SELECTION FOR Meat Quality

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INTRODUCTION

In South Africa, carcass weight and fat cover are important factors determining profit per animal for the producer. Palatability traits like tenderness and juiciness, however, are important for consumers. Meat Quality traits can therefore be broadly defined to include various carcass traits, from those that are economically important to producers, right through to traits important to consumers. Most of these traits are under genetic control and can therefore be successfully selected for.

Carcass data was historically collected with progeny testing. The calves of potential stud bulls were placed in a feedlot and carcass and meat quality traits were measured on the carcasses of the offspring. This is however a very expensive and slow way of evaluating bulls, resulting in only a few bulls' genetic abilities for carcass traits being measured. Fortunately, using modern-day technology, this is not the case anymore.

RTU *(Real-Time Ultrasound)*

One of the advantages of the ability to accurately measure carcass traits on live animals is that many more animals can be measured. These improve selection accuracy and thus genetic progress. RTU (Real-Time Ultrasound) scanning is currently the most common method used worldwide to measure carcass traits on live cattle and has been used in South Africa for many years. RTU scanning is relatively inexpensive. The device is easily transportable, even to remote farms. There is also no radiation involved and animals do not need to be sedated

RTU Scanning of a bull.

RTU Scanning apparatus comprises a probe and a screen to portray the RTU image.

RTU scanning of carcass traits is performed at the end of growth tests for young bulls. Economically important traits like weight, growth, height, length, as well as intake (some tests) of young bulls, are measured in growth tests. These traits influence red meat yield and are therefore linked to optimal production and profit.

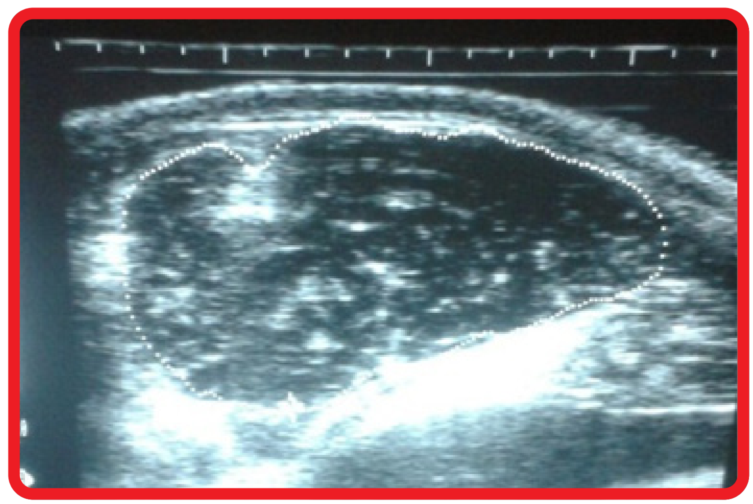
RTU traits include:

EMA: the eye muscle area of the longissimus dorsi (ribeye) muscle. Animals with larger eye muscles have scientifically been found to carry more red meat.

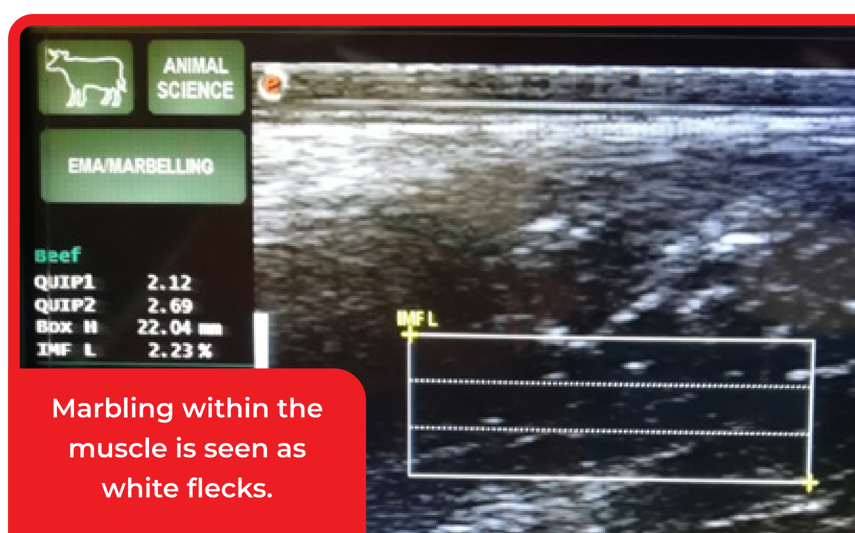
FAT: subcutaneous fat thickness on the back of the animal between the 12th and 13th ribs, as well as Rump fat thickness. Backfat thickness is a good indicator of fat coverage on the carcass, while rump fat thickness is beneficial when scanning very lean animals and can be used to improve the overall fat coverage estimate.

MARBLING: The intramuscular fat, which is sometimes visible as flecks of fat inside the muscle, is an important characteristic of cooked meat, affecting both juiciness and flavour and is important to consumers.

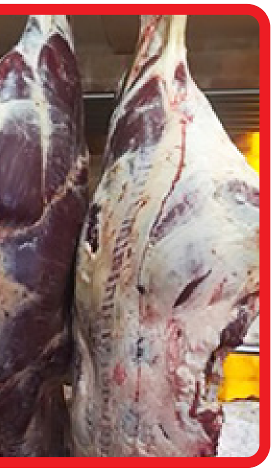
MEAT TENDERNESS: RTU scanning cannot directly measure meat tenderness.



Eye muscle area image on the screen.



Marbling within the muscle is seen as white flecks.



The importance of Fat

Consumers prefer soft, juicy and flavourful meat without visible fat. Therefore, if breeders select for the market, it should be for animals with less subcutaneous fat and more marbling. However, due to the underlying genetic correlations, selecting for less fat will decrease marbling.

According to the literature, selection for reduced fat can also negatively affect female fertility. It has been shown that the daughters of bulls selected for less fat often show delayed puberty, have difficulty in becoming pregnant and also have a longer gestation period which may increase birth weight and calving problems.

A good fat layer around the carcass is also beneficial as it protects the carcass against weight loss and cold shock during cooling and thus prevents the meat from getting tougher. In addition, high subcutaneous fat is well correlated with early sexual maturity and is also beneficial for carcass traits (including marbling), but it is negatively correlated with weight gain and consumer preference.

Fat thickness is therefore an attribute with an intermediate optimum - both extremes are undesirable. Bulls with desired performance levels for both intermediate fat and higher fertility should be selected by using breeding values.

Genomic selection

GENES FOR MEAT TENDERNESS

Meat tenderness is classified as one of the most important organoleptic quality traits affecting customers' choices. It was also considered the most important quality challenge for the beef industry as measurements of meat tenderness cannot be measured with RTU, and can only be obtained after the animal has been slaughtered. It is measured with a Warner-Bratzler apparatus that measures the force required to cut through a sample of meat.

However, several genomic markers (SNPs) have recently been successfully identified as markers for meat tenderness traits. The inheritance of the Calpain, Calpastatin and DGAT1 variants is additive, indicating that the combined effect is equal to the sum of the effects of individual variants. These markers are available when genotyping animals through SA Stud Book.

ENZYME	GENE VARIANTS	EFFECT
Calpain	CAPN1_316	More tender meat (Enzymes involved in the process of meat tenderization following rigor mortis)
	CAPN1_4751	
	CAPN1_530	
Calpastatin	CAST_282	
	CAST_2870	
	CAST_2959	
DGAT1	DGAT1	Increases Marbling

Table 1: Gene variants for meat tenderness currently available on the SNP chip.

CALPAIN AND CALPASTATIN

Polymorphisms in the μ-calpain (CAPN1) and calpastatin (CAST) genes (Table 1) are significantly associated with meat tenderness in several beef cattle breeds. Both μ-calpain and calpastatin are proteolytic enzymes involved in the process of meat tenderization following rigor mortis.

DGAT1

A polymorphism encoding DGAT1 (diacylglycerol O-acyltransferase 1), a microsomal enzyme that catalyses the final step of triglyceride synthesis, is associated with the percentage of the fat content of milk as well as the percentage of fat within the muscle (marbling).

GEBVs *(Genomic Breeding Values)*

In addition to single-gene information, genotypes, phenotypes, and pedigree information are also incorporated to estimate GEBVs (genomic estimated breeding values), which have been reported to result in a 32% improvement in accuracy compared to parental average breeding values.

Tail hair roots contain the DNA which is used for genotyping.

Summary

Selection for carcass and meat quality traits is possible because it can be measured on live animals using RTU and genomic technology. ■