Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 67

2014

Aging time affects color stability and sensory properties of ground beef patties adjusted

Brandi D. Cleveland

Robert S. McEwan

John A. Unruh

C. M. Garner

See next page for additional authors

Recommended Citation

Cleveland, Brandi D.; McEwan, Robert S.; Unruh, John A.; Garner, C. M.; and Stroda, Sally L. (2014) "Aging time affects color stability and sensory properties of ground beef patties adjusted," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. https://doi.org/10.4148/2378-5977.1470

Aging time affects color stability and sensory properties of ground beef patties adjusted

Abstract
Palatability traits of flavor, juiciness, and tenderness are associated with consumer satisfaction. Although grinding offers an opportunity to mechanically minimize differences in tenderness, muscle source and product quality may still affect the sensory properties of ground beef. The objective of this study was to determine the effects of two quality grades (Premium Choice and Select) and vacuum storage aging time (7, 21, and 42 days) before processing on ground beef patty display color from chuck roll and knuckle subprimals combined to obtain a common percentage of fat.

Keywords
Cattlemen's Day, 2014; Kansas Agricultural Experiment Station contribution; no. 14-262-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1101; Beef Cattle Research, 2014 is known as Cattlemen's Day, 2014; Beef; Ground beef; Fat levels; Color; Vacuum storage; Aging time

Authors
Brandi D. Cleveland, Robert S. McEwan, John A. Unruh, C. M. Garner, and Sally L. Stroda

Aging Time Affects Color Stability and Sensory Properties of Ground Beef Patties Adjusted to a Similar Fat Composition by Combining Subprimals from the Chuck Roll and Knuckle

B.D. Cleveland, R. McEwan, J.A. Unruh, C.M. Garner, and S. Stroda

Introduction

Ground beef is the most commonly consumed beef product in the United States. Fat can typically range from ≤5 to 30% in ground beef, and the product may become less palatable as the fat level decreases, especially below 10% fat. The amount and composition of fat in subprimals can be influenced by the subprimal type, quality grade, and fatness of the carcass from which it was derived. Processors can combine different subprimals of varying fat percentages to obtain an overall target percentage.

In retail, consumers use color as the major criteria in selecting meat products and associate a bright red color with freshness. Longer display life without discoloration can result in more opportunities to sell the product and greater potential profit for retailers. Display life can vary for different muscles based on their fiber type and metabolic activity.

Palatability traits of flavor, juiciness, and tenderness are associated with consumer satisfaction. Although grinding offers an opportunity to mechanically minimize differences in tenderness, muscle source and product quality may still affect the sensory properties of ground beef. The objective of this study was to determine the effects of two quality grades (Premium Choice and Select) and vacuum storage aging time (7, 21, and 42 days) before processing on ground beef patty display color from chuck roll and knuckle subprimals combined to obtain a common percentage of fat.

Experimental Procedures

At the end of each aging time (7, 21, or 42 days), four knuckles or two chuck rolls, representing their respective quality grade categories (upper 2/3 Choice and Select), were combined and ground through a 3/8-in. plate followed by a 1/8-in. plate to form a grind batch. These batches were evaluated for percentage of fat using a Hobart Fat Percentage Indicator (Model F-100, Hobart Manufacturing Company, Troy, OH). Using this fat analysis, chuck roll and knuckle grind batches from the same quality grade and aging time were used to formulate Premium Choice and Select sample batches that contained similar percentages of fat. Each treatment combination of 2 quality grades × 3 aging times (n = 6) was replicated 6 times. Ground beef patties (1/4-lb patties) for display and sensory characteristics were made using a patty machine (Supermodel 54 Food Portioning Machine, Hollymatic Corporation, Countryside, IL).

For display color, ground beef patties were packaged in polyvinyl chloride–overwrapped trays and displayed at 36°F in a coffin-type retail case under 150-foot candles of contin-

uous fluorescent lighting. A minimum of 6 trained color panelists evaluated patty visual color to the nearest 0.5 using an 8-point scale, with 1 = extremely bright cherry-red, 2 = bright cherry-red, 3 = moderately bright cherry-red, 4 = slightly bright cherry-red, 5 = slightly dark cherry-red, 6 = moderately dark red, 7 = dark red, and 8 = extremely dark red. Ground beef patties were visually evaluated by the trained color panelists at 0, 24, 48, and 72 hours of display.

For sensory panels and instrumental tenderness (slice shear force, textural profile analysis, and Lee-Kramer shear), patties were crust-frozen at -40° F before vacuum-packaging, stored at -4°F, thawed at 36°F for 24 hours, and cooked on a griddle to an internal endpoint temp of 160°F. For sensory panels, patties were cut into eight wedge slices and evaluated by a trained sensory panel. Trained sensory panelists used a scale of 1 to 8 to evaluate firmness (1 = extremely soft, 8 = extremely firm), cohesiveness (1 = not cohesive at all, 8 = extremely cohesive), juiciness (1 = extremely dry, 8 = extremely juicy), beef flavor intensity (1= extremely bland, 8 = extremely intense), mouth coat (1 = abundant, 8 = none), off-flavor intensity (1 = abundant, 8 = none), and desirability (1 = extremely dislike, 8 = extremely like).

For instrumental properties, the cooked patties were cooled to room temperature for approximately 30 minutes before the measurements were taken. For slice shear force, two 1.2-in. strips were removed from each patty, and each strip was sheared twice. Two patties per sample were used, resulting in eight measurements that were averaged for analysis. The blade was attached to the crosshead of an Instron Universal Testing Machine (Model 5569, Instron Corporation, Canton, MA) with a 220-lb load cell and crosshead speed of 9.8 in/minute.

To determine Lee-Kramer shear values, two patties from each sample were cut into 2.4 × 2.4-in. subsamples, weighed, and sheared in the Lee-Kramer cell attached to the Instron with a 220-lb load cell and a crosshead speed of 13.8 in./minute. Peak force was determined and divided by the sample weight to obtain force/ounce. The average of the two patty measurements was used for analysis.

For texture profile analysis, three 1-in.-diameter cores were removed perpendicular to the flat surface of each of two patties from each sample. Each core was compressed by 30% of its height for two cycles. We used the Instron with a 220-lb load cell and a cross-head speed of 7.9 in./minute. Sample averages for hardness (peak force of first compression), cohesiveness (total energy of second compression ÷ total energy of the first compression), springiness (base depth of second compression ÷ base depth of first compression), and gumminess (hardness × cohesiveness) were used for statistical analysis.

Results and Discussion

Since Premium Choice subprimals had higher percentages of fat, the resulting Premium Choice treatments had lower percentages of chuck roll and higher percentages of knuckle than the Select treatments (Table 1). The resulting percentages of total fatty acids were similar ($P > 0.05$) for the two quality grade treatments. As expected, there were no differences ($P > 0.05$) due to aging time for subprimal composition or percentages of total fatty acids.

In a quality grade × display time interaction ($P < 0.05$), visual color became ($P < 0.05$) progressively darker/browner with each increase in days of display for patties from both Premium Choice and Select subprimals (Figure 1). At 0, 24, and 48 hours of display, ground beef patties from Select subprimals had ($P < 0.05$) lower (brighter red) visual color scores than those from Premium Choice subprimals. These results were expected because patties from Premium Choice subprimals had a higher percentage of knuckles, which have been characterized as having muscles with lower color stability.

In an aging time × display time interaction ($P < 0.05$), visual color became ($P < 0.05$) progressively darker/browner with each increase in days of display for patties from subprimals aged 7, 21, and 42 days (Figure 2). At 0 hours of display, ground beef patties aged 21 days had ($P < 0.05$) the lowest color scores (brightest red), and those aged 7 days had ($P < 0.05$) the highest (darkest) color scores. At 24 hours of display, patties aged 7 days maintained their color and had ($P < 0.05$) the brightest red color scores. At 48 hours, patties aged 42 days had ($P < 0.05$) the darkest color scores, and patties aged 21 days had ($P < 0.05$) darker color scores than those aged 7 days. At 72 hours of display, patties aged 42 days had the darkest color scores, and patties aged 7 days had ($P < 0.05$) the least dark/brown color scores. Overall, patties were less able to maintain their color stability with increased days of aging.

For sensory analysis properties, few differences were detected between quality grades for cookery, sensory panel, or instrumental properties (Table 1). Patties from Premium Choice subprimals that contained a higher percentage of knuckle had ($P < 0.05$) less hardness and gumminess as measured by texture profile analysis.

The sensory panel indicated that patties from subprimals aged 42 days had ($P < 0.05$) more juiciness than those from subprimals aged 7 days. They also found patties from subprimals aged 7 days had ($P < 0.05$) less mouth coat (higher scores) than those from subprimals aged 21 and 42 days, and patties aged 21 days had ($P < 0.05$) less off flavor (higher scores) than those from subprimals aged 42 days.

For both the slice and Lee-Kramer shear forces, patties from subprimals aged 21 and 42 days had ($P < 0.05$) lower (more tender) shear forces than those from subprimals aged 7 days. The texture profile analysis found patties from subprimals aged 42 days had ($P < 0.05$) less hardness and the second-highest compression and gumminess than those from subprimals aged 7 and 21 days.

Implications

Extended aging for 42 days results in more rapid deterioration in display color and more off flavors, and instrumental measures indicate that aging increases tenderness and reduces hardness.

Table 1. Effects of quality grade and aging time on composition, sensory traits, and instrumental characteristics of ground beef patties

	Quality grade			Aging time			
Composition	Premium Choice	Select	SE	7 days	21 days	42 days	SE
Chuck roll, %	26.3[a]	76.6[b]	2.47	51.2	54.6	48.6	3.0
Knuckle, %	73.7[a]	23.4[b]	2.47	48.8	45.4	51.4	3.0
Total fatty acids, %	11.8	12.2	0.42	11.8	12.0	12.2	0.52
Sensory traits[1]							
Firmness	5.1	5.1	0.06	5.1	5.0	5.1	0.07
Cohesiveness	5.1	5.1	0.05	5.1	5.1	5.2	0.06
Juiciness	5.3	5.2	0.08	5.1[a]	5.3[ab]	5.4[b]	0.10
Beef flavor	5.4	5.3	0.06	5.3	5.3	5.4	0.07
Mouth coat	7.0	6.9	0.07	7.1[b]	6.9[a]	6.8[a]	0.07
Off-flavor	7.6	7.7	0.11	7.7[ab]	7.9[b]	7.4[a]	0.13
Desirability	5.2	5.2	0.11	5.1	5.3	5.1	0.14
Shear force							
Slice (lb)	6.35	6.42	0.15	6.64[b]	6.13[a]	6.39[a]	0.18
Lee-Kramer, lb/oz	184.4	191.3	3.12	202.5[b]	180.6[a]	181.3[a]	4.2
Texture profile analysis[2]							
Hardness, lb	6.17[a]	6.99[b]	0.22	7.10[b]	6.92[b]	5.71[a]	0.26
2nd peak force, lb	5.64[a]	6.35[b]	0.20	6.46[b]	6.33[b]	5.20[a]	0.24
Cohesiveness	0.58	0.58	0.01	0.59	0.57	0.58	0.01
Gumminess, lb	3.57[a]	4.01[b]	0.18	3.97[b]	3.75[b]	3.33[a]	0.21
Springiness	3.75	3.55	0.08	3.66	3.62	3.68	0.09

[1] Sensory traits: firmness (1 = extremely soft, 8 = extremely firm); cohesiveness (1 = not cohesive at all, 8 = extremely cohesive); juiciness (1 = extremely dry, 8 = extremely juicy); beef flavor intensity (1 = extremely bland, 8 = extremely intense); mouth coat (1 = abundant, 8 = none); off-flavor intensity (1 = abundant, 8 = none); desirability (1 = extremely dislike, 8 = extremely like).
[2] Texture profile analysis: hardness: (peak force of first compression); second peak force: (peak force of second compression); cohesiveness: (total energy of second compression ÷ total energy of the first compression); gumminess: (hardness × cohesiveness); springiness: (height that the food recovers during the time elapsed between the end of the first compression and the start of the second compression).
[a-b] Means within a row and main effect with a different superscript letter differ ($P < 0.05$).

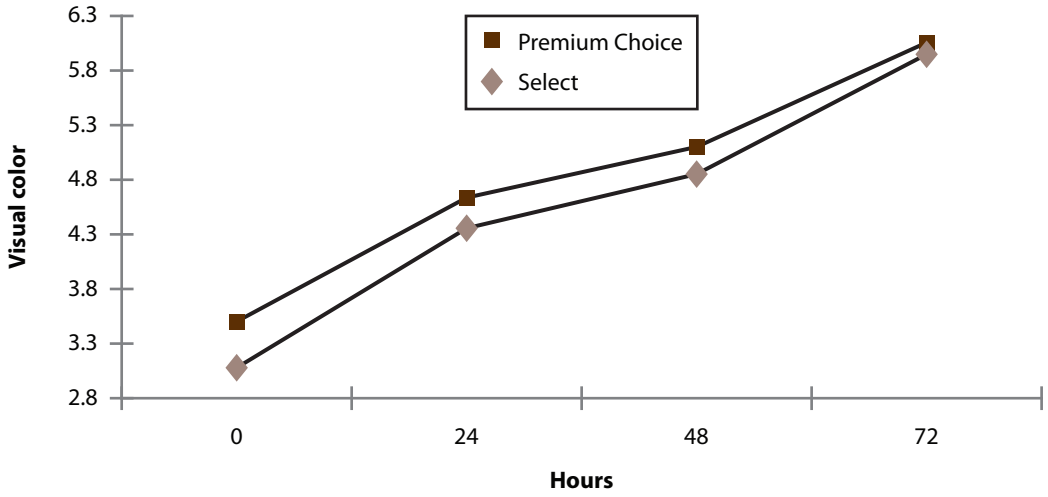

Figure 1. Quality grade × display time interaction means for visual color (2 = bright cherry-red, 5 = slightly dark cherry-red, and 8 = extremely dark red) of ground beef patties displayed for 72 hours (SE = 0.084).

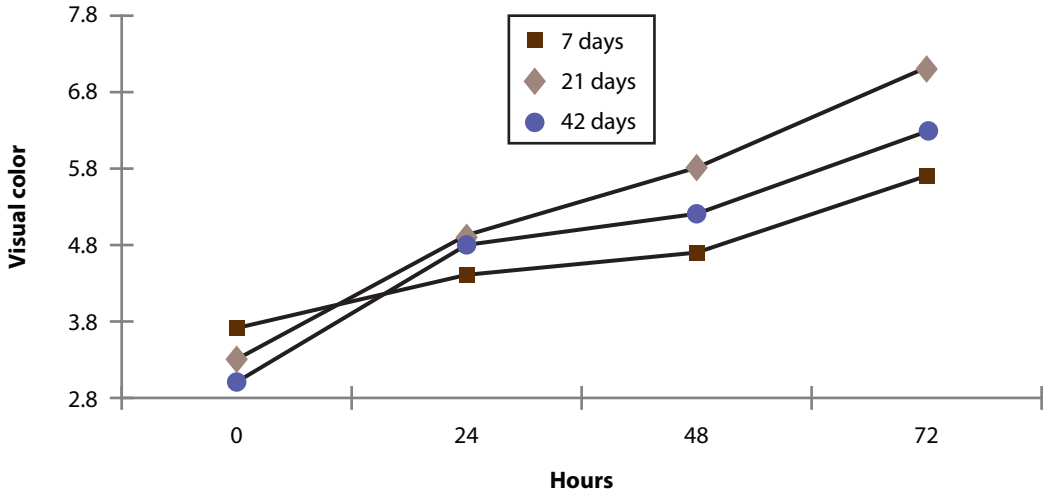

Figure 2. Aging time × display time interaction means for visual color (2 = bright cherry-red, 5 = slightly dark cherry-red, and 8 = extremely dark red) of ground beef patties displayed for 72 hours (SE = 0.103).