CUP Lab
CENTRALIZED ULTRASOUND PROCESSING

August 1, 2009

Carcass Ultrasound 101

Volume 13

Carcass Ultrasound & DNA Technology: A Progress Report

The science and technology that has infiltrated the beef cattle business within the past decade is mind boggling. The tools available to seedstock breeders and commercial producers seem to grow by the day. In a competitive business world, breeders can find themselves marketing the science before anyone really knows if the science will impact the market. Nonetheless, it's important for cattle producers to remain diligent in their quest to produce a protein source desired by the consumer. Recent developments in carcass ultrasound and DNA technology offer breeders an unparalleled "package" of science to use in beef cattle production. By the time this article reaches publication, it's likely that a new piece of the genetic puzzle will be discovered.

Every trait in a beef animal, whether it be the length of their eyelashes or the size of their ribeye, is controlled by genes. Some traits are influenced by environmental conditions or the management scheme of the livestock's caretaker. Other traits are controlled by only one gene, like genetic abnormalities. DNA tests can be developed to identify these genes, and thus, cattlemen can use DNA technology to manage their herd away from those genes. Carcass traits, however, appear to be controlled by many genes, and the expression of each gene is influenced by environment. Ultrasound technology can measure the level of expression of all the genes that influence ribeye area (REA), marbling or % intramuscular fat, and subcutaneous fat deposition or backfat. DNA technology is currently trying to identify the number of genes involved, the amount of influence each gene has on the trait, and whether the presence of a gene has a positive or negative impact on a trait.

Recent studies published in the 2009 Beef Improvement Federation Proceedings indicate that genetic markers, often referred to as SNPs (Single Nucleotide Polymorphisms), can do a reasonably good job of identifying a level of gene effect on a trait of one breed, but the same SNP has no effect on the same trait of another breed or population of cattle. For example, if a DNA company tests a group of cows from breed "A" for 50,000 SNPs, they may find 100 SNPs appear to influence marbling via live animal ultrasound. If they mate those breed "A" cows to breed "B" bulls, the resulting F1 progeny will likely show different levels of effect in marbling for some SNPs, other SNPs will still work very well, and some SNPs will show no impact at all on marbling. If breed "B" is tested for marbling using the same 100 SNPs, its likely very few SNPs will show an influence on marbling. As a result, larger populations of distinctly different cattle (breeds) need to be tested with a larger number of SNPs in order to develop more accurate DNA tests. As the research populations are collected, a "line" of tests for each breed may surface, even though the same SNPs are being tested in all breeds. Mike Goddard, DVM, Ph.D., suggested that >300,000 SNPs may be needed in order to accurately develop and validate DNA tests that work across breeds and composite lines of cattle (BIF 2009 Proceedings, 86). Cost

may be an increasing concern; the 50,000 SNP chip discussed earlier in the article currently costs approximately $200 per animal.

The drive of DNA technology has changed a bit of focus in regards to Expected Progeny Differences (EPD). In traits where phenotypic data is readily collected (i.e. weight and carcass traits), DNA tests can be used to increase the accuracy values of EPDs for young, unproven sires. For example, a DNA test for Weaning Weight may offer a yearling bull the same level of accuracy as a 2 year-old that had sired 10 calves. Genetic information from DNA testing will continue to migrate into traditional performance EPDs as more tests are independently validated.

Ultrasound has proven to be the most accurate tool to assess carcass value on the live animal over the past decade. New and improved ultrasound machines and computer software are further streamlining the process and creating a competitive market for breeders. The technician training and certification programs are ensuring that only accurate measures are being submitted to breed associations for genetic evaluation. Ultrasound Guidelines Council (UGC) Board Member Matt Spangler, Ph.D., reported recent statistical analysis of ultrasound image quality. The study showed that images with some "guesswork" still accurately predicted carcass traits (BIF 2009 Proceedings, 145). The highly-trained eye of a lab technician interpreting images continues to be important. The current struggle for ultrasound is penetration into the commercial sector. Gains in technology and speed have been offset by rising transportation costs. Market conditions and input costs make it more difficult to justify spending additional live animal carcass evaluation dollars in some cases. Still, numerous feedlots and commercial cow-calf producers are finding a niche where ultrasound can help them capture profits or reach end product goals within their operation.

The future of DNA technology as it pertains to carcass evaluation is largely unknown, but rapidly changing. Buzzwords like "whole-genome selection" and MBVs, or Molecular Breeding Values, will increasingly be under your nose in the beef trade press. It's important to understand the limitations of technology. Breeders will never know the size of a bull's ribeye or how much marbling is within it from a DNA test alone. The environment will always have a major impact on phenotype or gene expression. Likewise, ultrasound will not determine the number of SNP markers present or absent in any beef animal. New tools to beef cattle breeding do not appear likely to replace old tools just yet. A herd sire can have all the positive alleles for every trait we measure, ultrasound off the charts, and still not be any good! In a tough world economy, consumers are purchasing protein sources they can afford instead of maybe what their taste buds desire. Beef cattle breeders undoubtedly have all the genetic resources needed to satisfy their appetite without emptying their wallet.