Registered Highland Bull D/N
Carrier nt821
(myostatin Del11 gene)

Registered Highland Cow D/N
Carrier nt821
(myostatin Del11 gene)

Registered Highland Bull N/N
Not a Carrier
(negative for nt821)

Double-Muscling in Highland Cattle:
Some of what we know and what we don't know.

by Pat White, DVM

Myostatin and Testing for the Myostatin NT821 Gene Deletion in Highland Cattle

What is Myostatin? Myostatin is active both before and after birth and normally limits muscle growth, controlling hypertrophy (increase size of muscles). Nt821 is a genetic partially recessive mutation where a segment of the MSTN gene is missing (or deleted). When present in both copies of the gene, this mutation causes the myostatin to be inactive and fail to regulate excessive muscle size. Again, this is a partially recessive gene and it appears that TWO copies are required to manifest classic PHYSICAL evidence of double muscling such as seen in the Belgian Blue or Piedmontese.

Why is this bad? Well, we really don't know how much of a problem this is or can be in Highland cattle. In other breeds, two copies of the gene can result in calves that are larger at birth and can contribute to difficulty calving. Two copies in adults of other breeds causes extreme heavy muscling with abnormally large rounded wide rumps and thighs with little fat covering, prominent creases between the muscle groups that are evident in the living animal, and leg bones that tend to be thinner. Affected cattle tend to be long, but shallow-bodied, more tubular in appearance, with less abdominal capacity for ideal utilization of forage and may prove to be harder keepers on pasture alone. However, double-muscled animals may demonstrate increased feed efficiency in the feedlot and carcass qualities – including tenderness – may be improved. Females may have smaller pelvic diameters, adding to potential calving difficulties even with so-called normal-sized calves.

What does a bull or cow that carries only one copy of the gene look like? At this time, the nt821 deletion is believed to be a partially recessive gene, i.e. it requires two copies to be able to recognize the full effects of the gene just by observation of the animal. While other breed associations that have been aware of this mutation in their breed for many years and maintain the carriers are indistinguishable from non-carriers, it appears that different breeds with the same mutation can demonstrate the double-muscling phenotype differently. This can occur both between breeds and within breeds. We do not know if a carrier Highland with only one copy of the gene shows consistent phenotypic traits that would allow detection through visual examination. We assume that an animal homozygous (D/D) for the gene would be easily identified but we do not know that for a fact either.

Why is this a big deal in Highlands all of a sudden? Information shared by other Highland breed associations worldwide alerted both the AHCA Executive Committee and Pedigree Committee that this gene mutation had been found in Highland cattle in Europe and Australia. A few breeders here have tested some of their cattle and have had several carriers confirmed in the USA as well. However, we do not know at this time how serious this may or may not be. To date, we only know some breeding histories of a few carriers of a single copy. We do not know of any breeding or feeding history of any Highlands that carry two copies of the gene.

Registered Highland Bull D/N, Carrier nt821 (myosatin Del11 gene)

Registered Highland Bull N/N, sired by the above carrier. Not a Carrier (negative for nt821)

Well then, what are those breeding histories of the known carriers? So far, we only have a few results to go on, but one carrier bull with almost 100 offspring reported to AHCA revealed NO evidence of any contribution to calving problems. We know by tracing results from another carrier cow, that at least one of this bull's daughters was a carrier and she was an Elite Impact dam (with 15 live calves on the ground, all delivered without assistance), who was processed due to lack of milk production a few months short of her 18th birthday.

Another carrier bull had almost 80 offspring reported over 7 years of use, again, with no statistically significant history of calving difficulties in his breeding partners.

Then why should we test? AHCA decided that it would be wise to alert the membership about this mutation and the possible ramifications to our breed. Those breeders who wish to test can do so under the auspices of AHCA by requesting the test submission form from the office. The point of testing is to garner more information and to get an idea of the magnitude of carriers in the AHCA population of Highland cattle.

What do we call this test? This is a specific test for the nt821 variant of a MSTN gene. This appears to be the most common variant that causes double-muscling in cattle. It is the same variant that causes double-muscling in the Belgian Blue breed. It is called by a confusing variety of names, including nt821, myostatin DEL11 or just M1.

How do I interpret my results? If you use AHCA for testing, and you have already submitted hair samples for other DNA testing such as parentage or color, that sample is available for use in this testing assuming an adequate amount of material is still in storage at the Veterinary Genetics Laboratory at UC-Davis.

Requests presently are for Double-Muscling Test Result: Myostatin Del11

Results are reported as:
N/N – Normal, Negative for the myostatin Del11 mutation.
D/N – One copy of myostatin Del11 mutation is present.
D/D – Two copies of myostatin Del11 mutation are present.

Interpretation
N/N Normal
D/N Carrier
D/D Fully Affected

What should I do if I have a carrier animal? Theoretically, our recommendation would be to make sure to breed that animal to a non-carrier. This would result in a 50% risk of having a carrier calf, a 50% chance of having a non-carrier calf, and a 0% chance of having a calf that carries two copies of the gene and would be fully affected. Any growth information, calving histories, feed given and photographs would be greatly appreciated to further our understanding of the carrier state.

What should I do if I have an animal that tests positive (two copies of the gene)? Don't hide under a rock! Please let us know. We will treat all results with the utmost confidentiality, but we would like photos, calving histories, types of feed fed and growth information if available of either sex carrying two copies of the gene. We are gathering information and if there are animals that are carrying two copies of the gene and are double-muscled we want to see them and know more about them.

Carrier cow from page 4, as a calf with her carrier dam.

So what is AHCA going to do about the cattle that carry the gene? At this point in time we are asking for voluntary testing to collect data only. Any resulting information that may be shared with the membership will be strictly confidential: i.e. no animals or breeders will be identified. There will be no action taken other than the collection of data. To date, the Highland Cattle Society is also collecting data and it appears that the Australian Highland Cattle Society is doing the same.

Footnote:
***If you are the owner or previous owner of the animal* and are interested in testing for nt821, AHCA has set up a test with UC-Davis. To order a test on an animal:**

Animals with DNA on file – contact the AHCA office by email info@highlandcattleusa.org and ask them to have the UC-Davis Veterinary Genetics Laboratory run a test on the existing sample (hair or semen). If a sufficient sample is in storage, there is no need to submit another sample. The cost of the test is $30.

Animals without DNA on file – contact the AHCA office by email info@highlandcattleusa.org to start the DNA kit process. A DNA kit will be sent to you to attach the sample from the animal in question. Pulled hair samples with hair follicles intact and thawed semen straws (keep cool and mail ASAP after thawing to prevent mold growth) are both acceptable materials to test. If mailing semen straws, please protect well to prevent the plastic straw from breaking and leaking all the contents. The cost of the nt821 test is $30.00. You can also complete a DNA test (including parentage) at the same time for an additional $40.00.

CONTRACTUAL COMMITMENT CONCERNING THE USE OF DNA TESTING TO DETERMINE THE PRESENCE OF THE NT821 VARIANT IN HIGHLAND CATTLE

1. Samples submitted to the University of California Bovine Genetics Laboratory under the auspices of the American Highland Cattle Association (AHCA) for nt821 testing will be used by this Association to determine the presence of the nt821 variant. Should it be necessary to retest any sample on file because of legitimate inability to determine the presence of the nt821 variant, this Association is under no obligation to contact the original or subsequent owner of the animal under study to authorize retesting.
2. The Association holds title to all nt821 DNA marker results on any animal tested under the auspices of AHCA. These results will be shared by the Association with only AHCA office employees, the owner and/or previous owners of record of the animal (if results are on file and requested) and personnel at the University of California. Results provided to AHCA from a private account will be treated identically to those ordered through AHCA although AHCA does not claim title to privately submitted results.
3. Nt821 determinations in cattle will remain confidential and subject to the limitations as listed in section 2.
4. Limitations set forth in this contractual statement in no way prevent AHCA from establishing new guidelines concerning the requirements for DNA analysis, that may require resubmitting samples for different testing needs.

Nt821 DNA Testing Contract