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Changes in unscourable discolouration of Romney wool samples during storage for one month

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ABSTRACT

Samples of four Romney fleeces were dried to 8 % moisture immediately after harvesting, then water was added to achieve moisture contents of 8, 19, 30, 41 or 52 % of the clean, dry wool weight. Additional samples were left untreated (11 % moisture) or scoured (16 % moisture). CIE X, Y, Z and Y-Z measures of scoured wool colour were recorded after 0, 5, 12, 21 or 33 days storage at 3 or 20 °C.

There was no change in colour values of untreated and scoured samples during storage at 3 or 20 °C. X, Y and Z values decreased linearly when moisture content increased ($P<0.05$), the effect being most marked at 20°C. A trend for Y-Z values to increase with moisture content was not significant.

The findings indicate that if damp greasy wool is to be stored for a month or more before colour is measured, it should be dried at 30 °C or less before storage, stored at cool temperatures, or scoured and dried before storage.

Keywords: Wool; storage; moisture content; temperature; unscourable discolouration.

INTRODUCTION

The New Zealand standard method of measuring wool colour (NZS 8707: 1984) measures Commission Internationale de l'Eclairage (CIE) X, Y, Z and Y-Z values that denote red, green, blue and yellow reflectance, respectively. Decreases in X, Y and Z and increases in Y-Z are taken to indicate discolouration. Also, increases in Y are taken to indicate increases in brightness. The principal measure of discolouration important to wool processors is Y-Z of scoured wool, because it limits the ability to achieve light shades of dyed wool. These colour measurements on core samples from bales can be included on pre-sale test certificates for wool lots, along with other indicators of the wool's performance during processing and in the end-product. The measurements may also be used on samples of fleece wool to select individual sheep for breeding or culling, though heritability and repeatability estimates for Romney-type sheep are low (Bigham *et al*., 1983; Morris *et al*., 1996).

Loose greasy wool discolours rapidly over a period of days when held at 40 °C and high moisture conditions (Aliaga *et al*., 1996; Cottle *et al*., 1992; Wilkinson, 1981). When stored compressed in bales under lower temperature and moisture conditions, unscourable yellow discolouration can occur over a period of months at a slower rate (Ranford *et al*., 1991; Cottle, 1998). This tendency to discolour needs to be taken into account when handling wool samples in which colour is to be measured. This experiment was undertaken to determine effects of moisture content and temperature during storage of loose wool for up to one month.

MATERIALS AND METHODS

Four Romney ewes were selected from a larger flock on the basis of the Y-Z values of their fleece wool, to provide a range in degrees of unscourable yellow discolouration. At least 700g of fleece wool (free from yolk, urine and faecal stains) that had grown since shearing in the previous August was harvested from each sheep in May.

Immediately after harvest, 70 samples of 8g were obtained by stratifying the 700g of fleece wool into 8 quadrants (2 sides x 4 quarters) and then taking approximately 1g (1 staple) from each quadrant. The samples were randomly allocated to 7 moisture x 2 temperature x 5 storage time treatments, remained untreated or were scoured and conditioned before storage. Plastic bags containing the untreated samples were sealed after harvesting. Scoured samples were aqueous scoured, dried at 60 °C, conditioned at 20 °C and 65% relative humidity overnight, re-weighed and sealed. The greasy samples to be subjected to the moisture content treatments were dried in a forced draft oven at 30 °C overnight. Distilled water was then sprayed onto them at 0, 10, 20, 30 or 40% of the oven dry weight before bags were sealed.

Samples subjected to the same moisture treatments were sealed within another plastic bag to minimise moisture contamination between treatments. The samples were then stored in temperature controlled rooms at 3 or 20 °C for 0, 5, 12, 21 or 33 days before being aqueous scoured, dried for 1 hour at 60 °C, and carded. X, Y and Z values were then measured using the New Zealand standard method (NZS 8707: 1984).

The data were analysed for effects of treatments on X, Y, Z and Y-Z values by analysis of variance, using individual animals as replicates. The rate of discolouration during storage was determined by regression of treatment means against time.

RESULTS

The moisture content of wool at harvest was 11 % of the clean, dry wool weight. Drying overnight at 30 °C reduced it to 8% and addition of water then increased it to 8, 19, 30, 41, or 52 % of clean, dry wool. Scoured samples contained 16% moisture after conditioning and before storage.

Colour measurements on day 0 did not differ between samples that were untreated, those that were scoured and those that were dried at 30 °C overnight before water was added.

There were no significant changes in X, Y, Z or Y-Z during storage of the untreated or scoured samples. In the greasy samples that had water added, X, Y and Z values decreased and Y-Z values increased with time at higher moisture and temperature levels. At day 33, X ($P<0.01$), Y ($P<0.01$), and Z ($P<0.05$) values declined linearly as moisture contents increased. The effect on Y-Z was not significant. Figure 1 illustrates these changes at different moisture contents during storage at 20 °C. Figure 2 illustrates the magnitude of the effects of temperature on responses to moisture contents measured after 33 days storage.

Among X, Y and Z, the biggest changes and greatest variation occurred in Z values (Figures 1 and 2). The fastest rates of change in the colour parameters between days 0 and 33 of storage occurred in the samples with 52 % moisture stored at 20 °C. They were –0.10, -0.10, -0.15 and +0.05 units per day for X, Y, Z and Y-Z respectively.

FIGURE 1: Mean X, Y, Z and Y-Z values (CIE units) of wool samples containing moisture contents of 8, 19, 30, 41 or 52 % of the clean, dry wool weight, during storage at 20 °C. 8 % = X; 19 % = ▲; 30 % = •; 41 % = ♦; 52 % = ■.

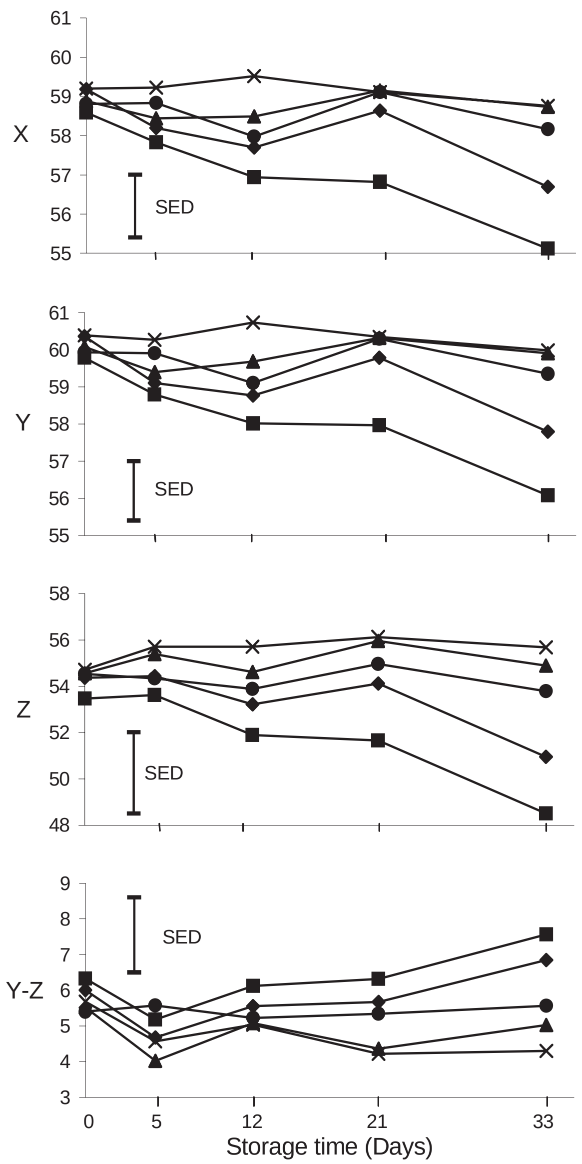
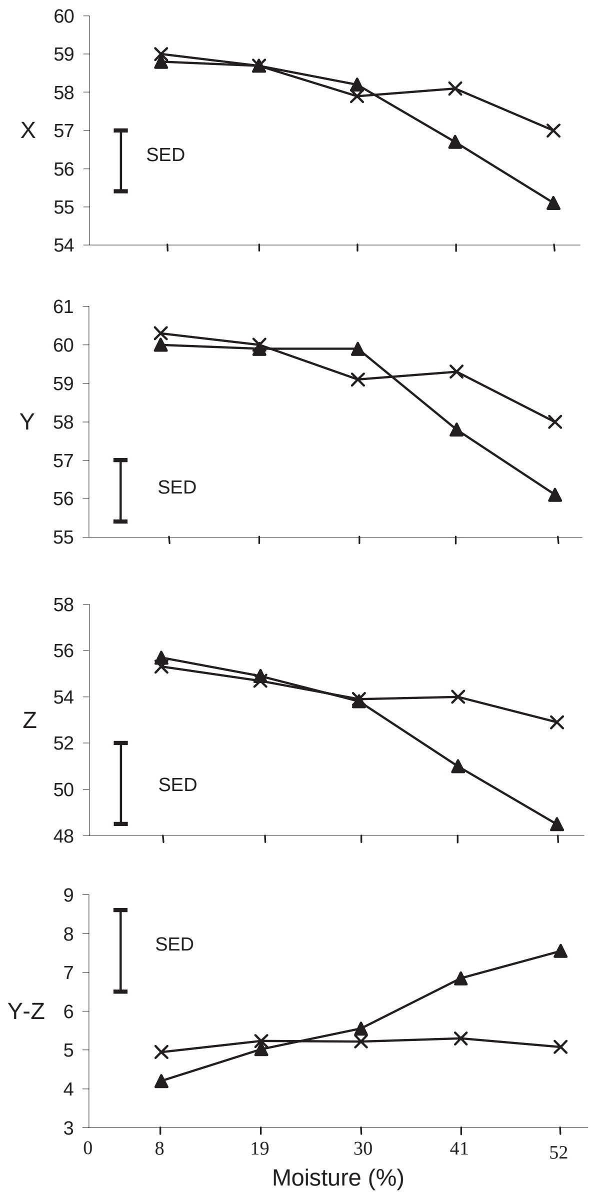


FIGURE 2. Mean X, Y, Z and Y-Z values (CIE units) of wool samples containing moisture contents of 8, 19, 30, 41 or 52 % of the clean, dry wool weight, after 33 days storage at 3 or 20 °C. 3 °C = X; 20 °C = ▲.



DISCUSSION

Unscourable yellow discolouration occurs within days when wool is incubated at higher than ambient temperatures and moisture contents. This is the basis of tests to establish the susceptibility of wool to discolour or to induce stable colour (Wilkinson, 1981; Cottle *et al*., 1992; Cottle and Zhao, 1995; Reid, 1993; Aliaga *et al*., 1996). Aliaga *et al*. (1996) reported rates of yellowing of 0.5 to 2 Y-Z units per day over 6 or 14 day periods when moist, greasy wool was incubated at 40 °C. In marked contrast, Ranford *et al*. (1991) and Cottle (1998) both reported average rates of only 0.001 units per day in bales of greasy wool stored at ambient temperatures. The maximum rate observed in the present study (0.05 units per day) was intermediate. One possible reason for the difference in rates is variations in the susceptibility of wool to discolour. Susceptibility to yellowing has been shown to vary markedly between individual sheep, flocks and wool lots due to genetic and environmental factors (Wilkinson, 1982; Wilkinson and Aitken, 1985; Ranford *et al*., 1991; Reid, 1993; Reid *et al*., 1995).

Other factors responsible for different rates of unscourable discolouration will be temperature and moisture conditions. Reid *et al*. (1995) and Aliaga *et al*. (1996) reported that discolouration increased with temperature. The greater discolouration at 20 °C compared to 3 °C in the present experiment is consistent with those earlier findings, albeit the earlier studies were conducted at much higher temperatures. There was no indication of discolouration during drying of greasy wool samples with 11 % moisture at 30 °C overnight. This can be contrasted to the marked changes recorded over 3 days at 40 °C in the modified test used by Aliaga *et al*. (1996).

Also consistent with the results of Aliaga *et al*. (1996) is the finding that discolouration was increased at higher moisture contents. In the present study the effect of moisture was most marked at contents over 30 %.

It is interesting to note that the strong similarity of the pattern of responses in X, Y and Z (Figures 1 and 2). This suggests that they are not independent. The responses in them and in Y-Z, were most marked in samples exposed to the combination of 41 to 52 % moisture and storage at 20 °C. The Z values were more sensitive to the treatments than X or Y values.

CONCLUSIONS

Since wool types differ in their susceptibility to discolouration, it is unwise to take anything more than broad guidelines from the present experiment. The findings are, however, reinforced by other studies in indicating that moist wool samples in which colour is to be measured should not be held in warm places. To minimise unscourable discolouration between collection and measurement, they should be dried to low moisture percentages at temperatures of not more than 30 °C, or they should be stored in a chill room at 3 °C or less, or they should be scoured.

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