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The Myostatin Mutation: A Basic Overview

While the weather was anything but spring-like, The ASA Board of Directors met in late February for their spring board meeting. During the course of the meeting, the topic of breeder education came up many times and on different topics under the umbrella of Shorthorn cattle production. There are a lot of pieces to the puzzle of purebred cattle production, and the board is committed to utilizing some of our resources as an association to help explain and grow the knowledge of our membership.

One point of interest that the Board of Directors feels is worthy of some educational information is myostatin in beef cattle and how the mutation works from a genetic standpoint. It does not operate the same as other mutations and genetic mechanisms you are already familiar with, so some background information and explanation will hopefully be helpful.

Technically, myostatin is a protein produced by the body to control muscle growth. The myostatin protein is what tells the body to quit producing new muscle fibers and stop muscle growth. There is a mutation of the gene that produces a different protein in place of myostatin that is much less effective in controlling muscle mass development. Without the presence of the myostatin protein, increased muscle mass (what we refer to as "double muscling" in the beef cattle industry) is exhibited by the animal. The cattle that exhibit the double muscled look don't actually have two copies of a muscle, but rather their muscle fibers are just larger than normal. The genes that control myostatin production are actually found in all mammals, not just beef cattle.

The mutation of myostatin can be found in all breeds of beef cattle, including Shorthorns. In some breed populations, it can be seen more commonly. Breeds such as the Piedmontese and Belgian Blue are prime examples of the presence of the myostatin mutation. These cattle are known for their extremely heavy muscle patterns and high carcass yield, due in large part to the myostatin mutation and selection for this type of cattle. In beef cattle, there are three common variants of the myostatin mutation (nt419, E226X, and F94L). Each of the three most common mutations results in the extremely muscular phenotype, but can vary in some others traits that might also be expressed; such as calving dystocia or inadequate fertility. Cattle that are homozygous for any of the three mutations will fully express the double muscled trait. What makes the myostatin mutation unique is that animals can have one copy of the gene and exhibit some of the characteristics associated with the mutation to a lesser degree than an animal that has two copies of the gene.

Genetic tests for variants of the myostatin mutation have been around for many years, and it is available to determine if an animal possesses any of the three common variants in the Shorthorn breed. To date, there have only been 11 head tested through ASA. Within DigitalBeef, the results are presented a little differently. Each of the three common variants (nt419, E226X, and F94L) are listed in the database. This is due to the fact that the DigitalBeef platform is used by multiple breeds, and different breeds have different variants more prominently in their population. At this point, only the E226X variant has been seen in our ASA testing. Animals tested by GeneSeek are listed in DigitalBeef as either "Free" (0 copies of the mutation, myostatin functions normally in the animal) or "Carrier" (1 copy of the mutation). Breeding a bull that is a myostatin mutation carrier to a cow that is also a carrier would result in a 50% chance of producing a calf that is a myostatin mutation carrier, and a 25% chance of producing a homozygous, double muscled calf. It should be noted that while the additional muscle expression might be an interesting idea, being a carrier of these variants can lead to significant problems that are not desirable in the herd in any way, such as calving difficulty and subpar fertility. Also, even with the multiple variants of the myostatin mutation, breeding a carrier of one variant to a carrier of a different variant can still cause these issues and undesirable consequences. Doing such matings is not advised.

I will admit this is certainly a confusing trait to wrap one's head around, as it can almost be viewed as backwards in the way it presents itself. It's best to try to remember that myostatin is the protein that causes normal muscle patterns. When the gene mutates to produce one of the abnormal variants is when we see some changes in the body type of beef cattle. As always, if you have questions on the myostatin mutation or testing for the mutation, please feel free to contact the ASA office.

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