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Efficient, high-quality beef

Researchers in muscle biology uncover new interactions between implants and marbling

By Miranda Reiman

Producers have been using implants to improve cattle efficiency for decades, even before the use of value-based grids.

But now that quality grade has become an important factor in marketing beef and maintaining demand, many scientists are taking a closer look at the relationship between marbling and implants.

Brad Johnson, of Texas Tech University, is one of those people. He recently co-authored a white paper, "Factors affecting intramuscular adipose tissue development in beef cattle." It documents how marbling is formed, down to the genes that influence it and how implants fit into that process.

"They stimulate lean tissue deposition. Whenever you do that, you're probably going to have some sort of tradeoff," says the university's Gordon W. Davis Regent's Chair in Meat and Muscle Biology. "The tradeoff in this case is marbling development."

The paper cites research showing aggressive implant programs add more than $85 per head compared to non-implanted cattle, but there's more on the table. Using a "stair-step" implant program can help maximize quality and efficiency to push that total past $103 per head.

The effect implants have on marbling is clear. A review of 37 trials shows an average 24% reduction in marbling scores. That means a reduction in quality grade, proportionately worse as implant strategies move from mild to aggressive.

"If we can unlock some of those mysteries of what's going on from a drug standpoint, then we can manage it so we can benefit from improvements in productivity while trying to mitigate the negative effects on beef quality," Johnson says.

Before an animal lays on fat, it first develops skeletal and muscle tissue. Then when it does deposit adipose (fat) tissue, typically it develops intermuscular, or seam fat, followed by backfat and then, finally, intramuscular or marbling.

But new research shows that marbling "is not strictly a late-developing depot, but has the potential to develop early in the feeding periods," he says.

Johnson has used the university's tissue culture lab to follow these cells from their very beginning, as mesenchymal cells to their development into the adipoblasts that eventually become preadipocytes, a final precursor to marbling.

"These mesenchymal cells can become muscle, bone or fat cells," Johnson says. "If we catch them early enough, there is probably a population of cells that, instead of becoming muscle cells, could be triggered to become preadipocytes that ultimately form marbling."

That trigger could be glucose, which is found in grains but not much in forages. It accounts for 70% of the fatty acid synthesis in marbling, but only 5% of it in subcutaneous fat. Glucose also drives the level of TZD (thiazolidinendione), an anti-diabetic, Johnson explains.

All of that is important because studies show when mesenchymal cells are exposed to TZD, the genes are influenced and the cells eventually become marbling.

"These studies indicate that under the appropriate stimulation, populations of various cells in the model can express adipogenic genes and accumulate lipid," the paper confirms.

That adds one more theory to the traditional knowledge about how implants affect beef quality.

Scientists have pointed to the repartitioning of nutrients and dilution effects for years. Since fat is a "lower priority" than muscle development, implants redirect energy to the latter. The other idea is that the amount of marbling stays the same, but the implant increases the ribeye size so marbling is relatively diluted.

That may still be happening, but scientists now know steroids also affect the genes.

"Within three to four weeks after we give the implants, we see this repression in gene expression of the key ones that are important for adipogenesis or marbling development," Johnson says. "We're turning on genes important for muscle growth and we're probably having a direct negative effect on genes for marbling."

This research could translate to specific production recommendations in the future.

"Maybe timing of when we give implants is going to be crucial," he says. "There may be opportunities to develop new products that could offset that negative effect on marbling, but still have a positive effect on lean tissue deposition, which in turn improves feed efficiency."

New feed additives or tweaks to implant strategies could be on the horizon, Johnson says.

The paper concludes with a call to action: "As the demand for quality continues to increase, it is vital that producers find a management strategy that will allow them to be efficient in producing more pounds of high-quality beef."

To read the entire research paper, visit: http://www.cabpartners.com/news/research/.

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