2013

Effects of Feeding Condensed Distillers Solubles With and Without Oil Extraction on Growing Cattle Performance

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Summary

A growing study compared the effects of condensed distillers solubles (CDS) with and without corn oil removal at 20 and 40% inclusion in a grass hay diet and 40% inclusion in wheat straw or grass diets. Steers responded positively to increasing levels of CDS. Fat content had no effect on ending BW, DMI, or ADG but impacted F:G. Steers fed normal fat CDS had 13.6% greater F:G at 20% inclusion but only 1% greater F:G at 40% inclusion than de-oiled CDS. Normal CDS had greater value at 20% inclusion but at 40% inclusion, oil content likely hindered fiber digestion.

Introduction

Two recent studies conducted at the University of Nebraska–Lincoln have shown that condensed distillers solubles (CDS), which is typically added back to distiller grains, can be the sole byproduct in forage diets for growing cattle (*2009 Nebraska Beef Cattle Report*, pp. 30 and 35). The ethanol industry has the ability to remove a portion of the corn oil from CDS which produces a de-oiled byproduct for the livestock industry. The objectives of this study were to: 1) evaluate CDS with (normal) and without (de-oiled) corn oil at 20% and 40% inclusion; and 2) compare normal fat and de-oiled CDS in a grass diet to a wheat straw diet on growing performance.

Procedure

An 84-day growing trial utilized 60 crossbred steer calves (BW = 530 ± 31 lb) that were individually fed using the Calan gate system. Prior to initiation of the trial, steers were limit fed 50% wet corn gluten feed and 50% grass hay at 2% of BW for five days to minimize gut fill, and then weighed on three consecutive days to determine initial BW. Based on initial BW, steers were stratified and assigned randomly to one of seven treatments within strata. Of the seven treatments (Table 1), five of the treatments were designed as a 2x2+1 factorial consisting of 20% or 40% de-oiled (6.3% fat) or normal CDS (20.1% fat) and a control diet with no CDS (+1). These diets also contained a 80:20 blend of brome hay and sorghum silage (GRASS) that CDS replaced. The last two treatments were designed as a separate 2x2 factorial comparing de-oiled and normal fat CDS with different forage bases of either wheat straw or the GRASS diet in the previous treatments with 40% de-oiled or 40% normal CDS.

The six treatments containing CDS consisted of 8 steers per treatment with the control diet containing 12 steers. All diets were formulated to meet metabolizable protein requirements using the 1996 NRC model. Feed refusals were sampled weekly, weighed, and then dried in a 60°C forced air oven for 48 hours to calculate DMI. At the conclusion of the trial, steers were limit fed for five days receiving the 50% wet corn gluten feed and 50% grass hay diet. Steers were weighed on three consecutive days and averaged to determine ending BW. All diets were formulated to provide 200 mg/steer daily of monensin.

Data were analyzed using MIXED procedures of SAS as a completely randomized design with animal serving as the experimental unit. The 2x2+1 factorial design was analyzed for a fat (de-oiled, normal) by CDS level (20, 40) interaction, and using the control, orthogonal contrasts were used to evaluate level of either

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Table 1. Diet composition on a DM basis fed to growing steers.

	Control	De-oiled CDS[1]		Normal CDS[1]		De-oiled WS[1]	Normal WS[1]
Ingredient, % of DM	0	20	40	20	40	40	40
Brome Hay	77.1	59.6	42.2	59.6	42.2	—	—
Sorghum Silage	19.3	14.9	10.5	14.9	10.5	—	—
Wheat Straw	—	—	—	—	—	55.2	55.2
CDS: De-Oiled	0	20	40	—	—	40	—
CDS: Normal Fat	0	—	—	20	40	—	40
Supplement[2]	3.7	5.5	7.3	5.5	7.3	4.8	4.8
CGM[3]	2.0	3.4	4.8	3.4	4.8	2.5	2.5
Analyzed Composition, %							
Dietary Fat	1.47	2.39	5.15	3.23	8.83	2.91	8.42

[1]CDS = Condensed Distillers Solubles; WS = Wheat Straw.
[2]Formulated to provide 200 mg/steer daily of Rumensin.
[3]Corn gluten meal increases in supplement as CDS inclusion increases in diet.

Table 2. Effects of de-oiled and normal fat CDS fed at 20 or 40% in grass diets.

		De-Oiled		Normal					De-Oiled		Normal Fat	
	0	20	40	20	40	SEM	Int[1]	Fat[2]	Lin[3]	Quad[4]	Lin[3]	Quad[4]
Initial BW, lb	530	532	527	531	528	11	0.94	0.99	0.98	0.76	0.78	0.94
Ending BW, lb	637	702	770	712	783	15	0.93	0.54	<0.01	0.99	<0.01	0.99
DMI, lb/day	12.5	15.3	16.4	14.3	17.1	0.6	0.16	0.85	<0.01	0.14	<0.01	0.36
ADG, lb	1.27	2.01	2.88	2.15	3.03	0.10	0.94	0.21	<0.01	0.66	<0.01	0.93
F:G[5]	9.80	7.58	5.71	6.67	5.65		0.14	0.07	<0.01	0.56	<0.01	0.10

[1]Int = Effect of CDS level and fat content interaction.
[2]Main effect of oil removal.
[3]Lin. = *P*-value for the linear response to CDS inclusion.
[4]Quad = *P*-value for the quadratic response to CDS inclusion.
[5]F:G was analyzed as G:F, the reciprocal of F:G.

Table 3. Effect of forage and 40% distillers solubles (CDS) with or without oil on growing performance.

	40 GRASS		40 Wheat Straw			*P*-values		
	De-Oiled	Normal	De-Oiled	Normal	SEM	Int[1]	Fat[2]	Forage[3]
Initial BW, lb	527	528	527	529	11	0.94	0.89	0.97
Ending BW, lb	770	783	686	674	15	0.43	0.97	<0.01
DMI, lb/day	16.4[a]	17.1[a]	13.4[b]	11.5[c]	0.6	0.06	0.41	<0.01
ADG, lb	2.88	3.03	1.89	1.72	0.10	0.13	0.92	<0.01
F:G[4]	5.71	5.65	6.99	6.76		0.84	0.40	<0.01

[a,b,c]Within a row, means without a common superscript differ.
[1]Int = Effect of fat content and forage type interaction.
[2]Main effect of fat content.
[3]Main effect of forage type.
[4]F:G was analyzed as G:F, the reciprocal of F:G.

de-oiled or normal CDS. The other 2x2 factorial design was analyzed for a fat (de-oiled, normal) by forage type (GRASS or wheat straw) interaction.

Results

The fat contents of the de-oiled and normal CDS were 6.3% and 20.1%, respectively. Crude protein was slightly greater in the de-oiled CDS (28.0%) than in the normal fat CDS (26.4%), suggesting CP or nutrient concentration may slightly increase when corn oil is removed. The sulfur content for the de-oiled and normal fat CDS was 0.99% and 0.83%, respectively. The DM content of de-oiled and normal fat CDS was 27.0 and 27.5%, respectively.

Level of Solubles

Ending BW, DMI, and ADG increased linearly with increasing levels of CDS ($P < 0.01$), but fat content of CDS did not impact ($P > 0.21$) these variables (Table 2). There was a tendency ($P = 0.14$) for an interaction between solubles level and oil content for F:G. Feed conversion was 13.4% improved for normal CDS than de-oiled CDS when both were fed at 20% of the GRASS diet. When fed at 40% of the GRASS diet, feed conversion differed only 1%. When analyzed including the control, the de-oiled level response was linear ($P < 0.01$) while the normal CDS level response tended to be quadratic ($P = 0.10$). We conclude that a biological interaction exists due to a negative impact of dietary oil on fiber digestion at high inclusions of CDS in the diet. Past research has shown that unsaturated fat such as corn oil, is toxic to fiber digesting bacteria.

Forage Type

Analyzing the 2x2 factorial for forage type and oil content, an interaction was observed ($P = 0.06$) for DMI, tended to for ADG ($P = 0.13$), and no interaction for BW or F:G ($P > 0.43$) (Table 3). Dry matter intake was not different ($P = 0.43$) between de-oiled and normal fat CDS in GRASS treatments, but was lower ($P = 0.06$) for normal fat CDS compared to de-oiled CDS in wheat straw diets. Steers fed GRASS diets had greater DMI than either wheat straw treatment ($P < 0.01$). Ending BW was greater for steers fed GRASS diets compared to steers fed wheat straw due to greater ADG. Even though DMI was greater for GRASS diets, F:G was better (5.67) for GRASS fed steers than steers fed wheat straw (6.85). At 40% inclusion, fat content of CDS had no impact on F:G ($P > 0.40$) in either type of diet.

Growing calves fed CDS had greater ending BW and ADG with increasing inclusions of CDS. Fat content of CDS impacted F:G with steers fed the normal fat being 13.4% more efficient at the 20% inclusion level than the steers fed de-oiled diets, but there was no difference between the two at the 40% level of CDS. The response in F:G due to CDS inclusion suggests that oil may have hindered fiber digestion at 40% inclusion of CDS in forage diets.

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