REPRO TRACKS

by Cliff Lamb, Texas A&M University

Fertility of Developing Bulls

Discover the effects of nutrition on fertility of developing bulls.

In recent years, a significant amount of research has focused on developmental or fetal programming. There is good reason for this, as this is the period of time when there is a significant amount of plasticity in the development of a fetus/calf, and the percentage of lifetime spent during each phase of the beef production cycle is greatest during pregnancy (Figure 1).

As we have understood for years, an animal's genotype along with the environmental stimulus or insults during development result in the observed phenotype of an animal. However, we are learning more every day about how the environmental stimulus or insult may have lasting effects on phenotype. These environmental effects may influence subsequent milk production, carcass yield, feed efficiency and/or reproductive function.

For example, two identical embryos transferred into two separate recipient cows, allowed to gestate, calve and then raised in different environments, would be expected to have differing lifelong phenotypic differences.

The phenotypic changes to these animals' developmental trajectory is thought to be greatest when they were embryos or fetuses. Once the calves are born, they have decreased developmental plasticity, which continues to decline as the calf becomes older.

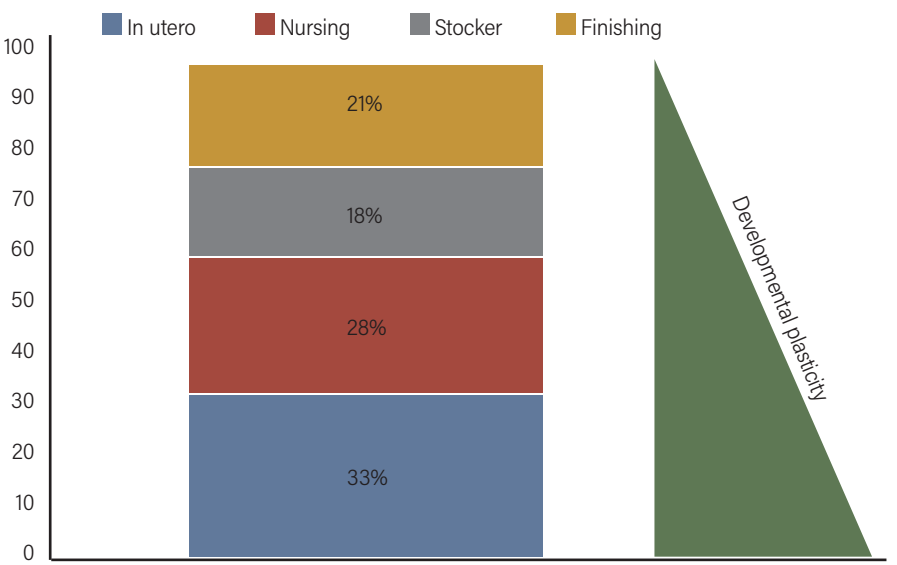
Fetal programming has been shown to effect birth weight which increased risk of morbidity and mortality; slowed postnatal growth; and resulted in poor body composition (increased fat and reduced muscle growth), metabolic disorders, cardiovascular pathologies, and dysfunction of several organs such as the ovaries, testes, mammary gland and gastrointestinal.

Cattle exposed to poor nutritional environments during pregnancy to dams that compete for nutrients with the fetus may result in lifelong negative effects to development of the offspring.

Poor nutrition may be a result of poor pasture conditions, deficiencies in supplementation of key nutrients, or environmental heat or cold stress can decrease nutrient availability to the developing embryo or fetus.

Poor forage quality in grazing systems can negatively affect the nutritional intake of beef cattle. Pregnant beef cows grazing poor

Figure 1: ***Percentage of total lifetime during each phase of the beef production system from conception to harvest. Adapted from Lemley, 2019 (https://beefrepro.org/wp-content/uploads/2020/09/10-Lemley-C.pdf).***



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forage can have altered fetal growth during increased periods of developmental plasticity.

In one experiment, when maternal nutrient restriction occurred for 100 days before birth, calf birth weight was decreased by 7% with an increased calf mortality rate of 10%, while an additional 20% of calves died between birth and weaning due to scours.

In addition to nutritional management during pregnancy, other management practices such as heifer development may also have long-lasting effects on subsequent offspring performance. In some cases, beef producers opting for low-input forage-based replacement heifer management programs leads to lighter weights at breeding, with some heifers reaching only 50-55% of expected mature body weight at breeding vs. a traditionally recommended target weight of 60-65% of expected mature body weight.

Current research has concluded heifers developed on low-input management schemes until confirmation of pregnancy (Day 30 to 45 of gestation) showed no compromise in uterine blood flow or calf birth weights compared to conventionally developed heifers.

However, the volume of late-gestation uterine artery blood flow relative to maternal body weight was significantly increased in low-input heifers vs. conventionally developed heifers, which may be a compensatory mechanism to safeguard fetal development.

Understanding the effects of maternal environment on placental function is a relevant consideration for beef cattle producers since cattle raised for red meat production spend as much as 33% of their life being nourished by the placenta.

As additional information on developmental programming is discovered, producers should attempt to adopt practices that more effectively improve subsequent performance of their calves. AJ

Editor's note: Cliff Lamb is the animal science department head and a professor at Texas A&M University in College Station, Texas.