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Combining Carcass Ultra-sound Data and Molecular Breeding Values for Powerful Selection Tools

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The world is rapidly changing. Technologies that were barely imagined just a few years ago have become a normal way of life. Genomics[i] is the new buzz word for beef, and research into the genetic make-up of cattle holds great promise. But no new science is complete without practical context, and in beef selection and production that means measuring physical attributes, or phenotypes,[ii] to assess end result.

Mark Thallman, research geneticist in the Genetics & Breeding Research Unit of the U.S. Meat Animal Research Center (USMARC), part of the USDA Agricultural Research Service, makes the case for continuing to collect phenotypes, beginning with the limitations of genotypic[iii] data. "The DNA-based approaches are an exciting development, but currently we're accounting for relatively minor proportions of genetic variations with them. We still get better accuracy by accounting for more of that variation by including additional sources of information," says Thallman.

Research geneticist M.D. MacNeil and his team make the case for both sources of information in citings included in their published work "Genetic Evaluation of Angus Cattle for Carcass Marbling Using Ultrasound and Genomic Indicators" (MacNeil et al., 2007). "If both phenotypic and molecular data are available, their joint consideration is the most powerful selection strategy." (Dekkers and Hospital, 2002; Spangler et al., 2007)

Larry Kuehn, also a research geneticist at USMARC, explains why ultrasound data, in particular, is needed to make the equation work. "In terms of ultrasound," he says, "the advantage is rapidly getting pedigree, or progeny, phenotypes. In other words, if both the ultrasound and molecular breeding values[iv] (MBV) tests had the same correlation with an actual carcass measure, both would increase the accuracy of that carcass EPD by the same amount. But ultrasound can also be done on that bull's progeny and that will make accuracy shoot up quite a bit higher. Getting a MBV on progeny doesn't do anything for that."

Again, MacNeil and company concur. "In predicting breeding values, records of MBV from relatives do not increase accuracy, whereas IMF[v] records from relatives improve the accuracy of prediction." (Beef CRC, 2009).

Continuing to collect phenotypic data is also crucial to ongoing accuracy of the genetic information. "These MBVs probably aren't good forever," says Kuehn. "Over time, the relationship of the MBV with the current set will deteriorate. They will become reorganized, fixed in some cases. They aren't going to work forever with the same level of accuracy."

Matt Spangler, assistant professor of animal science at the University of Nebraska-Lincoln, agrees. "We need something to continue to validate those genomic tools," he says. "It's not like a DNA marker

panel comes out onto the market and for perpetuity it predicts marbling extremely well. It doesn't work that way. We have to "retrain" it every few generations, and by that I mean validate it again to see how good it's doing. And the only way to do that is to have phenotypes to validate it against."

"In the micro view, for the individual producer, we need to look at it from the perspective of how do we evaluate each individual animal," says Thallman. "And just having that additional info from ultrasound is going to increase accuracy substantially, relative to what we can do with just a DNA test."

"From a more macro perspective," he continues, "it's really a benefit to the industry to continue to collect all these phenotypes in order to really know how much impact DNA tests are having, and how much variation they're accounting for. To understand what the relationships are between DNA tests, ultrasound, and carcass data, we're going to have to collect all those sources of information."

In addition, Kuehn says there is a continuing need for ultrasound and phenotypes in research circles: "In terms of trying to develop new novel phenotypes for things like disease resistance, cow longevity, or whatever, we need a lot of phenotypes, and most of us don't have anywhere what we need right now. If we're going to try to use this marker technology we're going to need more than we've been collecting, not less."

"Ultrasound has provided a very reliable data set across a multitude of breeds to include in national cattle evaluations, and make very valuable EPDs, and we've seen the amount of change that's occurred because of that," adds Spangler. "Genomic technology holds a tremendous amount of promise, but for it to be truly as useful as it could be, genomic information has to be integrated into EPDs. And so that becomes the benefit of ultrasound right now. Across the board, it is."

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[i] **Genomics** - is the study of the entire complement of DNA characteristic to individuals of a species.
[ii] **Phenotype** — The visible or measurable expression of an animal.
[iii] **Genotype** — The genetic makeup of an animal.
[iv] **Molecular Breeding Value (MBV)** – An estimate of the transmissible genetic merit of an individual based entirely upon genomic tests.
[v] **Intramuscular fat** reported as percent (%)