INTERACTION BETWEEN SUPPLEMENTAL PROTEIN AND ENERGY FOR LACTATING BEEF COWS GRAZING DORMANT NATIVE GRASS

T.A. Thrift[1], C.A. Hibberd[2], K.S. Swenson[3] and J. Lee[4]

Story in Brief

Seventy-two fall calving crossbred beef cows were assigned to 12 supplements (6 cows per supplement) providing four levels of protein and three levels of energy to evaluate the interaction between supplemental protein and energy. Cows grazed native grass (3.9% protein, organic matter basis) and were fed supplements individually for the 93-day study. Supplements were formulated using soybean meal and soybean hulls to provide three levels of energy (Low, 2.9 lb Total Digestible Nutrients or TDN/day; Medium, 3.9 lb TDN/day; High, 4.9 lb TDN/day) and four levels of protein (80, 95, 110, 125% of protein requirement). Cow weight (24 hour fast), calf weight (6 hour fast), and body condition scores (1-9 scale) were recorded. Although the probabilities for the protein x energy interactions for changes in cow body weight, body condition and calf gain were intermediate, cows fed higher levels of energy did appear to be more responsive to supplemental protein. For example, cows fed high energy (4.9 lb TDN/day) were more responsive to supplemental protein (.78 lb body weight/lb supplemental protein) than cows fed the low energy supplements (.64 lb body weight/lb supplemental protein). Similarly, calves suckling cows fed high energy (4.9 lb TDN/day) gained .30 lb body weight/lb of supplemental protein compared to .20 lb body weight/lb of supplemental protein at the low energy level (2.9 lb TDN/day). This study suggests that the response to supplemental protein is dependent on the level of supplemental energy. More information is necessary, however, to accurately define this interaction.

(Key Words: Beef Cattle, Native Grass, Supplements, Protein, Energy.)

---

[1]Graduate Research Assistant [2]Professor [3]Agricultural Technician [4]Herd Manager

Introduction

Nutritional management of fall calving beef cows grazing dormant grass presents a major challenge to cow/calf producers in Oklahoma. High nutrient requirements of the cow coincide with low forage quality (forage CP 2-4%) and cold environmental temperatures to make proper nutrition a high priority. Additionally, purchased feed is one of the major costs associated with cow/calf production. Therefore, it is important for producers to utilize supplemental feed efficiently in an effort to maintain profitability.

Supplementation recommendations are obtained by a comparison of forage nutrient intake to nutrient requirements of the cow to determine nutrient deficiencies. A supplement is then developed to satisfy the deficiencies. This system does not consider the initial body condition of cows nor the balance of nutrients required for weight and body condition change. In addition, the nutrient requirements of ruminal microflora are not considered.

Previous supplementation studies have compared energy to protein supplements or have evaluated protein effects at a single energy level. Few have studied the interaction between supplemental protein and energy. The objective of this study was to improve the accuracy of predicting supplemental feed requirements for lactating beef cows by quantifying the interaction between supplemental protein and energy.

Materials and Methods

Seventy-two fall calving crossbred beef cows (average calving date September 29, 1991) were allotted to one of 12 supplementation treatments on December 12, 1991. Cows were allocated to treatment by cow age, calving date and calf sex. All cows were maintained on a 320 acre native grass pasture for the duration of the experiment. In addition to supplement, cows had access to a mineral mix containing trace mineralized salt and dicalcium phosphate.

Supplements were formulated to provide four levels of protein and three levels of energy (Table 1). The four levels of protein provided 80, 95, 110, and 125% of the NRC protein requirements for a 1,100 lb lactating beef cow (forage protein contribution included). Soybean meal was used as the protein source and soybean hulls as the energy source. Dicalcium phosphate, trace mineralized salt and Vitamin A were added to meet NRC (1984) requirements for calcium, phosphorus, and Vitamin A. In addition, sodium sulfate was included to maintain a supplemental nitrogen:sulfur ratio of 12:1. Cows were individually fed their respective weekly allotment of supplement in five feedings (M, T, W, F, S).

Cows were fed 5 lb cottonseed meal/day for five days prior and five days following the trial to equalize fill. Initial and final weights (24 h fast) were

Table 1. Composition, feeding rate and nutrient supply of supplements providing graded levels of protein and energy.

	Low (2.9 lb) TDN				Moderate (3.9 lb) TDN				High (4.9 lb) TDN			
Item	80[a]	95	110	125	80	95	110	125	80	95	110	125
Supplement composition (%, DM basis)												
Soybean meal	21.5	43.8	67.7	92.9	8.0	24.3	41.3	59.1		12.8	26.1	39.7
Soybean hulls	70.4	48.5	24.8		85.3	69.3	52.4	35.0	94.1	81.5	68.4	55.0
Supplement[b]	8.0	7.7	7.5	7.1	6.7	6.4	6.2	6.0	5.9	5.7	5.6	5.3
Feeding rate												
lb DM/day	4.0	3.9	3.7	3.7	5.3	5.2	5.1	5.0	6.7	6.6	6.5	6.3
Nutrient content (%, DM basis)												
CP[c]	22.2	27.6	33.9	43.0	17.3	21.9	28.7	31.7	13.7	19.0	24.6	25.3
TDN[d]	73.1	75.3	77.6	80.2	72.9	74.5	76.2	78.0	72.7	74.0	75.3	76.8
Nutrient supply (lb/day)												
CP[c]	.88	1.07	1.27	1.57	.92	1.14	1.46	1.58	.92	1.25	1.59	1.60
TDN[d]	2.9	2.9	2.9	2.9	3.9	3.9	3.9	3.9	4.9	4.9	4.9	4.8

[a] % of total CP requirement including the estimated CP contribution form the forage.
[b] Molasses, dicalcium phosphate, trace mineralized salt, sodium sulfate, and Vitamin A.
[c] Actual analysis.
[d] Estimated from NRC (1984).

used to evaluate treatment effects over the entire trial. Body condition score (1=emaciated, 9=obese) was evaluated by three independent observers. Calves were weighed after a six hour fast. Diet samples were collected every 21 days with esophogeally cannulated steers to quantify forage quality.

Changes in cow weight, body condition and calf weight were analyzed by least squares procedures with calf sex, level of protein (CP), level of energy (TDN) and calving date (covariate) included in the model. Orthogonal polynomials were used to evaluate treatment responses.

Results and Discussion

The protein content of the native grass used in this study declined from December 12 (4.5% CP) through February 13 (3.4% CP, Figure 1). During the last three weeks of the study, forage protein increased (4.3% CP).

Cow weight loss was decreased with increasing level of supplemental protein (linear, P<.0001) and energy (linear, P=.005, Figure 2). The CP*TDN interaction for cow body weight was intermediate (P=.24). Cows fed the high energy supplements (4.9 lb TDN/day) responded more to level of supplemental protein (.78 lb body weight/lb supplemental CP) than cows fed the low energy supplements (.64 lb body weight/lb supplemental CP). Consequently, cows appeared to be more responsive to supplemental protein at higher levels of supplemental TDN.

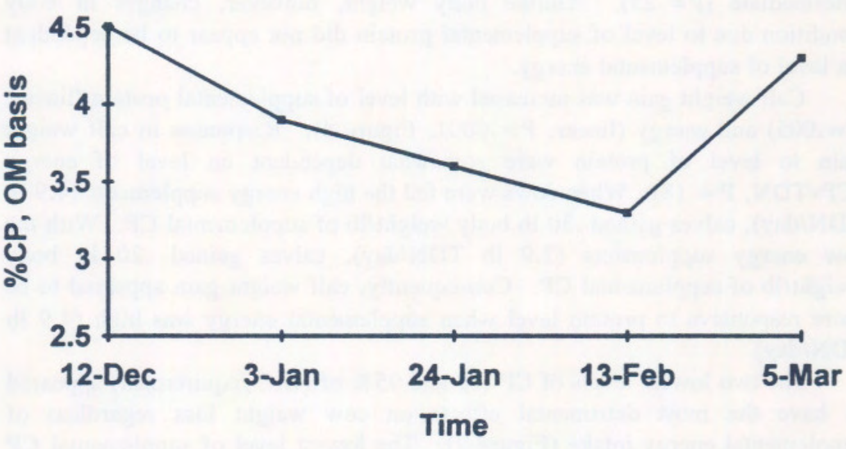

Figure 1. Changes in the protein content (OM basis) of native grass during the study.

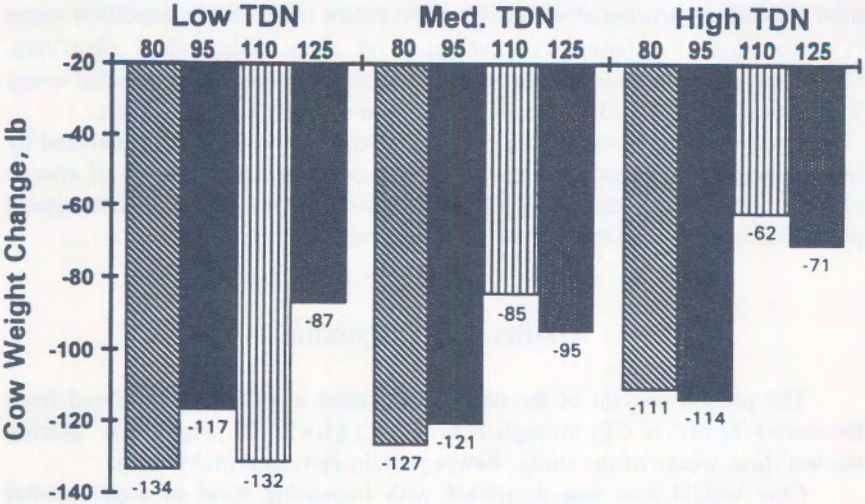

Figure 2. Changes in cow body weight due to level of supplemental energy (Low=2.9 lb TDN/day, Medium=3.9 lb TDN/day, High=4.9 TDN lb/day) and supplemental protein (expressed as a percent of NRC protein requirement).

Cow body condition loss was decreased with increased supplemental protein (linear, P=.07) and energy (linear, P=.11, Figure 3). As with cow body weight, the CP*TDN interaction for cow body condition loss was intermediate (P=.23). Unlike body weight, however, changes in body condition due to level of supplemental protein did not appear to be dependent on level of supplemental energy.

Calf weight gain was increased with level of supplemental protein (linear, P=.005) and energy (linear, P=.0001, Figure 4). Responses in calf weight gain to level of protein were somewhat dependent on level of energy (CP*TDN, P=.18). When cows were fed the high energy supplements (4.9 lb TDN/day), calves gained .30 lb body weight/lb of supplemental CP. With the low energy supplements (2.9 lb TDN/day), calves gained .20 lb body weight/lb of supplemental CP. Consequently, calf weight gain appeared to be more responsive to protein level when supplemental energy was high (4.9 lb TDN/day).

The two lowest levels of CP (80 and 95% of NRC requirement) appeared to have the most detrimental effects on cow weight loss regardless of supplemental energy intake (Figure 2). The lowest level of supplemental CP had the most detrimental effects on calf weight gain (Figure 4), and body condition loss (Figure 3), irrespective of TDN level. Consequently, this study

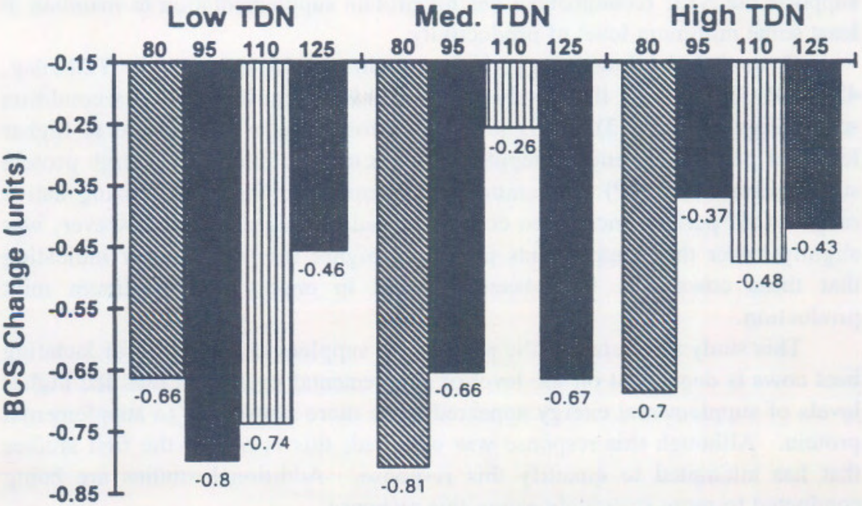

Figure 3. **Effect of level of supplemental energy (Low=2.9 lb TDN/day, Medium=3.9 lb TDN/day, High=4.9 lb TDN/day) and supplemental protein (expressed as a percent of NRC protein requirement) on changes in cow body condition score.**

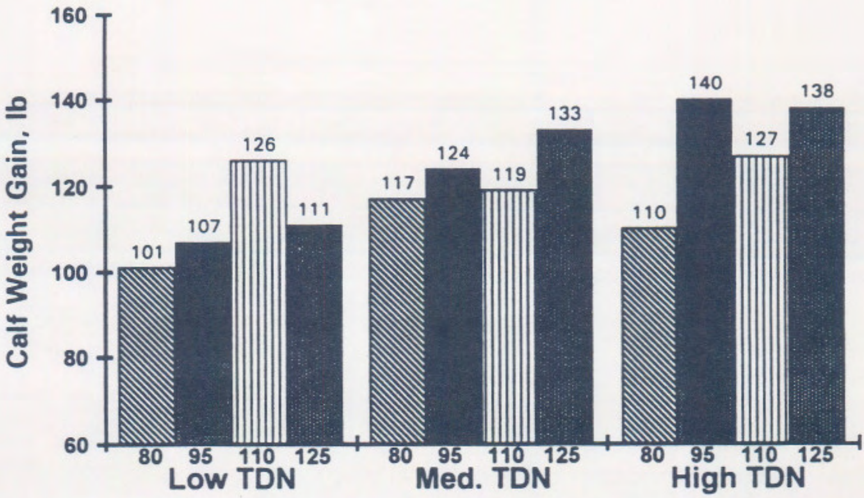

Figure 4. **Calf weight gain in response to level of supplemental energy (Low=2.9 lb TDN/day, Medium=3.9 lb TDN/day, High=4.9 TDN lb/day) and supplemental protein (expressed as a percent of NRC protein requirement) fed to their dams.**

supports the NRC recommendations for protein supplementation to maintain at least some minimum level of productivity.

Cows fed the low energy, high protein supplement (3.6 lb TDN/day, 43% CP) lost only 37 lb of body weight and less than one half of a condition score (Figures 2 and 3). This level of performance is comparable to higher levels of protein and energy supplementation used in this study. High protein supplements (40% CP) are commonly recommended for cows grazing native range. Calf performance when cows were fed this supplement, however, was slightly lower than supplements providing higher levels of energy indicating that these cows may have been deficient in energy for maximum milk production.

This study suggests that the response to supplemental protein for lactating beef cows is dependent on the level of supplemental energy. Cows fed higher levels of supplemental energy appeared to be more responsive to supplemental protein. Although this response was expected, this is one of the first studies that has attempted to quantify this response. Additional studies are being conducted to more accurately assess this response.

Literature Cited

NRC. 1984. Nutrient Requirements of Beef Cattle. National Academy Press, Washington, DC.