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Quality classification affects firmness of ground beef patties from the chuck roll

Abstract

Consumers often use color as the main criteria in selecting meat products, and they associate a bright red color with freshness. Longer display life without discoloration can result in more opportunities to sell the product and greater potential for profit. Flavor, juiciness, and tenderness are also associated with consumer satisfaction. Although grinding offers an opportunity to mechanically minimize differences in tenderness, product quality can affect these sensory properties of ground beef. The objective of this study was to determine the effects of three quality classifications and their combinations on ground beef patty display color stability and sensory attributes evaluated by a trained sensory panel and consumer panel.

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; Subprimals; Color; Consumer satisfaction; Sensory attributes

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Quality Classification Affects Firmness of Ground Beef Patties From the Chuck Roll

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Introduction

Ground beef is the most commonly consumed beef product; the average American consumes over 28 lb of ground beef per year. The source of ground beef has historically been lower quality cuts, trimmings from subprimals, and subprimals from cull cows, but consumer demand for distinctive ground beef items has led to alternative grinds from whole and/or premium quality subprimals.

Consumers often use color as the main criteria in selecting meat products, and they associate a bright red color with freshness. Longer display life without discoloration can result in more opportunities to sell the product and greater potential for profit. Flavor, juiciness, and tenderness are also associated with consumer satisfaction. Although grinding offers an opportunity to mechanically minimize differences in tenderness, product quality can affect these sensory properties of ground beef. The objective of this study was to determine the effects of three quality classifications and their combinations on ground beef patty display color stability and sensory attributes evaluated by a trained sensory panel and consumer panel.

Experimental Procedures

A total of 18 chuck roll (NAMP 116A) subprimals from Choice, Select, and non-graded (older maturity) quality grade categories were obtained from a commercial purveyor. The product originated from two sources. The Choice and Select subprimals originated from a commercial steer and heifer harvest facility, whereas the older maturity meats originated from a commercial fed-cow harvest facility. Two chuck rolls representing each quality category were combined and ground though a 3/8-in. plate followed by a 1/8-in. plate to form a grind batch. Treatments consisting of Choice, Select, older maturity, 50% Choice/50% older maturity, and 50% Select/50% older maturity were produced and replicated 3 times. At the time of grinding, all products were 7 to 9 days past the box date. After grinding, samples were evaluated for percentage of fat using a Hobart Fat Percentage Indicator (Troy, OH). Using a Hollymatic patty machine (Hollymatic Corporation, Countryside, IL), 1/4-lb ground beef patties were made for display and sensory evaluation.

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 continuous fluorescent lighting. Six 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 evaluated by trained color panelists and a HunterLab MiniScan (Reston, VA) to evaluate visual and instrumental color at 0, 24, and 48 hours of display.

For the trained sensory panel and consumer panels, ground beef patties were crust-frozen at -40°F before vacuum-packaging, stored at -4°F, thawed at 36°F for 24 hours, and cooked in a forced-air convection oven set at 325°F to an internal endpoint temperature of 160°F. Patties were cut into eight wedge slices, and duplicate samples were served warm to a 7-member 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 (1 = were abundant, 8 = none), and desirability (1 = extremely dislike, 8 = extremely like).

For the consumer panel, 117 beef consumers from the 2013 Cattlemen's Day, 2013 Meat Processors Workshop, and Spring 2013 Meat Science class evaluated wedge slices that were prepared similarly to those served the trained sensory panel. A scale of 1 to 8 was used to evaluate juiciness (1 = extremely dry, 8 = extremely juicy), flavor (1 = extremely bland, 8 = extremely intense), firmness (1 = extremely soft, 8 = extremely firm), and overall acceptability (1 = extremely acceptable, 8 = extremely unacceptable).

For slice shear force, patties were cooled to room temperature for approximately 30 minutes before two 1.2-in. strips were removed from each patty; 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 with a 220-lb load cell and crosshead speed of 9.8 in/minute.

Results and Discussion

No treatment differences were detected ($P > 0.05$) for fat percentage (Table 1) or visual or instrumental display color (Table 2). Although not significant ($P > 0.05$), patties from the older maturity treatment visually appeared to have the darkest, most discolored score. Ground beef patties declined in visual color from 0 to 48 hours of display (Table 3), with the darkest, most discolored visual scores at 48 hours of display and the brightest red scores at 0 hours of display ($P < 0.05$). This agreed with instrumental color values that showed patties were darker (lower L*) at 48 hours ($P < 0.05$) than patties at 0 and 24 hours, and that they were progressively less red (lower a*) and less yellow (lower b*), resulting in less color intensity (lower chroma values) from 0 to 24 hours and 24 to 48 hours.

The trained sensory panel found that ground beef patties from older maturity beef were ($P < 0.05$) firmer than those from the Choice, Select, and Select/older maturity treatments. In addition, patties from the Choice/older maturity treatment were firmer ($P < 0.05$) than those from the Select and Select/older maturity treatments. Patties from the Choice, Select, and Select/older maturity treatments were more tender ($P < 0.05$) than those from the older maturity and Choice/older maturity treatments; however, patties from the Select/older maturity treatment were ($P < 0.05$) evaluated as the juiciest, and those from the older maturity treatment were ($P < 0.05$) juicier than those from the Choice treatment. Patties from the older maturity treatment were ($P < 0.05$) more flavorful than those the Select and Choice/older maturity treatments, and those from the Choice and Select/older maturity treatments were ($P < 0.05$) more flavorful than those from the Select treatment.

The consumer panel found patties from the older maturity and choice/older maturity treatments were ($P < 0.05$) firmer than those from the Choice and Select treatments. Patties from the older maturity treatment had greater ($P < 0.05$) slice shear forces (were tougher) than those from the Choice and Select treatments.

Overall, the data would suggest that ground beef patties from the older maturity treatment were firmer/tougher than those from the Choice and Select treatments. Patties from the older maturity treatment had greater firmness ($P < 0.05$) and less tenderness as evaluated by a trained sensory panel, greater firmness as evaluated by a consumer panel, and greater slice shear force than those from the Choice and Select treatments.

Implications

With minimal differences in composition (fat percentage) and display color, patties from Choice and Select chuck rolls provided softer characteristics to the palate and instrumentally than those from older maturity chuck rolls.

Table 1. Effects of quality classification on fat percentage, trained sensory panel, consumer panel, and slice shear force characteristics

Trait	Choice	Select	Choice/ older maturity	Select/ older maturity	Older maturity	SE
Fat, %	16.1	13.9	15.4	14.3	14.7	1.1
Trained panel[1]						
Firmness	5.5^{ab}	5.3^{a}	5.7^{bc}	5.4^{a}	5.9^{c}	0.1
Cohesiveness	5.4	5.3	5.6	5.5	5.6	0.08
Tenderness	6.4^{b}	6.5^{b}	6.0^{a}	6.4^{b}	6.0^{a}	0.12
Juiciness	5.5^{a}	5.6^{ab}	5.6^{ab}	6.0^{c}	5.7^{b}	0.07
Flavor	5.6^{bc}	5.3^{a}	5.5^{ab}	5.6^{bc}	5.7^{c}	0.07
Off-flavor	7.7	7.5	7.6	7.9	7.8	0.13
Consumer panel[2]						
Juiciness	5	4.9	4.9	5.2	4.9	0.15
Flavor	5.1	5.2	5.1	5.2	5.2	0.11
Firmness	4.3^{a}	4.4^{a}	4.7^{b}	4.5^{ab}	4.8^{b}	0.16
Acceptability	5.1	5.1	5	5.2	5.1	0.12
Slice shear force, lb	6.6^{a}	6.4^{a}	7.9^{ab}	7.5^{ab}	8.8^{b}	0.4

[1] Scores of 1 to 8: 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 (1 = were abundant, 8 = none), and desirability (1 = extremely dislike, 8 = extremely like).
[2] Scores of 1 to 8: juiciness (1 = extremely dry, 8 = extremely juicy), flavor (1 = extremely bland, 8 = extremely intense), firmness (1 = extremely soft, 8 = extremely firm), and overall acceptability (1 = extremely acceptable, 8 = extremely unacceptable).
[a-c] Means with different superscript letters differ ($P < 0.05$).

Table 2. Effects of quality classification on visual and instrumental display color

Trait	Choice	Select	Choice/ older maturity	Select/ older maturity	Older maturity	SE
Visual color[1]	4.0	3.8	4.1	4.2	4.7	0.24
L*[2]	44.9	45.2	44.1	44.3	44.1	0.66
a*[3]	23.0	21.7	21.2	20.8	22.8	0.57
b*[4]	22.1	21.2	20.8	22.2	21.1	0.54
Chroma	31.8	30.1	29.4	31.7	29.8	0.75

[1] Visual color scores: 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.
[2] L* lightness (0 = black, 100 = white).
[3] a* redness/greenness (positive values = red, negative values = green).
[4] b* yellowness/blueness (positive values = yellow, negative values=blue).

Table 3. Effects of display time on visual and instrumental color

	0 hours	24 hours	48 hours	SE
Visual color[1]	2.9[a]	4.4[b]	5.3[c]	0.12
L*[2]	45.6[a]	45.0[a]	42.9[b]	0.50
a*[3]	26.6[a]	20.8[b]	18.1[c]	0.47
b*[4]	23.3[a]	21.3[b]	19.8[c]	0.46
Chroma	35.4[a]	29.8[b]	26.8[c]	0.64

[1] Visual color scores: 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.
[2] L* lightness (0 = black, 100 = white).
[3] a* redness/greenness (positive values = red, negative values = green).
[4] b* yellowness/blueness (positive values = yellow, negative values=blue).
[a-c] Means with different superscript letters differ ($P < 0.05$).