Fetal Programming Series

Fetal Programming in the First Trimester

Emerging studies surrounding fetal programming have proven the first trimester is as essential to growth and health as the third.

by **Grace Vehige**

It has been a tradition amongst cattlemen and women to believe cow nutrition only affects calf growth during the last trimester of gestation. However, recent data related to fetal programming suggests this may not be the case.

Fetal programming is the maternal environment's impact on a calf both before and after birth, as outlined in the first article of this fetal programming series, featured in the August 2020 *Hereford World*. Elizabeth Backes-Belew, Ph.D., nutritionist with Purina Beef Technical Solutions, says fetal programming is true for all mammals. In fact, fetal programming was first recognized in humans.

Backes-Belew shares that although important, the third trimester is not always where to focus to improve calf growth. "The calf's future performance is affected throughout all three trimesters," she says.

First things first: gene expression

"Expression" is an alternative way to describe when a fetus' genes begin to externalize in different ways due to maternal environment, and these can be generational – this is called epigenetics. While the fetus' genetic composition itself does not change, a fetus' genes can be programmed differently depending on its maternal environment, and environmental factors play a role in how genes express themselves.

With all this in mind, in order to ensure a healthy and productive calf crop, as well as continued reproductive performance in a cow, maintaining a healthy maternal environment for optimal gene expression is essential. It all starts with the first trimester of pregnancy.

First trimester development

In the first trimester of pregnancy, the placenta forms and develops. This is critical to fetal development because not only does the placenta create a bed for the fetus, but the fetus also becomes attached to it and forms blood vessels. This is essential to further growth because blood feeds the fetus and provides nutrients. Although the embryo and fetus are very small in the first and second trimesters alike, even small fetuses have large demands for nutrients.

Backes-Belew further explains the first trimester is also critical because there is organ development for the fetus. Limbs and organs begin to form in the first trimester, and a fetus' health at birth can be compromised if these are not formed properly.

While 75% of fetal growth occurs in the third trimester, the fetus' ability to healthily reach the third trimester, as well as its ability to perform once it is born, is a direct result of its fetal programming in the first trimester.

"By keeping an eye on body score, producers can ensure proper maintenance at this stage of calf development," Backes-Belew says.

To better prepare a cow and calf for future success, it is important to provide all the right nutritional supplements – vitamins, minerals, energy and protein. Learn about the effects of fetal programming throughout second trimester of pregnancy in the next article of the *Hereford World's* fetal programming series. HW

Series Recap: What is Fetal Programming?

When it comes to pregnancy, one thing is certain. Lifetime performance is influenced by all the events leading up to the birth. Both positive and negative outcomes are possible throughout a pregnancy and after a birth depending on the maternal environment.

A famished discovery

One historical event paved the way for a key scientific discovery about maternal reproduction. During World War II, a blockade caused a detrimental decline in the Dutch food supply. Over 4.5 million people were impacted by the food shortage, a crisis later named the "Dutch Hunger Winter."

From the famine, it was later noted nutritionally deprived pregnant women birthed children with different diseases based on the trimester of that deprivation. Those children developed cardiovascular issues, high cholesterol, asthma, kidney disease and various other health implications. The Dutch Hunger Winter clearly displayed how the environment affects fetal development, a phenomenon now known as fetal programming.

Maximizing genetic potential

Elizabeth Backes-Belew, Ph.D., nutritionist with Purina Beef Technical Solutions, says fetal programming was first recognized in cattle about 20 years ago, and managing nutrition and weight is as vital as ever during a cow's gestation.

In a traditional sense, many cattlemen and women do not worry about a calf until it hits the ground, but its future performance is dictated by its environment in the womb.

Of the many factors and stressors that can potentially affect a cow's health, the leading setback for fetal development is depriving the cow of her nutritional requirements.

"Lack of nutrition as a fetus develops can impact growth, fertility, carcass merit and organ development once a calf hits the ground," Backes-Belew says.

While a calf's DNA cannot change, the way genes are expressed can change depending on environment factors. This is called DNA methylation. Offering adequate nutrition is the best way to maximize genetic potential and to help prevent DNA methylation. HW