Feeding Extruded Full-Fat Cottonseed or White Tallow as a Source of Fat in Finishing Beef Diets: I. Carcass Characteristics, Lipid Oxidation, Color, and Tenderness

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Abstract

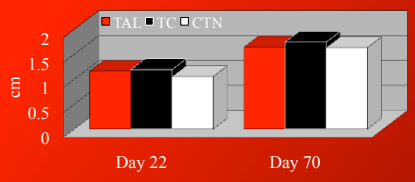
Twenty-one Angus heifers were fed extruded full-fat cottonseed (FuZzy Pellets™) or tallow to examine the effects of finishing diets with various fat sources on carcass, tenderness, and shelf-life characteristics. Heifers were blocked by weight and randomly assigned to one of three total mixed ration finishing diets with 13.0% protein and 7.5% fat, as fed, supplied by: 1) 3.7 % white tallow (TAL), 2) 1.9% white tallow and 12.5% extruded full-fat cottonseed pellets (TC), or 3) 25.0% extruded full-fat cottonseed pellets (CTN). The heifers were individually fed, ad libitum, for 82 d. Live weight and ultrasound composition measurements for rump fat, 12th rib fat, intramuscular fat, and ribeye area were taken on d 22 and d 70. At the end of the feeding period, heifers were transported 47 km to a federally-inspected slaughter facility. After slaughter, carcass characteristics were measured including hot carcass weight, dressing percentage, 12th rib fat, ribeye area, percent kidney, pelvic and heart fat, overall maturity, marbling, yield grade, and objective lean color. The *Longissimus lumborum* was removed from the right side of carcass for further analysis. Five steaks (2.54 cm) were cut, vacuum packaged, and aged for 1, 3, 7, 14, and 21 d for slice shear force determination. As well, four steaks were cut (1.27 cm) for objective color, subjective color, overall appearance, discoloration and lipid oxidation when displayed under retail conditions for 1, 3, 6, and 10 d. Objective color, subjective color, and lipid oxidation analysis was also conducted on ground trimmings (80% lean, 20% fat) for 1, 2, 4, and 7 d of retail display.

Heifer weight and ultrasound rump fat, 12th rib fat, ribeye area, and percent intramuscular fat were greater ($P < 0.01$) after 70 d on feed when compared to 22 d. However, there were no ($P > 0.10$) treatment effects for live weight or ultrasound carcass composition after 22 or 70 d of feeding. Shrunk live weight at slaughter, hot carcass weight, dressing percentage, 12th rib fat, ribeye area, percent kidney, pelvic and heart fat, overall maturity, marbling score, yield grade, and objective lean color were similar ($P > 0.10$) among all treatments. Treatment did not influence ($P > 0.10$) slice shear force. As expected, slice shear force decreased ($P < 0.01$) as post-mortem aging period increased. Diet was not ($P > 0.10$) a factor in panelist scores for subjective color, overall appearance, or discoloration for the steak or ground beef samples, however, as retail display time increased overall acceptance decreased ($P < 0.01$) and discoloration increased ($P < 0.01$). Treatment did not ($P > 0.10$) affect lipid oxidation of ground beef, but, lipid oxidation increased ($P < 0.01$) as retail display increased in ground beef samples. Contrary to the ground beef samples, retail display of steaks did not ($P > 0.10$) affect lipid oxidation. However, TC steaks had increased ($P < 0.05$) lipid oxidation when compared to CTN steaks. Extruded full-fat cottonseed pellets are an acceptable fat source in feedlot finishing diets when compared to tallow.

Table 1. Live animal performance for heifers fed TAL, TC or CTN as the main fat source

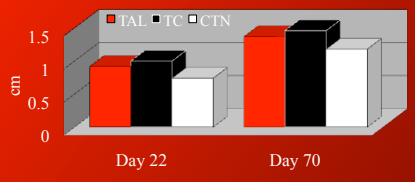
	Fat source		
Trait	TAL	TC	CTN
Gain:Feed	0.24	0.25	0.28
ADG, kg	1.29	1.50	1.40
Weight, kg	505.30	516.49	508.08

Figure 1. Ultrasonic rump fat depth



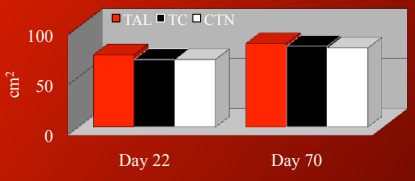
Main effect of day is significant at $P < 0.05$

Figure 2. Ultrasonic 12th rib fat



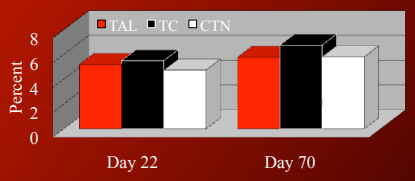
Main effect of day is significant at $P < 0.05$

Figure 3. Ultrasonic ribeye area



Main effect of day is significant at $P < 0.05$

Fig 4. Ultrasonic intramuscular fat



Main effect of day is significant at $P < 0.05$

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Table 2. Carcass characteristics for heifers fed TAL, TC or CTN as the main fat source

	Fat source		
Trait	TAL	TC	CTN
HCW, kg	335.53	342.11	332.97
Dressing percent	63.16	61.91	61.50
Fat thickness, cm	1.38	1.47	1.22
Ribeye area, cm^2	75.07	74.80	73.21
KPH, %	2.29	2.21	2.00
Maturity	A^{77}	A^{77}	A^{79}
Marbling score	Small^{01}	Small^{33}	Slight^{61}
Yield Grade	3.45	3.67	3.34

Table 3. Meat quality attributes for loin steaks from heifers fed TAL, TC or CTN as the main fat source

	Fat source		
Trait	TAL	TC	CTN
Slice shear, kg	4.05	3.82	3.93
In. tenderness[1]	4.79	4.96	5.11
O-all tenderness[1]	4.89	5.07	5.19
Juiciness[1]	5.19	5.13	5.34
Beef flavor[1]	4.86^{b}	4.87^{b}	5.15^{a}
Off-flavor[2]	0.19	0.13	0.25
Thaw loss, %	1.81	1.43	1.63
Cook loss, %	50.47^{a}	46.55^{ab}	42.95^{b}

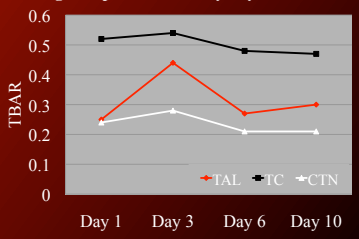
[1]1 = Extremely tough, juicy, or intense; 8 = Extremely tender, juicy, or intense.
[2]0 = No off-flavor detected; 8 = Extreme off-flavor detected

Table 4. Subjective color analysis for loin steaks from TAL, TC and CTN displayed under retail conditions for 1, 3, 6 or 10 days

	Days of display			
Trait	Day 1	Day 3	Day 6	Day 10
Visual color[1]	5.76^{a}	4.89^{b}	4.01^{c}	2.95^{d}
Overall acceptance[2]	6.14^{a}	4.89^{b}	3.40^{c}	2.14^{d}
Discoloration[3]	6.87^{a}	5.82^{b}	4.05^{c}	3.13^{d}

[1]8 = Extremely bright cherry red; 1 = Extremely dark red.
[2]8 = Extremely acceptable; 1 = Extremely unacceptable.
[3]8 = 0% discolored; 1 = 100% discolored.

Fig 5. Lipid oxidation by day for loin steaks



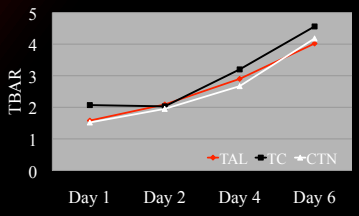
Main effect of fat source is significant at $P < 0.05$

Table 5. Subjective color analysis for ground beef from TAL, TC and CTN displayed under retail conditions for 1, 2, 4 or 7 days

	Days of display			
Trait	Day 1	Day 2	Day 4	Day 7
Visual color[1]	6.95^{a}	5.74^{b}	4.10^{c}	2.12^{d}
Overall acceptance[2]	6.78^{a}	5.91^{b}	3.44^{c}	2.20^{d}
Dis-coloration[3]	7.43^{a}	6.56^{b}	4.64^{c}	2.15^{d}

[1]8 = Extremely bright cherry red; 1 = Extremely dark red.
[2]8 = Extremely acceptable; 1 = Extremely unacceptable.
[3]8 = 0% discolored; 1 = 100% discolored.

Fig 6. Lipid oxidation by day for ground beef



Days on display is significant at $P < 0.05$

Implications

Feeding full-fat extruded cottonseed pellets as the main fat source in finishing beef diets was similar to using tallow or a combination of extruded full-fat cottonseed pellets and tallow. Extruded full-fat cottonseed pellets are an acceptable feed source for beef finishing diets.