HORN/POLLED TECHNICAL SUMMARY

KEY POINTS

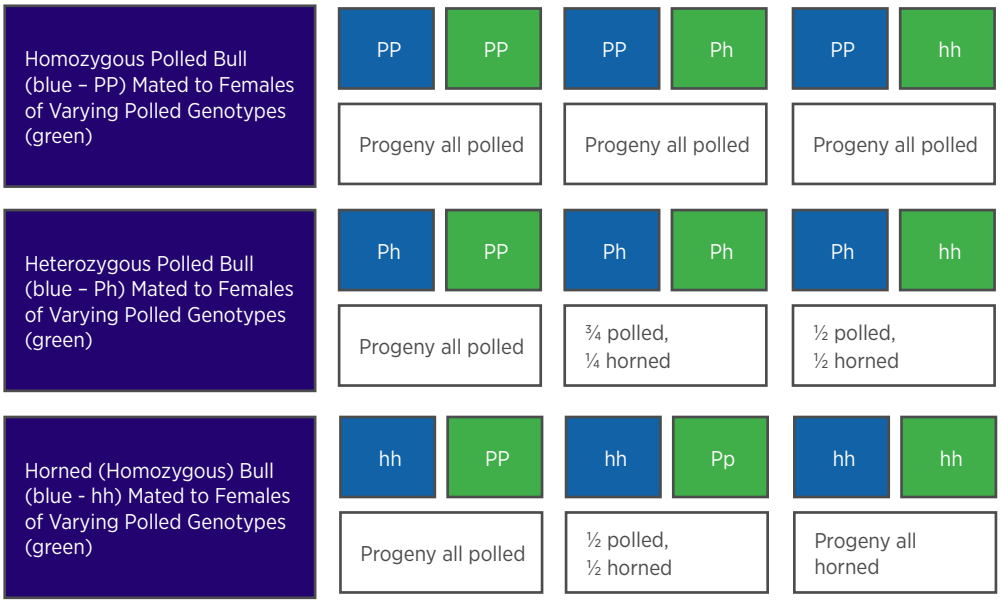
- Zoetis now offers a test for the polled condition in beef cattle that has been validated for Limousin, Simmental, and Brahman cattle, as well as Angus crosses thereof
- The Horn/Polled test determines whether phenotypically polled animals are heterozygous or homozygous polled with a very high degree of accuracy
- The Horn/Polled test includes markers associated with both the Celtic (more common in beef breeds) and Friesian (more common in dairy breeds) polled variants

INTRODUCTION

Cattle that are naturally polled (i.e., lacking horns) are desirable for a variety of reasons. Chief among them is that the need to dehorn cattle to avoid injury and bruising of carcasses is eliminated, as is the stress, discomfort, and cost of the dehorning procedure. As a result, breeding and feeder cattle that are naturally polled tend to be worth more.[1,2,3]

The polled condition (allele) in cattle is dominant to horned, and is controlled by a gene on chromosome 1.[4,5] Two polled genetic variants (Celtic[6] and Friesian[7]) have been identified and genetic markers associated with these variants can be used to accurately identify animals with one or two copies of the polled mutation. Using data from peer-reviewed literature and internal sequencing data, scientists at Zoetis have developed a new genetic test that accurately characterizes homozygous and heterozygous polled genotypes validated for use in the Simmental, Limousin, and Brahman breeds, and associated Angus derivatives.

It is straightforward to identify polled breeding stock and implement strategies to increase the proportion of homozygous polled animals within the herd. Given that polled is dominant, we know a homozygous polled bull (i.e., two copies of the polled gene) will always produce polled offspring. A heterozygous polled bull (i.e., one copy of the polled gene) will produce at least 50% polled progeny, depending on the genotype of the dam (see figure to the right).



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ASSAY DEVELOPMENT AND VALIDATION

With the help of the North American Limousin Foundation, the American Simmental Association, the American Brahman Breeders Association, as well as associated breeders and A.I. companies, Zoetis developed an internal reference population including animals of known horned and polled genotype (heterozygous and homozygous) as determined by pedigree analysis and progeny testing. Candidate markers identified from internal sequencing efforts and published literature[8,9,10] were considered. No single marker demonstrated a high degree of accuracy (maximum accuracy 77%)[11] in predicting proven polled genotypes. However, evaluation of combinations of genetic markers provided high degrees of accuracy in the validated breeds.

Test accuracy, defined as the proportion of animals with correctly predicted polled genotypes, in phenotypically polled animals was 98.6%, 96.5%, and 100%[11] for Simmental, Limousin, and Brahman cattle, respectively. Validation in other breeds was not performed due to insufficient numbers of animals with known genotypes. Additional validation experiments are underway to expand the scope of breeds and crosses supported. The test is not intended for use in animals known to possess horns (genotype is known (hh)) or scurs (genotype is presumed to be Ph), and results may vary in unsupported breeds.

RESULTS AND INTERPRETATION

Results will be reported as one of 4 possible outcomes:

- **PP** – These animals are predicted homozygous polled. All progeny will be phenotypically polled.
- **Ph** – These animals are predicted heterozygous polled. Phenotype of progeny will depend on genotype of the other parent, but at least 50% are expected to be phenotypically polled.
- **I** – Some results are classified as Indeterminate indicating that the presence of a polled variant cannot be definitively determined, or results are not consistent with an animal possessing an authenticated/known polled genotype (i.e., genotype is consistent with a horned animal (hh)).
- **NR** – No result available due to poor sample or DNA quality resulting in assay failure. Please submit a new sample.

TESTING AND IMPLEMENTATION

Seedstock and commercial producers that are interested in breeding for polled cattle should prioritize use of bulls that are documented as homozygous polled. In addition, replacement females and cows can be tested – especially in seedstock herds - whereby polled females identified as homozygous may be mated to homozygous polled bulls, and reduce the need to necessarily test future offspring. Samples from animals known to possess horns or scurs, and those that have been chemically or mechanically dehorned should not be submitted.

[1] Stutts K, Beverly M, Kelly S, and Freel B. (2012) Management practices on selling price of Texas feeder cattle. J Anim Sci 90(Suppl 1):77. (Abstr).

[2] Troxel T and Gadberry M. (2013) Comparing the factors affecting the selling price of beef calves sold at Arkansas livestock auctions during a declining cattle inventory. Prof Anim Scient 29:652-664.

[3] Williams G, Raper K, DeVuyst E, Peel D, and McKinney D. (2012) Determinants of price differentials in Oklahoma value-added feeder cattle auctions. J Agric Res Econ 37:114–127.

[4] Georges M, Drinkwater R, King T, Mishra A, Moore SS, et al. (1993) Microsatellite mapping of a gene affecting horn development in Bos taurus. Nat Genet 4: 206–210.

[5] Drogemuller C, Wohlke A, Momke S, Distl O. (2005) Fine mapping of the polled locus to a 1-Mb region on bovine chromosome 1q12. Mamm Genome 16: 613-620.

[6] Fahrenkrug S and Carlson D. (2014) Hornless Livestock. U.S. Patent Application Publication US 2014/0201857 A1. 17 Jul 2014.

[7] Rothammer S, Capitan A, Mullaart E, Seichter D, Russ I, et al. (2014) The 80-kb DNA duplication on BTA1 is the only remaining candidate mutation for the polled phenotype of Friesian origin. Genet Sel Evol 46:44.

[8] Glatzer S, Merten NJ, Dierks C, Wöhlke A, Philipp U, et al. (2013) A Single Nucleotide Polymorphism within the Interferon Gamma Receptor 2 Gene Perfectly Coincides with Polledness in Holstein Cattle. PLoS ONE 8(6): e67992. doi:10.1371/journal.pone.0067992.

[9] Medugorac I, Seichter D, Graf A, Russ I, Blum H, et al. (2012) Bovine Polledness – An Autosomal Dominant Trait with Allelic Heterogeneity. PLoS ONE 7(6): e39477. doi:10.1371/journal.pone.0039477.

[10] DeNise S, Oberg E, Ferrie B, Rosenfeld D, Chevalier P, et al. (2011) Method and markers for determining the genotype of horned/polled cattle. U.S. Patent No. 7,972,783 B2. 5 Jul 2011.

[11] Genotype Determination of Homozygous and Heterozygous Polled Cattle in Beef Breeds December 2014, Zoetis, Inc.

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