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Table 1. Effect of corn distillers solubles inclusion meat quality characteristics.

	CDS[1], %						
	0	9	18	27	36	SEM	*P*-value
Moisture, %	69.52	70.46	69.94	69.87	70.10	0.39	0.56
Fat, %	9.78	8.69	9.46	9.60	9.33	0.46	0.52
Cooking loss, %	18.63	19.65	17.39	18.62	20.34	1.11	0.39
Shear force, kg	2.58	2.72	2.57	2.60	2.74	0.09	0.48

[1]CDS = corn distillers solubles.

Summary

Condensed distillers solubles were fed to cattle at 0, 9, 18, 27, or 36% inclusion. There were no effects on objective steak color, subjective discoloration, Warner-Bratzler shear force, moisture content, fat content, or oxidation values. Diet did not affect polyunsaturated fatty acid levels in meat, but the control diet had higher total unsaturated fatty acids and monounsaturated fatty acids than all other treatments. Feeding condensed distillers solubles to cattle has no detrimental effects on shelf life.

Introduction

Feeding wet distillers grains with solubles to cattle causes an increase in polyunsaturated fatty acids and increased oxidation rates in the meat (*2009 Nebraska Beef Cattle Report*, pp. 110-112; *2009 Nebraska Beef Cattle Report*, pp. 113-115). With increased oxidation rates comes decreased shelf-life and a major loss of steak value. When distillers grains, without solubles, are fed to cattle the same effects can be seen (*2011 Nebraska Beef Report*, pp. 96-99). Little research has been conducted to describe the effects of the solubles portion on beef shelf life. The objective of the current project was to determine if feeding only solubles to cattle would have the same effects on shelf life as when distillers grains are fed.

Procedure

Condensed distillers solubles (CDS) were fed to cattle (n = 250) with inclusion rates of 0, 9, 18, 27, and 36% (DM). No distillers grains were added to any diets. After 132 days cattle were harvested at the Greater Omaha Packing plant in Omaha, Neb. Seventy-five carcasses grading USDA Choice, 15 from each treatment, were selected. Strip loins were wet aged for 14 days and then fabricated. Five steaks were cut from each strip loin.

The first steak, cut 1-in thick, was used for initial Warner-Bratzler Shear Force (WBSF) determination. The second steak, also 1-in thick, was placed on a Styrofoam tray, wrapped with PVC overwrap film, and placed in a retail display case for 7 days. Objective color was measured and subjective discoloration scores were assigned by a 4-member panel daily. At the end of retail display, WBSF was determined. Steaks 3, 4, and 5 were cut ½-inch thick and assigned to 0, 4, or 7 days of retail display, respectively. After retail display these steaks were used to measure oxidation.

Objective color was measured using a Minolta Chromometer CR-400 set at a D65 light source and 2° observer with an 8 mm diameter measurement area. L*, a*, and b* values were recorded using an average of six readings per steak. Subjective discoloration was evaluated based on percentage of surface discoloration (0% indicating no discoloration and 100% indicating complete discoloration of the entire steak) by four trained panelists.

Tenderness was determined using WBSF. Initial weight and temperature were recorded and then steaks were placed on a Hamilton Beach Indoor/Outdoor grill. When steaks reached an internal temperature of 95°F they were turned over and cooked on the other side until they reached an end-point temperature of 160°F. Steaks were removed from the grill, final weight and temperature were recorded and cooking loss was determined. Cooked steaks were covered with plastic wrap and placed in a cooler overnight. The next morning six ½-inch cores were removed from each steak and sheared to determine WBSF.

For oxidation analysis, partially frozen 0, 4, and 7 day steaks were cut into small cubes, flash frozen using liquid nitrogen, and powdered using a Waring blender. A thiobarbituric acid reducing substances assay was used on the powdered samples to measure oxidation.

Powdered samples from 0 day steaks were also used to analyze fatty acid, moisture, and fat content. Gas chromatography was used to determine fatty acid content using a Chrompack CP-Sil 88 (0.25 mm x 100 m) column. Moisture was measured using a LECO thermogravimetric analyzer and fat was measured using an ether extract.

Data were analyzed using the Mixed procedure in SAS (SAS Inst., Inc., Cary, N.C.). Repeated measures was used to analyze color and oxidation data.

Results

Neither dietary treatments nor treatment by day interaction had an effect ($P > 0.10$) on subjective discoloration (Figure 1) or objective color a* (redness) values (Figure 2). There were no differences ($P > 0.10$) in WBSF, cooking loss, moisture or fat due to dietary treatment (Table 1).

(Continued on next page)

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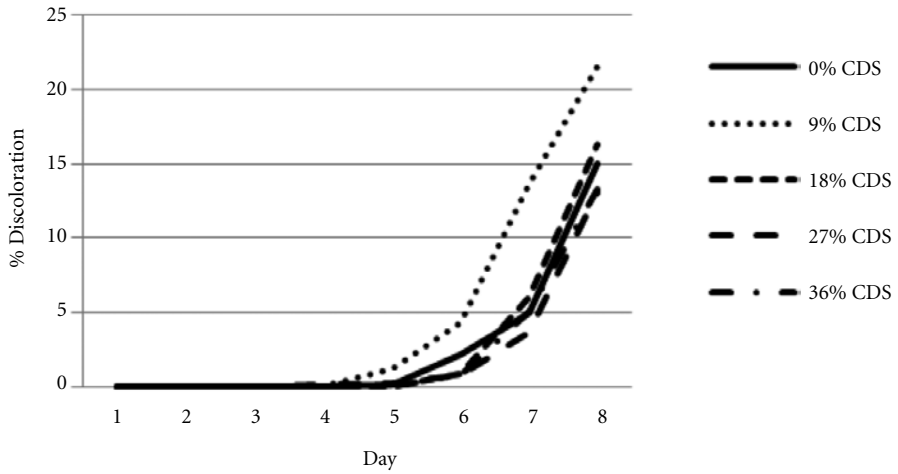


Figure 1. Effect of corn distillers solubles inclusion on subjective discoloration scores during retail display ($P > 0.10$)

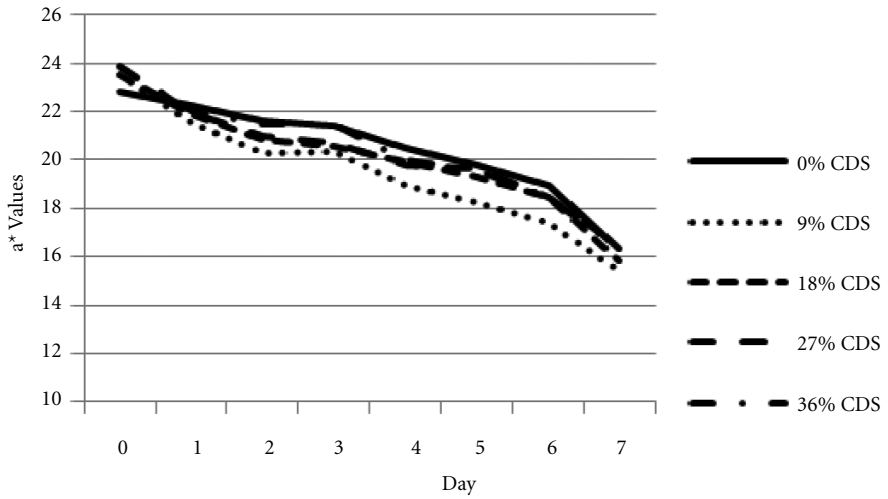
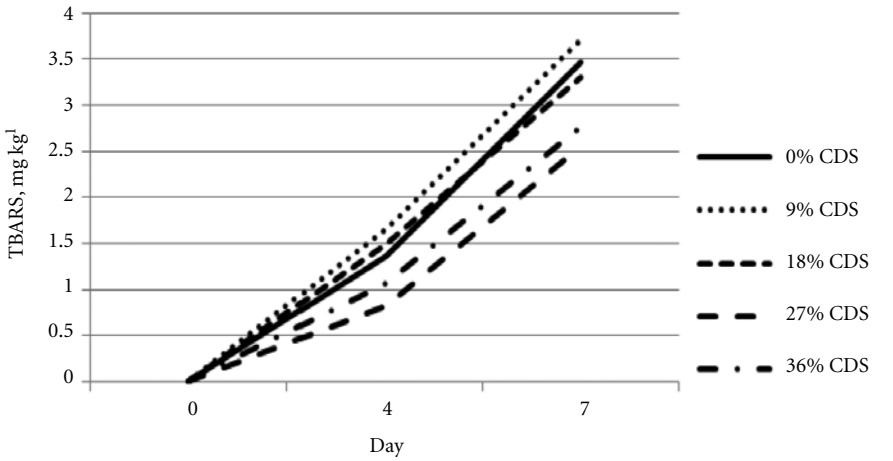


Figure 2. Effect of corn distillers solubles inclusion on a* (redness) values during retail display ($P > 0.10$)



[1]TBARS = Thiobarbituric acid reactive substances.

Figure 3. Effect of corn distillers solubles inclusion on oxidation values during retail display ($P > 0.10$)

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Table 2. Effect of corn distillers solubles inclusion on fatty acid profiles.

	CDS[1], %						
	0	9	18	27	36	SEM	*P*-value
C10:0	0.04	0.04	0.04	0.04	0.04	0.002	0.60
C12:0	0.06	0.06	0.06	0.06	0.06	0.003	0.43
C14:0	2.85	2.90	2.84	3.06	2.91	0.098	0.49
C14:1	0.71	0.63	0.59	0.67	0.59	0.039	0.13
C15:0	0.52	0.52	0.51	0.54	0.51	0.020	0.81
*iso*16:0	0.20	0.24	0.18	0.21	0.18	0.021	0.23
C16:0	25.38	25.41	25.40	25.04	24.52	0.279	0.15
C16:1	3.54[a]	3.44[ab]	3.17[bc]	3.27[abc]	3.04[c]	0.107	0.03
C17:0	1.97	1.59	1.59	1.57	1.48	0.068	0.46
*iso*18:0	0.12	0.14	0.10	0.13	0.11	0.015	0.37
C17:1	1.24[a]	1.13[ab]	1.06[bc]	1.07[bc]	0.95[c]	0.059	0.03
C18:0	12.44[b]	13.51[a]	13.76[a]	13.70[a]	14.11[a]	0.334	0.02
C18:1 *trans*	2.85[c]	2.56[c]	3.51[bc]	4.68[ab]	5.77[a]	0.442	<0.01
C18:1 (*n*-9)	39.13[a]	37.74[ab]	37.58[ab]	36.53[bc]	34.95[c]	0.705	<0.01
C18:1 (*n*-7)	2.35[a]	2.27[a]	2.00[b]	1.85[bc]	1.73[c]	0.069	<0.01
C18:1 Δ13t	0.39[a]	0.15[b]	0.15[b]	0.28[ab]	0.21[b]	0.051	0.01
C18:1 Δ14t	0.25	0.24	0.26	0.27	0.26	0.011	0.33
C19:0	0.09[cd]	0.10[cd]	0.11[c]	0.12[b]	0.13[a]	0.004	<0.01
C18:2 Δ9t,12t	0.09[c]	0.10[b]	0.11[b]	0.13[a]	0.14[a]	0.005	<0.01
C18:2 Δ9c,12c	3.12	3.20	3.10	3.37	3.46	0.131	0.23
C20:0	0.08	0.07	0.07	0.07	0.07	0.006	0.58
C18:3 Δ6c,9c,12c	0.16	0.14	0.15	0.15	0.14	0.008	0.28
C18:3 (*n*-3)	0.16	0.16	0.17	0.16	0.17	0.005	0.16
C20:1	0.22[bc]	0.19[c]	0.23[b]	0.25[b]	0.30[a]	0.013	<0.01
C20:3	0.18[ab]	0.19[a]	0.16[bc]	0.16[bc]	0.15[c]	0.010	0.02
C20:4	0.57	0.66	0.54	0.56	0.50	0.046	0.17
C22:4	0.09	0.10	0.09	0.09	0.08	0.007	0.12
C22:5	0.17	0.13	0.11	0.12	0.10	0.026	0.46
Total FA	97.60[a]	97.19[b]	96.96[bc]	96.91[bc]	96.69[c]	0.122	<0.01
SFA	43.46	44.58	44.67	44.55	44.14	0.459	0.34
UFA	54.14[a]	52.61[b]	52.29[b]	52.36[b]	52.55[b]	0.454	0.04
SFA:UFA	0.81	0.85	0.86	0.85	0.84	0.016	0.20
MUFA	49.60[a]	47.91[b]	47.84[b]	47.62[b]	47.81[b]	0.461	0.03
PUFA	4.55	4.69	4.44	4.74	4.75	0.178	0.68

[1]CDS = corn distillers solubles.
[a,b,c]Means with different superscripts within the same row differ ($P \leq 0.05$).

There were no significant differences ($P > 0.10$) for oxidation due to either dietary treatment or treatment-by-day interaction (Figure 3).

Fatty acid content was the only parameter affected by dietary treatment (Table 2). The control diet had significantly higher levels of total unsaturated fatty acids than all other treatments ($P = 0.04$). Polyunsaturated fatty acid content was unaffected by treatment, but the control diets had significantly higher amounts of monounsaturated fatty acids ($P = 0.03$). Specifically, levels of the monounsaturated fatty acids C16:1, C17:1, C18:1, and C18:1 (*n*-7) (cis-vaccenic acid) were significantly decreased as CDS inclusion increased ($P = 0.03$, $P = 0.03$, $P = 0.004$, and $P < 0.0001$, respectively). Unlike distillers grains, CDS do not affect polyunsaturated fatty acids and therefore the meat is not as affected by oxidation. An isomer of conjugated linoleic acid, C18:2 Δ9t,12t, was found to linearly increase as inclusion of CDS increased ($P < 0.0001$). In summary, feeding CDS to cattle has no detrimental effects on beef shelf life when fed to cattle at inclusion levels as high as 36%.

[1]Kimberly A. Varnold, graduate student; Chris R. Calkins, professor; Asia L. Haack, graduate student; Jerilyn E. Hergenreder, graduate student; Siroj Pokharel, graduate student; Lasika S. Senaratne, graduate student; Anna C. Pesta, graduate student; Galen E. Erickson, professor, University of Nebraska–Lincoln Department of Animal Science, Lincoln, Neb.

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