Winter Forage Replacement Value Evaluation of a Blended Field Pea-Based Co-Product Supplement Fed to Cows Daily or on Alternate Days

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Abstract

One hundred-seven mixed age cows (3-10 yr.) were randomly assigned to weight blocks, in a 112.5 day study, and fed either an all mixed hay control wintering diet (C) or a mixed hay/wheat straw diet in which the amount of dry matter fed was reduced 25% and replaced with a field pea/co-product supplemented that was fed either daily (D) or on alternate days (Alt-D) at the rate of 0.25% of body. Unsupplemented C cows consumed an average 34.8 lb of mixed hay /cow/day compared to 26.0 lb/cow/day of the mixed hay/wheat straw blend fed to the reduced forage treatment groups. The pelleted supplement contained field peas (70.0% RDP), distiller's dried grain (65.0% RUP), and barley malt sprouts (64.0% RDP).

Ending cow weight, body condition score, and 12th rib fat depth following the 25% forage reduction and replacement with a supplement high in both RDP and RUP did not differ ($P > 0.10$).

Data relating to the effect of treatment on reproductive performance and weaning weight were not completed when this report was prepared. These data will be available in the project final report.

Introduction

Blending co-product ingredients that are high in rumen degradable (RDP) and undegradable protein (RUP), such as that resident in field pea (PEA), distillers dried grains with solubles (DDGS), and barley malt sprouts (BMS), may provide a more consistent supply of nitrogen to the rumen, when used as a replacement supplement for lower quality forage in gestating and lactating beef cow diets.

When PEA, DDGS, and BMS are blended together, a desirable ratio of rumen degradable and undegradable protein occurs. When wet distiller's grains are dried after fermemtation, heating a portion of the degradable protein becomes resistant to rumen degradation and passes to the small intestine where it is digested. By blending a largely RDP ingredient (field pea) with a largely RUP ingredient (DDGS), the resultant supplement, based on recent research published by Atkinson et al. (2009), has potential to be utilized in an alternate-day supplementation regime. Briefly, when supplementation occurs on alternate days, RDP is readily available on the day of supplementation, while RUP (ammonia) is recycled to the rumen on the day of non-supplementation; effectively providing a consistent supply of available nitrogen to the rumen.

Applying this simplified explanation of a complex ammonia feedback system, a blended supplement of PEA (70.0% RDP), DDGS (65.0% RUP), and BMS (64.0% RDP) was used in a 2 x2 factorial arangement of treatments in which two forage reduction levels (0.0% and 25.0%) and two delivery times (daily and alternate day) were evaluated.

Materials and Methods

One hundred-seven mixed age (3-10 year old) range beef cows were randomly assigned to the following treatments (9 cows/pen and 4 pen replicates/treatment):

1. Unsupplemented all hay cow wintering diet (Control)
2. 25% of forage DM replacement with blended RDP/RUP field pea/co-product supplement fed daily at the rate of 0.25% of body weight.
3. 25% of forage DM replaced with a blended RDP/RUP field pea/co-product supplement fed

on alternate days at the rate of 0.50% of body weight (2 x daily rate).

Diets –

Alfalfa-grass mixed hay (10.2% CP) was the only forage fed to the unsupplemented control cows (Table 1). For the supplemented treatment groups that received a 25% forage reduction, alfalfa-grass mixed hay (10.2% CP) and wheat straw (4.7% CP) (Table 1) were fed. Within a 7 day feeding period, alfalfa-grass mixed hay was fed 6 days and wheat straw was fed 1 day. The field pea-co-product supplement (20.8% CP) shown in Table 2 was fed at 0.25% of body weight among the cows receiving supplement daily, and 0.50% of body weight among those cows assigned to receive supplement every other day. Winter ambient temperature and wind speed in North Dakota can fluctuate widely from pleasant temperatures and light wind to strong wind, blizzards, and subzero temperatures. During the 16 week study, the amount of daily dry matter fed was based on the following intake formula (NRC, 1996):

$DMI = ((SBW^{0.75} * (0.04997\ NEm^2 + 0.04361/NEm)\ (TEMP\ 1)\ (MUD\ 1) + 0.2\ Yn)$

DMI is dry matter intake, kg/day.
SBW is shrunk body weight,kg.
NEm is net energy value of diet for maintenance and was set at 1.35 Mcal/kg.
Yn is milk production and was set at +1.23 kg.
MUD did not require adjusting and was set at 1.
TEMP in the equation was adjusted weekly and was based on the local weather forecast for the upcoming week. Adjustments to the NRC dry matter intake formula for declining temperatures were as follows:

Temperature Range	**Dry Matter Increase**
10º F & Above	No Adjustment
5º to10º F	7%
0º F	10%
0º to -10º F	16%
-10º to -20º F	20%

Feeding Periods –

Gestation diets were fed from the first week of January to the 3rd week of March, when wheat straw was removed and the diets were reformulated for lactation. The lactation diets were fed until the wintering phase of the experiment was terminated the last week of April.

Measurements –

Measurements of cow performance include body weight change, body condition score change (BCS), 12th rib fat depth change, the number of cows cycling by the start of the breeding season June 15th, breeding cycle and overall pregnancy rates, and weaning weight. Visual BCS and ultrasound fat depth measurements were collected each time the cows are weighed. The number of cows cycling at the start of a 45 d breeding season will be based on the level of circulating progesterone (analysis of two blood serum samples separated by 10 days) just prior to the start of the breeding season.

Statistical Analysis –

Pen served as the experimental unit. MIXED procedures of the Statistical Analysis System (SAS, 1996) were used to separate means and identify statistical significance.

Results and Discussion

Forage and Supplement Consumption –

Cows in the study consumed the gestation diet for 70 days and the lactation diet for 42.5 days; a total feeding period of 112.5 days. Forage consumption is shown in Table 3. The control cows consumed 3,910 lb of hay (34.8 lb/Head/Day) during the wintering period and the cows that received the reduced forage diets consumed an average 2,708 lb (26.0 lb/Head/Day) of the hay and wheat straw blend (Hay: 20.75 lb + Wheat Straw: 5.3 lb). The daily supplemented cows consumed 371.3 lb of supplement during the wintering period (3.38 lb/cow/day) and the alternate-day group consumed 365.5 lb (6.76 lb/cow/day). Compared to the all hay control diet, cow body weight change, body condition score change, and ultrasound fat depth change did not differ ($P > 0.10$).

Birth Weight and Growth Performance –

Calf birth weight and weight at the end of the wintering phase showed an interesting trend. Compared to the C and Alt-D supplemented treatments, calves from reduced forage dams that were supplemented daily had lighter birth weight ($P < 0.05$) and heavier turnout weight ($P < 0.05$) at the end of the study; however, calves in this group tended to be from 2 to 4 days older.

Estrous Cyclicity –

This progress report was prepared during the post-partum period before the start of the breeding season and blood for serum recovery had not been collected from the cows. This data and reproductive performance will be available in the final report.

Weaning Weight –

The effect of winter treatment on weaning weight will also be summarized in the final report.

Implications

Wintering performance of mixed age range beef cows in which the amount of a mixed hay/wheat straw blend was reduced by 25% and replaced with a field pea/co-product containing both RDP and RUP at the rate of 0.25% of body weight did not effect change in cow body weight, body condition score, and ultrasound fat depth. There is a preliminary indication that forage reduction and daily supplementation may result in lighter birth weight and heavier weaning weight. This will be determined at weaning and reported in the final report.

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Table 1. Mixed Hay and Wheat Straw Nutrient Analysis

Nutrient	***Mixed Hay Dry Matter (%)***	***Wheat Straw Dry Matter (%)***
Dry Matter	84.90	84.40
Crude Protein	10.20	4.70
TDN	52.5	35.0
ADF	39.00	49.20
NDF	57.60	77.06
Calcium	0.93	0.27
Phosphorus	0.17	0.04

Table 2. Field Pea-Co-Product Based Supplement Composition and Nutrient Analysis

Composition		***Nutrient Analysis***		
Ingredient	***Dry Matter (%)***	***Nutrient***	***Dry Matter (%)***	***Mcal/lb***
Field Peas	49.80	Dry Matter	90.28	-
Barley Malt Sprouts	22.00	Crude Protein	22.80	-
Distillers Dried Grain (DDCS)	20.00	ADF	10.52	-
Beet Molasses	5.00	NDF	27.74	-
Dicalcium Phosphate (21%)	2.45	TDN	79.08	-
Salt	0.50	Crude Fat	3.35	-
Trace Mineral Pre-Mix[a]	0.15	Fiber	8.36	-
Vitamin Pre-Mix[b]	0.0250	Starch	29.62	-
		Calcium	0.63	-
		Phosphorus	0.11	-
		NEm	-	0.88
		NEg	-	0.59

[a] Trace Mineral Content: Potassium, % 0.96, Sodium, % 0.42, Chloride, % 0.47, Magnesium, % 0.19, Sulfur, % 0.43, Manganese, ppm 161.28, Iron, ppm 164.58, Copper, ppm, 105.27, Zinc, ppm 371.64, Cobalt, ppm 1.82, Iodine, ppm 8.84.

[b] Vitamin Content: Vitamin E, IU/Lb 22.15, Vitamin A, IU 22.1533, Vitamin D_3 2.2153, Thiamine, Mg/Lb 0.60.

Table 3. Hay, Straw and Field Pea-Based Supplement Consumption

	Control	***Supplemented Daily***	***Supplemented Alternate Daily***	***SE***	***P-Value***
Hay Intake:					
Total Hay Fed, lb	35189.0[a]	20944.0[b]	20964.0[b]	0.74	0.001
Hay, lb/Cow	3910.0[a]	2328.0[b]	2329.3[b]	84.68	0.001
Hay, lb/Cow/Day	34.8[a]	20.7[b]	20.8b[a]	0.74	0.001
Total Straw Fed, lb	-	3411.3	3411.3	7.14	-
Straw/Cow, lb	-	379.0	379.0	0.79	-
Straw/Cow/Day, lb	-	5.3	5.3	0.01	-
Total Hay & Straw/Cow, lb	3910.0	2707.0	2708.3		
Total Forage/Cow/Day, lb	34.8	26.0	26.1	-	-
Field Pea-Based Supplement Intake:					
Total Supplement Fed, lb	-	3342.8	3288.8	-	-
Supplement/Cow, lb	-	371.3	365.5	-	-
Supplement/Cow/Day, lb	-	3.38	6.76	-	-
Percent of Cow Body Wt., %	-	0.249	0.497	-	-

Table 4. Cow Performance Following Hay Replacement with a Field Pea-Based Supplement Fed Either Daily or on Alternate Days

	Control	*Supplemented Daily*	*Supplemented Alternate Daily*	*SE*	*P-Value*
Trial Length, Days	112.5	112.5	112.5	0.41	1.000
Cow Body Weight Change:					
Cow Start Wt., lb	1436.5	1445.8	1443.0	74.15	0.441
Cow End Wt., lb	1362.3	1358.0	1359.0	73.70	0.987
Cow Wt. Gain (Loss), lb	(-74.20)	(-87.8)	(-84.00)	21.04	0.888
Cow Wt. Gain (Loss)/Head/Day, lb	(-0.66)	(-0.78)	(-0.75)	0.188	0.891
Percent Wt. Decline	5.16	6.07	5.82	-	-
Cow Body Condition Score Change:					
Start BCS	6.10	6.00	5.95	0.23	0.810
End BCS	5.39	5.47	5.14	0.34	0.624
BCS Increase or (Loss)	(-0.71)	(-0.53)	(-0.81)	0.12	0.191
Percent BCS Decline	11.64	8.83	13.61	-	-
Cow Ultrasound Fat Depth Change:					
Start Rib Fat Depth, mm	6.42	6.31	6.53	0.67	0.973
End Rib Fat Depth, mm	3.97	4.92	4.67	0.74	0.415
Rib Fat Depth Inc. (Decline), mm	(-2.46)	(-1.39)	(-1.86)	0.47	0.190
Percent Rib Fat Depth Decline	38.16	22.03	28.48	-	-
Calf Birth and Growth Performance:					
Calf Birth Wt., lb.	91.83[a]	87.00[b]	95.35[a]	1.58	0.014
Calf Age on 4-28-2011	25.99	27.14	23.88	1.37	0.062
Calf Wt., on 4-28-2011	154.40	158.10	158.50	5.73	0.688
Calf Wt. Gain, lb	62. 57[a]	71.10[b]	63.15[a]	5.09	0.023
Calf ADG, lb	2.41	2.62	2.64	0.109	0.195