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Delaying Postpartum Supplementation in Cows Consuming Low-Quality Forage Does Not Alter Cow and Calf Productivity

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Abstract

Reducing the amount of supplemental feed postpartum without affecting productivity may enhance profitability of cow-calf operations. Therefore, sixteen 2-yr-old fall calving cows were used to evaluate effects of delaying postpartum supplementation on milk production, serum metabolites, and cow and calf BW change. Cows were stratified by calving date and randomly assigned to one of two treatments: 908 g/d of a 46% CP supplement beginning 5 d postpartum (Supp5, n = 7); or 908 g/d of the same supplement beginning 30 d postpartum (Supp30, n = 9). Supplements were formulated to provide 425 g/d of CP with 225 g coming from ruminally undegradable protein (RUP), and were fed twice weekly. Cows were daily fed 8.2 kg chopped sudangrass hay (5.5% CP, 74% NDF, OM basis) during lactation. Cows and calves were weighed before feeding on two consecutive days on d 0, d 30, and d 80 postpartum. Milk production and constituents were evaluated on d 90. Cow BW was not different at d 0 ($P = 0.21$) and 80 ($P = 0.12$) between treatment groups. Cows receiving supplement starting on d 5 postpartum were heavier ($P = 0.04$) than Supp30 cows on d 30. However, no differences ($P \geq 0.17$) were found in BW change or ADG during the duration of the study. Milk production was similar ($P = 0.99$) for postpartum supplementation treatments. No differences ($P \geq 0.27$) were observed in milk fat, lactose, protein, or solids-non-fat. However, there was a tendency ($P = 0.09$) for milk urea nitrogen to be greater for cows receiving supplement on d 5 than d 30 of lactation. Serum urea nitrogen was greater ($P = 0.02$) in cows receiving Supp5 than cows receiving Supp30. Serum non-esterified fatty acid (NEFA) and glucose concentrations were not different ($P \geq 0.40$) between treatment groups. Calf BW and average daily gain (ADG) was not influenced ($P \geq 0.81$) by timing of initial postpartum supplementation. These results indicate that withholding supplementation during the first 30 d postpartum may change pattern of cow BW loss without affecting net BW loss, milk production, or calf growth. Therefore, timing of postpartum supplementation can be manipulated to reduce amount of feed provided without sacrificing cow or calf productivity.

Keywords

Beef Heifers, Postpartum Supplementation

1. Introduction

The quality of forage available in rangeland cow-calf production systems is often inadequate to meet or maintain a desired level of productivity. To better meet production goals supplemental nutrients can be provided; however, the cost of feed and delivery to augment grazing is often the highest variable cost incurred by cow-calf producers. In order to maintain production and profitability, the producer must provide nutrient supplements at particular times when productive response to supplementation is likely to be the greatest such that efficiency of supplement utilization is maximized and output is optimized.

The postpartum cow experiences greater nutrient demand than at any other time during the production cycle due to nutrient requirements for lactation and recovery from gestation. This rise in nutrient demand is often exasperated in typical western USA range production systems since forage quality is often low at late winter and spring calving. The efficiency of utilization of endogenous mobilized nutrients during lactation is high [1]; however, excessive endogenous nutrient utilization may be detrimental to subsequent reproduction [2]. Therefore, the postpartum period is well suited to strategic nutrient supplementation, since profit determining responses may be realized from timely inputs.

Delaying supplementation immediately after parturition could have the effect on reducing peak milk yield and therefore, decrease nutrient requirements. If so, cows could attain a positive energy balance sooner since fewer nutrients would be needed for lactation if the lactation curve was minimized. This cascade of events could promote (due to fewer nutrients going to milk production) the reproductive axis to achieve results similar to early weaning [3] and reduce costs and create the opportunity to increase profitability if productivity is not impaired. Since efficiency of nutrient utilization improves after a period of nutrient restriction [4], the utilization of subsequent costly supplemental nutrients may be improved. By delaying postpartum supplementation, we hypothesized that dietary nutrient utilization would be enhanced, resulting in compensatory cow BW gain without altering calf performance. The objective of this experiment was to evaluate the effects of delaying postpartum supplementation on cow productivity by using milk production and cow and calf BW changes as production indicators.

2. Materials and Methods

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

Animals and Treatments. Sixteen 2-yr-old fall Angus × Hereford with an initial BW of 428 ± 22 kg were placed into 15 × 20 m pens (2 cows/pen) equipped with automatic water troughs and 10 m of concrete bunk space per pen. Cows were fed 7 kg/d of chopped alfalfa hay until calving and had free access to trace mineralized salt blocks.

Within 5 d of calving, cows and neonatal calves were assigned to pens based on initial postpartum BW. Postpartum cows were fed 8.2 kg/d sudangrass hay (5.5% CP, 74% NDF, OM basis) to simulate range forage quality and intake during the early postpartum period and to restrict supply to minimize confounding forage intake effects with supplementation delay effects. Hay was fed at 0700 each morning. Cows were fed hay in concrete feedlot bunks which restricted calf access to hay so that calf growth rate is a reflection of nutrient consumption acquired from dam milk production. Cows were stratified by calving date and randomly assigned to one of two treatments (Table 1): 908 g/d of 46% CP supplement beginning 5 d postpartum (Supp5; n = 7) or 908 g/d of the same supplement beginning 30 d postpartum (Supp30; n = 9). Supplement was formulated to provide 425 g/d CP with 225 g/d of RUP. Supplement was individually fed to cows twice weekly 1 h prior to feeding the daily allotment of hay (at 1100 h). Cows were fed supplement for 90 d postpartum. Due to a concurrent drought at time this study was conducted cows and calves were sold after samples were collected and no reproductive assessments were conducted.

Table 1. Ingredients of protein supplement (all units as fed).

Item	%
Ingredient	
Cottonseed meal	62.47
Hydrolyzed feather meal	19.00
Molasses	8.40
Monocalcium phosphate	6.50
Porcine blood meal	2.10
Potassium chloride	0.95
Urea	0.30
Trace mineral premix	0.20
Vitamin A premix	0.08
Supplement (as fed), g/d	908
TDN, g/d	572
CP, g/d	425
RUP[1], g/d	225
RDP[2], g/d	200

[1]RUP = ruminally undegradable protein. [2]RDP = ruminally degradable protein.

Sampling and Measurements. Cows and calves were weighed prior to feeding on two consecutive days beginning on each of d 0, 30, and 80 postpartum. Individual BW was averaged and the average 2 d BW was used as the weight measurement. Cow BW change was calculated for the periods d 0 to 30, d 30 to 80, and the overall change from d 0 to 80 with calf ADG calculated for the same period times.

Cows were individually milked with a portable milking machine at approximately d 90 postpartum following daily feeding of hay on a day after protein supplementation using a modified weigh-suckle-weigh technique [5]. Cows were injected with 1 mL of oxytocin (20 IU; Vedo, Inc., St. Joseph, MO) i.m. to facilitate milk letdown and milking began 2 min later. Cows were milked dry and milk was discarded. After being separated from calves for 4 h, cows were milked again using the same procedure. Milk output was recorded and a subsample collected for constituent analysis. Milk constituents were analyzed by an independent dairy laboratory (Pioneer Dairy Labs, Artesia, NM) and included milk fat, protein, lactose, solids non-fat, and urea N. Milk weight was calculated for a 24-h milk production.

Blood samples were collected from each cow into serum separator tubes (9 ml; Corvac, Sherwood Medical, St. Louis, MO) at −2, 2, 6, 10, 14, 22, 26, 32, 36, 40, and 44 h post feeding hay on the day following milking. Blood samples were collected via jugular venipuncture. Blood was cooled and allowed to clot at ambient temperature for 1 h then centrifuged at 2000 ×g for 20 minutes at 4˚C. Serum was harvested and frozen (−20˚C) until analysis. Samples were analyzed using commercial kits for NEFA (Wako Chemicals, Richmond, VA), serum urea N (SUN) (Thermo Electron Corp., Waltham, MA), and glucose (enzymatic endpoint, Thermo Electron Corp., Waltham, MA). Inter- and intra-assay CV were less than 10%.

Statistical Analysis. Normality of data distribution was evaluated using PROC UNIVARIATE procedure of SAS (SAS Inst. Inc., Cary, NC). Data were analyzed as a completely randomized design with cow as the experimental unit using the Kenward-Roger degrees of freedom method. The MIXED procedure of SAS (SAS Inst. Inc., Cary, NC) was used to analyze the mixed model with cow as the experimental unit and with the fixed effects of supplement with calving date used as a covariate. Serum metabolite concentrations were analyzed with sample time as the repeated factor and cow as the subject with compound symmetry as the covariance structure. The model included supplement, sample time and their interaction.

3. Results and Discussion

Timing of supplementation did not influence ($P \geq 0.21$; Table 2) cow BW at d 0 and d 80. Cows receiving Supp5 were heavier ($P = 0.04$) than cows receiving Supp30 at d 30, resulting in greater BW loss ($P = 0.05$) and ADG ($P = 0.06$) from d 0 to d 30 for cows receiving Supp30. However, cow BW change and ADG from d 30 to d 80 and d 0 to d 80 were not different ($P \geq 0.17$) between timing of postpartum supplementation groups. Differences in BW loss during the first 30 d were expected since cows in the Supp30 treatment didn't receive any supplement until d 30. Cow weight loss is indicative

Table 2. Effects of delayed postpartum supplementation on cow body weight and body weight change in 2-yr-old fall calving cows consuming low-quality forage.

	Treatment[1]			
Measurement	Supp5	Supp30	SEM	*P*-value
Cow BW, kg				
d 0	439	425	9	0.21
d 30	429	405	5	0.04
d 80	409	390	8	0.31
BW change, kg				
d 0 - d 30	−10	−20	3	0.05
d 30 - d 80	−20	−15	3	0.55
d 0 - d 80	−30	−34	2	0.84
ADG[2], kg/d				
d 0 – d 30	−0.33	−0.67	0.13	0.06
d 30 – d 80	−0.67	−0.50	0.11	0.17
d 0 – d 80	−0.38	−0.41	0.13	0.79

[1]Cows were fed 908 g/d of a protein supplement beginning on d 5 postpartum (Supp5) or d 30 postpartum (Supp30).
[2]ADG = average daily gain.

of the utilization of endogenous nutrients by the animal to ameliorate dietary inadequacy. A more rapid decline in weight observed in cows receiving Supp30 was expected due to a lower nutrient intake during a period of similar nutrient demand during early lactation.

Treatment and sampling time did not interact ($P > 0.10$; Table 3) for concentrations of serum metabolites. Circulating serum NEFA and glucose concentration were not different ($P \geq 0.40$) between expedited and deferred timing of postpartum supplementation. Since serum NEFA concentrations were elevated above 300 μmol/L, it could be assumed that lipid reserves had been mobilized equally in both treatment groups. Serum urea N concentrations at 91 d postpartum were greater ($P = 0.02$) for cows receiving supplement beginning on d 5 postpartum compared to those not receiving supplement until d 30. Serum urea N concentrations for both treatment groups are below 10 mg/dL suggesting that the cows were not in a detrimental protein catabolic state and that ruminal N was not in excess or inadequate for ruminal microbial needs.

Contrary to our hypothesis, after 90 d postpartum, 24-h milk production was similar ($P = 0.99$; Table 4) for all cows receiving both treatments. Milk urea N was the only milk constituent that was affected by treatment, where cows receiving Supp5 had a tendency ($P = 0.09$) to have greater milk urea N concentrations than cows receiving Supp30. Milk urea N concentrations, which are highly related to circulating blood urea N concentrations, were greater in cows receiving Supp5. Decreased SUN concentrations and a tendency for lower milk urea N concentrations in cows receiving Supp30 may suggest that these cows were retaining more of the supplemental protein at 90 days

Table 3. Effects of delayed postpartum supplementation on serum metabolites in 2-yr-old fall calving cows consuming low-quality forage.

	Treatment[1]			
Measurement	Supp5	Supp30	SEM	P-value
NEFA[2], μmol/L	636	656	29	0.61
Glucose, mg/dL	73.3	71.5	1.6	0.40
Serum urea N, mg/dL	8.9	8.1	0.3	0.02

[1]Cows were fed 908 g/d of a protein supplement beginning on d 5 postpartum (Supp5) or d 30 postpartum (Supp30).
[2]NEFA = non-esterified fatty acid.

Table 4. Effects of delayed postpartum supplementation on milk production and constituents in 2-yr-old fall calving cows consuming low-quality forage.

	Treatment[1]			
Measurement	Supp5	Supp30	SEM	P-value
Milk production[2], g/d				
24-h production	6194	6198	539	0.99
Fat	241	225	22	0.58
Protein	184	180	15	0.86
Lactose	294	301	30	0.86
Solids non-fat,	522	526	48	0.95
Urea N	560	468	52	0.09

[1]Cows were fed 908 g/d of a protein supplement beginning on d 5 postpartum (Supp5) or d 30 postpartum (Supp30).
[2]Milk production measured ~d 93 postpartum.

postpartum, suggesting that protein turnover was reduced by the previously (d 5 to 30) experienced rapid BW loss [6] or that protein was utilized more efficiently. The similarity in milk production and nutrient content was reflected in calf BW and ADG. Calf BW and ADG was not influenced ($P \geq 0.81$; **Table 5**) by delaying the onset of supplementation. Since calf BW at weaning is the basis of gross income for most cow-calf producers, maintaining calf growth rate is an important attribute of any supplementation strategy.

Restricting nutrient supply early postpartum did not affect milk production in this experiment. Minimal effects of increasing energy level on peak milk yield or total milk yield in Angus and Hereford cattle [7]. These findings seem to indicate that in beef breeds with moderate to low milk potential, the genetic "setpoint" for lactation will be met by utilization of either endogenous or exogenous nutrients, and that moderate short term nutritional fluctuation has minimal effect on lactation traits and my facilitate a short term improvement in nutrient use efficiency. Under more extreme nutrient restriction, lactation may be impaired; however, the total difference in nutrient intake was not extreme in Supp5 in comparison to Supp30 cows. In breeds exhibiting greater milk production potential with increased energy supply, at least 80 kcal/kg $BW^{0.75}$ was required to influence lactation parameters [8]. In this experiment, supplement supplied

Table 5. Effects of delayed postpartum supplementation on calf body weight and average daily gain in 2-yr-old fall calving cows consuming low-quality forage.

	Treatment[1]			
Measurement	Supp5	Supp30	SEM	*P*-value
Calf BW, kg				
Birth	33	33	2	0.81
d 30	67	67	3	0.95
d 80	95	95	5	0.98
Calf ADG[2], kg/d				
d 0 - d 30	1.20	1.17	0.12	0.84
30 - d 80	0.57	0.57	0.08	0.98
d 0 - d 80	0.79	0.79	0.07	0.85

[1]Cows were fed 908 g/d of a protein supplement beginning on d 5 postpartum (Supp5) or d 30 postpartum (Supp30).
[2]ADG = average daily gain.

an estimated 32 kcal/kg $BW^{0.75}$/d and therefore, it might be expected that milk production would be unaffected by treatment.

4. Implication

Overall, the results of this study indicate that withholding supplementation for the first 30 d postpartum improved efficiency of protein utilization fed to cows for calf production (calf weight produced/cow nutrient intake) by maintaining a given level of production while reducing the amount of supplemental feed provided by 22 kg in 25 days. Since reproductive measurements are not collected, results from this experiment should be practiced with caution. Although with a limited number of animals utilized in this experiment, withholding supplemental feed during the early postpartum period may prove to have potential as a component of an alternative management scheme to nutritionally condition cows for greater nutrient efficiency.

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