SBTS SOUTHERN BEEF TECHNOLOGY SERVICES
TBTS TROPICAL BEEF TECHNOLOGY SERVICES
TechTalk
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Breeding for Polledness

Polledness, or the absence of horns, is an important trait being actively selected for within many beef breeding programs across Australia. Breeding polled cattle provides a permanent solution to many of the problems associated with horned cattle, including easier handling of stock, reduced bruising, reduced risk of injury to stock handlers, reduced labour costs and reduced concerns regarding the animal welfare issues associated with dehorning.

Importantly, breeding for polled cattle is not as simple as just using visually polled bulls within a breeding program and for this reason, a number of tools now exist that enable producers to transition to a polled herd relatively quickly. One of these tools is the Australian Poll Gene Marker test that was initially released by the Beef CRC in 2010. This DNA based test has recently been greatly enhanced by the CSIRO, with the assistance of funding from Meat and Livestock Australia (MLA), and now has considerably greater accuracy than the previous test.

The Genetics of Polledness

Unlike many traits of importance to beef producers, polledness is a qualitative trait controlled entirely by genetics, with non-genetic factors having no influence on the polled status of an animal. Animals can either be polled, horned or scurred (small horns not attached to the skull), although considerable variation in expression is observed within these three different phenotypes.

The genetics of polledness is thought to be controlled by only a few genes, with the polled gene thought to be located in a region of the animal's DNA on chromosome 1. Two basic alleles (ie. different forms of gene) have been identified for the polled gene, the polled allele and the horned allele, with each animal inheriting two alleles for polledness, one coming from each parent. The polled allele is dominant over the horned allele, so that only animals which are homozygous horned (ie. inherit two horned alleles – referred to as hh) will be horned. Animals that are homozygous polled (ie. inherit two polled alleles – referred to as PP) or are heterozygous polled (ie. inherit one polled and one horned allele – referred to as Pp) will be either polled or scurred.

The scurs gene (Sc) interacts with the polled gene and is only expressed when the poll allele is present (e.g. in animals with the genotype PP or Ph). The expression of the scurs gene is also sex dependant, so that males only need one copy of the scurs allele to be phenotypically expressed (Scsc or ScSc) whereas females need two copies (ScSc).

The possible genotypes and their corresponding phenotypic expressions are shown in Table 1.

Table 1
Possible Phenotypes and the Corresponding Genotypes for Polledness

Phenotype	Possible Genotypes
Poll	PP, Ph
Horned	Hh
Scurred	PP, Ph

Breeding for Polledness – The Theory

Because animals possess two alleles for polledness, it is possible that their phenotype does not reflect their underlying genotype. For example a polled or scurred animal may be heterozygous polled (Ph), possessing one polled and one horned allele, or homozygous polled, possessing two polled alleles. In scenarios where the polled animal is heterozygous polled, their progeny will on average, inherit a horned allele, rather than a polled allele, 50% of the time.

The effect of this when breeding for polledness is demonstrated in the following scenario where two polled bulls, one being homozygous polled and the other heterozygous polled, are joined to a herd of horned cows.

In the first scenario, a homozygous polled sire (PP) is joined to horned cows (hh) with the resulting offspring all being heterozygous polled, and being all either polled or scurred. If the resulting polled or scurred heifers (i.e. 100% of heifers) are then mated with a homozygous polled sire (PP) then all offspring will also be either polled or scurred, with 50% of them homozygous polled and no longer carrying the horned gene.

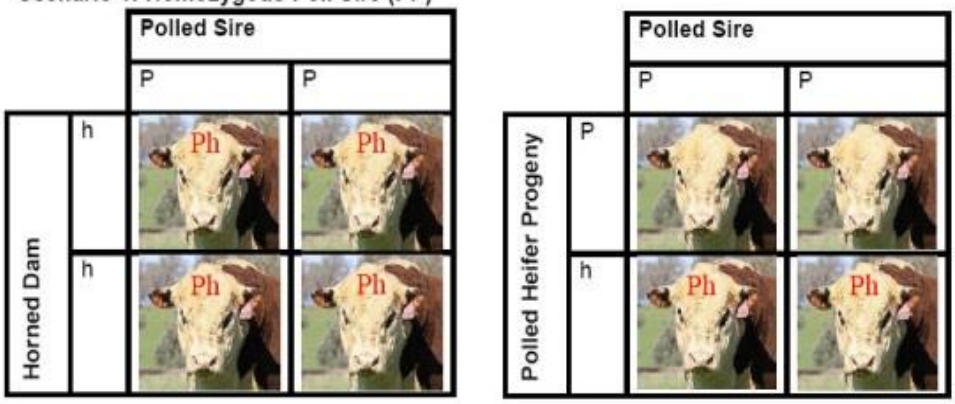
By contrast, in the second scenario, a heterozygous polled sire (Ph) is joined to horned cows (hh), with 50% of the resulting offspring being polled or scurred and 50% being horned (hh). If the resultant polled heifers (Ph) are then mated to a heterozygous polled sire (Ph), 75% of the resultant progeny will be either polled or scurred and 25% will be horned. Importantly, only 25% of the progeny will be homozygous polled and no longer carrying the horned gene (PP).

Breeding for Polledness – The Practical

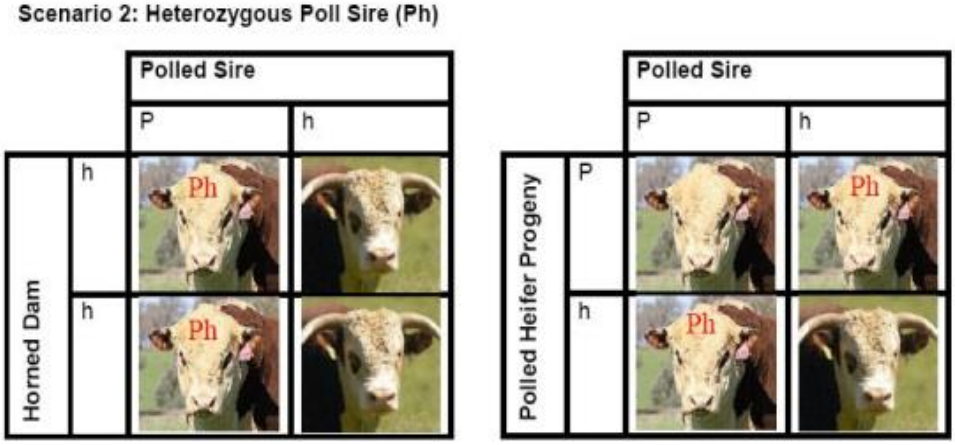
Breeders wishing to increase the number of polled animals within their herd can achieve the desired outcome in a variety of ways, however the pathway chosen will significantly affect both the time taken and the cost that is incurred.

As with other traits, individual sires contribute proportionally more to the genetics of the herd and so careful selection of sires with polled genetics results in the biggest gains. This may involve use of polled bulls as a basic principle, but as the previous scenarios indicate, where available, use of sires that have been identified by a DNA test as being homozygous polled will greatly increase the speed by which a herd can transition to a polled herd.

Scenario 1: Homozygous Poll Sire (PP)



Scenario 2: Heterozygous Poll Sire (Ph)



Breeders who are able to apply a level of selection pressure to their cow herd can also use the same philosophies that have been outlined for bulls. Retaining only polled or scurred females will increase the frequency of polled genes within the herd, while giving priority to polled females that have been identified by DNA test as being homozygous polled will maximise the rate of polled gene introgression into the herd.

Importantly, breeding for polledness should always be balanced with selection for other traits of economic and functional importance within the breeding objective. Simply selecting for polledness without any consideration of other important traits is not recommended as it may potentially compromise the genetics of animals for these other traits.

DNA Tests for Polledness

A number of DNA tests are available that enable breeders to determine whether a polled animal is homozygous polled or heterozygous polled. The precise location of the polled gene has not yet been identified, and so the DNA tests indirectly detect the polled gene though linked gene markers. No markers for the scurred gene have been identified as yet.

The tests currently available are predominantly available through the Animal Genetics Lab (AGL) at the University of Queensland and Zoetis Animal Genetics. Both the AGL and Zoetis Animal Genetics offer the Australian Poll Gene Marker Test initially developed by the Beef CRC, while the AGL also offer tests developed in the United States by GeneSeek (previously Igenity). A number of overseas DNA labs also offer tests in some breeds.

Australian Poll Gene Marker Test

The Australian Poll Gene Marker test was initially developed by the Beef CRC and released to industry in 2010. The initial test was based on a single DNA marker and worked very well in some breeds, but not so well in others.

The test was further developed by the CSIRO, with funding assistance from Meat and Livestock Australia, and a greatly improved test was released in 2013. The improved Australian Poll Gene Marker test uses the same marker as the initial test but also incorporates information from nine other markers close by in the genome. The genotype information from all ten markers is combined to create a 'haplotype' to more accurately track the origin of alleles and associate them with being horned or polled. The additional marker information increases the proportion of animals for which the test returns an informative result, and also increases the accuracy of those results.

The Australian Poll Gene Marker test can be used with a high degree of confidence across a range of tropical and temperate breeds including Brahman, Santa Gertrudis, Tropical Composite, Brangus, Droughtmaster, Hereford, Limousin, Shorthorn, Simmental and Charolais. Research conducted to date has demonstrated that the test will return an informative result for the vast majority of animals tested. The table below outlines the number of animals by breed that were tested in the research project, and the proportion of animals for which the test returned an informative result.

Breed	Number Tested	Informative Results
Brahman	299	84%
Brangus	104	89%
Charolais	65	89%
Droughtmaster	102	77%
Hereford	174	96%
Limousin	297	95%
Santa Gertrudis	225	92%
Shorthorn	167	94%
Simmental	118	93%

The test has potential application in a variety of other breeds, including cross-bred herds, and producers should contact the service laboratories for advice on the utility of the test for their herd.

For those animals where the test returns an informative result, this result is highly accurate (above 98% in the majority of cases). Only results with an accuracy value above 90% will be returned to the breeder. For those animals where the test cannot return an informative result (that is, the accuracy is not above 90%), no result will be returned.

The cost of the test will be set by the individual service providers but is expected to be in the magnitude of $20-$30 per animal and can be performed using hair, blood, tissue or semen samples.

An example of the test result is displayed in Figure 1. The results will describe the percentage chance of the most likely genotype, with the possible genotypes being reported including homozygous polled (PP), heterozygous polled (Ph) or homozygous horned (hh). The accuracy of the test result will be reported alongside the most likely genotype. This accuracy will range from 90% to 99%. For animals where the test cannot return an informative result (that is, the accuracy of the prediction is less than 90%) the result will be returned as ND (Not Determined).

For further assistance in understanding the genetics of polledness, or the use of the Australian Poll Gene Marker test, contact staff at Southern Beef Technology Services (SBTS) or Tropical Beef Technology Services (TBTS).

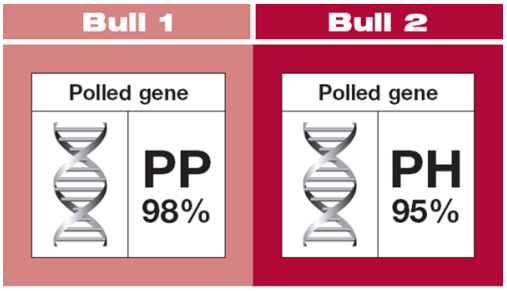


Figure 1. Example Display of Test Result from Australian Poll Gene Marker Test

References

"The Australian Poll Gene Marker Test" Fact Sheet, CRC for Beef Genetic Technologies, (2012), Accessed November 2013 http://www.beefcrc.com/publications/fact-sheets.html.

"Transitioning to a Polled Herd" Fact Sheet, CRC for Beef Genetic Technologies, (2012), Accessed November 2013 http://www.beefcrc.com/publications/fact-sheets.html.

Meat and Livestock Australia (2013), "The Australian Poll Gene Marker Test", Animal Health and Welfare Fact Sheet