Coat Colour Genes - basic and industry relevance

The wool industry relies on effective sheep breeding and management and woolclassing requirements to minimise and separate wool containing pigmented fibre. When pigmented fibres are recognised substantial penalties apply and if not detected until after value adding by processing then these surprises affect client profitability and in turn the competitiveness of wool fibre. While culling affected sheep can reduce future occurrences it is also clear that genomic research could bring about the most efficient and effective solutions. The study of genes controlling coat colour and pigmented fibres are most relevant to white wool production yet there has been little specific research. Therefore, comparisons are made with other species (human, mouse, pig, cattle, horse, fox) in which relevant molecular genetics achievements are documented. SARDI has undertaken or collaborated in several projects that have advanced knowledge about the genetic control of white fleece in sheep and the elimination of pigmented fibre.

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Recessive Black

- Continuing problem for ram breeders - client complaint and culling problems
- Carrier sheep recognised when a black lamb occurs (1 in 4 lambs from carrier parents)
- A carrier ram can leave many progeny (half will be carriers) before being recognised
- Black lambs and wool are penalised in the market and cause some contamination
- Black lambs arise with different patterns and amounts of white spotting
- SARDI helped Macquarie Uni., with wool industry funding, to locate the gene responsible to sheep chromosome 13
- The *Agouti* gene is the prime candidate and several parties are interested in characterising the DNA involved to develop diagnostics for carriers.

White Spotting

- Sheep are usually white due to white spotting genes
- White areas result from restriction on pigment cell migration and colonisation or survival
- These genes are not always entirely effective
- Several genes likely to be involved
- Some white spotting genes produce undesirable effects
- Need to identify those genes withlarge effect
- Need to characterise the DNA variation within each gene that is most effective and has least undesirable effects
- SARDI has shown the effects of a white spotting gene in Merinos that reduces residual pigmentation including random spots
- SARDI helped Sydney Uni. Study white spotting in Awassi x Merino backcross flocks for gene mapping

Dominant Black

- Accompanied the importation of fat tail breeds to Australia from 1996
- Involves a defect in the receptor on pigment cells for alpha melanocyte stimulating hormone - continual signalling for black pigment
- The first pigment gene in sheep to be DNA characterised - Dala breed of Norway in 1999
- SARDI collaborated with Norwegian scientists to establish that Dominant Black from a heterozygous Damara ram and his Merino crossbred progeny had the DNA change previously found in the Norway sheep and mapped it to sheep chromosome 14
- SARDI shows that Dominant Black also reduces the potential for white spotting and this implicates the *Agouti* gene in usually enhancing white areas on the coat of sheep.

Albino

- Rarely recognised in sheep - 2 cases documented. Classic type involves a defect of the key enzyme (tyrosinase) in the melanin pigment pathway
- SARDI documented a type of albinism occurring in a Suffolk flock at Marrabel in South Australia
- Genes that prevents colouration by restricting pigment cell function rather than their location are potentially more efficient and effective.
- Could replace or add to the effects of existing white spotting genes
- Evaluation and characterisation is required.

Useful Links

International Albinism Centre (USA): http://albinismdb.med.umn.edu
InterpigDatabase (USA): http://ifpcs.med.umn.edu/micemut.htm
Retina International (Germany): http://www.retina-international.org/sci-news/
SheepCRC (Australia): http://www.sheepcrc.org.au/articles.php3?rc=35
University of Saskatchewan (USA): http://skyway.usask.ca/~schmutz/colors.html
Institute of Cytology and Genetics (Russia): http://www.bionet.nsc.ru/chromosomes/maps/map.htm
Institut National de Recherche Agronomique (France): http://locus.jouy.inra.fr/cgi-bin/lgbc/mapping/common/main.pl?BASE=
Meat and Animal Research Centre (USA): http://www.marc.usda.gov/genome/gene.html
Roslin Institute (UK): http://www.thearkdb.org/
National Centre for Biothechnology Information (USA): http://www.ncbi.nlm.nih.gov/
The Jackson Laboratory (USA): http://www.informatics.jax.org/
Australian Sheep gene Mapping Site: http://rubens.its.unimelb.edu.au/~jillm/asgmws_top.htm
Australian National Genomics Information – ANGIS: http://www.angis.org.au/Databases/
Genetic Technologies Ltd: http://www.gtg.com.au/index_general.asp?menuid=100.050

Further Reading

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