How Could DNA Affect Your Operation?

PHOTO & STORY BY TROY SMITH

Scientists have deciphered the DNA code, gaining new understanding of the structure and function of the genetic blueprint for humans and a variety of other organisms. University of Nebraska animal scientist Daniel Pomp predicts this modern-day genomic revolution may be one of the most important periods in the history of humankind, opening avenues to diagnose and to treat many maladies. But what payoffs might the revolution offer animal agriculture and the beef industry in particular?

Pomp says the DNA research conducted during the last 10 years has focused on DNA-assisted selection. Use of information on the DNA of animals will become an additional tool for identifying which are superior or inferior. Pomp believes the first and perhaps most beneficial application of DNA technology may be for fine-tuning management rather than breeding. That's the impetus behind DNA-marker research at Ohio State University being funded by Certified Angus Beef LLC (CAB). It aims to predict marbling and tenderness potential for individual animals.

The first practical application of DNA information in beef cattle has been in identity testing. Pomp says the relatively simple technology for evaluating genetic markers to obtain an animal's unique genetic "fingerprint" is now commonly used for determining or verifying parentage for registration purposes. The American Angus Association switched to DNA testing for parent verification on Jan. 1.

DNA testing also may be used in sire verification of calves resulting from multiple-sire pasture situations.

"DNA testing enables retrospective selection. For example, high- or low-quality carcasses may be traced from the kill floor back to sire of origin, allowing for selection or culling of sires with high or low genetic potential for carcass traits," Pomp adds. "Traceback of DNA from meat to carcass to individual animal may become an integral component of production-system accountability and food safety programs."

Pomp says selection based on phenotypic records has been the driving force behind genetic improvement. Expected progeny difference (EPD) values emerged (by combining performance information from an individual animal, its ancestors, siblings and progeny) as a tool for predicting that individual's genetic potential. However, significant amounts of data are required before EPDs accurately predict actual genetic makeup. The ability to evaluate DNA directly, at genes controlling economically important traits, could be of tremendous value in increasing the accuracy and efficiency of selection.

"DNA-based selection can already be practiced for simple traits," Pomp offers. "Embryos may be sexed with a simple DNA test. Certain coat-color variations can be predicted, and some diseases may be diagnosed at the DNA level. Most recently, the gene causing the double-muscling phenotype has been identified."

Still elusive are practical tests for more-complicated traits, including growth and feed efficiency, carcass quality, milk production and reproduction. Pomp says evidence indicates that genes may exist in combinations to account for these traits.

"In a beef animal, there are 3 billion individual pieces of genetic information that are interactive and influenced by thousands of proteins, as well as the environment. It's very complex," Pomp says. "It's highly possible that a gene that helps to control a complex trait may have different effects in different breeds and in different environments. For any new genetic test to be used for predicting breeding value of cattle, research will be needed to evaluate the consistency of the test in different breeds and across variable environments and management systems."

Pomp says at least four private companies are seeking to unravel the complexities and to develop testing techniques for commercial use.

Eventually DNA testing could become a widespread on-farm practice whereby a producer could analyze a DNA sample from a newborn calf and, within minutes, gain valuable insight into the calf's genetic potential.

It's likely that the first genetic tests for complex traits will focus on carcass quality phenotypes, such as marbling and tenderness, and eventually will be used to influence breeding decisions. But since management plays such a key role in carcass quality, Pomp believes the first and perhaps most beneficial use will be for developing management regimens.

"Carcass quality genetic testing could be used as a sorting tool in the feedlot. Tests will likely be developed to choose implants for maximum response, increase efficiency of nutritional programs and optimize drug treatments," Pomp explains.

Those tools are already getting a test in licensed CAB partner feedlots, says Ron Bolze, CAB director of genetic programs who oversees the field studies. Blood samples for DNA analysis were drawn in several states this winter from hundreds of commercial feedlot cattle with known sires and dams. DNA-marker patterns are being correlated with individual carcass results and parent DNA markers. The data should allow for correlation by implant treatment as well, Bolze adds. AJ

Above: DNA technologies may prove most beneficial for helping make management decisions, such as sorting in the feedlot, assigning nutritional regimes, and selecting appropriate implants and drug treatments.