Spotlight on Dry Aging Beef: Effects of Loin Type, Aging Methods, and Aging Time[1]

S. L. DeGeer, M. C. Hunt, C. L. Bratcher, B. A. Crozier-Dodson, D. E. Johnson, and J. F. Stika

Introduction

Dry aging is an old-time process used to produce a high quality beef product marketed to high-end customers. Its most unique quality is the distinctive dry-aged flavor. Dry aging has been accomplished through many protocols over the years, but an optimum protocol has not been adopted. Practitioners of this art are very interested in providing a consistent, quality, safe product.

Traditionally, dry aging is done without packaging, which places more emphasis on plant quality control practices to achieve a consistent product. This limits the number of processors that have the ability to produce dry-aged product. Packaging bags with a very high water vapor transmission rate that may simulate traditional dry aging are now available. If the quality from dry aging in these bags is equal to that obtained with the traditional unpackaged method, other processors might consider dry aging because this bag allows for less stringent facility needs and potentially greater yields. Overall, an in-the-bag dry-aging system would require fewer controls and still result in decreased weight losses, which would provide a significant yield advantage.

Objectives of this research were to determine the combined effects of two different dry-aging methods (unpackaged and in the bag), two loin-cut styles (bone-in shell loins and boneless strip loins), and two aging times (21 and 28 days) on flavor, juiciness, tenderness, palatability, development of the unique dry-aged flavor, moisture vapor loss, and microbial growth. An additional objective was to determine effects of vacuum packaging after dry aging on dry-aged flavor stability of steaks.

Experimental Procedures

Six pairs (both the left- and right-side loins from a carcass) of bone-in, Certified Angus Beef, strip shell loins (#175; NAMP, 1997) and six pairs of boneless, Certified Angus Beef, strip loins (#180; NAMP, 1997) were fabricated 2 days postmortem. Three additional pairs of bone-in and boneless loins were selected for determination of weight losses associated with dry aging.

Loins selected from carcasses that had normal bloomed beef color and absent of quality defects were vacuum packaged (Hollymatic Vacuum Packager, Hollymatic Corp., Countryside, IL), shipped to a dry-aging facility, and then stored at 37.4°F for a total of 9 days postmortem. Loins were then cut transversely at the midlength so that each pair provided four half-loin sections. No subcutaneous fat was trimmed prior to aging. These sections were each dry aged by one of two methods for one of two aging times.

[1] The authors thank Certified Angus Beef; MacPak, LLC; Buckhead Beef Foods Co.; and Tyson in Emporia, KS, for their support in this study.

One of eight treatment combinations (two cut styles × two aging methods × two aging times) were assigned randomly to the eight loin sections after 9 days of refrigerated storage. Sections assigned to unpackaged dry aging were aged on racks directly exposed to the environmental conditions in the dry-aging cooler. Sections assigned to the bag aging treatment were vacuum packaged in dry-aging bags (11.8 × 23.6 × 0.002 in.; thermoplastic elastomer made of flexible polymere and rigid polyamide; water vapor transmission rate 2500 $g/m^2/24$ hours at 100.4°F and 50% relative humidity; MacPak, LLC, Wayzata, MN). These bags have a much greater than normal water vapor transmission rate, which facilitates a more efficient exchange of water vapor from product surface to the atmosphere, thereby simulating dry-aging conditions.

Samples were taken for pH, shear force, moisture, fat, protein, thiobarbituric acid-reactive substances (TBARS), microbial, and sensory analyses. Weight losses were measured throughout the drying process on additional loins and sample loins.

Results and Discussion

The loins selected had an expected pH and typical composition for more highly marbled cuts of the longissimus lumborum muscle. Tenderness, juiciness, mealiness, and Warner-Bratzler shear force did not differ ($P>0.05$) among the four cut style × aging method combinations (Table 1). Overall, aged beef flavor was higher for steaks from strip loins than for those from shell loins. In addition, brown roasted notes also tended ($P<0.08$) to be higher for steaks from the boneless loins. Thus, it appears that leaving the bone on the loin decreased flavor development, perhaps by limiting the loss of moisture during aging and reducing the "concentration" of flavor components. Differences between the other flavor traits were either not significant or small.

Perhaps noteworthy are the TBARS values, which are indicative of lipid oxidation. Less ($P<0.05$; data not shown) oxidation occurred in steaks from loins dry aged in the bag than in steaks from loins aged traditionally. However, the higher TBARS values did not seem to negatively affect sensory flavor. In fact, it appears that some lipid oxidation may be contributing to the development of dry-aged flavor.

Weight losses (Table 2) during dry aging were lowest ($P<0.05$) for shell loins in the bag, intermediate for shell loins aged traditionally, and highest for strip loins aged by either method. Weight loss differences for strip loins aged traditionally or in a bag approached significance ($P<0.1$). Apparently, bone removal from loins accentuates greater moisture movement because of greater exposed surface area, regardless of aging method. In addition, percentages of trim losses were greater for strip loins than for shell loins. Use of bone-in, shell-style loins would have economic advantages over boneless product; however, additional trimming must be done by consumers. Weight losses during cooking for steaks from loins aged in the bag were 2 to 3% more than those for traditionally aged steaks.

Weight loss on whole dry-aged loins increased as aging time increased (Figure 1). Weight loss during dry aging is expected and likely associated with development of many dry-aged traits. However, controlling weight loss is also an important economic factor. These data show that aging in a bag that is highly permeable to moisture vapor significantly reduced weight losses yet produced product with dry-aged sensory properties similar to those of a product dry aged traditionally. In addition, dry aging in a bag would provide processors with more process control, which could have important economic ramifications.

Initial aerobic plate counts for selected loins were similar ($P>0.05$; data not shown). *Escherichia coli* and coliforms were lower ($P<0.05$; data not shown) for shell loins than for boneless loins; however, none of the bacteria were pathogenic. Counts for yeasts, molds, and lactic acid bacteria were low and not different ($P>0.05$; data not shown) among treatment combinations. At the end of dry aging, aerobic plate counts were similar for three of the treatment combinations, whereas counts for shell loins aged in the bag were elevated (3×105 CFU/cm^2). No significant differences occurred for the other microbial traits at the end of dry aging.

Because dry-aged product must be stored before consumption, some steaks from all treatment combinations were vacuum packaged and stored post-dry aging for an additional 7 days. Tenderness, juiciness, and mealiness scores were not different among treatment combinations; however, mealiness scores were higher ($P<0.05$; data not shown) than those of steaks not stored in vacuum. Aged beef flavor was scored more uniformly across treatment combinations and did not differ between steaks from shell vs. strip loins. All other sensory trait scores were essentially the same as those of steaks not stored in vacuum. Thus, it appears that product dry aged traditionally or in a bag can be stored post-dry aging with negligible losses in palatability.

In general, there were few significant differences for many traits due to aging time; however, some important differences occurred. Aging for 28 days increased moisture and protein percentages (data not shown); however, this effect most likely was due to the greater lipid content (12 vs. 10%) of the cuts aged 21 vs. 28 days. Percentage of trim loss was greater ($P<0.05$) at 28 vs. 21 days, and the amount of aging losses was numerically greater at 28 days but was not significantly ($P>0.05$) different from that at 21 days.

The only sensory trait that differed ($P<0.05$) because of aging time was sourness, which was slightly higher at 21 vs. 28 days after 7 days of vacuum storage. Overall, it appears that aging for 28 days does not significantly increase unique dry-aged flavor components compared with aging for 21 days.

Implications

- Dry aging in a bag will produce dry-aged flavor and microbial growth equal to that achieved with traditional dry aging.
- Dry-aged product can be vacuum stored post-dry aging with negligible loss in palatability.
- Bone-in shell loins have higher yields of dry-aged product than boneless strip loins.
- Product dry aged for 21 days will have the same flavor profile but less weight loss than product dry aged for 28 days.

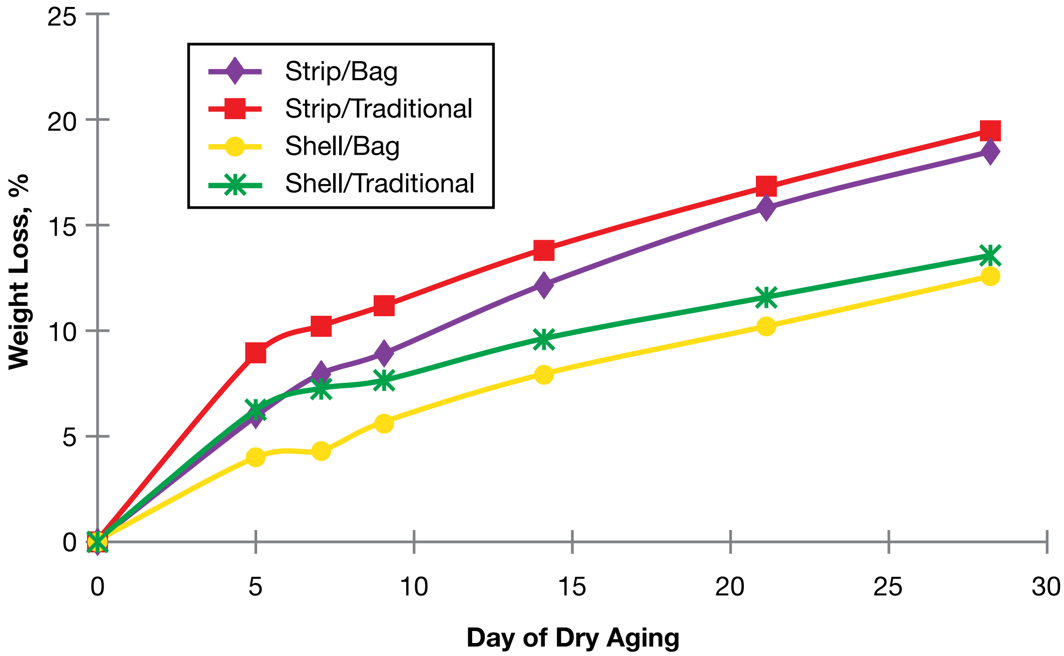

Figure 1. Weight loss throughout the aging process of beef shell and strip loins dry aged unpackaged or packaged in a bag with high moisture vapor permeability.

Table 1. Means for sensory traits[1] and WBSF[2] of steaks (end of dry aging) from beef shell and strip loins dry aged traditionally and in a bag

	Treatment combinations				
	Shell loin		Strip loin		
Trait	Traditional	Bag	Traditional	Bag	SEM[3]
Tenderness	8.5[a]	8.5[a]	9.1[a]	9.2[a]	0.28
Juiciness	5.4[a]	5.3[a]	5.7[a]	5.8[a]	0.22
Mealiness	1.0[a]	1.3[a]	1.0[a]	1.0[a]	0.15
Overall aged beef flavor intensity	6.8[b]	6.8[b]	7.4[a]	7.7[a]	0.18
Beef flavor intensity	10.5[b]	10.4[b]	10.9[ab]	11.1[a]	0.19
Brown roasted	10.4[c]	10.5[bc]	10.9[ab]	11.2[a]	0.17
Bloody serumy	5.3[a]	5.1[a]	5.2[a]	5.3[a]	0.16
Metallic	2.0[ab]	2.1[a]	1.9[b]	2.0[ab]	0.07
Astringent	1.9[a]	2.1[a]	1.9[a]	2.0[a]	0.06
Sweet	1.7[b]	1.6[b]	1.6[b]	1.8[a]	0.04
Salty	2.1[a]	2.1[a]	2.1[a]	2.2[a]	0.05
Sour	2.0[a]	2.0[a]	1.9[a]	2.0[a]	0.06
Bitter	2.2[b]	2.4[a]	2.3[ab]	2.3[ab]	0.06
WBSF, lb/ 0.5-in. core	6.8[a]	6.6[a]	5.9[a]	5.7[a]	0.16

1 Sensory traits were evaluated on a 15-point scale: 1 = lowest intensity and 15 = greatest intensity.
2 Warner-Bratzler shear force.
3 Standard error of the mean.
abc Within a row, means without a common superscript letter differ ($P<0.05$).

Table 2. Means for weight losses of beef shell and strip loins dry aged traditionally and in a bag

	Treatment combinations				
	Shell		Strip		
Trait	Traditional	Bag	Traditional	Bag	SEM[1]
Age loss[2], %	14.7[b]	11.1[c]	19.1[a]	17.5[a]	0.92
Trim loss[3], %	22.5[b]	23.5[b]	34.4[a]	34.1[a]	1.1
Cook loss[4], %	16.2[b]	18.3[a]	15.0[b]	18.4[a]	0.87

[1] Standard error of the mean.
[2] (Weight loss during aging/weight before aging) × 100.
[3] (Weight loss due to trimming/untrimmed weight) × 100.
[4] (Weight loss during cooking/weight before cooking) × 100.
[abc] Within a row, means without a common superscript letter differ ($P<0.05$).