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Wool contamination – pigmented and highly medullated fibres

Introduction

Australia has a valued reputation as a supplier of wool with relatively low content of dark and medullated fibre (Hansford and Swan 2005). Dark and medullated fibres (DMF) can be produced by the sheep or may be acquired (e.g. urine stain). Merino sheep are recognised to have a low risk of inherent pigmented and highly medullated fibre (Fleet 1996; Fleet *et al* 2005) as a result of selection practices (e.g. Fleet 1998) while other sheep breeds are identified as having a higher DMF risk (AWEX 2007). Urine stain is a major source of acquired dark fibre but, together with fibrous non-sheep contaminants, can be controlled by simple farm practices including preshearing crutching (Fleet 1998; AWEX 2007).

Merino crossbreeding or running Merinos with coloured or highly medullated sheep types can lead to wool contamination. Concern about such management led the wool marketing industry to introduce special bale branding and a vendor declaration to identify specified exposures. Projects funded by Australian Wool Innovation Ltd. (AWI 2003) initiated both the Dark and Medullated Fibre Risk (DMFR) scheme (Hansford *et al* 2003; http://www.woolindustries.org/dmfr.htm), that provides guidance to wool buyers about risk levels of contamination from dark and medullated fibre based on farm information, and developed technology for potential presale testing of wool lots (AWTA *et al* 2004; Fleet *et al* 2007).

The problem

When dark or highly medullated fibre (DMF) is identified in greasy wool the discounts applied can be substantial (Fleet *et al* 2002a). If DMF is present as sporadic clumps or isolated fibres in the wool bulk these faults can easily escape visual recognition at sale and cause problems in processing; so documentation of such risks is important. Where contaminant fibres are widely dispersed in a wool lot then core sampling can be representative and the potential exists for presale measurement (Fleet *et al* 2001; Fleet *et al* 2002b; Hansford *et al* 2003; Balsingam *et al* 2007; Fleet *et al* 2007).

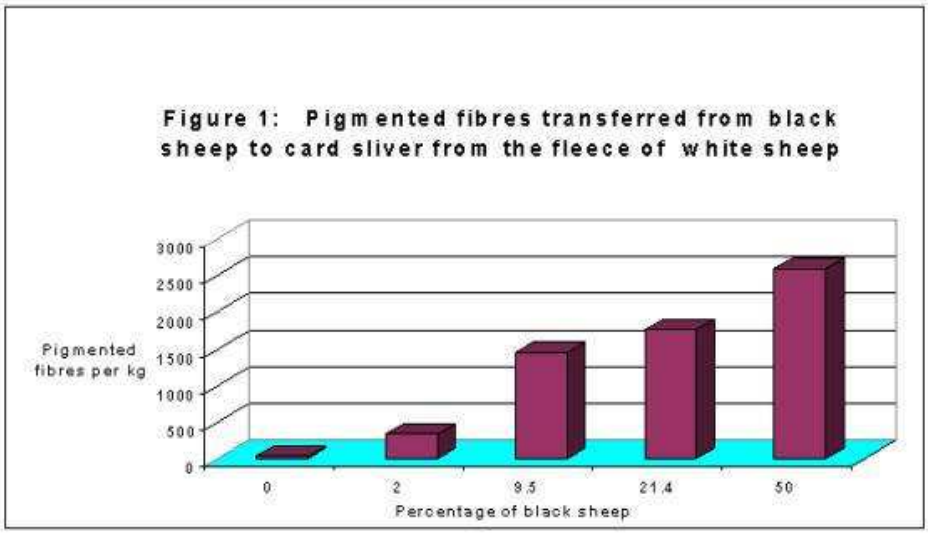
Problems due to unidentified DMF contamination in wool sale lots are often not recognised until after blending of various growers' wool sale lots and processing that reveals the fault. One producer's mistake or oversight of DMF contamination can downgrade or ruin an entire processing batch. Faults identified at a late stage can result in expensive fabric or garment mending or be prohibitive (Hansford *et al* 2003; Tester 2004; AWI 2008). Dark fibres form a visible defect in white or pastel products and highly medullated white fibre may not take sufficient dye and stand out in coloured products (Balasingam and Mahar 2005a,b). This publication focuses on the evidence available about DMF contamination arising from direct contact between white Merino sheep and coloured and/or highly medullated sheep.

Black sheep

In self-replacing Merino flocks, an occasional black lamb may be reproduced from white sheep due to the inheritance of a recessive gene and these lambs are usually culled in early life. Even though such minor occurrences may have little effect for the whole mob (Stobart *et al* 1990) it is best to separate coloured lambs (ideally also their rearing mothers) as soon a possible and shear separately; as advised in the Code of Practice for Clip Preparation (AWEX 2007).

Several trials have shown contamination arising from the running white and coloured sheep together (e.g. Johnston and Larson 1957; Fleet *et al* 1986; Hatcher *et al* 1999). The SARDI experiment showed the degree of contamination increased with the proportion of black Merino sheep (Figure 1). Hatcher *et al* (1999) processed the fleece wool from white Merino sheep in contact with an equal number of black Merino sheep in pen. The levels of pigmented fibres in the processed top and fabric were less than in scoured fleeces but remained excessive.

Black sheep in the white flocks can cause serious dark fibre contamination.



Suffolk or black-faced Downs breeds

Suffolk sheep are recognised as having the problem of isolated pigmented fibres in the apparently white fleece wool (Nichols 1927; Johnston and Larsen 1957; 1963). Similar problems are likely to exist for the Merino crossbreds as shown in other breeds for sheep with areas of pigmented hairs evident on the points (Fleet 1996; Fleet and Lush 1997). It is not clear how important are the fibres transferred during crossbreeding of dark-faced Downs rams to Merino ewes, as limited information exists (Stobart *et a.* 1990; Hatcher *et al* 2000a). Suffolk crossbred lambs tend to have visible pigment confined to the points and their fleeces are not "hairy", so the shedding fibre that contaminates the ewe fleeces may mainly be short.

Purebred Suffolk ewe with Merino cross lambs

Awassi

Awassi and Karakul fat tail sheep were introduced to Australia in the mid-1980's. These sheep produce carpet wool that requires regular shearing. Nevertheless, these breeds are classified as “shedding” types (AWEX 2007) due to the high degree of pigmentation and medullation that can be present. The potential for Merino wool contamination arising from exposure to Awassi or crossbred sheep was studied (Hatcher *et al* 1999, 2000a,b,c), and in summary:

- Purebred Awassi ewes penned together with white Merino ewes (equal proportion) increased the concentration of pigmented fibres in the scoured wool by 7-fold relative to the white Merino control.
- Purebred Awassi rams mated in pens or paddocks to white Merino ewes increased pigmented fibre concentration immediately after mating but not 8 weeks post-mating.
- Merinos run in a paddock previously grazed by Awassi sheep, or in paddocks adjoining Awassi sheep, or run together did not show markedly elevated pigmented fibre levels relative to the Merino control.
- Awassi x Merino lambs progressively transferred pigmented fibres to their Merino mothers during the rearing period. Concentrations of pigmented fibres in scoured wool from ewes shorn after weaning were extremely high.

A survey of wool lots (Hansford *et a.* 2003) found little contamination in Merino wool grazed separately in paddocks next to mobs of high-risk sheep. However, direct contact of Merinos with Awassi, Karakul, Damara and Dorper sheep or their crossbreds produced similar high contamination.

Purebred Awassi rams

Awassi x Merino lambs

Dorper and White Dorper

The Dorper and White Dorper have a short shedding wool fleece containing "floating kemp" (chalky white shed fibre considered to be highly medullated). Purebred sheep have pigmented heads and necks while Dorper crossbred animals have a wider variation in pigmentation over the coat. This breed was first introduced from South Africa in 1996 with the Damara and later other ”fleece shedding” breeds - Van Rooy, Ronderib Africana and Black-Head Persian – were imported.

Contamination from crossing of Dorper rams to Merino ewes was studied in South Africa (Van Zyle 1995). While there was no detectable effect of ram mating, the fleeces of ewes that reared crossbred lambs (when shorn 12 months after mating) had pigmented fibre levels that were increased by 21 to 23-fold.

Purebred Dorper ram

Extensively coloured first cross Dorper x Merino lambs (left and right) and comeback Dorper lamb (centre)

While the “White Dorper” does not show pigmented fibre and the Merino crossbred lambs are usually white, there remains the problem of floating kemp that is shed from the fleece together with the shorter hairs from the face and legs.

Left: Purebred White Dorper ewes

Top left: White Dorper comeback lambs

Top centre: Floating kemp in the comeback wool

Above right: white kemp transferred to a black lamb

Damara

The Damara is a “fleece shedding” breed that includes a variety of colours (tan, brown, black and white spotted) and was first imported from South Africa in 1996 with the Dorper. The fleece is usually pigmented and has a high content of coarse “hairy” fibre with pronounced medullation.

Damara rams

Damara crossbred lambs with Merino ewes

On-farm research arising from wool industry concerns has shown:

- Usual paddock mating of Merino ewes to Damara rams did not produce pronounced contamination (Rose *et al* 2000; Fleet *et al* 2001; 2002c). This result reflects the usual low proportion of rams involved and the relatively brief close exposure period for each Merino ewe; though other situations may be more serious (AWEX 2007).
- Merino ewes rearing Damara crossbred lambs and Merino lambs running with Damara crossbred lambs produced wool with extremely high concentrations of DMF; that remained excessive if shorn 3.5 month after weaning (Fleet *et al* 2001, 2002c).

Off-farm research has shown:

- DMF contamination can be detected from wool lot core sample tests as the fault is dispersed through fleeces and sheep mob (Fleet *et al* 2001; Fleet *et al* 2002b; Hansford *et al* 2003; Balasingam *et al* 2007).
- Dark and medullated fibre (DF & MF) contaminants persist in processing (Table 1). Only some of the fault is separated to secondary products (Fleet *et al* 2006a,b; 2007; 2008).
- A rapid test being developed for wool sale lots has shown good agreement with existing methods (Fleet *et al* 2006a,b; 2007; 2008).

Table 1: Processing trial (Fleet *et al* [A]2006b [B]2008) Damara contact	Core sample [A]DF+[B]MF/10g	**Processed Top**	[A]DF+[B]MF/10g Noil
None – Merino (Mo) ewes shorn after mating	1.1	**0.3**	3.4
Ram – Mo ewes shorn after mating	1.4	**0.3**	2.3
XB lambs – Mo ewes shorn 3.5 months after weaning	10.6	**3.7**	27.3
XB lambs – Mo ewes shorn at weaning	31.5	**18.1**	136.9
XB lambs – Mo lambs after 7 months contact	36.3	**15.2**	133.8

Dark and Medullated fibre risk scheme

The woolclasser has a key role in quality assurance and new wool sale lot test certificate changes aim to identify wool that lacks this attention or is non-complying for other reasons (AWEX 2008). The DMFR scheme (Hansford *et al* 2003 AWEX 2007) together with revised vendor declarations (http://www.woolindustries.org/dmfr.htm) was initiated by the Federation of Australian Wool Organisations due to inquiry and concern from the wool textile industry about increased problems with DMF that was associated with crossing of Merino sheep to coloured and highly medullated breeds (e.g. Damara). The DMFR scheme is based on a previous CSIRO proposal (Foulds *et al* 1988; Burbidge and McInnes 1994) that made use of farm information to provide an insight to risk of urine stain and inherent pigmented fibre.

The wool textile industry is making use of the DMFR information to assist in selection of wool lots for sensitive end-uses (AWI 2008). Increased adoption of the DMFR scheme (http://www.awta.com.au/en/Home/News2/General-Information/), together with other test developments in progress, should ultimately provide price incentives that encourage greater emphasis on producing low risk wool (http://www.woolindustries.org/dmfr.htm).

Conclusion

It is clear there is transfer of pigmented and/or medullated fibres from coloured and/or highly medullated sheep types to Merino sheep in circumstances of direct contact. While there is little or no objective information regarding the contamination potential of many of the breeds mated to Merino ewes in Australia some guidance about the likely relative risk is provided (AWEX 2007). Apart from sheep contact situations, contamination can easily occur indirectly where different sheep/animal types share the same facilities (e.g. yards, shearing shed) – hence the need for cleanliness and shearing in order of increasing risk. The AWEX Code of Practice (2007) provides guidance about minimising the risk of contamination and for the declaration and branding of wool known to be at risk. Fleet (1998) provides guidance about the control of inherent dark fibre in Merino flocks.

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Author: Malcolm R Fleet
South Australian Research and Development Institute, Livestock Systems Alliance ,Turretfield Research Centre, Rosedale SA 5350 Australia.

E-mail: fleet.malcolm@saugov.sa.gov.au

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