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HAY SUBSTITUTION USING A CONTROLLED RELEASE DISTILLERS DRIED GRAIN SUPPLEMENT

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ABSTRACT: Determining the forage replacement value of a 24.0% CP controlled release distillers dried grain supplement was the basis for this study. Mixed age (3-10 yr.) range beef cows (n=108) were used to evaluate the effect of supplementation that began either 56d before calving or at the onset of calving. The research objective was to determine the substitution effect on potential change in cow weight, body condition score (BCS), 12th rib fat depth, reproductive performance, and calf weaning weight. Control, pre- and post-calving treatment groups consisted of 4 pen replicates of 9 cows per replicate; a total of 36 cows per treatment. The data was analyzed using the generalized least squares procedure of PROC MIXED. Once supplementation was initiated, it was fed continuously until May 1 (89.5d; 56d pre-calving, 33.5d post-calving). During the supplementation periods, and due to the 56d longer pre-calving supplementation period, pre-calving cows consumed the least amount of hay ($P = 0.0001$) and a greater amount of supplement per cow ($P = 0.061$). The post-calving treatment group consumed 41.9% more supplement per head per day overall ($P = 0.055$; 0.2735 vs. 0.3881 kg/day). Cow starting, ending, and overall weight change did not differ ($P = 0.213$), however, weight decline was numerically less among supplemented groups, and ending BCS did not differ ($P = 0.469$). Although ending BCS was not different, ending 12th rib ultrasound fat depth tended to be greater for supplemented cows ($P = .092$). Rebreeding pregnancy performance following pre- and post-calving supplementation did not differ for 1st ($P = 0.564$), 2nd ($P = 0.172$) and 3rd ($P = 0.765$) breeding cycles. The overall pregnancy rate ($P = 0.66$), and the percent of cows that did not become pregnant ($P = 0.62$) during a 63d breeding period also did not differ. At weaning, cow BCS did not differ ($P = 0.825$), weaning weight did not differ ($P = 0.971$), and calf weight gain per day of age did not differ ($P = 0.484$). Using a 24.0% CP controlled release distillers grain supplement as a forage replacement strategy resulted in comparable cow wintering, rebreeding, and calf performance.

KEY WORDS: Distillers Grain, Beef Cows, Forage Replacement

Introduction

Drought in the northern Great Plains region is common and often impacts hay production. Short hay supplies are often addressed by selling cattle and replacing hay shortages with purchased hay, annual forages, and co-products. Considering the readily available supply of corn distiller's dried grain with solubles (**DDGS**), the co-product is an obvious choice for forage replacement in gestating and lactating cow diets. Drying method is a primary factor in determining the overall quality of distiller's grain (Rasco et al., 1989). The nutritional components most affected were protein and NDF. Distillers grains and distillers grains with solubles contain significant amounts of both rumen degradable and rumen undegradable protein and the post-ruminal digestibility of the rumen undegradable protein is generally high (Ingalls, 1994; Stern et al., 1995 and O'Mara et al., 1997). Values for rumen by-pass protein for corn and DDGS are 54 and 47% of the CP value (NRC 1996), however, large variations can be found in the literature (Nakamura et al., 1994a; Grings et al., 1992; Powers et al., 1995). Nakamura et al. (1994a) reported rumen undegradable protein values ranging from 16 to 80% for DDG. Harty et al. (1998) reported rumen degradable protein values for DDGS averaged 53% (range: 40 – 68%) of the crude protein value. Stern et al., (1995) has reported similar values for rumen undegradable protein. Harty et al., (1998) tested DDGS samples and reported in vitro estimates of intestinal digestibility for rumen degradable protein averaging 77%, and ranging from 71 to 94%. Using the mobile bag technique, Ingalls (1994) and O'Mara et al., (1997) documented that the disappearance of individual amino acids in by-pass protein is quite high, ranging from 76 to 84% for corn DDG.

The average nutrient composition of corn DDGS is 29.5% CP, 46.0% NDF, 88.0% TDN, 10.3% fat, 0.32% calcium, 0.83% phosphorus, 1.07% potassium, and 10.56 mg/kg copper, and 0.40% sulfur (NRC 1996). Distiller's gains are used extensively in the cattle feeding industry and are a desirable nutrient source in forage-based cow diets. The relatively high fat content found in DDGS is expected to provide energy for lactation and may also be beneficial with respect to reproductive performance that is independent of caloric content. While dried DGs are considered to be highly desirable nutritionally, the co-product is fine textured and difficult to feed without waste under range conditions. One supplement delivery method is the use of a controlled release lick-tub system (**CR**).

Our research group hypothesized that daily hay dry matter fed to gestating and lactating range beef cows could be replaced with an experimental DDGS-based CR supplement without adversely effecting cow body condition, cow and calf performance, and reproductive performance.

Materials and Methods

All procedures used in this project were approved by the North Dakota State University Institutional Animal Care and Use Committee. Mixed age (3-10 yr.) range beef cows (n=108) were randomly assigned to the following three treatments: 1) all hay control diet, 2) reduced hay diet plus a CR DDGS-based supplement beginning 56d pre-calving, and 3) reduced hay diet plus a CR DDGS supplement beginning at the onset of calving. Each treatment group consisted of 4 pen replicates of 9 cows/replicate; a total of 36 cows/treatment. Supplementation in the post-calving treatment was fed for 33.5 days.

Medium-quality alfalfa-bromegrass mixed hay (*Medicago sativa* and *Bromus inermis*) was fed throughout the study and was delivered to the cows daily using a Haybuster forage processor equipped with electronic scale. The bales fed were core sampled, composited weekly, and analyzed for percent CP, TDN, NDF, ADF, calcium, and phosphorus (Table 1). The CR DDGS supplements were offered continuously from the initiation of each treatment until the cows and their calves were turned out on crested wheatgrass (*Agropyron desertorum*) pasture the first week of May. Prior to the initiation of feeding, the experimental CR supplements were core sampled and analyzed for percent CP, NDF, ADF, IVDMD, IVOMD, calcium, and phosphorus (Table 1).

Table 1. Hay and Supplement Nutrient Analysis

	Alfalfa-Brome Hay DM (%)	*24.0% Controlled Release Suppl. DM (%)*
CP, %	13.3	27.78
TDN, %	51.6	-
NDF, %	58.5	12.85
ADF, %	39.7	2.54
IVDMD, %	-	85.75
IVOMD, %	-	63.39
Calcium, %	0.95	9.62
Phos., %	0.28	1.52

Measurements: Cows were weighed, condition scored, and an ultrasound fat depth measurement that was taken between the 12th and 13th ribs was recorded at the start and end of the supplementation period. During calving, as each calf was weighed and processed, the dam was visually scored for body condition (BCS). Final cow and calf weight, and BCS were recorded at weaning. Cows in the study were bred naturally and breeding cycle pregnancy rate was determined using regression analysis of ultrasound fetal cranial eye socket width.

Statistics: The data was analyzed using the generalized least squares MIXED procedures of SAS (1996).

Results

By design, the supplemented cows that received the CR DDGS supplement consumed less hay than the unsupplemented control cows. Among supplemented cows (Table 2), pre-calving cows consumed the least amount of hay (P = 0.0001; 17.68 vs. 18.10 kg/cow/d) and a correspondingly larger amount of supplement (P = 0.0614; 24.48 vs. 12.97 kg/cow) during the entire supplementation period (56d pre-calving and 33.5d post-calving). The post-calving supplementation group received supplement beginning at the onset of calving and continued until the cows were turned out on crested wheatgrass pasture, a period of 33.5d. Cows in the post-calving treatment consumed less total supplement per cow (P = 0.0614; 24.48 vs. 12.97 kg/cow), but average daily consumption was 41.9% greater (P = 0.055; 0.2727 vs. 0.3872 kg/cow/d) than the pre-calving cows.

Cow starting (P = 0.217), ending (P = 0.433), and weight change (P = 0.217) did not differ between treatments (Table 3); however, cow body weight decline was numerically less among the supplemented groups.

Initial (P = 0.938), calving (P = 0.854), and ending (P = 0.0.469) cow body condition score (BCS) did not differ (Table 3). Although visual BCS evaluation was not sensitive enough to detect a difference between treatments, body condition evaluation based on ultrasound external fat thickness over the 12th and 13th ribs identified a significant ending fat depth difference between control and supplemented cows (Table 3). On average, fat depth decline among the supplemented cows was 23.4% less than the unsupplemented control cows.

Calf performance has been summarized in Table 4. Hay and CR supplement feeding was terminated the first week of May when the cows and their calves were moved to Crestedwheat grass pasture; followed by native range pastures the third week of June. Calf birth weight (P = 0.507), May turnout calf weight (P = 0.872), final weaning weight (P = 0.971) and calf age at weaning (P = 0.381) did not differ.

First (P = 0.564), second (P = 0.172), and third (P = 0.765) breeding cycle pregnancy rates did not differ (Table 5). While breeding cycle pregnancy rates did not differ, there was a numerical 15% fewer number of cows pregnant in the first breeding cycle among cows supplemented pre-calving. The number of open cows (P = 0.620) and the overall percent pregnant (P = 0.66) did not differ between the control and supplemented treatments.

Discussion

This project was conducted during one of the most severe winters in North Dakota history. Multiple blizzards during the March – April calving period resulted in statewide calf death losses of approximately 85,000 head as reported through the North Dakota Extension Service. Calf death loss across all treatments in this experiment was 5.5%.

Corn distiller's dried grains with solubles are very difficult to feed without waste, due to their fine texture, unless the ingredient is included in TMR rations or in other types of limit-fed manufactured feed supplements. The release rate from the experimental 24.0%CP CR supplement used in this evaluation was desirable considering the many nutritional and environmental factors that can impact lick supplement release rate. Ideally, when used as a substitute feed for hay, it would have been more desirable to have a greater release rate/cow/d.

The significantly high consumption/cow/d observed after calving (41.9%) was not expected considering the more consistent consumption level observed among those cows supplemented pre-calving. The greater observed response among the post-calving supplementation treatment would suggest that an acclimation period prior to the onset of calving would be a beneficial management strategy.

Implications

Utilizing a controlled release lick supplement system as a replacement for hay following drought is a very practical and effective way to deliver DDGS to range beef cows with virtually no waste.

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Table 2. Hay Consumption and Controlled Release 24% CP DDGS Supplement Intake

	Control	*Ctrl-Rel DDG Pre-Calving*	*Ctrl-Rel DDG Post-Calving*	*SE*	*P-Value*
Hay Intake:					
Hay, kg/Cow[a]	1616.4[a]	1539.3[b]	1574.7[c]	34.6	<.0001
Hay, kg/Head/Day[a]	18.58[a]	17.68[b]	18.10[c]	0.40	0.0001
Controlled Release Supplement Intake:					
Days Supplement Fed	-	89.75	33.5		
kg/Cow[a]	-	24.48[a]	12.97[b]	4.52	0.0614
kg/Cow/Day[a]	-	0.2727[a]	0.3872[b]	0.072	0.055

[a] Means with unlike superscripts differ ($P < 0.10$).

Table 3. Cow Performance Following Hay Replacement with a Controlled Release 24% CP DDGS Supplement

	Control	*Ctrl-Rel DDG Pre-Calving*	*Ctrl-Rel DDG Post-Calving*	*SE*	*P-Value*
Trial Length, Days	89.25	89.75	89.5	0.263	0.244
Cow Body Weight Change:					
Cow Start Wt., kg	689.4	685.6	679.8	26.24	0.217
Cow End Wt., kg	630.7	640.0	640.9	25.46	0.433
Cow Wt. Gain (Loss), kg	(58.7)	(45.6)	(38.9)	7.44	0.217
Cow Wt. Gain (Loss)/Head/Day, kg	(0.658)	(0.508)	(0.435)	0.084	0.213
% Weight Decline	8.51	6.65	5.72		
Cow Body Condition Score Change:					
Start BCS	6.39	6.42	6.39	0.233	0.938
Calving BCS	6.39	6.47	6.47	0.223	0.854
End BCS	5.75	6.06	5.83	0.317	0.469
BCS Increase or (Loss)	(0.64)	(0.36)	(0.56)	0.133	0.358
% BCS Decline	10.0	5.61	8.76		
Cow Ultrasound Fat Depth Change:					
Start Rib Fat Depth, mm	5.86	5.91	6.03	0.702	0.955
End Rib Fat Depth, mm[a]	3.58[a]	5.09[b]	5.00[b]	0.867	0.092
Rib Fat Depth Inc. (Decline), mm	(2.28)	(0.82)	(1.03)	0.548	0.185
% Rib Fat Depth Decline	38.9	13.9	17.1		

[a] Means with unlike superscripts differ ($P < 0.10$).

Table 4. Calf Performance Following Pre- and Post-Calving Hay Replacement with a Controlled Release 24% CP DDGS Supplement

	Control	*Ctrl-Rel DDG Pre-Calving*	*Ctrl-Rel DDG Post-Calving*	*SE*	*P-Value*
Cow Weight Change:					
Cow Weight at Calving, kg	668.3	682.5	684.1	31.02	0.460
Cow Weight at Weaning, kg	702.2	664.7	677.4	17.94	0.185
Cow Weight Gain (Loss)	33.9	(17.8)	(6.67)		
Weaning Cow BCS	6.22	6.02	6.03	0.248	0.825
Calf Performance:					
Calf Birth Weight, kg	44.6	43.1	43.0	1.06	0.507
Calf May Turnout Weight, kg	77.3	79.4	79.4	3.17	0.872
Calf Age at Weaning, Days	187.8	190.6	193.2	2.44	0.381
Calf Weaning Weight, kg	292.6	292.2	290.6	6.21	0.971
Calf Wt Gain/Day of Age, kg	1.32	1.31	1.28	0.023	0.484

Table 5. Rebreeding Performance Following Pre- and Post-Calving Hay Replacement with a 24% CP DDGS Controlled Release Supplement

	Control	*Ctrl-Rel DDG Pre-Calving*	*Ctrl-Rel DDG Post-Calving*	*SE*	*P-Value*
Breeding Cycle Pregnancy Rate:					
1st Breeding Cycle, %	52.8	38.9	55.1	11.14	0.564
2nd Breeding Cycle, %	23.4	38.9	24.9	5.83	0.172
3rd Breeding Cycle, %	21.3	19.4	13.4	7.85	0.765
Open, %	2.8	2.8	6.7	3.19	0.620
Overall Pregnancy, %	97.2	97.2	93.6	3.13	0.660