BEEF CATTLE RESEARCH UPDATE

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Effects of Maternal Nutrition on Progeny Performance

In recent years, a number of researchers have been studying the influence of maternal nutrition on the subsequent performance and growth characteristics of the dam's offspring. A paper presented at the 2010 Annual Meeting of the American Society of Animal Science noted that meat animals spend about one third of their life inside the uterus, and more importantly, all major developmental events are accomplished during the fetal stage.[1] Thus, proper maternal nutrition is crucial for fetal development and the growth characteristics of offspring. These researchers reported that maternal under-nutrition during mid to late gestation reduces birth weight, muscle weight and fatness of offspring at birth, but increases fatness at slaughter, resulting in a permanent impairment of the offspring's growth.

They also noted that the impact of maternal over-nutrition on fetal development and offspring growth is more complicated, depending on whether placental function is impaired. If maternal obesity and over-nutrition impairs the function of the placenta, nutrient delivery to fetuses is limited, resulting in poor fetal development and offspring growth. However, maternal obesity and over-nutrition without impairment of placental function provides excessive macronutrients to fetuses, which may slightly improve the growth performance of offspring.

A recent paper reviewed research evaluating the impact of protein supplementation of beef cows during the last third of gestation on the subsequent performance of both steer and heifer progeny.[2] Three Nebraska studies (conducted at Gudmundsen Sandhills Laboratory near Whitman, NE) evaluated the effect of protein supplementation of beef cows grazing dormant Sandhills range during late gestation (Dec. 1 to Feb. 28) on steer progeny feedlot performance. In two of these studies (a 3-year study - Stalker et al., 2006[3] and a 4-year study - Stalker et al., 2007[4]), crossbred spring-calving cows were either fed no supplemental protein or were supplemented three times per week with the equivalent of 1 lb/day of a 42% protein cake. Feedlot performance of steer calves in the 4-year study was only determined in years 2 and 3. In a third study (3-year study), composite spring-calving cow were either fed no supplemental protein or were supplemented three times per week with the equivalent of 1 lb/day of a 28% protein cake (Larson et al., 2009).[5] In all three studies, after weaning, steer calves were fed hay for about two weeks in a drylot before being shipped 104 miles to a feedlot at the West Central Research and Extension Center in North Platte, NE.

In all three of these studies, protein supplementation during late gestation had no affect on cow pregnancy rate (90 vs. 93%, 97 vs. 95%, and 95 vs. 97% for unsupplemented vs. supplemented cows for studies 1, 2 and 3, respectively) and only small affects on calf birth weight. However, steer progeny from the protein-supplemented cows were heavier when they entered the feedlot and yielded heavier carcasses (Table 1). Steers from supplemented dams also consumed more feed. However, feed efficiency was not impacted because steers from supplemented cows appeared to gain faster. Protein supplementation of the dams also increased marbling deposition resulting in a higher percentage of the carcasses grading choice.

Two Nebraska studies evaluating the effect of maternal protein supplementation on heifer progeny performance were reviewed.[2] In the first study, the heifers were mates to the steer calves in the 3-year study in which spring-calving cows were either fed no supplemental protein or were supplemented three times per week with the equivalent of 1 lb/day of a 42% protein cake during late gestation (Martin et al., 2007).[6] Data from year 1 of this study is limited to birth and weaning information. The heifers from year 2 remained on upland range throughout development after weaning and were then exposed to bulls for 45 days. The heifers from year 3 remained on range for 109 days, were then fed for 98 days, and then exposed to bulls for 45 days.

The heifers in the second study were mates to the steer calves in the 3-year study in which composite spring-calving cows were either fed no supplemental protein or were supplemented three times per week with the equivalent of 1 lb/day of a 28% protein cake during late gestation (Funston et al., 2010b).[7] The heifers grazed dormant pasture for 114 days post-weaning and were individually fed for 87 days before natural service breeding (45-day breeding season).

In these two heifer studies, protein supplementation of the dams during late gestation increased weaning weights without a change in birth weight, and this change persisted through pregnancy diagnosis. In the first study, age at puberty was not affected by protein supplementation of the dams. However, the percentage of heifers that calved in the initial 21 days of the calving season and the overall pregnancy rate was greater for heifers born to supplemented cows compared too heifers from unsupplemented cows (77 vs. 44% and 93 vs. 80%, respectively). In the second study, heifers from protein-supplemented cows reached puberty 14 days sooner than heifers from unsupplemented cows. These heifers tended to have an overall greater pregnancy rate (90 vs. 80%, P = 0.13).

Table 1. Effect of maternal protein supplementation on steer progeny performance.

	Dietary Treatment					
	Stalker et al., 2006		Stalker et al., 2007		Larson et al., 2007	
Item	No Supp.	Supp.	No Supp.	Supp.	No Supp.	Supp.
Adj. 205-day weaning wt, lb.	----	----	----	----	494	505
Feedlot Performance						
Initial wt., lb	462[a]	475[b]	462[a]	488[b]	508[x]	522[y]
DMI, lb	18.7	18.8	24.6[a]	26.6[b]	19.8[x]	20.3[y]
ADG, lb	3.45	3.44	3.52	3.70	3.66[x]	3.75[y]
Feed:Gain	5.41	5.46	6.97	7.19	5.37	5.38
Carcass wt., lb	800	814	764[a]	805[b]	804[a]	822[b]
Marbling[1]	467	479	449	461	445[a]	492[b]
% Choice	85	96	----	----	71[a]	85[b]

[a,b] Means within a study differ with different superscripts (P ≤ 0.05).
[x,y] Means within a study differ with different superscripts (P ≤ 0.10).
[1]400 = Small[0].
Adapted from Stalker et al., 2006; Stalker et al., 2007; Larson et al., 2007; and Funston et al., 2010a.

Table 2. Effect of maternal protein supplementation on heifer progeny performance.

	Dietary Treatment			
	Martin et al., 2007		Funston et al., 2010b	
Item	No Supp.	Supp.	No Supp.	Supp.
Adj. 205-day weaning wt, lb.	481[a]	498[b]	470[x]	478[y]
Pre-breeding wt., lb	587[a]	609[b]	698	711
Pregnancy diagnosis wt., lb	851[a]	882[b]	803	810
Age at puberty, days	334	339	366[x]	352[y]
Calved in 1st 21 days, %	49[a]	77[b]	85	77
Pregnant, %	80[a]	93[b]	80[x]	90[y]

[a,b] Means within a study differ with different superscripts (P ≤ 0.05).
[x,y] Means within a study differ with different superscripts (P ≤ 0.15).
Adapted from Martin et al., 2007; Funston et al, 2010a; and Funston et al., 2010b.

In an additional 2-year Nebraska study presented at the 2010 Annual Meeting of the American Society of Animal Science, the effects of maternal nutrition on steer progeny performance was evaluated using crossbred spring-calving cows at two locations of a commercial ranch in the Nebraska Sandhills.[8] In one location, the cows were supplemented three times per week with the equivalent of 2.42 lb/day of a 28% protein cake (HN) while cows at the second location were supplemented three times per week with the equivalent of 0.88 lb/day of the protein cake (LN) from December thru February. In both locations, the cows were fed meadow hay starting in March through calving in March or April. After weaning, a random group of steers from each management regimen were placed in a feedlot and slaughtered 218 days later.

There was no difference in initial body weight between HN and LN calves. However, weights at re-implant time (964 vs. 944 lb, P = 0.09) and at closeout (1378 vs. 1354 lb, P = 0.07) were greater for HN calves than LN calves. In addition, daily gains tended to be greater for HN calves (P = 0.12). Carcass weights (P = 0.07) and marbling scores (P = 0.05) were also greater for HN calves, whereas, backfat thickness, ribeye area, final yield grade, and percent USDA choice were similar among treatments.

Conclusions

In these Nebraska studies, even though protein supplementation of cows during late gestation did not affect pregnancy rates, the subsequent performance of both steer and heifer offspring was improved by late gestation supplementation. Steer progeny from supplemented cows tended to perform better in the feedlot producing heavier carcasses with more marbling resulting in a higher percentage of the carcasses grading choice. Protein supplementation of cows in late gestation resulted in heifer progeny with increased body weights from weaning through pregnancy diagnosis. Supplementation of the cows also increased pregnancy rates in the heifers.

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