Genetic Profiling Helps Select for Polled Cattle

Horned cattle still represent a significant cost to the beef industry due primarily to these animals' impact on bruising in the rib, loin and round areas of the beef carcass.[1]

The 2005 National Beef Quality Audit (NBQA) reported that cattle with horns comprise 22 percent of the fed cattle population in the U.S.[2] This is a reduction of 1 percent compared with the 2000 NBQA report — falling far short of the goal stated in the 2000 NBQA report to "reduce horns to less than 5 percent of the fed cattle supply." At that time, reduction of horned cattle was listed as one of the industry's top five goals.

Horns and bruising affect the economics of both fed and nonfed beef cattle:

- Horned feeder calves can sell for $1.50 to $2.00 less per hundredweight than those without horns.[1]
- In nonfed cattle, where the frequency of horns in cull cows and bulls is often higher than in fed cattle — bruises can create a $12 loss for every cull cow and bull.[3]

PHENOTYPIC AND GENOTYPIC OPTIONS FOR ELIMINATING HORNS

The cost of removing horns from cattle can vary significantly depending on animal age and whether or not the practice is incorporated into other management activities. Additionally, several countries have implemented maximum age restrictions (ranging from a few weeks to a few months) for dehorning without the animals being under anesthesia/sedation.[4]

As an alternative, the AVMA recommends the selection and breeding of polled seedstock because it eliminates the animal pain and production expenses associated with dehorning.

Genetic analysis is now available for horned/polled traits in many breeds of cattle as an option from IGENITY®. See inside.

ECONOMIC ADVANTAGE OF SELECTING FOR POLLED CATTLE — A CASE STUDY

From a seedstock perspective, research conducted by Colorado State University and the North American Limousin Foundation (NALF) revealed very large value differences between horned, phenotypically polled and animals that had been confirmed as homozygous polled through DNA testing.[5]

A total of 2,422 registered Limousin bulls ranging in age from 9 to 30 months were included in the analysis. Limousin bull buyers at sales during 2004 and 2005 paid $1,733 more for the DNA-tested bulls that were homozygous polled than their horned counterparts. The value of DNA-tested bulls was further noted by the $1,331 difference between bulls reported to be double-polled (both parents are polled) and bulls determined to be truly homozygous polled via DNA testing.

igenity®

Practical Identification of Horned/Polled Genetics

INHERITANCE OF POLLEDNESS

In beef cattle of European ancestry (*Bos taurus* cattle), the trait of being polled or having horns is believed to be determined by one pair of genes. The polled form (P) is dominant to the horned form (H).[6] The only situation when an animal will be horned is when it possesses two recessive horned genes (HH or homozygous horned).[7]

Inheritance of horns in zebu-type cattle may be different from that observed in British and Continental breeds, and is believed to be influenced by the African horn gene, which has its own unique mode of inheritance.

A CLOSER LOOK AT THE HORN

The horned condition in cattle is defined by a bony outgrowth from the skull and the extension of the sinus cavity into the horn (see Figure 1). A related condition to horns in cattle is scurs. Scurs do not have the bony outgrowth from the skull and the extension of the sinus cavity into the horn (see Figure 2). They can range in size from tiny scablike growths to large protrusions, almost as large as horns. Scurs are generally loose and movable beneath the skin, and not attached to the skull.

It is believed that there is a separate gene for scurs, transmitted independently of the horn gene and that only cattle that are heterozygous for the polled/horned genes can express the scurred trait.[8] In males, the scur gene is dominant, meaning that if only one of the two genes is for scurs, the bull will be scurred. In females, the scur gene is recessive, meaning that she must possess both genes for scurs in order for the female to be affected.[6]

Figure 1. *True **horns** are bony outgrowths from the skull and sinus.*

Figure 2. ***Scurs** are scablike growths, neither bony nor attached to the skull.*

HORNED/POLLED ANALYSIS FROM IGENITY

The horned/polled analysis available from IGENITY uses technology developed at Texas A&M University and identifies variation at the polled locus in *Bos taurus* cattle.

Using a comprehensive set of markers across the polled genome region, the analysis is derived by examining the DNA from animals of known status for the horned/polled genes, based on breeding records. Development typically involves up to 200 bulls per breed, which allows evaluation of records on well over 50,000 progeny.

The analysis is breed-specific, to reflect how the polled condition was introduced and subjected to recombination within each breed. The horned/polled analysis is currently available from IGENITY for the following breeds, as well as any of these breeds crossed with Angus, since Angus carries only polled haplotypes:

- Charolais
- Gelbvieh
- Hereford
- Limousin
- Shorthorn
- Simmental
- Jersey

NOTE: Recombination events may occur within any of these breeds — as well as breeds added to the analysis in the future. In these cases an "indeterminate" result will be reported in the analysis (see Table 1).

VALIDATION PROCESS FOR THE HORNED/ POLLED ANALYSIS FROM IGENITY

IGENITY is an industry leader in validation of its analyses using a variety of populations. The validation process for the horned/polled analysis includes three phases:

1. The first phase involves internal blind testing in which results are reported without knowing the animals' phenotypes.
2. In the second phase, extensive pedigree information provided by breed associations is compared with the genotypes on homozygous polled, heterozygous polled and horned bulls per breed. These bulls often have progeny resulting from mating to at least 25 different horned and polled females.
3. The third phase includes blind testing in which animals are submitted for testing without animal identification and results are compared with animal breeding records.

RESULTS

While additional breeds continue to be added to the IGENITY profile, the analysis was first developed in Angus, Hereford and Limousin cattle (see Table 1). More than 2,000 animals were evaluated, representing more than 200 different chromosomes. Within each breed a number of unique genotype combinations, referred to as haplotypes, were identified and related to horned or polled status based on breed records. The number of haplotypes found within a breed can be as little as 8 or number over 300 possible haplotypes.

Table 1. Horned/Polled Analysis[a]

	Angus	Charolais	Gelbvieh	Hereford	Holstein	Jersey	Limousin	Shorthorn	Simmental
Number of animals tested	455	254	322	274	180	81	342	118	137
Percent indeterminate	0	7	0.1	3	0.01	0.1	0.5	2	0*
Percent error	0	0	0.6	0	0	0	0	2	6

*The percent indeterminate for commercial Simmental horned/polled results may be somewhat higher, due to the large amount of variation within the breed and limited breeding records with bulls mated to horned cows.

For each breed, the percent indeterminate and percent error rate can be calculated. Indeterminate results occur when there are not enough animals from the breed with the haplotype and good breeding records to establish the horned/polled status for that haplotype. The percent indeterminate in Table 1 is calculated based on the number of animals tested for each breed in the discovery and validation populations. If an animal receives an indeterminate result for a breed which has a 0 percent indeterminate in Table 1, it means that particular haplotype was not seen in the discovery or validation population. The percent error rate in Table 1 represents the number of animals tested where the breeding record did not match the haplotype in the discovery or validation population. This could be due to errors in the genotypes, the breeding record or the calculation of the haplotype result.

HORNED/POLLED ANALYSIS TERMS

Recombination — The process by which a strand of genetic material (usually DNA) is broken and then re-joined (recombined) to a different DNA molecule. Recombination commonly occurs during meiosis as chromosomal crossover between paired chromosomes. A recombination event results in offspring having different combinations of genes than their parents.

Haplotype — The term is a combination of the two words "haploid genotype." A haplotype is a genetic combination of alleles at multiple loci that are transmitted together on the same chromosome. It may refer to as few as two loci, or to an entire chromosome, depending on the number of recombination events that have occurred.

Homozygous — Describes the presence of two identical alleles or DNA sequences at one locus.

Heterozygous — Describes the presence of only a single copy of the gene in an otherwise diploid organism.

For the latest information on breeds included in the IGENITY profile, or additional technical information about the horned/polled analysis, visit www.igenity.com or call 1-877-IGENITY.

The comprehensive IGENITY profile analyzes horned/polled status — and much more.

Only IGENITY offers the most powerful profiling technologies with user-friendly applications and consultation. The comprehensive IGENITY profile empowers producers to make more confident real-time decisions and higher-quality, more profitable products.

IGENITY works with research partners around the globe to continue to discover and integrate innovative technologies, and enhance the value of the IGENITY profile. At press time, IGENITY offered analyses related to the following economically significant traits:

- Residual feed intake
- Average daily gain
- Tenderness
- Marbling
- Quality grade
- Yield grade
- Fat thickness
- Ribeye area
- Heifer pregnancy rate
- Stayability (longevity)
- Calving ease
- Docility
- Myostatin
- Arthrogryposis Multiplex
- Coat color
- Breed-specific horned/polled
- Multisire parentage
- BVD-PI diagnostic test

As IGENITY advances the science of DNA technology, more analyses will be added.
For the latest information about the IGENITY profile, visit www.igenity.com or call 1-877-IGENITY.

[1]Hopkins FM, Neel JB, Kirkpatrick FD. Dehorning calves. University of Tennessee Extension Bulletin No. 1684.
[2]National Beef Quality Audit. 2005. National Cattlemen's Beef Association and Cattlemen's Beef Board.
[3]National Non-fed Beef Quality Audit. 1994. National Cattlemen's Beef Association and Cattlemen's Beef Board.
[4]American Veterinary Medical Association. 2007. Dehorning and disbudding of cattle. Available at: http://www.avma.org/reference/backgrounders/dehorning_cattle_bgnd.asp. Accessed December 29, 2008.
[5]North American Limousin Foundation. Many factors affect prices of Limousin bulls. *Bottom Line* 2006.
[6]Allen CK. The inheritance of horns and scurs. *Fact Sheet.* American Gelbvieh Association. Available at: http://www.gelbvieh.org/pdf/tech/factsheet/horn_pld_inherit_factsheet_med.pdf. Accessed December 29, 2008.
[7]Allison BC. Inheritance of polledness, horns and scurs in beef cattle. North Carolina State University. Animal Science Extension. Available at: http://www.cals.ncsu.edu/an_sci/extension/animal/news/aug96/aug96-3.html. Accessed December 29, 2008.
[8]Schalles RR. Inheritance of color and the polled trait. *Beef Briefs.* American Simmental Association. Available at: http://www.simmental.org/userimages/Inheritance%20of%20Color%20and%20the%20Polled%20Trait(3).pdf. Accessed December 29, 2008.
[9]Data on file at Merial.