REPRO TRACKS

by Cliff Lamb, Texas A&M University

The Role of the Microbiome in Fertility

Discover how the microbiome can affect fertility in your beef herd.

Frequently we focus on immediately applicable topics in this column, but in recent years we have heard the term "microbiome," which is usually used in connection with the rumen or nutrition of livestock. Since the microbiome essentially focuses on all of the microorganisms in a particular environment, the reproductive tract of cattle is one area that may be significantly influenced by the microbiome.

Consider that the reproductive tract has opportunities to have alterations in microorganisms as a result of mating or artificial insemination (AI) or after calving. In these cases, there are opportunities for external microorganisms to enter the reproductive tract. In addition, change in the reproductive tract, such as hormones, pH or immune responses, may alter the environment and have an effect on the microbiome.

Therefore, this area of research may provide solutions to enhance fertility of beef cattle.

Becky Poole, Texas A&M University, recently published an article focused on the microbiome and fertility in beef cows after calving and approaching the breeding season. This work is important, since reproductive efficiency is vital to cow-calf producers to reduce losses and maintain profit.

Infertility, defined as the inability to develop and maintain a pregnancy in a defined breeding season, is estimated to cost the beef and dairy industries more than $1 billion annually in the United States. Infertility can be attributed to numerous factors such as genetics, nutrition, body condition, environmental stress or disease.

These factors are particularly challenging for the postpartum cow because of the rapid changes during the uterine involution period, when the uterus returns to a normal, non-pregnant size.

Normally the placenta will be expelled within 12 hours after calving, followed by many other processes that prepare the cow to become pregnant and sustain a pregnancy again. All of these processes need to occur so a cow will reinitiate her postpartum estrous cycles between 30 and 70 days after calving. However, if the placenta or necrotic tissues are not properly expelled, inflammation and/or bacterial infections may occur, leading to uterine diseases such as metritis or clinical and subclinical endometritis.

Most endometritis research has focused on dairy cattle. However, the prevalence of subclinical endometritis in postpartum beef cattle can range from 34% to 88% within a herd.

The presence of pathogenic bacteria from any infection in the uterus is detected by the innate immune system (the immune response of the cow has to immediately defend itself from the effects of a pathogen). This innate immune response results in the production of small proteins called cytokines, which communicate between immune cells and initiate an inflammatory environment and the influx of immune cells into the uterus to clear the infection.

Although the immunological environment of the reproductive tract is most often associated with the response to postpartum uterine diseases, the immune system plays a role in healthy cows for normal reproductive functions and the development and maintenance of pregnancy. One common example is the semi-allogeneic fetus, expressing both maternal antigens and foreign paternal antigens. The maternal immune system must tolerate the presence of the fetus to maintain pregnancy.

Cytokines serve as the communicators between immune cells present in the reproductive tract to then regulate the local immune environment and stimulate the proper response to the semi-allogeneic fetus before and throughout pregnancy.

For example, in cattle, the reproductive tract experiences a decrease in mRNA abundance of pro-inflammatory cytokines, such as interleukin (IL)-1b and IL-6, and an increase in anti-inflammatory cytokines, such as IL-10, during the postpartum period and prior to breeding.

The immune system has a vital role in the clearance of uterine diseases, normal reproductive functions, and establishment and maintenance of pregnancy. However, specific to cattle approaching the breeding season, the diversity of bacterial communities of the reproductive tract shifts throughout an estrous synchronization protocol.

This is likely due to the composition of the bacteria in the uterus and vagina. As a result, the generations of bacteria differ between cows that became pregnant and those that failed to become pregnant.

An anti-inflammatory uterine environment prior to AI appears to be associated with the successful establishment and maintenance of pregnancy. Therefore, Poole's future research will focus on factors that can positively affect the uterine immune and microbiota environment while ultimately improving reproductive efficiency.

Stay tuned, as this may have positive effects on the fertility of your herd! AJ

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