

Does a Cow's DNA or Her Dam's Environment Determine Her Disease Response?

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In July 2014, University of Kentucky graduate and undergraduate students attended the American Dairy Science Association Joint Annual Meeting in Kansas City, Missouri. An emerging topic was epigenetics, or heritable changes in gene expression caused by mechanisms other than changes in the underlying DNA sequence. This article will summarize talks on this topic related to disease response in dairy cattle.

Dairy producers understand that animals often react differently to what is seemingly the same problem. For example, if two calves were born hours apart and housed in the same environment, one calf with pneumonia may recover in a few days whereas another calf may not even survive to the next day. Some of this variation relates to the severity of the disease. Even in studies with controlled environmental conditions, disease response variation will occur, which begs the question of whether the immune system is the major determinant of how strongly an animal reacts to a particular pathogen or stressor.

Dr. David Kerr and his team at the University of Vermont study initial inflammatory responses, which can result in tissue damage. Dr. Kerr presented a study where 10 Jersey and 10 Holstein cows were infected with *Esheria coli* mastitis and “high responders” were better in 10 days whereas “low responders” were better in just three days. Low responders had a slower and weakened response to the infection but recovered more easily than high responders, who reacted more quickly and severely. Bovine serum albumin, which is related to tissue damage and detectible in milk, was greater in high responders, meaning they had more tissue damage resulting from the same level of infection. In another study, low responding cows challenged with *Staphylococcus aureus* had a delayed somatic cell count response, but actually cleared the infection, versus the high responding cows in which some cows never recovered completely.

Understanding that there are different levels of immune response between animals is an important step in selecting for specific traits that may help animals fight off diseases more easily. Dr. Bonnie Mallard and her team from the University of Guelph study adaptive immune responses, which are responsible for the immune system's long-term memory. In this type of immune response, high responders are superior. Dr. Mallard explained that genetic selection for this type of immune response could improve disease management efficiency through improved vaccine protocols, improved colostrum management, improved breeding and culling decisions, and improved hoof health information. Mastitis heritability is just 4%, but immune response heritability is 25%. In comparison, production traits are 25 to 30% heritable. Therefore, instead of focusing on chances of obtaining a specific disease, selecting for overall immunity may create healthier cows that are better able to fight off those targeted diseases.

Canada is adding a Mastitis Selection Index to their genetic selection starting in August 2014. Mallard and her team are working on developing an immune response test to classify

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animals because high responders have 27% less mastitis, 17% less metritis, and 32% less retained placenta. These cows will have less severe mastitis (less need for human intervention and shorter intervention when it is needed) and have better quality colostrum (total immunoglobulin, or IgG). Economic savings of high immune responders was estimated at \$124 compared to an average cow in the herd per year. Semex has tested 929 Holsteins so far and is marketing it as "Immunity +".

Although genetic selection for immunity is just now gaining attention from much of the dairy industry, it is one with a lot of potential. Diseases are costly and often painful so an improved ability to ward off disease could mean decreased costs and improved animal well-being.