

Precalving Nutrition of Beef Females in Florida¹

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Introduction

The primary goal of precalving supplementation of protein and energy is to increase body condition score (BCS) of beef cows before calving, which is positively correlated with reproductive success of cows during the subsequent breeding season. Body condition score is an assessment of the fat cover (energy reserves) that the cow is carrying. For more details on how to measure BCS and its impacts on cow reproduction, see Ask IFAS publications AN319 (“Implications of Cow Body Condition Score on Productivity”) and AN347 (“How to Measure Body Condition Score in Florida Beef Cattle”). This publication was developed for beef cattle producers to modify the supplementation strategy during the precalving period to improve calf performance after birth.

Benefits beyond Cow Reproduction

Beef cattle production in Florida is constantly exposed to environmental (e.g., heat and humidity) and seasonal conditions (e.g., cyclic forage maturity and nutritive value) that can lead to nutrient deficiency in beef females during gestation, particularly for late pregnancy in fall-calving herds. Maternal nutrition during gestation regulates fetal development by affecting fetal organ and tissue development and tissue-specific epigenetics (i.e., alterations to gene expression that result in increased or decreased gene expression). These modifications to fetal development will determine the long-term growth and health of beef calves following birth (fetal programming theory). For example, late gestation is one of the most critical periods for the formation of muscle and adipose tissues (Du et al. 2010). In terms of health, nutrient restriction during late gestation has been shown to reduce vaccine response, increase the number of antibiotic treatments needed to combat bovine respiratory disease, and increase morbidity and mortality of beef calves (Moriel et al. 2021). Therefore, precalving nutrition of beef cows can be explored by beef producers to optimize future performance of the offspring.

Precalving Supplementation of Beef Females in Florida

Since 2016, the UF/IFAS Range Cattle Research and Education Center in Ona, FL has conducted multiple

studies identifying the benefits of improved maternal nutrition during pregnancy on future offspring performance (Table 1). These studies demonstrated that precalving supplementation of protein and energy (on average, 2.2 lb/cow daily of a protein and energy supplement for the last 70 days before calving) could be implemented to increase cow BCS at calving by 0.50 to 0.75 units (scale of 1 to 9). In terms of cow reproduction, we observed that precalving supplementation of protein and energy did not increase pregnancy rates during the subsequent breeding season compared to no precalving supplementation when all cows calved in acceptable BCS (BCS \geq 5). However, it increased pregnancy rates compared to no precalving supplementation when cows calved with a below-optimal BCS (BCS $<$ 5). In certain studies, precalving supplementation of protein and energy also altered calving distribution and increased the percentage of cows calving during the first 21 days of the calving season, leading to older and heavier calves at weaning (Palmer et al. 2020; Palmer et al. 2022a).

In terms of offspring preweaning growth, these studies observed that precalving supplementation of protein and energy increased calf body weight at weaning by, on average, 25 lb, regardless of cow BCS at the time of calving (Table 1). We did not include an economic analysis in this fact sheet because economic calculations need to be performed frequently due to the dynamic changes in feed cost and calf prices. Nonetheless, the income from the additional weaning weight was often sufficient to offset the cost of precalving supplementation in all studies. The following sections will discuss additional changes to precalving nutrition and their implications for calf performance.

Timing of Supplementation

Energy and protein requirements of beef cows reach their lowest values immediately after weaning (beginning of the third trimester of gestation) but dramatically increase as the third trimester of gestation progresses, mainly because of the exponential fetal growth (NASEM 2016).

Differentiation and maturation of each fetal organ and tissue occur at different moments during gestation (Lemley 2020). Therefore, timing of protein and energy supplementation during late gestation can have different impacts on offspring performance. In 2020, Brangus cows

were provided: 0 lb/day of dried distillers' grains during the third trimester of gestation; 2.2 lb/day of dried distillers' grain during the last 84 days of the third trimester of gestation (185 lb of supplement per cow); or 4.4 lb/day of dried distillers' grains during the first 42 days of third trimester gestation (also 185 lb of supplement per cow). Calf weaning weight was greater for calves born from cows that received protein and energy supplementation during the first half of the last trimester of gestation compared to calves born from cows that did not receive precalving supplementation (575 lb vs. 562 lb, respectively). However, calves born from cows that were supplemented with protein and energy during the entire last trimester of gestation achieved the best results on calf preweaning growth (593 lb) (Palmer et al. 2022). Therefore, we recommend implementing a longer period of precalving supplementation of protein and energy if maximizing calf weaning weight is your primary goal. In this study, we also observed that vaccine response against bovine respiratory disease and percentage of carcasses grading Choice were greater for calves born from cows supplemented during the first 42 days of third trimester gestation compared to calves born from cows that did not receive precalving supplementation. Calves born from cows that were supplemented during the entire third trimester of gestation were intermediate (Palmer et al. 2022). Therefore, we recommend that producers implement precalving supplementation of protein and energy during the first 42 days of the third trimester of gestation if maximizing calf post-weaning vaccine response and carcass quality are the primary goals.

Frequency of Supplementation

Several conditions can create a negative nutrient availability for fetal development, including altered cow metabolic status caused by infrequent concentrate supplementation. Decreasing the frequency of concentrate supplementation reduces labor and feeding costs of beef cattle while modulating blood concentrations of hormones and metabolites (Moriel et al. 2016; Moriel et al. 2020a). In a study conducted in North Carolina with Angus cows, reducing the frequency of wet brewers' grains supplementation from daily to 3 times weekly during the last 60 days of gestation did not impact BCS change and reproduction of cows. However, it led to fluctuations in precalving plasma glucose concentrations of cows (glucose is essential for fetal growth) and calf plasma concentrations of haptoglobin and cortisol (indicators of inflammatory response). These data suggest a greater physiological stress in offspring born from infrequently supplemented cows (Moriel et al. 2016). In 2021, we completed a study at the UF/IFAS Range Cattle Research and Education Center to evaluate the impacts of reduced frequency of dried distillers' grains supplementation during late gestation on cow and calf performance (see Table 2) (Izquierdo et al. 2022). Cows were assigned to receive 0 lb/day of dried distillers' grains (NOSUP) or

precalving supplementation of dried distillers' grains at: 2.2 lb/cow daily (7X); 5.1 lb/cow every Monday, Wednesday, and Friday (3X); or 15.4 lb/cow every Monday (1X) during the last 77 days of late gestation. All cows assigned to receive precalving supplementation consumed the same total amount of dried distillers' grains (15.4 lb/cow) during late gestation. The main question was, what is the lowest frequency of supplementation that can be provided during late gestation without negatively impacting cow and calf performance? In the study, decreasing the frequency of maternal protein and energy supplementation from daily to either once or 3 times weekly during late gestation did not impact cow body condition score, but it reduced offspring preweaning growth (Table 2). Therefore, frequent supplementation of protein and energy is required during late gestation to maximize calf body weight at weaning.

Feed Additives

Precalving supplementation of protein and energy provides an opportunity to include feed additives known for improving cattle performance. For example, methionine is an essential amino acid that has a crucial role in early embryonic development (Palmer et al. 2021). Methionine supplementation to lactating beef cows from calving until the end of the breeding season altered post-weaning performance of the offspring (Silva et al. 2021). Cows offered supplemental methionine rather than a control supplement without methionine tended to produce more milk without increasing calf adjusted weaning body weight. However, calves born from dams supplemented with methionine had greater total intestinal tract digestibility, average daily gain, and gain:feed compared with control calves during a 42-day post-weaning metabolism evaluation (Silva et al. 2021). In contrast, maternal supplementation of methionine during the third trimester of gestation altered calf muscle gene expression (Palmer et al. 2021) but did not impact offspring preweaning and post-weaning growth (Moriel et al. 2020b; Palmer et al. 2020) or immune function after vaccination (Moriel et al. 2020b) compared with supplementation without methionine. It is possible that a methionine deficiency did not occur in the last studies described above (Palmer et al. 2020; Moriel et al. 2020b). Oversupplying methionine during the third trimester may have not been sufficient to modulate calf growth and immune responses following birth. Cattle subspecies, final protein intake (combined outcome of forage quality and forage and supplement intake) and lack of methionine deficiency in some grazing scenarios, source, amount, timing, and duration of methionine supplementation (and potentially an interaction among all these factors) are potential explanations for the inconsistent results. Therefore, we currently do not have evidence that methionine supplementation during late gestation of beef cows in Florida is beneficial to calf performance.

Another feed additive that our group evaluated was monensin, which is an ionophore widely used in cattle diets to alter the ruminal microbial population and fermentation routes. Monensin supplementation may also support rumen propionate production, and subsequently the circulating concentrations of glucose and insulin growth factor-1 (Vendramini et al. 2018; Moriel et al. 2019), which play an important role in fetal development. In our study, cows were assigned to receive no precalving supplementation of protein and energy (NOSUP), precalving supplementation of protein and energy during the last 77 days of gestation (SUP), or precalving supplementation of protein and energy with 200 mg/day of monensin (SUPMO) during the last 77 days of gestation (Table 3). After calving, all cows and their calves were managed similarly and were not given monensin. Overall, cows that received precalving supplementation (with or without monensin) had greater pregnancy rates and BCS at calving, and weaned heavier calves compared to cows that did not receive precalving supplementation (Table 3). Adding monensin to maternal supplements did not improve maternal performance compared to maternal supplementation without monensin, but significantly increased preweaning growth of their offspring (Table 3). Therefore, we recommend adding monensin to precalving supplementation of beef cows to optimize calf weaning weight. However, extreme caution must be used when adding monensin. Accidental consumption of monensin by monogastric animals (e.g., dogs, horses, and humans) could lead to death.

Conclusion

Beef producers could explore precalving supplementation with protein and energy in beef females in Florida to enhance offspring growth, immune function, and carcass quality. Offspring outcomes to previous maternal precalving nutrition are variable and dependent on the timing and frequency of supplementation as well as the feed additive included. Maternal supplementation with protein and energy during gestation enhanced offspring growth more consistently during preweaning compared to post-weaning phases. Additionally, optimal calf body weight at weaning was achieved when cows were supplemented for longer periods (i.e., entire third trimester of gestation vs. first half of third trimester of gestation), more frequently (i.e., daily vs. infrequent supplementation), and when monensin (but not methionine) was included into cow supplementation during late gestation. Further studies to evaluate additional supplementation strategies are necessary. Findings will be shared with producers in future Ask IFAS publications.

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Table 1. Summary of five studies¹ evaluating the cow-calf performance after cows received (Supp.) or did not receive (No Supp.) supplementation of protein and energy during the precalving period.

Item	Study 1		Study 2		Study 3		Study 4		Study 5	
	No Supp.	Supp.	No Supp.	Supp.	No Supp.	Supp.	No Supp.	Supp.	No Supp.	Supp.
Initial BCS (September)	5.7	5.7	5.5	5.5	5.3	5.4	5.0	5.0	5.5	5.5
Calving BCS (November)	5.8 ^a	6.1 ^b	5.0 ^a	5.4 ^b	5.2 ^a	5.8 ^b	4.7 ^a	5.6 ^b	5.0 ^a	5.5 ^b
Pregnancy rate, % of total	91.7	94.4	78.5	75.8	96.2	96.3	82.0 ^a	95.0 ^b	93.3	86.8
Calf weaning weight, lb	275 ^a	295 ^b	579 ^a	597 ^b	561 ^a	591 ^b	535 ^a	563 ^b	557 ^a	581 ^b
Response to vaccination, %	56.1 ^a	81.5 ^b	-	-	21 ^a	54 ^b	-	-	-	-

^{a,b} Means without a common superscript differed ($P < 0.05$).

¹ **Study 1:** Cows provided 0 lb/day or 2.2 lb/day of molasses and urea supplement (20% crude protein) for 57 days before calving (Moriel et al. 2020b).

Study 2: Cows provided 0 lb/day or 2.2 lb/day of molasses and urea supplement (20% crude protein) for 47 days before calving (Palmer et al. 2020).

Study 3: Cows provided 0 lb/day or 2.2 lb/day of dried distillers' grains for 90 days before calving (Palmer et al. 2022).

Study 4: Cows provided 0 lb/day or 2.2 lb/day dried distillers' grains for 70 days before calving (Izquierdo et al. 2022).

Study 5: Cows provided 0 lb/day or 2.2 lb/day dried distillers' grains for 77 days before calving (Vedovatto et al. 2022).

In all studies, cows and their calves were managed similarly from calving until calf weaning. Calves were weaned early at 2 to 3 months of age in Study 1 and normally weaned at 8 to 9 months of age in Studies 2, 3, 4, and 5.

Table 2. Performance of cows (and their calves) assigned to receive 0 lb/day of dried distillers' grains (NOSUP) or precalving supplementation of dried distillers' grains at 2.2 lb/cow daily (7X), 5.1 lb/cow every Monday, Wednesday, and Friday (3X), or 15.4 lb/cow every Monday (1X) during the last 77 days of late gestation. Adapted from Izquierdo et al. (2022).

Item	Supplementation Frequency				SEM
	NOSUP	1X	3X	7X	
Cow BCS at calving	4.75 ^a	5.34 ^b	5.36 ^b	5.45 ^b	0.092
Pregnancy rate ¹ , % of total cows	93.3	81.5	85.7	93.3	5.91
Calf birth body weight ² , lb	73.1 ^a	78.0 ^{ab}	81.7 ^b	79.5 ^b	2.55
Calf weaning body weight, lb	557 ^a	575 ^b	575 ^b	593 ^c	7.48

^{a,b} Means without a common superscript differed ($P < 0.05$).

¹ Pregnancy rates did not differ among treatments ($P = 0.39$).

² No signs of calving difficulty or differences in percentage of calves born alive were observed in this study.

Table 3. Performance of cows (and their calves) assigned to receive no precalving supplementation of dried distillers' grains (NOSUP) or dried distillers' grains supplementation at 2.2 lb/cow daily (dry matter basis) with 0 mg (SUP) or 200 mg/day of monensin (SUPMO) for the last 77 days of late gestation. Adapted from Vedovatto et al. (2022).

Item	Maternal Precalving Supplementation			SEM
	NOSUP	SUP	SUPMO	
Cow BCS at calving	4.68 ^a	5.57 ^b	5.74 ^b	0.091
Pregnancy rate, % of total cows	82.1 ^a	94.9 ^b	92.3 ^b	5.15
Calf birth body weight ¹ , lb	75.1 ^a	81.5 ^b	80.6 ^b	2.31
Calf weaning body weight, lb	535 ^a	564 ^b	588 ^c	9.5

^{a,b} Means without a common superscript differed ($P < 0.05$).

¹ No signs of calving difficulty or differences in percentage of calves born alive were observed in this study.

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