Repro Tracks

▶ by **Bill Beal,** *beef cattle reproductive physiologist, Virginia Tech*

Maternal undernutrition: Effects depend on timing

Undernutrition of cows during pregnancy is most often reflected in lower birth weights of their calves and greater susceptibility of calves to calfhood diseases. Depending on when nutrient restriction occurs, however, the effects of maternal undernutrition may be less direct or occur later in the life of the calf. Therefore, managing resources to ensure proper cow nutrient intake during gestation is important.

Question No. 1:

I'm a veterinarian in south-central Kansas and the drought has affected some of the cattle we are pregnancy-checking. It seems the fetuses that I'm encountering are not as large as I would expect compared to the other indicators of fetal age. Will fetal size/calf weight decrease in cattle that are on the thin side?

Response: Controlled research trials that examine the effects of maternal undernutrition during pregnancy in cattle indicate that the effects on fetal weight are dependent on the timing of the undernutrition. The majority of fetal growth (70%) occurs during the last 90 days of pregnancy. Therefore, maternal undernutrition during the last 3 months of gestation decreases the weight gain of the fetus and results in a lower birth weight for calves born to undernourished dams. If birth weight is significantly decreased, calves are also more likely to exhibit respiratory illness after birth and have a higher death rate.

In contrast to undernutrition during late pregnancy, undernutrition of a pregnant cow during early pregnancy does not decrease the weight of the calf measured at birth. The placenta of a cow undernourished during early pregnancy increases in size to compensate for the nutritional stress posed by the undernourished dam. Because fetal weight gain is much lower during early pregnancy, the placental adaptation is able to maintain fetal weight gain in the face of the dam's undernutrition.

Based on this research, it seems unlikely that fetuses of thin cows palpated in early- or mid-pregnancy would be noticeably smaller than fetuses of cows in better body condition. However, cows undernourished in research trials may not have suffered as severe a weight loss or as great a reduction in body condition as cows in drought conditions.

Question No. 2:

We graze our pregnant cows on dormant range or crop residues after weaning their calves. Sixty days prior to calving we begin supplementing cows to avoid having cows in poor body condition when they calve. I have read how undernutrition of women during pregnancy negatively affects "fetal programming" of their babies. Are we causing harm to our cows by offering lower-quality feed until they get close to calving?

Response: Fetal programming refers to the mechanism in which the uterine environment during pregnancy may alter expression of the fetal genome and have lifelong consequences. A major factor in determining the uterine environment during pregnancy is the nutritional status of the dam. A recent article in the *Angus Journal* (April 2008) described how maternal nutrition during pregnancy exerted effects on postnatal health, average daily gain, carcass weight, backfat thickness and marbling scores of steer calves.

Nutrition of cows during pregnancy has also been reported to influence the reproductive efficiency of their daughters. Researchers in Nebraska and Montana have reported that age at puberty, pregnancy rate during their first breeding season and culling rate after five years were more desirable among heifer calves born to dams receiving adequate rather than marginal nutrition during pregnancy.

The exact mechanism involved in fetal programming has not been clearly or completely defined. At present, it is believed that the uterine environment in which a fetus develops has an "epigenetic" effect. In short, the presence or absence of certain nutrients derived from the dam may alter the expression of genes in the fetus. The epigenetic effect may activate or silence certain genes, but does not change the DNA sequence.

Hence, animals with similar genes for disease resistance or growth may perform differently due to the epigenetic effect. The effect may be to cause over- or under-activity of the genes and the expression of the affected genes may not occur until after the animal is born. In this way undesirable conditions in the uterine environment, such as the lack of adequate nutrients during pregnancy, may have effects that are not expressed until late in an animal's life.

Because the mechanism by which fetal programming occurs is not clear, it is possible that when pregnant cows are "roughed" through a winter using limited quantities of low-quality feedstuffs, it may negatively affect their developing calves. Therefore, managing resources to ensure proper cow nutrient intake during gestation is important.

Unfortunately, our understanding of the critical times during fetal development when undernutrition of the dam may affect lifetime performance or progeny health remains unclear. Until we know more, the best target for managing pregnant cows may be to feed them to achieve a body condition score of 5 or better at calving.

Question No. 3:

When pregnancy checking my cows, the veterinarian kept referring to what she called the "transition period." Her point was that my cows needed to receive more feed during the transition period in order to maximize their lactation and ability to rebreed quickly after calving. What is the transition period?

Response: The transition period for a cow is from two to three weeks before calving until two to three weeks after calving. It is a term more commonly used in the dairy industry. The term "transition" is used to emphasize the important physiological, metabolic and nutritional changes occurring during this period. Proper nutrition during the transition period in dairy cows is closely linked to lactation performance, clinical and subclinical postpartum diseases, and reproductive performance.

For beef cows, the risk of metabolic diseases (ketosis, milk fever, acidosis, etc.) is lower; however, the transition period does represent a critical period when nutrient demands for completing fetal growth, developing an udder and supporting

lactation are at near peak levels. The challenge of devising the optimum transition ration is further compounded by the fact that feed intake during the last week of gestation and first week of lactation are usually depressed by 10%-30%.

Your veterinarian is wise to alert you to the importance of the transition period. Assuming the long-term goal of having beef cows in a body condition score of 5 or better at the time of calving has been achieved, the purpose of a proper transition diet is to make the physiological and metabolic changes that occur before and after calving cause as little stress as possible.

Feeding a supplement that provides added energy and protein prior to calving increases the nutrient density of the diet and counteracts the effects of depressed feed intake. Supplement feeding prior to calving also allows rumen microorganisms to adapt to the presence of grain in the diet. Therefore, if more grain is added to the diet after calving, rumen acidosis is less likely to occur. Feeding large amounts of grain after calving to cows that have been on an all-hay or all-forage diet prior to calving would not be recommended.

Editor's Note: *Bill Beal is a beef cattle reproductive physiologist and professor emeritus at Virginia Tech. He conducts research involving estrus synchronization, artificial insemination, embryo transfer and the use of ultrasound technology. This column is designed to provide answers to questions about reproductive management commonly posed by commercial and purebred breeders. If you have questions or comments related to the reproductive management of cows or bulls, email them to him at wbeal@vt.edu.*