Abstract

Near infrared spectroscopic prediction of diameter and yield of cashmere fibres in undehaired raw samples

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Introduction

Cashmere corresponds to the inner layer of fine fibres produced by secondary follicles, in the fleece of some goats, notably the Cashmere goat, but also in other types of indigenous goats that have different proportions of fine fibres under the dominant coarse and long hairs produced by primary follicles. Important economic traits for cashmere are diameter, which should not exceed 18µm, and yield of fine fibres, after removing coarse hairs in the industrial process (dehairing). Breeding programs oriented to improve cashmere production in indigenous and Cashmere crossbred goats could be greatly strengthened by a rapid and accurate method of measuring fibre diameter and fine fibre yield. The objective of this work was to evaluate the potential of NIRS to predict average cashmere fineness and yield in samples of greasy un-dehaired fleeces of Cashmere and Cashmere cross goats.

Materials and methods

Samples were taken from the mid-rib sector of 149 greasy raw fleeces of male and female indigenous and Cashmere-cross goats from flocks across different regions of Chile. Spectra of raw samples were taken with a scanning monochromator (Foss-NIRSystems 6500, Silver Springs, Maryland, USA) using a spinning module. The sample was inserted in a circular cuvette. After taking the spectra, samples were analysed by the OFDA method (optical fibre diameter analyser) for cashmere fibre diameter and fine fibre yield (reference values), in the wool-testing laboratory of the Macauley Institute (Auchincruive, Scotland). Using WinISI software, calibrations were developed by modified partial least squares (MPLS) regression analysis, with two passes of elimination of "T" outliers, testing different math treatments (derivative order, subtraction gap and

smoothing interval), and with or without light scatter correction treatments (SNV and Detrend). Cross validation was performed to limit the number of equation terms to avoid overfitting. The best equation for each trait was selected according to a higher proportion of explained variance (1-*VR*), a lower root mean standard error of cross validation (*RMSECV*) and a higher proportion of standard deviation (*SD*) to *RMSECV*.

Results and discussion

The diameter of the cashmere type fibres in the calibration set showed an average, *SD* and range of 15.25 µm, 1.67 µm and 11.49–20.45 µm, respectively. Average, *SD* and range for yield, were 45.17, 20.67 and 4.1–89.5%, respectively. The best calibration was obtained for fibre diameter with a math treatment 2,4,4 plus detrend. For yield, the selected equation was obtained after a treatment 2,4,4 plus SNV and detrend. The statistics are presented in Table 1.

Results show that fibre diameter could not be predicted with confidence by NIR spectroscopy, although there is a significant relationship between the NIR spectra of the raw, unwashed samples (guard hair and cashmere) and the diameter of fine fibres, which is remarkable. On the other hand, calibration for yield of cashmere, a very important economic trait, resulted in an equation which could be used for prediction or, more realistically, for selection of the best performing animals in a breeding scheme. Moreover, the analysis can be performed faster and with less sample preparation and handling, in comparison with the reference method.

Table 1. Statistics for selected calibrations for fibre diameter and yield.

Variable	Average	*SD*	*SEC*	R^2	*RMSECV*	1-*VR*	*RPD*
Diameter	15.17 (µm)	1.62(µm)	0.83(µm)	0.74	1.01(µm)	0.62	1.60
Yield	45.30 (%)	20.02(%)	5.87(%)	0.91	6.83(%)	0.89	2.93