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DNA tests for sheep carrying genes for black wool

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Over half a million lambs with pigmented wool are born annually in Merino flocks; these range from almost entirely black (or brown) to lambs with relatively few patches of dark wool. This phenomenon is more than just a nuisance. Most pigmented lambs are slaughtered at birth, in itself a significant reproductive wastage, but those with small pigmented areas may escape the initial cull and have to be removed as more mature animals. In the worst case, these animals may be shorn, and pigmented fibres may enter the clip.

Culling pigmented lambs has little effect on the frequency of pigmented animals. Most of the genes responsible are recessive and are carried undetected in white animals. While carriers themselves are unaffected, they can pass on the undesirable genes to their offspring. A ram carrying pigmentation genes can produce a significant number of pigmented and carrier offspring, and clearly it would be an advantage to both producers and ram breeders if such carriers could be identified. The aim of this project is to determine the genes involved in pigmentation and to develop DNA-based tests that would allow the detection of these genes in phenotypically white animals. Such tests could be used for routine screening, especially in ram breeders' flocks, to eliminate the problem in the industry. We have taken a gene mapping and gene expression approach to identifying these genes.

The two most noticeable recessive pigmented Merino sheep phenotypes in Australia are self-coloured black (a largely pigmented animal, commonly with a white blaze on the head) and badgerface (an animal with a darker belly and legs with lightly or non-pigmented wool on moving from the belly to the flank and side). These pigmented Merino sheep are believed to be caused by variations of the *Agouti* gene, which is well known to produce similar patterns in other species.

We have investigated Merino sheep DNA at the *Agouti* gene and identified numerous small regions of the DNA that display differences between white and coloured animals. Some of these differences appear to be associated with the self-colour black and badgerface phenotypes respectively. However, the structure of the sheep *Agouti* gene region is apparently different to that of other species and further research is required to establish if these DNA differences can be used as a basis for developing genetic tests. In future work we will continue to investigate these and other differences in the genetic code to determine if they can be used to differentiate between white animals that do or do not carry genes causing pigmentation.

Gene expression profiling techniques detect differences in gene activity between tissue samples. We have used gene expression profiling of sheep skin samples to find specific patterns of gene expression associated with pigmented and non-pigmented fleece. Some of these genes are now being investigated to confirm they are showing differences in activity. Those that do will help in understanding how the coloured sheep patterns occur and become new candidates for the development of genetic markers.

The principle outcome of this research will be sets of DNA-tests that can be licensed to service providers and used by both the ram-breeding sector and other producers to identify and eliminate pigmentation genes from their flocks.