



Cattle Producer's Handbook

Nutrition Section

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Fetal Programming and Its Effect on Growth, Carcass Composition, and Reproductive Performance of Ruminants

Allison M. Meyer, Assistant Professor, University of Missouri
Chance L. Marshall, Extension Educator, University of Wyoming
Scott L. Lake, Associate Professor, University of Wyoming

What is Fetal Programming?

“Fetal programming” is the theory that **the environment an animal is exposed to *in utero* and/or early in life affects its development and impacts its health and performance later in life.** Livestock producers have long known that keeping the pregnant cows well nourished and healthy is important for the successful birth of live, healthy calves. Despite this, beef cows often graze poor quality winter range or are fed low quality hay during gestation, which usually do not meet the dam’s nutrient requirements for maintenance and growth of the fetus. Research on fetal programming in livestock is growing and is demonstrating the importance of providing proper nutrition during gestation to allow for optimal fetal growth and development.

Nutrient Demands of Pregnancy

Nutrient requirements increase dramatically in mid- and especially late gestation due to rapid fetal growth. For example, the energy requirements (NE_m requirements) of a 1,200 pound beef cow increases from 9 Mcal NE_m /day on day 120 of gestation to 13.5 Mcal NE_m /day on day 270 of gestation (Fig. 1). During this



Fig. 1. Beef cow energy requirements of pregnancy.

time, the proportion of total energy requirements that goes to fetal growth increases from less than 4 percent at day 120 to 38 percent on day 270 of pregnancy. Protein requirements increase similarly to energy requirements during pregnancy. Thus, when weaning occurs and nutrient requirements decrease because lactation ends, nutrients needed for gestation are increasing.

Critical Periods of Development

Cows that are under-nourished during gestation will partition nutrients to the developing fetus, even utilizing body stores of fat and protein to protect the fetus, but this has its limits. When nutrient requirements are not met during gestation or nutrients are diverted to growth (growing heifers) or lactation (early gestation), fetal growth may be impaired. The implications of limited nutrient availability to the fetus vary based on the period in which restriction occurs during gestation and/or neonatal life.

The first weeks after breeding are important for embryo development and recognition of pregnancy by the cow. The placenta, the site for fetal and maternal attachment and nutrient and waste exchange during gestation, begins to develop during this period, then has rapid growth in early to mid-gestation. The organ systems of the fetal calf form and begin to develop during early to mid-gestation then grow rapidly as the calf increases growth in late gestation. The time immediately around birth and early calf life are both important for the final maturing of organs to prepare the calf for life outside of its dam.

Recent research indicates that nutrition during gestation impacts milk production of the cow and ewe as well, even when her nutrient requirements are met postpartum. This means that effects of nutrition during pregnancy can extend past calving and decrease the