Cow biological type affects ground beef color stability

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Abstract

Our objective was to determine if cow biological type (beef vs. dairy) affects the color stability of ground beef. *M. semimembranosus* from beef cows (BSM) and dairy cows (DSM) were obtained 5 d postmortem and trimmed of all visible fat. Three lean source blends were made: 100% BSM; 50% BSM + 50% DSM; 100% DSM. Formulations were adjusted to 90% and 80% lean points using young beef trim (YBT) or beef cow trim (BCT). Four replications of 12 treatment combinations were made into 114 g patties and packaged in HiOx MAP. Packages were held in dark storage 5 d then displayed 4 d. The 80/20 blend of 100% BSM had the brightest cherry-red ($P<0.05$) initial color. The 80/20 blend of 100% DSM with BCT and 90/10 blend of 50% BSM + 50% DSM with BCT had the darkest ($P<0.05$) initial color. Patties containing 100% DSM with BCT at both lean points had the best ($P<0.001$) color stability at d 4. Patties from 100% BSM discolored by d 2 of display. Using BCT improved overall color life. Color stability of patties made from DSM had equal or better color stability compared to patties made from BSM.

Objective

Our objective was to determine if cow biological type, beef-type cows versus dairy-type cows, contribute differently to the color dynamics and stability of ground beef.

Materials and methods

Sampling. Inside rounds from beef cows (BSM) (n=4) and dairy cows (DSM) (n=4) were obtained 5 d postmortem from a commercial abattoir and trimmed free of all visible fat. *M. semimembranosus* has been classified as an intermediate color stability, hence the use of the inside round. Lean sources were blended to obtain 3 different combinations: 100% BSM; 50% BSM + 50% DSM; and 100% DSM. For each lean-source combination, ground beef was formulated to both 90% and 80% lean points using young beef trim (YBT) and beef cow trim (BCT), for a total of 12 treatment combinations. Meat pH was measured in triplicate using a glass electrode pH probe. Patties (114 g each) were made by hand using a mold.

Packaging, storage, and display. Patties were packaged in 4.32 cm deep rigid plastic trays and covered with oxygen-barrier film (Lid 550; 1.0 mils; < 20.0 oxygen transmission cc/24 h/m^2 at 4.4 °C and 100% relative humidity (RH); and less than 0.1 moisture vapor transmission g/24 h/645.2 cm^2 at 4.4°C and 100% RH). Patties were packaged in a high-oxygen (80% O_2, 20% CO_2) modified atmosphere (MAP). Measuring instrumental color in MAP requires opening a package, so 2 extra packages of each treatment were made for d 0 and d 2 of display. Those for use on d 4 were also those evaluated by the visual panel. Packages were stored in dark conditions for 5 d at 2 °C, then displayed for 4 d under continuous fluorescent lighting (2153 lux, 3000K and CRI=85) at 2°C in coffin-type retail display case and within the case rotated daily.

Instrumental and visual color evaluation. Instrumental color (L*, a*, and b*) was measured was measured in triplicate using a HunterLab MiniScan™ XE Plus Spectrophotometer (Model 45/0 LAV, 2.54-cm-diameter aperture, 10° standard observer) at 0, 0.5, 1, 2, 3, and 4 d of display.

Six trained visual panelists evaluated patties for 4 d of lighted display. On d 0, initial color was evaluated on an 8-point scale to the nearest 0.5 visual color unit. The initial color scale was: 1 = bleached, pale red, 2 = slightly cherry red, 3 = moderately light cherry red, 4 = cherry red, 5 = slightly dark red, 6 = moderately dark red, 7 = dark red, and 8 = very dark red. Display visual color was scored on an 8-point scale to the nearest 0.5 unit according to the following scale: 1 = very bright red or pinkish red, 2 = bright red or pinkish red, 3 = dull red or pinkish red, 4 = slightly dark red or pinkish red, 5 = reddish tan or pinkish tan, 6 = moderately dark red or reddish tan or moderately dark pinkish red or pinkish tan, 7 = tannish red or tannish pink, and 8 = tan to brown. A score of 5.5 was considered 'borderline acceptable' color by panelists.

Statistical analysis. The experiment had a split-split-plot design with the whole plot being lean combination treatment, fat source as the subplot, and lean point as the sub-subplot. Data were analyzed with

MIXED procedure of SAS. The experiment was replicated 4 times. Pairwise comparisons of least squares means were used to determine significant differences (P<0.05).

Results

The 80/20 BSM ground beef had a moderately light cherry-red initial color score. The 90/10 and DSM + BSM had intermediately dark initial color. The 90/10 DSM with BCT had the darkest (P<0.05) initial color score, described as moderately dark red (Table 1).

Table 1. Initial color score[a] means for ground beef patties sourced from dairy cows (DSM) and beef cows (DSM) formulated to 80% and 90% lean points with young beef trim (YBT) and cow beef trim (CBT)

Treatment		*Lean Point*	
Lean Source	**Fat Source**	**80/20**	**90/10**
BSM	**YBT**	3.2^{b}	3.8^{c}
BSM	**BCT**	3.4^{b}	4.0^{c}
DSM	**YBT**	4.2^{cd}	4.6^{d}
DSM	**BCT**	5.7^{f}	6.2^{g}
BSM + DSM	**YBT**	4.6^{d}	4.9^{de}
BSM + DSM	**BCT**	5.2^{e}	5.7^{f}

[a] 1 = bleached, pale red, 2 = slightly cherry red, 3 = moderately light cherry red, 4 = cherry red, 5 = slightly dark red, 6 = moderately dark red, 7 = dark red, 8 = very dark red

[b-g] Means in any column or row with a common superscript letter do not differ (P>0.05)

Ground beef composed of BSM blended with YBT or BCT had the brightest-red d 0 display color scores. In general, DSM with either YBT or BCT was scored darker at the beginning of display. Blends of BSM + DSM and BSM with BCT had intermediately red color at d 0 of display. The DSM fattened with BCT yielded superior (P<0.001) visual color score at d 4. This combination maintained a dull red color through d 3 of display. The DSM fattened with BCT developed a tannish-red color by d 3 of display. The BSM ground beef developed a tannish-red color by d 2 of display. The BSM + DSM had intermediate visual color scores.

Table 2. Display color score[a] means for ground beef patties sourced from dairy cows (DSM) and beef cows (DSM) formulated to 80% and 90% lean points with young beef trim (YBT) and cow beef trim (CBT)

Treatment		**d 0**		**d 1**		**d 2**		**d 3**		**d 4**	
Lean Source	**Fat**	**80/20**	**90/10**	**80/20**	**90/10**	**80/20**	**90/10**	**80/20**	**90/10**	**80/20**	**90/10**
BSM	**YBT**	1.8^{b}	2.2^{b}	3.8^{de}	3.6^{d}	5.8^{g}	6.0^{g}	6.6^{h}	6.3^{gh}	7.7^{ii}	7.2^{hi}
BSM	**BCT**	2.1^{b}	2.0^{b}	3.5^{d}	3.7^{d}	5.1^{f}	5.0^{f}	5.3^{f}	5.5^{fg}	6.8^{h}	6.7^{h}
DSM	**YBT**	3.2^{c}	3.4^{cd}	3.3^{c}	3.5^{d}	3.2^{c}	3.4^{cd}	5.4^{f}	4.9^{f}	5.3^{f}	5.0^{f}
DSM	**BCT**	3.6^{d}	3.3^{cd}	3.0^{c}	3.3^{c}	3.0^{c}	3.1^{c}	3.7^{d}	3.7^{d}	4.6^{e}	4.4^{e}
BSM + DSM	**YBT**	2.9^{c}	3.0^{c}	3.6^{d}	3.8^{de}	4.2^{e}	4.4^{e}	5.8	5.7^{g}	6.2^{gh}	6.3^{gh}
BSM + DSM	**BCT**	3.3^{cd}	3.5^{d}	3.4^{cd}	3.2^{c}	3.6^{d}	3.6^{d}	4.0^{e}	4.2^{e}	5.5^{fg}	5.7^{g}

[a] 1 = very bright red or pinkish red, 2 = bright red or pinkish red, 3 = dull red or pinkish red, 4 = slightly dark red or pinkish red, 5 = reddish tan or pinkish tan, 6 = moderately dark red or reddish tan or moderately dark pinkish red or pinkish tan, 7 = tannish red or tannish pink, and 8 = tan to brown

[b-i] Means in any column or row with a common superscript letter do not differ (P>0.05)

Ground BSM tended to have higher L* values than ground DSM (Table 3). The BSM fattened with YBT had higher (P<0.05) L* values at d 4 of display than ground beef fattened with BCT, and a similar trend was observed in all lean-source treatment combinations. Thus, the YBT had a lighter, whiter color as expected, than the BCT. The lightest (P< 0.05) color at d 4 of display was for BSM fattened with BCT. The initial (d 0) L* value for DSM and BSM + DSM fattened with BCT was lower (P<0.05) than the other treatment

combinations. Generally, lean source combinations, the 80/20 blends had higher (P<0.05) L* values throughout display.

Table 3. L* least squares means for ground beef patties sourced from dairy cows (DSM) and beef cows (DSM) formulated to 80% and 90% lean points with young beef trim (YBT) and cow beef trim (CBT)

Treatment		d 0		d 2		d 4	
Lean Source	**Fat Source**	**80/20**	**90/10**	**80/20**	**90/10**	**80/20**	**90/10**
BSM	**YBT**	53.0^{a}	47.4^{bc}	50.8^{ab}	47.4^{b}	48.6^{b}	45.4^{bc}
BSM	**BCT**	50.6^{ab}	46.3^{bc}	48.2^{b}	42.7^{c}	42.3^{c}	38.2^{d}
DSM	**YBT**	49.6^{ab}	43.1^{c}	47.6^{bc}	41.5^{cd}	45.7^{bc}	40.9^{d}
DSM	**BCT**	48.5^{b}	43.1^{c}	44.8^{c}	40.2^{d}	43.0^{c}	39.3^{d}
BSM + DSM	**YBT**	49.9^{ab}	46.0^{bc}	48.3^{b}	42.2^{c}	48.2^{b}	40.0^{d}
BSM + DSM	**BCT**	48.8^{b}	46.3^{b}	47.0^{b}	42.7^{c}	43.2^{c}	39.8^{d}

$^{a-d}$ Means in any column or row with a common superscript letter do not differ (P>0.05)

The display a* values for each treatment are summarized in Table 4. Ground DSM, fattened with either BCT or YBT, had higher (P<0.05) a* values throughout display than ground BSM. By day 4, a* values of ground DSM round were superior (P<0.001) to ground BSM. The BSM + DSM was intermediate.

Table 4. a* least squares means for ground beef patties sourced from dairy cows (DSM) and beef cows (DSM) formulated to 80% and 90% lean points with young beef trim (YBT) and cow beef trim (CBT)

Treatment		d 1		d 2		d4	
Lean	**Lean**	**80/20**	**90/10**	**80/20**	**90/10**	**80/20**	**90/10**
BSM	**YBT**	27.3^{b}	25.4^{bc}	13.6^{g}	11.8^{h}	10.5^{i}	10.2^{i}
BSM	**BCT**	28.0^{b}	27.7^{b}	17.7^{f}	16.7^{f}	12.1^{g}	13.3^{g}
DSM	**YBT**	29.6^{a}	29.4^{a}	23.4^{d}	25.4^{c}	18.3^{ef}	20.0^{e}
DSM	**BCT**	30.3^{a}	29.9^{a}	27.3^{b}	26.3^{bc}	24.6^{cd}	26.3^{c}
BSM + DSM	**YBT**	29.4^{a}	28.2^{ab}	18.6	20.2^{e}	14.8^{g}	17.8^{f}
BSM + DSM	**BCT**	29.1^{a}	29.2^{a}	22.0^{d}	23.8^{d}	18.9^{ef}	20.2^{e}

$^{b-i}$ Means in any column or row with a common superscript letter do not differ (P>0.05)

Conclusions and implications

Display color is integral to beef salability since is considered to be an indicator of quality and freshness to consumers (Carpenter, Corforth & Whittier, 2001; O'Sullivan et al., 2002). Improved ground beef display color may be possible with the best use of lean and fat from cows of different biological type. Ground dairy cow lean originating from muscles of intermediate color stability has a display color life equal to or better than ground beef cow lean of the same muscle type. Use of BCT for a fat source also improved the color stability of ground beef. The observed color differences between ground BSM and DSM is likely due to the inherent production differences between beef cattle and dairy cattle. We conclude that ground dairy cow lean is as color stable, if not better, than ground beef cow lean providing the dairy cow lean is from reasonably color stable muscle.

References

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