Effects of lactic acid dipped beef trimmings and post-grind age on subjective and objective color of ground beef in retail display.

J. M. Guana[1]; E. N. Mahalitc[2]; J. C. Brooks[2]; M. F. Miller[2]

[1]Zamorano University (SOWER scholar), Food Science and Technology, Tegucigalpa, Honduras.

[2]Texas Tech University, Department of Animal and Food Sciences, Lubbock, TX, 79409

INTRODUCTION

- Color is an indicator of product quality in relation to wholesomeness and eating acceptability of meat.
- Antimicrobial interventions and product age can affect the visual quality of fresh beef.
- Dip application can be effective to reduce pathogens but can affect visual sensory properties. (Ellebracht et al. 1999).
- Lactic acid could be use as an antimicrobial with a dosage of 2% to 4% without unfavorable effects on color (Jimenez J et al. 2003).
- Unacceptable appearance results in economic loss (Melcón et al. 2017).

OBJECTIVE

- To evaluate objective and subjective color of ground beef in retail display produced from lactic acid (2%) dipped beef trimmings aged 7 or 21 d post-grind.

METHODS

- Ground beef (n = 28; 16% fat) representing two treatments (lactic acid dipped (LA) or untreated control (CON) were furthered aged for 7 or 21 d at Texas Tech University, Lubbock.
- After regrinding, 454 g loaf formed samples were overwrapped on polystyrene tray with low-barrier polyvinylchloride film.
- Packages were displayed in a coffin-style retail case maintained at 2– 4 C˚ and continuously exposed to an average of 1900 lux of fluorescent lighting.
- CIE *L**, *a**, *b** values were measured with a handheld spectrophotometer at three random package locations every 12 h for 3 d in retail display.
- Trained panelists (n = 6) evaluated worst-point lean color on an 8-point hedonic scale with half-point increments (1 = very bright red; 8 = tan to brown) following the same timeline as objective color.
- Data were analyzed as a 2 × 2 factorial design using the GLIMMIX procedure SAS with fixed effects of lactic acid treatment, age and their interaction. Treatment least squares means were separated using the PDIFF option of SAS at a significance level of $P < 0.05$.

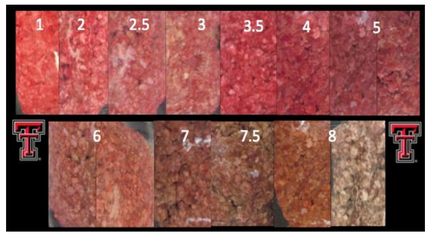

Figure 1. Worst-point lean color scale

Figure 2. Ground beef in retail display

RESULTS

Table 1. LS means for trained panelist worst-point color (n=28) scores of ground beef in retail display (h) of two ages x two treatment (TRT) types.

		Retail Display Length (h)						
Age	TRT	0	12	24	36	48	60	72
7		1.38[a]	1.71[a]	2.96	5.29	4.37[b]	5.17[b]	5.91[b]
21		1.17[b]	1.53[b]	3.2	3.66	6.82[a]	7.67[a]	7.86[a]
SEM		0.05	0.06	0.12	0.08	0.08	0.04	0.05
P - value		0.01	0.04	0.17	< 0.0001	< 0.0001	< 0.0001	< 0.0001
	CON	1.35	1.70	3.02	4.40	5.63	6.47	6.95
	LA	1.20	1.55	3.14	4.56	5.56	6.38	6.82
	SEM	0.05	0.06	0.12	0.08	0.08	0.04	0.05
	P - value	0.06	0.08	0.51	0.19	0.55	0.14	0.07
7	*CON*	1.44	1.81	3.03	3.77[c]	4.46	5.22	6.0
21	*CON*	1.26	1.59	3.02	5.02[b]	6.81	7.72	7.90
7	*LA*	1.32	1.62	2.89	3.56[c]	4.28	5.13	5.82
21	*LA*	1.09	1.47	3.40	5.57[a]	6.84	7.63	7.82
SEM		0.07	0.08	0.19	0.12	0.11	0.06	0.07
P - value		0.75	0.70	0.15	< 0.01	0.36	0.98	0.51

Table 2: LS means for CIE *L**(n=28) values of ground beef in retail display (h) of two ages x two treatment (TRT) types.

		Retail Display Length (h)						
Age	TRT	0	12	24	36	48	60	72
7		57.21[b]	54.85[b]	54.21[b]	54.30	54.15[b]	54.60	54.15
21		58.84[a]	56.36[a]	55.89[a]	54.91	55.38[a]	54.96	54.76
SEM		0.23	0.18	0.27	0.21	0.19	0.26	0.23
P - value		<0.0001	<0.0001	<0.001	0.05	<0.001	0.33	0.07
	CON	57.34[b]	55.36	54.60[b]	54.39	54.55	54.47	54.24
	LA	58.71[a]	55.84	55.50[a]	54.82	54.97	55.09	54.67
	SEM	0.23	0.18	0.27	0.21	0.19	0.26	0.23
	P - value	< 0.001	0.08	0.03	0.16	0.13	0.10	0.19
7	*CON*	56.52	54.37	53.88	54.41[b]	54.02	54.23	54.05
21	*CON*	58.16	56.35	55.32	54.37[b]	55.09	54.71	54.43
7	*LA*	57.90	55.32	54.55	54.20[b]	54.28	54.96	54.26
21	*LA*	59.52	56.36	56.46	55.45[a]	55.66	55.21	55.09
SEM		0.33	0.26	0.39	0.30	0.27	0.36	0.32
P - value		0.97	0.08	0.55	0.04	0.58	0.76	0.50

Table 3: LS means for CIE *a** (n=28) values of ground beef in retail display (h) of two ages x two treatment (TRT) types.

		Retail Display Length (h)						
Age	TRT	0	12	24	36	48	60	72
7		24.12	19.60[a]	17.42[a]	15.81[a]	14.72[a]	13.94[a]	13.24[a]
21		23.89	17.71[b]	14.31[b]	12.54[b]	10.55[b]	10.07[b]	9.63[b]
SEM		0.23	0.20	0.25	0.24	0.17	0.15	0.16
P - value		0.49	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
	CON	23.12	18.55	16.01	14.24	12.45	11.82	11.19[b]
	LA	24.89	18.76	15.72	14.11	12.82	12.19	11.68[a]
	SEM	0.23	0.20	0.25	0.24	0.17	0.15	0.16
	P - value	< 0.0001	0.48	0.44	0.69	0.15	0.09	0.04
7	*CON*	23.58[b]	19.49	17.22	15.88	14.61	13.76	13.09
21	*CON*	22.66[b]	17.61	14.80	12.61	10.30	9.88	9.29
7	*LA*	24.66[a]	19.71	17.62	15.73	14.83	14.11	13.39
21	*LA*	25.12[a]	17.81	13.83	12.48	10.81	10.27	9.96
SEM		0.33	0.29	0.36	0.35	0.24	0.21	0.22
P - value		0.04	0.97	0.07	0.98	0.55	0.93	0.43

Table 4: LS means for CIE *b** (n=28) values of ground beef in retail display (h) of two ages x two treatment (TRT) types.

Item	Retail Display Length (h)						
Age	0	12	24	36	48	60	72
7	16.73	14.37	13.38[a]	12.68	12.50[a]	12.23	12.01
21	17.2	14.07	12.65[b]	12.28	11.64[b]	11.92	12.01
SEM[4]	0.18	0.14	0.16	0.14	0.16	0.16	0.13
P - value	0.08	0.15	< 0.01	0.07	< 0.01	0.20	0.99
TRT							
CON	16.43[b]	13.98[b]	12.88	12.43	11.85	11.95	11.90
LA	17.49[a]	14.46[a]	13.15	12.53	12.30	12.20	12.12
SEM[4]	0.18	0.14	0.16	0.14	0.16	0.16	0.13
P - value	< 0.001	0.03	0.26	0.63	0.06	0.28	0.27

Figure 3. Re-grinding ground beef

Figure 4. Objective evaluation

CONCLUSION

- At subjective evaluations, there was no difference ($P > 0.05$) between treatments, however the interaction between age and treatment differs ($P < 0.05$) at retail hour 36.
- *L** values at retail hour 36 for 21 d LA were higher ($P < 0.05$) than all other interactions. Between treatments, LA had higher ($P < 0.05$) values than CON at hour 0 and 24. Retail hour 60 and 72 had no differences ($P > 0.05$) between age.
- Age × treatment *a** values, with 21 d CON was lower ($P < 0.05$) than all other interactions, which means a less red color. Between treatments, LA appears to be more red ($P < 0.05$) than CON. At hour 12, 7 d was more red ($P < 0.0001$) than 21 d.
- No differences ($P > 0.05$) were found for *b** values between treatments at retail hour 0 and 12. Age 7 had higher values ($P < 0.01$) at hour 24 and 48 than 21 d.

REFERENCES

Ellebracht, E. A, A. Castillo, L. M. Lucia, R. K. Miller, and G. R. Acuff. 1999. Reduction of pathogens using hot water and lactic acid on beef trimmings. J. Food Sci. 64:1094–1099.

J. Jimenez , F. Pohlman , Z. Johnson , Jr. A. Brown. 2003. Effects of chlorine dioxide, cetylpyridinium chloride, lactic acid and trisodium phosphate on physical, chemical and sensory properties of ground beef. Meat Science 65:1055–1062.

C. Melcón, C. Calleja, R. Capita. 2017. Lactic acid concentrations that reduce microbial load yet minimally impact colour and sensory characteristics of beef. Meat Science 129:169-175.

ICFIE