FELTABILITY OF MERINO WOOL IS INFLUENCED BY SCALE STRUCTURE

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Scales on wool fibres are generally believed to be fundamental to the ability of wool to felt (Chen *et al*. 2000). Theory states that scales produce a directional friction effect that causes fabric shrinkage. Friction is greater when a fibre is rubbed in 1 direction compared to the opposite direction, causing fibres to mat together, resulting in reduced fabric size. Several studies challenge this theory. Blackenburg (1969) found that samples with destroyed scale structure still had high felting power. Lipson and Rothery (1975) found Merino wool had a significantly higher felting ability than Polwarth wool with no differences in fibre surface friction or scale frequency between breeds. The hypothesis for this experiment was that scale structure was not the primary cause of felting in Merino wool.

Twenty eight Merino fleeces from the GSARI base flock at Katanning, Western Australia, were categorised into 4 groups based on felt ball diameter (FBD) and fibre curvature. Felt ball diameter is a measurement used to represent felting ability; lower FBD is indicative of higher felting ability. Fibre diameter and hauteur were kept constant at 19.5 µm and 68 mm, respectively. Groups were low curvature with 1) low and 2) high FBD, and high curvature with 3) low and 4) high FBD. Classification included high FBD above 24.5 mm, and low FBD below 23.9 mm, while high curvature was above 96 deg/mm and low curvature was below 83 deg/mm. Three treatments were applied to mid-side samples; 1) scouring, 2) hand carding, and 3) Shirley carding. Electron micrographs of samples were taken and fibres measured for fibre diameter, scale height, scale length and given a flakiness score. Fleeces were processed as 4 batches, and fabric shrinkage measurements performed. Data was analysed using ASREML (Gilmour *et al*. 2002). The model included group, treatment and a group by treatment interaction, with fibre diameter fitted as a covariate.

Scale height was linked to FBD to some degree, but scale length was influenced more by curvature (Table 1). The correlation between scale length and curvature was -0.26 while that between scale length and FBD was -0.13. No relationship was found between scale height and scale length. Fabric shrinkage appeared linked with scale height as group means shared the same sequence. Fabric shrinkage for group 4 was 23% lower than for the other 3 groups (average shrinkage = 39%). Flake score did not significantly differ between groups, but treatment had a significant effect on flake score with an increase in flakes evident with increasing severity of treatment (P=0.05).

Table 1: Least square means of the 4 groups for scale height (µm), scale length (µm), and flake score (1 - 10). Total fabric shrinkage (%) in the length direction is also presented.

Groups	Scale height	Scale length	Flake score	Fabric Shrinkage
1 - Low curve, low felt ball diameter	0.59^{ab}	11.08^{a}	4.7	42
2 - Low curve, high felt ball diameter	0.53^{c}	11.38^{a}	4.7	37
3 - High curve, low felt ball diameter	0.57^{abc}	11.04^{ab}	5.0	38
4 - High curve, high felt ball diameter	0.55^{bc}	10.63^{b}	4.8	30

Values in columns with different superscripts are significantly different (P<0.05)

The hypothesis for this experiment was partially supported because scale height contributed to significant differences in felting ability, but only at low curvature. The lack of correlation between scale height and scale length implied that these 2 traits were independent. Fabric shrinkage appeared linked to scale height and FBD. However, as the data set was limited, more work is required in this area to clarify raw wool morphological characteristics in relation to fabric shrinkage.

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