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Relationship Between Relative Humidity and Moisture Loss in Dry Aged Beef

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Objectives

The objective of this research was to assess the impact of low relative humidity (RH) during dry aging on moisture and trim loss, tenderness, and flavor. The working hypothesis was that rapid drying would create a hard crust on the meat surface that could reduce moisture release over time, thereby reducing weight loss, enhancing tenderness (by retaining more water), and altering flavor when compared to dry aging at higher RH.

Materials and Methods

Sixteen USDA low Choice boneless strip loins were assigned to one of the four aging treatments: vacuum (Wet), dry-aging at 50% RH (RH50), dry-aging at 70% RH (RH70), or dry-aging at 85% RH (RH85). Loins were placed in individual dry aging chambers and aged for 42 d at 1°C and 2200 RPM fan speed. A computerized dry aging system was designed and built that is capable of measuring and precisely controlling RH (± 1%), temperature (± 0.5°C), and air velocity (± 0.1m/s). The chambers have built-in weighing scales that can continuously monitor weight loss (± 5 g). All measured data can be saved on the connected computer in intervals of 1 s. After aging, loins were trimmed of dehydrated fat/lean and evaluated for trim loss. Loins were fabricated anterior to posterior, cut into steaks and evaluated for water activity (a_w), Warner-Bratzler shear force (WBSF), and by sensory analysis to detect flavor differences via triangle test (n = 32). Rate of moisture loss was analyzed as a split plot design with treatment as the main plot and days of aging as the repeated measures. All the other data were analyzed as a completely randomized design. Chamber (loin) was considered the experimental unit. Data were analyzed using the PROC GLIMMIX procedure of SAS with $\alpha = 0.05$.

Results

There was a treatment by day interaction for rate of moisture loss ($P < 0.001$). A faster rate of moisture loss was found for RH50 when compared to RH85 on the first day of aging ($P < 0.001$), while RH70 was intermediate. Loins dry-aged at RH50 and RH70 had higher rates of moisture loss than RH85 on Days 2 and 3 of aging ($P < 0.05$). By Day 4, no differences in rate of moisture loss among RH treatments were found ($P > 0.05$). Wet-aged samples had lower moisture loss ($P < 0.001$), trim loss ($P < 0.001$) and higher yield ($P < 0.001$) than all dry-aged treatments. However, there were no differences among RH treatments for total moisture loss ($P > 0.05$), trim loss ($P > 0.05$) and yield ($P > 0.05$). Steaks from dry-aging treatments had lower a_w values ($P < 0.001$) than steaks from the Wet group. No differences in aw values among RH treatments were found ($P > 0.05$). There was a location effect for aw values. Samples from the ventral region of the steak had lower aw values than samples from the central and dorsal region ($P < 0.001$). There were no differences among treatments for WBSF ($P > 0.05$). Results from the triangle test indicated that there was a detectable difference between Wet and RH70 ($P < 0.05$). However, there was no detectable difference between RH50 and RH85 ($P > 0.05$).

Conclusion

Results suggest that no such case hardening effect occurs when dry aging beef, even when the RH was kept very low (50%) and the total weight loss was 23%. Instead, the lower RH results in more rapid moisture loss at the beginning of the aging process without significantly affecting the total amount of moisture loss. Trim loss, yield, tenderness and flavor were not affected by relative humidity during dry aging.