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GeneNOTE 4
GeneSTAR® Tenderness – The first commercial gene marker test for beef tenderness.

Why Tenderness?

Inconsistency in beef tenderness leading to an unsatisfactory eating experience is a major problem around the world. Consumer surveys have consistently shown tenderness to be the single most important criteria of meat quality. Taste panel research by Meat Standards Australia (MSA) suggests that consumers can discern between tenderness levels and are willing to pay a premium for tender beef. The studies have shown that variation in beef tenderness is twice as large as that of juiciness and flavour factors.

Why a GeneSTAR® marker test for Tenderness?

The key contribution of DNA Marker technology is to provide information on traits that are difficult or costly to measure. Tenderness is one such trait. The fact that GeneSTAR® Tenderness provides a measure of tenderness on an individual animal without knowledge of pedigree (sire and dam) is extremely important. The commercial release of this test heralds a new era for consumers and for beef consistency that will be worth millions of dollars to the beef industry if it leads to increased consumer satisfaction and demand.

GeneSTAR® Tenderness

GeneSTAR® Tenderness is a DNA-based test for variants of the bovine calpastatin gene located on chromosome 7. The test detects two different forms of the gene - one is associated with increased tenderness and the other with increased toughness. Calpastatin is a naturally occurring enzyme that inhibits the normal tenderising of meat as it ages post mortem.

GeneSTAR® Tenderness was developed from gene marker research conducted by the Cattle and Beef Quality Cooperative Research Centre (CRC), CSIRO Livestock Industries and Meat and Livestock Australia. The team that made the breakthrough was led by Dr Bill Barendse who also led the team that discovered the gene marker behind GeneSTAR® Marbling, the first ever commercial DNA marker test for a production trait.

Evaluation Trials

Two independent trials have been conducted using the Beef Quality CRC DNA bank and database. The trials sought to measure the frequency of the tender and tough variants of the gene in different breeds and the size of effects on tenderness across representative groups of animals. Tenderness was measured as Warner Bratzler (WB) peak shear force of the *Longissimus dorsi* (LD) muscle.

The first trial detected a large and highly significant association using animals at the extremes of LD peak force i.e. very tough or very tender. In the second and largest trial more than 5000 straight bred cattle from 7 breeds represented by 384 sire groups were analysed.

There are large differences in genotype frequencies between the breeds (Figure 1). Angus, Hereford, Shorthorn and Murray Grey breeds have relatively high frequencies of 2-STAR animals, the tender genotype.

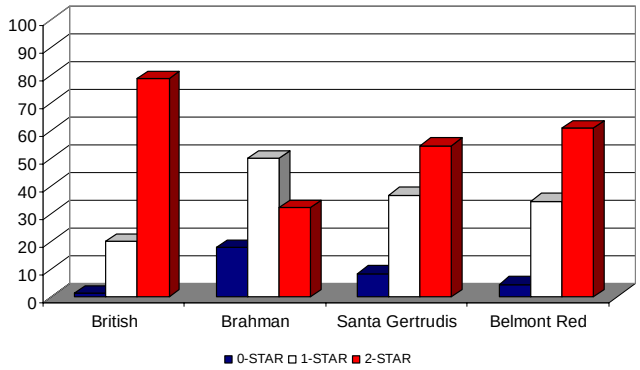

Figure 1. Frequency (%) of GeneSTAR® Tenderness genotypes by breed group

The Brahman breed shows a lower frequency of the 2-STAR with less than half the frequency of the British breeds and also a higher level of 1-STARs. Tropical-derived breeds such as Belmont Red and Santa Gertrudis are intermediate between the British and Brahman results.

However the fact that there were 0-STAR (the tough genotype) animals in each British breed tested indicates that all breeds can make use of this test.

The average differences between carcases with the different forms of the gene, plus the differences between the 2 and 0-STAR carcase groups are shown in Table 2. The carcases were from animals that had been fed for the domestic, Korean or long-fed Japanese markets using grass or grain feeding regimes. Lower values of shear force indicate more tender beef.

Table 2. Average differences (Kg) between GeneSTAR® Tenderness STAR results for WB Shear force

	Gene STAR® Tenderness Result			Difference
Group[1]	0	★	★★	★★ & 0
Full carcase set (5016 carcases)	+0.19	0.0	-0.18	0.37
Brahman (768 carcases)	+0.22	0.0	-0.22	0.44

[1] The average Shear force for all carcases was 4.86 kgs

The difference in shear force between the 2-STAR and 0-STAR carcases in the full dataset (5016 carcases) was 0.37 kgs, or 8% of the mean. 1-STAR carcasses were intermediate in shear force between 0-STAR and 2-STAR. For the Brahman dataset, the difference between the 2-STAR and the 0-STAR was 0.44 kgs of shear force or approximately 9%. In both cases, the genotype differences were 10% greater when 'processing effects' were removed by adjusting for the effect of cold shortening on muscle sarcomere length in the statistical analysis.

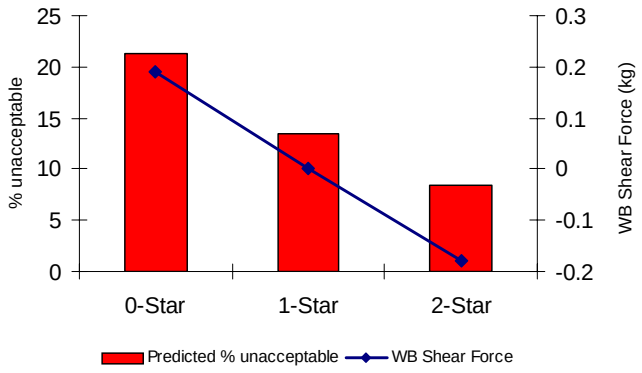

Figure 2. Relationship between % unacceptable carcases as judged by consumers and Warner Bratzler (WB) Shear Force values (deviation from mean) for 0, 1 and 2-STAR animals

It was noted in the study that the differences between the 2-STAR and 0-STAR carcases are in fact greater than the average difference between long and short grain fed animals or the average improvement in tenderness obtained by grain feeding over grass feeding.

Importantly for the beef industry, the difference in objective tenderness between 2-STAR and 0-STAR animals is predicted to more than halve (21% to 8%) the percentage of carcasses rated unacceptably tough by consumers based on threshold levels (>5.7kgs) proposed by USDA researchers (Figure 2). So on average 2-STAR animals will produce more tender carcases and this will result in significantly fewer unsatisfactory eating experiences.

Application of GeneSTAR® Tenderness

The test has application at the seedstock and commercial level though initially the priority for application is the seedstock sector. By selecting for a higher frequency of 2-STAR animals, inconsistency and variation in tenderness due to genetics can be reduced over time.

From a genetic point of view, the critical control point for herd tenderness is at each mating. The relevant questions are: what is the STAR rating of the sire and dam; what is the average STAR rating for the herd? The frequency of 2-STAR animals in each herd will depend on a number of factors, of which the most important will initially be breed.

i. Seedstock herds

Here the priority is for the seedstock breeder to quickly develop a herd profile for the tender gene. Testing current stud sires and semen sires is the first step. In many cases a straw or two of historical sires that have a lot of daughters in the current herd will be available and should be tested too. Important females eg ET donors should also be tested.

ii. Commercial herds

Buying 2-STAR sires is the quickest way that a commercial herd can influence the future tenderness of the herd. 2-STAR sires with an appropriate EBV profile and good structural and breeding soundness is the recommended way forward. If there are concerns about a high level of 0 and/or 1-STAR animals in the herd, an AI programme with 2-STAR semen may be a useful strategy. The objective should be to breed herds with a high frequency of 2-STAR animals.

Some breeds or herds will already have a high frequency of 2-STAR animals but still have a few 1-STAR and 0-STAR animals. The priority for those breeders is to eliminate the 1 and 0-STAR animals over time in order to increase the overall tenderness potential of their herd.

Risk Mitigation

The greatest risk to a herd's future meat quality is if by chance a 0-STAR or a 1-STAR sire is used. Until this test was available there was really no way of knowing. But now there are no excuses! Breeders should check their paddock sires and the semen they use. Seedstock breeders should also be checking key dams and cow families.

What is the relationship between tenderness and marbling?

Numerous investigations of the relationship between marbling and eating quality of beef have shown that although there is generally a positive relationship between degree of marbling and tenderness, the relationship is weak at best. Producers wanting to improve all aspects of eating quality should therefore select for both tenderness and marbling eg using GeneSTAR® Marbling plus GeneSTAR® Tenderness.

Costs and Ordering

The test can be conducted on DNA extracted from tail hair follicles or thawed straws of semen. When testing for GeneSTAR® Tenderness and Marbling or SireTRACE™ at the same time, there are special prices.

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