Winter protein management during late gestation alters range cow and steer progeny performance

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ABSTRACT: A 4-yr study was conducted at Corona Range and Livestock Research Center, Corona, NM, to establish if a protein-dense self-fed supplement could substitute for a traditional hand-fed (range cube) supplement that is less protein dense and minimize or maintain cow BW and BCS during late gestation and the subsequent steer progeny feedlot performance, health, and economic viability. Late gestation cows received one of 3 supplementation strategies: 1) 36% CP cottonseed meal base supplement (CSM; positive control) fed 3 times per week, 2) self-fed supplement (SMP) comprising 50% animal protein sources (blood meal and feather meal) and 50% trace mineral package, or 3) brief and intermittent supplementation of CSM based on periods of acute environmental stress (VAR; negative control) by ranch management. Initiation of supplementation varied across years due to changing forage conditions and climatically imposed grazing constraints but always ended approximately 2 wks before calving each year. Across all 4 yr, supplement consumption averaged 0.65, 0.21, and 0.04 kg head⁻¹ d⁻¹ for CSM, SMP, and VAR, respectively. After weaning, steers were preconditioned for 45 d and were received and treated as custom fed commercial cattle at a feedlot in mid November each year. Cow BW and BCS were not influenced (P ≥ 0.13) by prepartum supplementation; however, the strategy did have an effect on BW and BCS change with cows managed in the VAR group. Cows managed in the VAR group lost the greatest (P < 0.05) amount of BW and BCS whereas no differences were measured between CSM and SMP groups. Prepartum supplementation strategies did not influence (P = 0.98) pregnancy rates. Calf weaning, initial feedlot and final BW, and HCW were unaffected (P ≥ 0.80) by prepartum supplementation of the dam. Steers from dams fed CSM and VAR had a greater percentage treated for sickness than SMP steers (P = 0.03), which resulted in a tendency (P = 0.07) for medicine costs to be greater in steers from CSM and VAR cows. The use of a self-fed package supplement was equally effective as use of a traditional hand-fed, oilseed-based supplement in maintaining BW and BCS during late gestation. In addition, these results imply that although nutrition treatment of cows during the prenatal period had no effect on calf growth performance, calves from cows fed SMP had improved feedlot health.

Key words: beef cattle, fetal programming, protein supplementation, reproduction

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INTRODUCTION

Cows have the ability to modify energy metabolism during periods of moderate feed restriction and realimentation, which allows for development of management and supplemental strategies in pregnant beef cows (Freetly et al., 2008). In addition, efficiency of N use is increased during these times of nutrient restriction in beef cows (Freetly and Nienaber, 1998). Previous studies have demonstrated that low amounts of supplemental protein, particularly sources high in RUP, may be used efficiently (Coomer et al., 1993;
Sawyer et al., 2012). The use of small quantities of high supplemental RUP ingredients combined with salt and minerals sustained ruminal function with low quality warm season forage diets (Sawyer et al., 2012). Consistent with nutrient dose–response relationships, it was hypothesized that low quantities of a high RUP supplement can minimize BW and BCS loss in mature cows grazing dormant winter range.

Implementation of minimal supplemental protein strategies during late gestation may have the potential to affect postweaning progeny performance. However, the effect of reduced input prepartum range cow nutritional strategies on calf well-being from weaning through the feedlot is not well known. Previous research (Stalker et al., 2006; Larson et al., 2009) has suggested evidence for prenatal influences on steer progeny from cows grazing dormant winter range with and without protein supplementation. However, the extent of management or undernutrition during pregnancy on subsequent calf performance in the feedlot has not been well defined. Therefore, the objective of this study was to establish if a protein-dense self-fed supplement could substitute for a traditional hand-fed (range cube) supplement that is less protein dense and minimize or maintain cow BW and BCS during late gestation and subsequent steer progeny feedlot performance, health, and economic viability.

**MATERIALS AND METHODS**

All animal handling and experimental procedures were in accordance with guidelines set by the New Mexico State University Institutional Animal Care and Use Committee.

This study was conducted over 4 consecutive yr at New Mexico State University Corona Range and Livestock Research Center (CRLRC), Corona, NM. The CRLRC is located in central New Mexico with an average elevation of 1,900 m. Annual precipitation averages 401 mm, with approximately 70% of annual precipitation occurring from May to October. Pastures at this study site were primarily blue grama (Bouteloua gracilis), threeawns (Aristida spp.), and common wolftail (Lycurus phleoides).

**Prepartum Supplementation**

During the 4 yr study, 333 gestating Angus and Angus-cows from 3 to 9 yr of age were used. Each year, cows were stratified by breed and BW at weaning and randomly assigned to 1 of 6 replications or subherds such that subherds contained the same proportion of Angus and crossbred cows. Cows in the study the previous year were reassigned randomly to a treatment regardless of their treatment in the previous year. Each subherd was randomly assigned to 1 of 6 pastures containing 260 to 2,023 ha. Treatments were randomly assigned to each pasture, resulting in 2 subherd replications per treatment within each of the 4 yr. Pastures contained approximately 355 to 674 kg/ha of standing forage and were stocked at a rate that was 50% less than the Natural Resources Conservation Service recommended rate so that forage availability was assumed not to limit cow productivity (USDA-NRCS, 2002). Therefore, harvested forages were not fed during the study.

Due to variation in annual forage conditions and climatically imposed grazing constraints, the duration of the supplementation period strategically varied by year. Supplements were fed for 27, 62, 93, and 51 d, respectively, for yr 1 to 4. In all years, supplementation strategies were initiated when a combination of low temperatures, snow cover, wind duration, decreased cow condition, and trimester of pregnancy contributed to increasing energy requirements. A positive control strategy was developed based on a hand-fed, 36% CP cottonseed meal protein based cubed supplement (CSM; Table 1) fed 3 times per week at a rate of 953 (yr 1), 757 (yr 2), or 454 g·cow−1·d−1 (yr 3 and 4). Consistent with the annual variation in cow and forage conditions, the feeding rate for CSM varied by year. A negative control strategy was also developed, which allowed for brief and intermittent supplementation based on periods of acute environmental stress, such as snow cover, and is best described as variable supplementation (VAR). The VAR strategy, as a negative control, better reflects minimal practices that could be implemented by commercial operations in comparison with a no supplementation strategy that would rarely be found in extensive production settings. This VAR strategy relied on managerial discretion (based on experience) to supply supplement when conditions were determined to be critical for cattle well-being, but the directive was to minimize usage. The VAR strategy used the same batch of supplement formulation as CSM supplement and, when supplied, was always fed twice weekly, at the rate of 454 g·cow−1·d−1. Cows receiving VAR were fed for the equivalent of 10 d in yr 1, 8 d in yr 2, and 0 d in yr 3 and 4. Cows receiving CSM and VAR had ad libitum access to a salt–mineral supplement.

The last strategy used a self-fed supplement (SMP) formulated to contain 50% protein-dense high-RUP source and 50% mineral supplement according to the results found by Sawyer et al. (2012). The mineral portion of the SMP supplement was designed to provide the same level of mineral intake as the ad libitum supplement supplied to cows receiving CSM and VAR treatments. Ingredients for the SMP supplement were mechanically mixed and hand bagged at the CRLRC. Target intake rate of this supplement was 200 g·cow−1·d−1. Feed tubs that contained up to 45.5 kg of SMP were placed within
30 m of the pasture water source. Throughout the study, tubs always contained a minimal quantity SMP and were refilled as needed. The mean intake across years for SMP (weighted by duration of supplementation period) was 202 g-cow\(^{-1}\)d\(^{-1}\).

The rationale for the design of the supplements was taken from the results of Sawyer et al. (2012), a precedent to the current study. The 3 supplementation strategies were aimed at establishing if a protein-dense self-fed supplement targeted for 200 g of consumption per day could substitute for a traditional hand-fed (range cube) supplement that is less protein dense and concentration per day could substitute for a traditional hand-fed supplement targeted for 200 g of consumption per day. Self-fed strategies were aimed at establishing if a protein-dense source was needed to maintain total tract NDF digestion of a low-quality hay. This study took the next step to test if the findings of Sawyer et al. (2012) would recur in an applied-field scale range setting where frequency and delivery method varied.

The 3 strategies can be characterized by differences in feed amount consumed, protein concentration, protein degradability, frequency, and delivery method. However, the objective of the supplementation strategies was to optimize late gestation BW and BCS response to the respective strategy. The supplementation component of the 3 strategies by design were confounded; however, Sawyer et al. (2012) had previously demonstrated that fiber digestion could be similar if a smaller amount of supplement that was more protein dense and less ruminally degradable replaced a greater amount of supplement and protein if fed to cows consuming slowly degradable low quality hay. This study took the next step to test if the findings of Sawyer et al. (2012) would recur in an applied-field scale range setting where frequency and delivery method varied.

Composition of each supplementation was the same over the 4 yr of this study. Supplementation for all strategies ended approximately 2 wk before the expected initiation of parturition based on breeding season dates. Under management conditions in this study, the prepartum supplementation period ended the first week in February each year. Delivery amounts were recorded each week so that total inputs could be determined and consumption per cow on a weekly basis could be calculated for each supplementation strategy. Feed remaining in the open tub feeder for SMP was weighed once a week and subtracted from the amount of feed delivered the previous week to calculate intake. Supplementation rate, duration of supplemental feeding periods, total consumption, and supplemental costs are shown for each supplementation strategy by year for each prepartum treatment in Table 2. Efficiency of supplement use was expressed by the differences in BW change between supplemented of N use due to suspected low ruminal N losses when feeding low levels of supplemental N (i.e., 40 g/d). In addition, Mathis et al. (2000) observed no effect of increased RDP supplementation on intake or digestibility when warm season hay was fed, suggesting that ruminal N supply considered necessary for digestion of slowly fermentable low-quality forages maybe less than generally practiced. If this is true, protein sources greater in RUP used as supplement sources may improve CP use efficiency when fed at low amounts by maintaining a consistent and minimal ruminal N supply and by reducing ruminal and metabolic N losses (Coomer et al., 1993). Because minimal amounts of CP (~40 g/d) were needed to maintain total tract NDF digestion of a low-quality hay (Sawyer et al. 2012), it is likely that protein-dense sources greater in RUP could be added to a self-fed mineral program for ease of delivery and provide an amount of CP for high use efficiency intended for maintenance of beef cows grazing dormant rangeland in extensive environments.

### Table 1. Composition (as-fed basis) of protein supplements consumed by cow grazing dormant native range during the last trimester

<table>
<thead>
<tr>
<th>Item</th>
<th>CSM and VAR</th>
<th>SMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredients, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>56.94</td>
<td>–</td>
</tr>
<tr>
<td>Urea</td>
<td>1.20</td>
<td>–</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>21.45</td>
<td>–</td>
</tr>
<tr>
<td>Corn gluten meal</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Porcine blood meal</td>
<td>–</td>
<td>25.00</td>
</tr>
<tr>
<td>Hydrolyzed feather meal</td>
<td>–</td>
<td>25.00</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>10.00</td>
<td>–</td>
</tr>
<tr>
<td>Dried distillers grain</td>
<td>–</td>
<td>1.00</td>
</tr>
<tr>
<td>Molasses</td>
<td>9.00</td>
<td>–</td>
</tr>
<tr>
<td>Salt</td>
<td>–</td>
<td>19.35</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>0.95</td>
<td>2.00</td>
</tr>
<tr>
<td>Monocalcium phosphate</td>
<td>0.30</td>
<td>22.50</td>
</tr>
<tr>
<td>Manganese sulfate</td>
<td>0.06</td>
<td>0.15</td>
</tr>
<tr>
<td>Magnesium oxide</td>
<td>–</td>
<td>3.30</td>
</tr>
<tr>
<td>Trace mineral premix</td>
<td>0.02</td>
<td>1.25</td>
</tr>
<tr>
<td>Copper sulfate</td>
<td>0.01</td>
<td>0.20</td>
</tr>
<tr>
<td>g/d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP</td>
<td>221</td>
<td>89</td>
</tr>
<tr>
<td>RDP</td>
<td>163</td>
<td>25</td>
</tr>
<tr>
<td>RUP</td>
<td>58</td>
<td>65</td>
</tr>
</tbody>
</table>

1 CSM = CSM = 36% CP cottonseed meal base supplement fed 3 times per week. SMP = self-fed supplement comprising 50% animal protein sources (blood meal and feather meal) and 50% trace mineral package. VAR = brief and intermittent supplementation of CSM based on periods of acute environmental stress.
(CSM and SMP cows) and unsupplemented strategies (i.e., relative to VAR). The efficiency of supplement use was calculated as follows: [BW change between supplemented cows (CSM or SMP) – BW change of VAR cows]/kg of supplement fed.

Cows were weighed at weaning (October), initiation of the supplementation period, and termination of the supplementation period (February). Body condition scores (1 = emaciated and 9 = obese; Wagner et al., 1988) were assigned at these periods to each cow by visual observation and palpation by 2 trained technicians.

After the termination of the prepartum treatments, all cows were managed together in the same pasture. A 60-d breeding season was used in all years and was initiated in early or mid May with all cows managed as a single herd. Cows were exposed to fertile bulls at a ratio of approximately 1:25. Initiation of breeding occurred on average 65 ± 2 d postpartum across all years. Cows were fed CSM for 55 ± 2 d after calving at a rate of 908 g/d 3 times per week. At weaning, cows were diagnosed pregnant by rectal palpation.

**Calf Performance**

After weaning, all calves were preconditioned, conforming to Value Added Calf-45 management guidelines (Anonymous, 2005). Steers (n = 103) were entered into the New Mexico Ranch to Rail Program. Steers were fed at a commercial feedlot (Double A Feeders, Clayton, NM). Initial BW for the finishing phase was calculated from the final BW from the backgrounding phase. Each year, weaning prices were individually applied to each calf based on prices in the New Mexico Weekly Weighted Average Feeder Cattle Report (USDA CB LS 795) for the week steers were weaned.

Steers were received and processed as custom fed commercial cattle at the feedlot in mid November each year and were managed according to the procedures in place at the feedlot. Due to limited number of steers each year and treatment application occurring in utero, from birth on, steers across all prepartum treatments were commingled and managed together (during preconditioning and feedlot phases). Because only the steers in the current study were commingled across treatments in 1 feedlot pen each year, every steer had equal opportunity to be exposed to and challenged to the same factors that could initiate morbidity, thus eliminating any confounding environmental factors that are intimately associated with pen effects. Therefore, any differences in feedlot performance were due to an in utero treatment effect and truly reflected the ability of the steer to cope with the stress of the commercial feedlot environment. Steers were fed a step up diet for approximately 21 d before receiving a high concentrate finishing diet formulated by the commercial feedyard. Each year, experienced feedlot staff (individuals varied) diagnosed morbidity by subjective visual appraisal in compliance with the current feedlot policy. At receiving, all steers were administered a growth-promoting implant (Component ES, VetLife Inc., Overland Park, KS) and preventive pharmaceuticals based on feedlot management procedures. Steers were processed for a secondary application of growth implant at d 74 to 94 of the feedlot phase. At this time, an interim BW was recorded and steers were individually assigned to a marketing group using ultrasound technology and computer software from the Cattle Performance Enhancement Co. (Oakley, KS). Steers were harvested in a commercial facility (National Packing Co., Liberal, KS). Hot carcass weight was recorded at slaughter and carcass traits were evaluated by an independent data collection service (Cattle Trail LLC, Johnson, KS) after chilling. Steers were sold through the National Beef Grid and premiums and discounts were applied using HCW, USDA yield, and quality grade. Net

<table>
<thead>
<tr>
<th>Item</th>
<th>Prepartum supplementation1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CSM</td>
</tr>
<tr>
<td><strong>Yr 1</strong></td>
<td></td>
</tr>
<tr>
<td>Cows, n</td>
<td>28</td>
</tr>
<tr>
<td>Rate, g/d</td>
<td>953</td>
</tr>
<tr>
<td>Duration, d</td>
<td>27</td>
</tr>
<tr>
<td>Total fed, kg</td>
<td>25.7</td>
</tr>
<tr>
<td>Supplementation cost2, $/cow</td>
<td>11.54</td>
</tr>
<tr>
<td><strong>Yr 2</strong></td>
<td></td>
</tr>
<tr>
<td>Cows, n</td>
<td>26</td>
</tr>
<tr>
<td>Rate, g/d</td>
<td>757</td>
</tr>
<tr>
<td>Duration, d</td>
<td>62</td>
</tr>
<tr>
<td>Total fed, kg</td>
<td>46.9</td>
</tr>
<tr>
<td>Supplementation cost2, $/cow</td>
<td>21.57</td>
</tr>
<tr>
<td><strong>Yr 3</strong></td>
<td></td>
</tr>
<tr>
<td>Cows, n</td>
<td>36</td>
</tr>
<tr>
<td>Rate, g/d</td>
<td>454</td>
</tr>
<tr>
<td>Duration, d</td>
<td>93</td>
</tr>
<tr>
<td>Total fed, kg</td>
<td>42.2</td>
</tr>
<tr>
<td>Supplementation cost2, $/cow</td>
<td>20.94</td>
</tr>
<tr>
<td><strong>Yr 4</strong></td>
<td></td>
</tr>
<tr>
<td>Cows, n</td>
<td>22</td>
</tr>
<tr>
<td>Rate, g/d</td>
<td>454</td>
</tr>
<tr>
<td>Duration, d</td>
<td>51</td>
</tr>
<tr>
<td>Total fed, kg</td>
<td>23.2</td>
</tr>
<tr>
<td>Supplementation cost2, $/cow</td>
<td>11.48</td>
</tr>
</tbody>
</table>

1CSM = CSM = 36% CP cottonseed meal base supplement fed 3 times per week. SMP = self-fed supplement comprising 50% animal protein sources (blood meal and feather meal) and 50% trace mineral package. VAR = brief and intermittent supplementation of CSM based on periods of acute environmental stress.

2Winter supplementation cost = cost of protein supplementation + cost of mineral supplementation.
profit was calculated from the finishing net income.

**Statistical Analysis**

Normality of data distribution and equality of variances of measurements were evaluated using PROC UNIVARIATE, the Levene test, and PROC G PLOT, respectively. Prepartum supplementation cow performance data (cow BW, BW gain, BCS, and BCS change) were analyzed as a completely randomized design with a 3 × 4 arrangement of supplement and year (main effects) using the MIXED procedure (SAS Inst. Inc., Cary, NC) to test all main effects and all possible interactions with pasture within year as the experimental unit. The model included fixed effects of supplement, year, and their interaction using the Kenward-Roger degrees of freedom method. Differences in pregnancy rates were analyzed using logistic regression (PROC GLIMMIX of SAS) using a model that included the fixed effects of prepartum supplementation strategy, year, and their interactions. Calf performance data was analyzed as a completely randomized design with a 3 × 4 arrangement of cow prepartum supplementation strategy and year (main effects) using the MIXED procedure of SAS with pasture within year as the experimental unit. Categorical [carcass quality grade and yield grade, and calf feedlot morbidity] data were analyzed using the PROC GLIMMIX procedure of SAS using the same model as described previously. A binomial distribution was assumed for categorical data, with the ILINK option of the LSMEANS statement used to calculate least square means for the proportions.

**RESULTS AND DISCUSSION**

**Prepartum Supplementation**

No significant year × supplementation strategy interactions were observed (P > 0.10). The lack of year × supplementation strategy interactions indicates that a strategic method to supplementation each year did not add variation due to differences in duration or rate of supplement consumption and that cows responded to these strategies consistently across years. Additionally, the lack of interaction indicates that any differential responses due to annual variation in feeding rate or supplementation duration would be entirely explained by main effect terms.

Cows assigned to different strategies had similar BW before the study at weaning (P = 0.54; Table 3) and gained BW from weaning until the beginning of supplementation; therefore, BW at the initiation of supplementation was similar among treatments (P = 0.38). Supplementation strategy influenced BW change during the winter supplementation period (P = 0.01). Cows receiving CSM or SMP exhibited similar BW changes, essentially reflecting BW maintenance. However, cows receiving VAR supplement strategy lost BW during the supplementation period. These results indicate that nutrient limitations existed during this period and that these deficiencies were corrected by provision of either CSM or SMP. Body condition score was similar at the initiation and termination of supplementation (P ≥ 0.13); however, BCS change was affected (P = 0.05) by treatments. Cows receiving CSM or SMP maintained BCS during the supplementation period whereas cows receiving VAR lost condition. Pregnancy rates were unaffected (P = 0.98) by prepartum supplementation strategy. Stalker et al. (2006) and Larson et al. (2009) also found no difference in pregnancy rates in protein supplemented and unsupplemented strategies during late gestation.

In this study, both CSM and SMP were effective at maintaining cow BW and condition during late gestation in an extensive, large pasture environment. This study supports the finding of Sawyer et al. (2012) that concluded 40 g/d of CP had similar N retention and total tract digestibility (NDF and DM) as 160 g/d of CP.

**Table 3. Effects of supplementation type on reproduction, BW, and BCS in gestating cows grazing native dormant range**

<table>
<thead>
<tr>
<th>Item</th>
<th>Prepartum supplementation1</th>
<th>SEM2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow BW, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaning3</td>
<td>468</td>
<td>472</td>
<td>481 9 0.54</td>
</tr>
<tr>
<td>Initiation of supplementation</td>
<td>509</td>
<td>516</td>
<td>531 9 0.38</td>
</tr>
<tr>
<td>End of supplementation</td>
<td>515</td>
<td>518</td>
<td>517 11 0.98</td>
</tr>
<tr>
<td>BW change, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial BW to final BW</td>
<td>6a</td>
<td>2a</td>
<td>–14b 3 0.01</td>
</tr>
<tr>
<td>Cow BCS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaning3</td>
<td>4.4</td>
<td>4.9</td>
<td>4.9 0.2 0.13</td>
</tr>
<tr>
<td>Initiation of supplementation</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0 0.1 0.41</td>
</tr>
<tr>
<td>End of supplementation</td>
<td>5.1</td>
<td>5.0</td>
<td>4.5 0.2 0.13</td>
</tr>
<tr>
<td>BCS change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial BCS to final BCS</td>
<td>0.1a</td>
<td>0.0a</td>
<td>–0.5b 0.1 0.05</td>
</tr>
<tr>
<td>Pregnancy rate, %</td>
<td>95</td>
<td>94</td>
<td>94 0.7 0.98</td>
</tr>
</tbody>
</table>

Note: Means with different superscripts differ (P ≤ 0.05).

1CSM = 36% CP cottonseed meal base supplement fed 3 times per week. SMP = self-fed supplement comprising 50% animal protein sources (blood meal and feather meal) and 50% trace mineral package. VAR = brief and intermittent supplementation of CSM based on periods of acute environmental stress.

2SE of treatment means; n = 2 pastures per treatment.

3Before supplementation.
However, the supplements were used with different efficiencies. Efficiency of supplement use can be expressed as the difference in BW change between supplemented and unsupplemented strategies (i.e., relative to VAR) per unit of supplement fed. Using this calculation, CSM was used with an efficiency of 0.57 kg BW spared/kg supplement fed. The SMP supplement was used with an efficiency of 1.32 kg BW spared/kg supplement consumed, a 132% increase in apparent use efficiency of 1.32 kg BW spared/kg supplement consumed, and unsupplemented strategies (i.e., relative to VAR) per unit feed costs for SMP. Applying the unit feed costs for CSM, SMP, and VAR to the total consumption pooled across years results in per cow costs of US$16.39, $9.19, or $3.31/cow, respectively. Because cows receiving VAR failed to maintain BW, SMP was the most economical strategy for BW maintenance in this study. However, cows receiving VAR lost only 14 kg during the study with no difference in pregnancy rates; therefore, protein supplementation during late gestation in environmental conditions similar to conditions in this study may not be warranted to alter pregnancy rates.

**Calf Performance**

Calf weaning BW was not influenced ($P = 0.99$; Table 4) by the gestation supplementation strategy of the dam. Larson et al. (2009) reported that protein supplementation during late gestation increased calf weaning BW. After a 45-d postweaning precondition period, steer entry feedlot BW was not different ($P = 0.80$) among the gestation treatment of the dam. Similarly, steer final BW was unaffected ($P = 0.81$) among cow prepartum treatments, resulting in no difference in ADG throughout the finishing phase ($P = 0.46$). Stalker et al. (2006) found similar results when beef cows were either supplemented or not supplemented during gestation. However, Larson et al. (2009) reported a tendency for steers from protein supplemented cows to have heavier final feedlot BW and HCW than calves from cows receiving no protein supplementation.

Calves from SMP supplemented dams were treated for respiratory disease less during the finishing phase than calves from CSM and VAR dams ($P = 0.03$; Table 4). However, death loss was unaffected ($P = 0.89$) by the gestation treatment of the dam. Economic losses resulting from morbidity and mortality associated with respiratory disease in newly weaned or received cattle are problematic for the feeding industry (Galyean et al., 1999). Medicinal costs and percentage of steers treated in the feedlot can have a substantial effect on feedlot net income. Therefore, reduced medicine costs and fewer calves treated will impact profitability. Feedlot morbidity may cost more than mortality when expenses associated with medical treatments are combined with reduced income of chronic cattle due to premature sale and reduced performance during and after illness (Smith, 1998). McNeill et al. (1996) reported that “healthy” calves had greater daily BW gains and 12% more kilograms of lamb weaned per ewe. Larson et al. (2009) reported more calves from non-protein-supplemented cows received treatment for bovine respiratory disease between weaning and slaughter.

**Table 4. Effects of dam supplementation strategy during the last trimester on calf performance from weaning through the finishing phase**

<table>
<thead>
<tr>
<th>Item</th>
<th>Prepartum supplementation1</th>
<th>SEM2</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning BW, kg</td>
<td>CSM</td>
<td>SMP</td>
<td>VAR</td>
</tr>
<tr>
<td>Feedlot performance</td>
<td>Initial BW, kg</td>
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<td>276</td>
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<td></td>
<td>Final BW, kg</td>
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<td></td>
<td>ADG, kg</td>
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<td>DOF3</td>
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<td>164</td>
</tr>
<tr>
<td></td>
<td>% treated for sickness</td>
<td>48a</td>
<td>16b</td>
</tr>
<tr>
<td></td>
<td>% death loss</td>
<td>4.1</td>
<td>4.6</td>
</tr>
</tbody>
</table>

a,bMeans with different superscripts differ ($P ≤ 0.05$).

1CSM = 36% CP cottonseed meal base supplement fed 3 times per week. SMP = self-fed supplement comprising 50% animal protein sources (blood meal and feather meal) and 50% trace mineral package. VAR = brief and intermittent supplementation of CSM based on periods of acute environmental stress.

2SE of treatment means; n = 2 pastures per treatment.

3DOF = total number of days cattle were on feed.
Table 5. Effects of dam supplementation strategy during the last trimester on carcass traits in steer progeny

<table>
<thead>
<tr>
<th>Item</th>
<th>Prepartum supplementation</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CSM</td>
<td>SMP</td>
<td>VAR</td>
</tr>
<tr>
<td>HCW, kg</td>
<td>318</td>
<td>323</td>
<td>322</td>
</tr>
<tr>
<td>Dressing percentage</td>
<td>62.89</td>
<td>62.89</td>
<td>63.06</td>
</tr>
<tr>
<td>Marbling score</td>
<td>458</td>
<td>487</td>
<td>487</td>
</tr>
<tr>
<td>12th-rib fat, cm</td>
<td>1.38</td>
<td>1.42</td>
<td>1.36</td>
</tr>
<tr>
<td>LM area, cm²</td>
<td>80.86</td>
<td>82.29</td>
<td>80.54</td>
</tr>
<tr>
<td>Yield grade</td>
<td>2.7</td>
<td>2.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Choice or greater, %</td>
<td>33</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>Select, %</td>
<td>67</td>
<td>56</td>
<td>44</td>
</tr>
</tbody>
</table>

1CSM = 36% CP cottonseed meal base supplement fed 3 times per week. SMP = self-fed supplement comprising 50% animal protein sources (blood meal and feather meal) and 50% trace mineral package. VAR = brief and intermittent supplementation of CSM based on periods of acute environmental stress.

2SE of treatment means; n = 2 pastures per treatment.

3Dressing percentage = HCW/final unshrunk BW.

4Marbling score: 500 = small.

The use of a self-fed package supplement (i.e., SMP) was equally effective to a traditional hand-fed, oilseed-based supplement. The small package supplement was used with greater use efficiency with less winter supplementation cost. Although either supplement (CSM or SMP) might serve to mitigate production risk through reduced BW and condition losses, SMP supplement was more efficacious at optimizing the supplementation cost. However, late gestation supplementation strategy had no effect on pregnancy rates or pre- and postnatal calf growth and lifetime BW gain. It is likely that severe environmental stresses during gestation might play a bigger role in calf performance than the range of nutritional regimes reported here. However, this study does reveal that calves born from dams provided a high RUP supplement, consumed at relatively low quantities, were treated less for sickness and had decreased feedlot costs. This implies that there may be nutrient or ingredient formulations for range prepartum supplements that have positive effects on calf health and performance. In conclusion, considering the cost for prepartum supplementation and potentially reduce calf costs in the feedlot, feeding SMP during gestation appears to be a viable alternative to more conventional methods and reduces winter feed costs and decreases calf feedlot morbidity.

LITERATURE CITED


