Near Infrared Reflectance Spectroscopy for the Measurement of the Sulphur Content of Merino Wool

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Sheep selected for high clean fleece weight produce wool which is lower in both cysteine and sulphur content (Sun et al. 1991), raising the possibility that these might be useful indirect selection criteria. This would particularly be the case if these differences were apparent at an early age when clean fleece weight is a poor indicator of lifetime wool growing capacity. This appears to be so. Sun et al. (1991) showed that differences in wool sulphur concentration between control and fleeceweight selection lines were apparent as early as 15 weeks of age. There are also suggestions that wool sulphur concentration is related to crimp frequency and fibre diameter, and that total output of sulphur in wool is negatively related related to immunity to parasites and disease (Miller et al. 1998). To be a useful indirect selection criterion for wool growth, wool quality or parasite resistance, the measurement of wool sulphur must be rapid, inexpensive and accurate. The traditional method of measuring wool sulphur uses a wet chemical digestion followed by inductively coupled plasma atomic emission spectrometry (ICPAES) which is laborious, slow and involves the use of hazardous chemicals. Recently, Near Infrared Spectroscopy (NIRS) has been used to determine the S content of New Zealand Romney wool (Corson and Lee 1998). The method is rapid, non-destructive and requires no hazardous chemicals. In this paper we report on the potential for NIRS to be used to determine the S content of Merino wool fibres.

The S concentration of 184 Merino wool samples (94 Strongwool Merino and 90 Finewool Merino samples) was measured using ICPAES after a perchloric/nitric acid digestion. Corresponding samples were then scanned to obtain NIRS spectra using the Foss NIRSystem Model 6500 Spectrophotometer and Intrasoft International (ISI) NIRS 3 version software. The samples were washed in Lissapol TN450, packed into the cell and scanned via transport module in reflectance mode over the wavelength range 400-2500nm at 2nm intervals using a quartz window ring cup. For calibration development the wavelength range was narrowed to 1100-2500nm. 150 spectrally-distinct samples were chosen and were used as the calibration set, while the remaining 34 samples formed the validation sample set. The samples used to develop the calibration ranged in S content as determined by ICPAES from 2.52 to 3.40%.

The validation samples produced mean S values of 3.0365 ($\pm$0.0224) and 3.0209 ($\pm$0.0133) by ICPAES and NIRS respectively. The relationship between the two methods is shown in the figure. The regression equation relating the two was:

$$Y = 0.65X +1.06 \ (r^2 = 0.70; \ P<0.0001).$$

Figure 1. Relationship between the two methods

The results demonstrate a high degree of accuracy of the calibration such that wool S concentration can be measured by NIRS. NIRS is a rapid, accurate, non-destructive, inexpensive and non-hazardous method for measuring wool S content. Large numbers of wool samples can now be measured to allow estimation of the heritability of wool S content (and total S output) and the genetic correlations between wool S and other economic traits, as a prelude to the use of wool S as an indirect selection criterion for Merino sheep.


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