

Genes and meat quality: It starts before slaughter

By Dr Japie van der Westhuizen

Tenderness is one of the most important factors determining whether people enjoy the meat-eating experience. Yet tenderness is not created at the abattoir. It starts with the animal's genetics, even before it is born.

Meat quality is a complex trait. Genetic differences among animals contribute to tenderness, marbling, fat deposition and distribution, carcass composition, and meat and fat colour. Nutrition, age, growth rate, sex, the environment and management influence how that genetic potential is ultimately expressed.

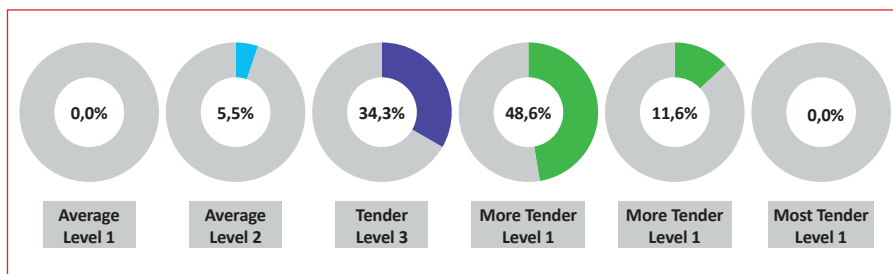
After slaughter, naturally occurring enzymes (calpains) break down structural proteins in muscle. Calpastatin inhibits calpain activity. The balance between these proteins influences the rate of post-mortem protein breakdown and therefore tenderness after ageing.

SA Stud Book's genomic service includes SNP markers in the calpain and calpastatin genes. Research in cattle populations has demonstrated associations between variants in these genes and measures of tenderness. Information from single-gene variants places animals into six categories representing their relative genetic potential for tenderness. Levels 1 and 2 represent lower genetic potential, levels 3 and 4 intermediate-to-higher potential, and levels 5 and 6 the highest potential.

In *Figure 1*, 34,3% of the animals were classified as level 3, 48,6% as level 4 and 11,6% as level 5, while only 5,5% were in level 2 and none in levels 1 or 6. Genomic testing not only reveals variation but, more importantly, identifies animals with more desirable combinations.

Marbling is also influenced by many genes and strongly affected by nutrition

Figure 1: The distribution in a breed.



and the animal's stage of maturity. Meat colour likewise has a genetic component, although (post-mortem) pH, ageing, oxygen exposure and handling have a major influence. Even fat colour has a genetic story. For example, yellow fat is strongly influenced by carotenoids consumed in green forage, but cattle differ genetically in their ability to deposit and metabolise these pigments.

Another, less obvious connection between genetics and meat quality is temperament. Temperament can affect how an animal responds to handling, transport, and other stressful events. Stress and physical exertion alter muscle energy metabolism and influence the biochemical conditions that develop after slaughter, and therefore meat quality.

Good recordings are always needed

An important limitation to genomic prediction is that DNA, based on single genes alone, does not tell us everything. The industry must move beyond a handful of single-gene markers towards more accurate genomic prediction of meat quality. More animals need both genotypes and reliable meat-quality records, including marbling, intramuscular fat, meat colour, fat colour, pH, carcass measurements, and objective tenderness measurements such as Warner-Bratzler shear force.

Relating DNA profiles to actual carcass and meat-quality measurements helps predict the genetic merit of animals that have been genotyped but haven't been slaughtered. This is why recording at abattoirs is important. Every reliable carcass and meat-quality record linked back to an identified, genotyped animal adds value to the industry's future ability to predict eating quality.

Initiatives such as ASM (Authentic Stud Meat) illustrate how information can be brought together along the value chain. Such a system can potentially combine information regarding genetic potential, lifetime production, and objective carcass and meat-quality measurements. The longer-term objective is a more precise assessment reflecting the actual quality and value of meat. Each genotyped animal also contributes to a growing pool of information that improves the accuracy of selecting for economically important traits.

Genetics therefore provides the starting point, not the finished product. Genes establish potential; nutrition and lifetime management influence development; temperament can influence stress response; slaughter conditions affect the conversion of muscle to meat; and chilling, ageing, and preparation determine how much of the genetic potential ultimately reaches the consumer. **SF**