Protecting Livestock—From Day One

Reproductive performance is the foundation of a successful food animal production system.

Sows need to deliver as many healthy piglets as possible to ensure an efficient and cost-effective pork production system, and cows need to deliver healthy calves to produce wholesome meat and milk. The reproductive health of poultry directly affects egg yield and the ability to seed broiler houses with quality stock.

One important part of reproductive performance is the health of neonatal—newborn—animals. This significance is supported by the fact that nearly 1 in 11 calves born alive dies before it is weaned. Effectiveness in preventing the many infectious and metabolic diseases that can lower reproductive performance determines at the onset whether an animal will realize its full potential.

Paradoxically, as our food animal production systems have become more efficient, there has been a concomitant decrease in the reproductive performance of dairy cows and a continuation of significant neonatal illness and death in our livestock and poultry industries.

Among ARS's responses to these trends is a concentration within the agency's National Research Program devoted to Animal Health on countermeasures to prevent and control reproductive and neonatal diseases. It's a focus that has led to many breakthroughs in treating diseases such as bovine viral diarrhea and toward improving reproductive health of dairy cows.

As the article on page 4 shows, ARS scientists are now making significant progress in the part of this focus aimed at protecting neonatal animals.

It details studies at the Virus and Prion Diseases of Livestock Research Unit. Scientists in this unit, part of the National Animal Disease Center (NADC) in Ames, Iowa, identify and characterize viruses and abnormal disease-causing proteins called "prions" that are associated with economically important diseases of livestock. They also develop methods to control or eradicate these diseases. The unit's goals include developing diagnostic tests and vaccines to control viral infections; understanding the development of specific diseases; and defining the prevalence and economic impact of emerging viral diseases.

Researchers there are targeting two opposing forces affecting neonate health: the need for effective passive transfer of maternal antibodies and the maternal antibody interference that hinders the newborn's ability to develop vaccine-based immunity to common pathogens.

The challenge is to find a way to protect young livestock against disease through vaccination while maintaining the benefits maternal antibodies provided to them as newborns.

Newborn mammals depend on these maternal antibodies, which are provided through colostrum, because the placental transfer processes of ruminants, pigs, and horses offer newborns virtually no protective antibodies.

But this maternal protection can also keep many vaccines from triggering a protective antibody response by the newborn's own immune system.

One project at NADC appears to have uncovered an immunological "trapdoor" that may help scientists overcome maternal immunity through vaccines that trigger cell-mediated immunity. The study involved developing a T-cell response to introduction of bovine viral diarrhea virus to calves.

In another exciting project, scientists placed selected swine virus genes into virus vectors, or carriers, that pig immune systems do not normally encounter. These genes "piggybacked" onto the engineered viruses, thus evading the maternal antibodies. Future studies will investigate whether this vectored vaccine approach also elicited protective T-cell responses.

The findings from these studies are significant in their own right. They are also stepping stones toward one day attaining reliable vaccination of very young animals.

But the consequences of this research on livestock health management practices will not be truly determined until commercial vaccine manufacturers demonstrate the efficacy and safety of vaccines administered in the face of maternal immunity.

And a final barrier to successful approval of such vaccines will be measuring antigen-specific, cell-mediated immunity. This is no simple task, as it requires significantly more laboratory testing than measuring levels of antibodies does. ARS and other research entities within USDA are investing today in developing a more extensive immunological tool chest that may someday provide more advanced means for measuring cell-mediated immunity in animals.

Recent ARS research recognizes reproductive performance as the foundation of a successful food animal production system. And understanding how immune systems in neonates develop into fully functional ones in adults will be critical to improving survival on farms, where exposure to infectious agents is increased by the mingling of large numbers of animals.

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