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Author:	L. K. Hillbrick and M. G. Huson
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Merino fibres with low cuticle step height and reduced surface roughness have a softer loose wool handle

L. K. Hillbrick[A,B,C] *and M. G. Huson*[A,B]

[A]Cooperative Research Centre for Sheep Industry Innovation, Armidale, NSW 2351, Australia.
[B]CSIRO Materials Science and Engineering, Belmont, Vic. 3216, Australia.
[C]Corresponding author. Email: linda.hillbrick@csiro.au

SUMMARY

Wool has little presence in the rapidly growing trans-seasonal, next-to-skin knitwear market, which is currently dominated by cotton and synthetic fibres. To be competitive in this market, it is necessary for wool garments to have an appealing, soft handle (softness). Resistance to compression (RtC) of loose wool is considered the best indicator of fibre softness and is significantly correlated with mean fibre diameter (MFD) and mean fibre curvature (MFC) (Madeley *et al.* 1998). Our previous work (Hillbrick and Huson 2008) showed that RtC and Young's modulus (tensile stiffness) were not significantly related, and for wool of similar diameter, Young's modulus was constant. We hypothesise that when the overwhelming effects of MFD and MFC are removed, fibre ellipticity, due to its effect on bending stiffness, and cuticle topography, because of its effect on fibre friction will be different for Merino wool samples that have different loose wool softness.

Two mid-side Merino samples, from the same flock, matched for MFD (15.8 μm) and MFC (64°/mm), with high (9 kPa) and low (7 kPa) RtC, were selected on the basis that their clean wool softness was significantly different. Raw wool staples from these samples were cleaned by gentle aqueous scouring. Fibre ellipticity and the coefficient of friction were measured on 20 randomly selected fibres from each scoured sample. Fibre ellipticity was determined from micrographs of fibre cross-sections. The coefficient of friction was measured in the with-scale (μ_{ws}) and against-scale (μ_{as}) directions using a capstan method. Cuticle step height, length and roughness measurements were made on 10 fibres from each sample using a scanning probe microscope (SPM) operated in Tapping-Mode™.

Table 1. Secondary fibre characteristics for 15.8 μm MFD, 64°/mm MFC fibre with soft or harsh hand (mean ± 95% confidence interval)

Fibre characteristic	n	Soft hand (RtC 7 kPa)	Harsh hand (RtC 9 kPa)	*P*- value
Ellipticity	20	1.16 ± 0.04	1.18 ± 0.04	0.59
Coefficient of friction μ_{ws}	20	0.27 ± 0.02	0.23 ± 0.02	<0.001
Coefficient of friction μ_{as}	20	0.31 ± 0.02	0.28 ± 0.01	<0.05
Cuticle step height (nm)	220	454 ± 23	598 ± 28	<0.001
Cuticle length (nm)	165	9.7 ± 0.4	9.3 ± 0.4	0.09
Cuticle roughness, rms (nm)	25	6.8 ± 0.64	8.2 ± 1.1	<0.05

Given that there were no differences in ellipticity (Table 1), and the assumption of equivalent Young's moduli (equal MFD), it seems unlikely that fibre bending stiffness plays a role in the differences in loose wool softness between these two Merino samples. The high coefficient of friction recorded for the softer sample is surprising and further investigation will be conducted using the capstan method as well as a SPM method. Fibres from the softer sample had a lower cuticle step height and a smoother surface. These are the most likely intrinsic fibre attributes, other than MFD and MFC, contributing to the softness of loose wool.

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