-A370*0.43)*10^6.

Results

The L* value (lightness) was lowest (P<0.05) for samples in VAC packaging and the a* value (redness) of LL was lowest (P<0.05) for samples in the NO2 packaging when compared with slices in the other two packaging treatments on day 0. By day 3, the nitrosomyoglobin pigment of LL in NO2 packaging had changed color to a brighter red. L* values were not different with packaging treatment after the first day. The a* values were greater for samples in NO2 packaging (18.0 and 16.2) than in OW (12.4 and 14.4) and in VAC (14.2 and 13.5) on days 9 and 12 of display. Similar results for color of LL were obtained with b* (yellowness) values of 13.5 and 12.6 for NO2, 10.7 and 9.2 for OWP, and 8.4 and 8.4 for VAC after 9 and 12 days of retail display, respectively. The L* and b* values from the present study were greater while the a* values were similar to those previously reported for goat meat in overwrap and vacuum packaging. Lipid oxidation in samples did not differ from day 0 until day 9, but goat meat in OWP had greater oxidation (P<0.05) at 1.4 mM/L malondialdehye than in the other two package types (0.5 mM/L in VAC and 0.4 mM/L in NO2) on day 12. Protein oxidation was measured on days 0 and 12. The low sample numbers prevented statistical comparisons, but numerical values of nmol/mg protein of LL samples in VAC (32.3) and in NO2 (37.4) were much less than for LL in OWP (100.8 mol/mg protein).

Conclusion

The VAC and NO2 packaging delayed lipid oxidation during 12 days of retail display and NO2 packaging caused desirable red color of goat meat when the film was in direct contact with the meat surface. The NO2 packaging appeared to be the preferred method of displaying goat meat for retail display and sale in a self-service meat case for extended time periods. Further studies should be done to analyze the characteristics of goat meat in different packaging after freezing and thawing, as might be done by consumers.

Notes