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Limousin Factsheet 3

Myostatin (Double Muscling) in British Limousin Cattle

Introduction

Myostatin – double muscling – in Limousin cattle (and most other beef breeds) is not a new phenomenon. As DNA tests for Myostatin are now easily available, the Limousin Society and Limousin breeders are adopting an initiative that, from 1st January 2015, will see the publication of individual animal Myostatin test results as part of their commitment to on-going improvement of the breed & service to its buyers.

- ✓ **For breeders**, knowing the Myostatin status of animals within herds will be important for the choices and options it offers herd management and breeding programmes.

- ✓ **For purchasers**, and across the industry, it will similarly allow choices to be made based on knowledge and understanding when buying Limousin cattle.

This notice explains the background to Myostatin, how to access the published information and how to use it.

Background

Most characteristics of cattle that we are familiar with such as growth, fertility, carcase traits etc are controlled by many genes. A few characteristics are controlled by single pairs of genes. Coat colour and polledness are examples of this, as is double muscling.

Breeding & Single Trait Genes

Where characteristics are controlled by single pairs of genes, the outcome of particular matings can be predicted once the status of both parents is known. Two main principles apply:

- Dominance: Most single gene traits have dominant and recessive forms of the gene. The combination of these in the pair of genes carried by each animal often determines what the animal looks like. For example, the polled gene in Limousins is dominant and the horned gene is recessive. If an animal carries two horned genes (represented by pp) it will be horned. If it carries two polled genes (PP) it will be polled. If it carries one of each (Pp) it will be polled because the polled gene is dominant.

- Homo- and Heterozygous: Using the example above, animals carrying two polled genes (PP) or two horned genes (pp) are known as homozygous. If the genes are different (Pp) the animal is heterozygous. While we know that all horned animals are homozygous for the horned gene (pp), we cannot tell if a polled animal is homo- (PP) or heterozygous (Pp), since both types appear polled.

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Predicting the outcome: Where both parents are homozygous, the outcome of a mating can be predicted with 100% accuracy. Where one or both parents are heterozygous, only the *probability* of the outcome can be predicted. For example, if a heterozygous polled bull (Pp) is crossed to homozygous horned cows (pp) all we know is that 50% of the progeny will be polled (Pp) and 50% will be horned (pp)…

	Bull	
Cows	**P**	**p**
p	Pp (25%)	pp (25%)
p	Pp (25%)	pp (25%)

What is Myostatin?

The Myostatin gene is found in all mammals and influences the production of a protein that controls muscle development. Natural mutations of the gene produce proteins that are less effective at controlling muscle development, which results in increased muscle mass. There are nine known mutations of the myostatin gene in cattle, some of which are breed specific and others which affect more than one breed. There are three main mutations that occur within all Limousin populations (as well as other breeds) as follows:

Variant F94L

This is perhaps the most familiar variant to us owing to the high levels of Society publicity of its benefits over recent years. F94L increases the size of muscle fibers with **no** associated increased in calving difficulty, lowered fertility or longevity and by far the majority of animals in the breed carry this gene. Homozygous animals (two copies of F94L) show increases in primal cut weights by up to 19% and overall Retail Beef Yield by up to 8%, this also leading to better rates of feed conversion. Meat quality is also typically better with higher rates of tenderness, reduced fat and higher proportions of polyunsaturated fats. Heterozygous animals also exhibit these characteristics but not to the same degree. The BLCS dubbed F94L as the 'Profit Gene'.

As a result of the high frequency of this gene in the Limousin population, most animals have double copies and exhibit its characteristics; increased muscle mass without increased calving difficulties, lowered fertility or longevity. It is therefore partly responsible for the breed as it is today and one of the reasons behind its commercial success.

Variant nt821

This variant is recessive and is carried by a lower proportion of animals in the breed. Animals that are homozygous recessive will exhibit characteristics of the condition: larger loin depths, reduced fat depths and large, rounded rump and thighs. However, unlike F94L, homozygous animals (ie those with two copies of the gene) may also have slightly heavier birth weights bringing with it the potential for more difficult calvings,

If animals are heterozygous with F94L (ie F94L/nt821) they will still exhibit quality carcase characteristics but are less likely to be affected by more difficult calvings. These animals are known as 'carriers'.

Variant Q204X

This is a 'partially dominant' mutation of the Myostatin gene and, as with nt821, it is carried by a small proportion of animals. Animals that are homozygous (two copies of the Q204X gene) will exhibit characteristics of larger loin depth, reduced fat cover and greater meat tenderness. However, they may also have the potential to exhibit larger birth weight and, if females, slightly reduced milking ability. Animals that are heterozygous with F94L (ie F94L/Q204X) – also known as 'carriers' - will still exhibit quality carcase characteristics but are less likely to be affected by larger birth weights and reduced milking ability.

Two further variants of Myostatin exist but are relatively rare in their occurrence. Known as nt419 and E291X, their effects in homozygous and heterozygous states are similar to nt821 and Q204X respectively.

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What are the Benefits of Myostatin?

The presence of Myostatin mutations in the Limousin population have been and could continue to be advantageous for the breed in supplying the carcase attributes it is known for:

Meat Yield: The carcases of double-muscled cattle dress out at between 65 and 70 percent due to a combination of increased muscle mass, reduced body fat, reduced bone mass and smaller internal organs. This is up to 19% higher than cattle that don't exhibit double muscling. When muscle weight gain per unit energy intake is taken into account, double-muscled cattle have better feed efficiency than normal cattle.

Meat Quality: Meat from double-muscled cattle tends to be of better quality due to a combination of increased tenderness, reduced fat content and a higher proportion of polyunsaturated fats.

Significance for Producers: Double-muscled animals produce a higher proportion of desirable cuts of lean meat with greater efficiency than do comparable, conventional cattle. The majority of animals carry the F94L mutation and exhibit all these characteristics without any detrimental effect on birth weight, calving ease, fertility, longevity and milk.

Significance for Consumers: This meat is more tender and, being lean and having a higher polyunsaturated fat content, conforms more closely with current nutritional guidelines than meat from normal animals.

What are the Disadvantages of Myostatin?

On a population level, because of the high frequency of F94L, there are no significant disadvantages to the presence of these mutations.

Some difficulties may present themselves at individual animal and herd level, however. If animals carrying nt821 and Q204X are mated to animals that are hetero- or homozygous for the same mutations, it does increase the potential to increase birth weight and reduce milk, depending on the genotypes of the two parents. Whilst this can be managed – and very successfully so – it is lack of knowledge of an animals' status that is a barrier to this and therefore the main disadvantage currently. Knowing what the genotypes of breeding stock are will help pedigree and commercial producers select animals for the best possible outcome and will allow all herds to set and achieve breeding goals that capture the beneficial characteristics they bestow.

How Should Myostatin Information be Used when Buying A Bull?

The most important factor to remember is that carcase traits (muscling, fat cover), calving traits and milk traits in cattle are controlled by MANY genes. Myostatin is only one of them and, as such, it is not an absolute predictor of an animal's performance.

A Myostatin genotype is a further bit of information that may help your decision, but it should be used in conjunction with wider information such as Estimated Breeding Values (EBVs), which bring together information of actual performance from the animal itself, its herdmates and its relatives to predict genetic merit, and your own judgment on type and pedigree.

The testing and publication of Myostatin genotypes is carried out at by breeders on animals of their choice. From 2015, results will be published on the Basco database ('www.basco.org', click on 'Beef 'Search'), at Society sales and in other relevant Society literature.

Conclusion

The aim of providing this new information to industry is to further enhance all Limousin breeders' and buyers' knowledge of the potential performance of the stock they are selecting. Coupled with the wealth of wider performance information available, it demonstrates the commitment by the Society and its members to providing the market with animals that will produce fast growing, quality carcases that are easily born with heifer replacements that make quality suckler cows – now and in the future.

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