Animal Performance, Storage Losses and Feasibility of Ensiling a Mixture of Tub Ground Low Quality Hay and Condensed Distillers' Solubles for Growing Cattle

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Summary and Implications

The ethanol industry is rapidly expanding. As much as 40% of the energy cost is associated with drying of the feed co-products. Distillers' grains are excellent sources of nutrients for the diets of beef cattle, but have a short shelf life. To expand the use of wet distillers' feeds to more producers, longer term storage methods are required. This study as designed to evaluate and demonstrate methods of preserving these feeds. In September, 2006 eight tons of condensed distillers' solubles were mixed with an equal quantity of tub ground low quality hay and placed in a bunker silo at the ISU Beef Nutrition Farm. This feed was fed to growing cattle for an 85 day backgrounding study and compared to those same feeds mixed daily, and also conventional diets. This study began October 2006 and the final weights were collected in January 2007. Mold was present on the bunker stored forage and continued throughout the experiment. The dry matter of the product (> 60%) and the small bunker size limited our ability to pack and properly exclude air from the feed mass. Performance of cattle fed the ensiled feed was significantly poorer than that of cattle fed the same feeds mixed daily. Storing CDS separately in tanks was superior to mixing with forage and preserving the mixture in a bunker silo under the conditions of this study.

Materials and Methods

Condensed distillers' solubles (32,100 lb.), (CDS) were delivered to the Iowa State Beef Nutrition Farm on Sept. 14, 2006. On Sept. 15 and 18, 16,632 lb. of CDS and 16,557 lb. of tub ground, low quality fescue hay were mixed in 23 mixer-wagon loads, delivered to a small wood sided bunker silo, packed with a skid loader, and covered with plastic. The nutrient analysis of the CDS hay and mixture are shown in Table 1. The remaining CDS was stored in plastic tanks until feeding.

Fifty four predominately Angus steer calves were purchased in Bassett, Nebraska and transported to the ISU Beef Nutrition Research Farm. The calves were vaccinated at the ranch prior to sale with Resvar 4 Somulas, 1 Shot Ultra-7 and treated for internal and external parasites with Dectomax. On arrival at the feedlot calves were vaccinated with Bovi-Shield Gold 5, ear tagged and weighed for allotment. The cattle were then stratified by weight and randomly allotted to nine pens on October 23, 2006. Three pens were each fed one of three diets. The diets consisted of the bunker mixture (Bunker), the same combination of feedstuffs mixed daily (daily mix) and a control ration. The specific diets fed are shown in Table 2. The control ration was formulated to be similar in protein and energy to the two CDS diets. Ration nutrient analyses calculated from ingredients are shown in Table 3.

After 56 days on feed all diets were adjusted to a higher energy level by the addition of approximately 45% corn grain. The diets fed for the last 29 days are shown in Table 4. Nutrient analyses of these diets, calculated from the analyses of ingredients are shown in Table 5. Cattle were weighed on days 28, 56 and 85. Feed consumption was measured on a daily basis. The data were analyzed using the General Linear Models statement of SAS. Means were separated using orthogonal contrasts comparing the content to the two CDS treatments and also the storage methods within the two CDS treatments. Pen was the experimental unit.

Table 1. Nutrient analysis of CDS, hay and 50:50 mixture.

	CDS	Fescue Hay	Mixture
Dry matter	34.2	88.1	63.35
	--------% of Dry Matter--------		
Crude protein	22.6	11.0	14.63
Fat	16.6	1.29	.93
Ash	7.7	---	10.2
Calcium	.09	1.29	.93
Phosphorus	1.23	.29	.58
Magnesium	.50	.22	.34
Potassium	1.75	2.26	1.91
Sulfur	1.11	.20	.48
pH	3.6	---	5.3
Acid detergent fiber		43.2	31.5
Neutral detergent fiber		65.8	47.3

Table 2. Diets fed for first 56 days.

	Control	CDS/hay Mixture (Bunker)	CDS/hay (mixed daily)
	--------% of Dry Matter--------		
CDS/hay mixture	---	92.79	---
CDS	---	---	46.86
Hay	59.238	---	46.86
Corn silage	32.79	---	---
Corn	10.253	5.89	5.89
Soybean meal	10.577	---	---
Molasses	.896	.30	.30
Limestone	---	.67	.67
Salt	.252	.27	.27
TM Premix	.027	.03	.03
Vit A Premix	.038	.04	.04
Rumensin 80	.018	.02	.02

Table 3. Nutrient analyses of diets fed the first 56 days.

Nutrient	Control	CDS/hay Mixture (Bunker)	CDS/hay (mixed daily)
Dry Matter, %	71.5	64.7	62.3
	--------% of Dry Matter--------		
Crude protein	14.2	14.1	13.8
Calcium	.48	1.11	.76
Phosphorus	.32	.58	.53
Magnesium	.22	.32	.28
Potassium	1.90	1.8	2.00
Sulfur	.21	.46	.43

Table 4. Diets fed the last 29 days.

	Control	CDS Mixture (stored)	CDS/hay (mixed daily)
	------------------------------% of Dry Matter--------------------------------		
CDS/hay mixture	---	40.68	---
CDS	---	---	20.34
Hay	33.12	---	20.34
Corn silage	8.32	---	---
Corn	48.48	55.30	55.30
Soybean meal	9.10	2.58	2.58
Molasses	---	---	---
Limestone	.67	.67	.67
Salt	.22	.24	.24
TM Premix	.024	.025	.025
Vit A Premix	.033	.036	.036
Rumensin 80	.017	.018	.018

Table 5. Nutrient analyses of diets fed the last 29 days.

Nutrient	Control	CDS/hay Mixture (Bunker)	CDS/hay (mixed daily)
Dry Matter, %	78.8	74.8	73.6
	-------------------------------% of Dry Matter-------------------------------		
Crude protein	13.5	12.9	12.7
Calcium	.55	.66	.50
Phosphorus	.35	.46	.44
Magnesium	.17	.21	.18
Potassium	1.22	1.03	1.10
Sulfur	.18	.29	.27

Table 6. Cattle Performance.

Item	Control	CDS/hay mixture (Bunker)	CDS/hay (mixed daily)	SE	Contrast: Control vs. CDS	Contrast: Bunker vs. Mixed daily
Initial weight	598	597	596	2.5	NS	NS
28-d weight	679	634	658	6.9	< .01	< .05
56-d weight	742	689	729	4.1	< .01	< .01
Final weight	838	761	829	12.1	< .05	< .01
28-day performance						
Dry matter intake	12.5	11.3	10.8	.07	< .01	< .01
Average daily gain	2.89	1.34	2.23	.20	< .01	< .05
Feed/gain	4.41	8.46	4.92	.46	< .01	< .01
28-56 day performance						
Dry matter intake	17.5	18.2	17.2	.32	NS	< .10
Average daily gain	2.25	1.98	2.52	.23	NS	NS
Feed/gain	8.23	9.26	6.93	.99	NS	NS
56-day performance						
Dry matter intake	15.0	14.8	14.0	.18	< .05	< .05
Average daily gain	2.57	1.66	2.38	.06	< .01	< .01
Feed/gain	5.86	8.91	5.889	.21	< .01	< .01
56-85 day performance						
Dry matter intake	17.1	18.1	18.0	.55	NS	NS
Average daily gain	3.33	2.45	3.46	.35	NS	< .10
Feed/gain	5.28	7.52	5.27	.56	NS	< .05
85-day performance						
Dry matter intake	15.7	15.9	15.4	.28	NS	NS
Average daily gain	2.83	1.93	2.74	.12	< .02	< .01
Feed/gain	5.58	8.23	5.61	.20	< .01	< .01

Results and Discussion

Results of cattle performance are shown in Table 6. Diets for the first 56 days were formulated to NEg of .37 Mcal/lb. of dry matter. At an expected dry matter intake of 15 pounds, this diet was anticipated to produce a daily gain of 1.5 to 1.7 lb. per day. This diet would be consistent with a typical wintering replacement heifer diet from the standpoint of energy concentration. At 56 days additional corn was added to each diet to achieve a NEg of .52 Mcal/lb. of dry matter. This diet would be more consistent with a growing or backgrounding diet and produce a daily gain of 2.5 to 2.7 lb. per day. Also the diets containing CDS for the first 56 days slightly exceeded the National Research Council (NRC) maximum tolerable level for sulfur of .4%. All diets were below .3% S during the last 29 days. Mold was present on the bunker stored forage and continued throughout the experiment. The dry matter of the product (> 60%) and the small bunker size limited our ability to pack and properly exclude air from the feed mass. There was some initial feed refusal, but dry matter intake was not greatly different for the cattle fed the bunker mixture compared to the CDS-hay mixed daily for the first 28 days. Average daily gain, although not greatly different than projected, was significantly less for the cattle fed the bunker mixture compared to the other treatments. Feed efficiency was also poorer for the cattle fed the bunker-stored hay/CDS mixture at 28 and at 56 days on feed. Performance of cattle fed the same feeds mixed daily was not greatly different at 28 and 56 days. These data suggest that spoilage organisms reduced the energy value of the feeds stored in the bunker. Since performance was similar to controls for the CDS hay diet mixed daily, it is suggested that storage spoilage rather than sulfur content was primarily responsible for the reduced performance. Similar results for the last 29 days were observed, although only the reduced feed efficiency of the bunker diet relative to the CDS-hay diet mixed daily were significant ($P < .05$). This suggests that the deletion of the added corn may offset much of the negative performance effects.

Over the course of the study, 30,346 lb. of feed from the bunker was fed. This represents a storage loss of 8.57%. Storage losses of the CDS stored in tanks was not measured. The use of small storage containers, the viscous nature of the material and the necessity to rinse with water for cleaning rendered any storage loss data on the CDS alone in this study impractical. It is our belief that systems that can capture the flush water and return it to the cattle feed would allow storage losses of CDS in tanks to be minimal. Cost of the plastic to cover the bunker was minimal at approximately $3 per ton of complete feed. However, performance differences in this study suggest that costs of installing permanent storage for CDS alone may be justified. It stored at moisture levels in excess of 50%; properly packed and covered mixtures of CDS and dry forage may be stored successfully without major spoilage in storage. This was not achieved in this study.

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Photo Highlights from the ISU Beef Nutrition CDS/Hay Storage Study.