

Supplementary Information

Valorisation of sulphonated lignin as a dye for the sustainable colouration of wool fabric using sustainable mordanting agents: Enhanced colour yield, colourfastness, and functional properties

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Index

List of Figures

Fig. S1. UV-vis spectra of aqueous solution of SL.

Fig. S2. Effect of Cu (top) and Fe (bottom) mordant concentrations (%ows) on the depth of shades of wool fabrics treated with 3% (owf) SL.

Fig. S3. Elemental distribution of C, N, O, S, and Al/Cu/Fe/Ca elements on wool fibre surface dyed with SL using various mordanting agents.

Fig. S4. ATR-FTIR spectra of wool fabric dyed with 1% owf SL in combination with various mordanting agents using their concentrations of 25% (ows).

List of Tables

Table. S1. Effect of mordanting agent concentration on *CIE L*a*b** values and colour difference compared to the undyed control of wool fabrics dyed 3% (owf) SL at 98 °C for 60 min.

Table S2. Colourfastness to washing of wool fabric treated with 3% (owf) SL at various conditions.

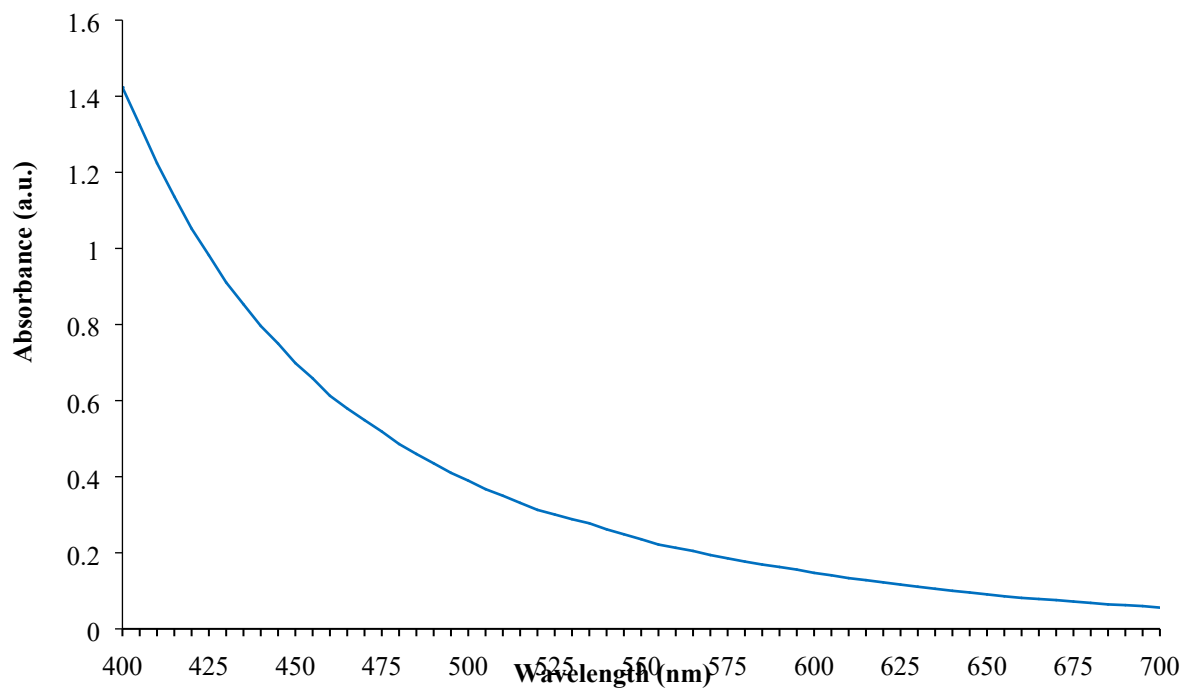


Fig. S1. UV-vis spectra of aqueous solution of SL.

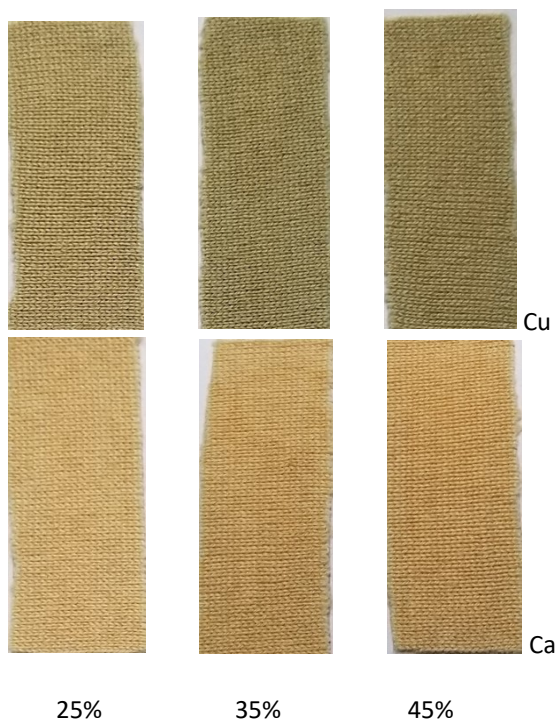


Fig. S2. Effect of Cu (top) and Ca (bottom) mordant concentrations (ows) on the depth of shade of wool fabrics treated with 3% (owf) SL.

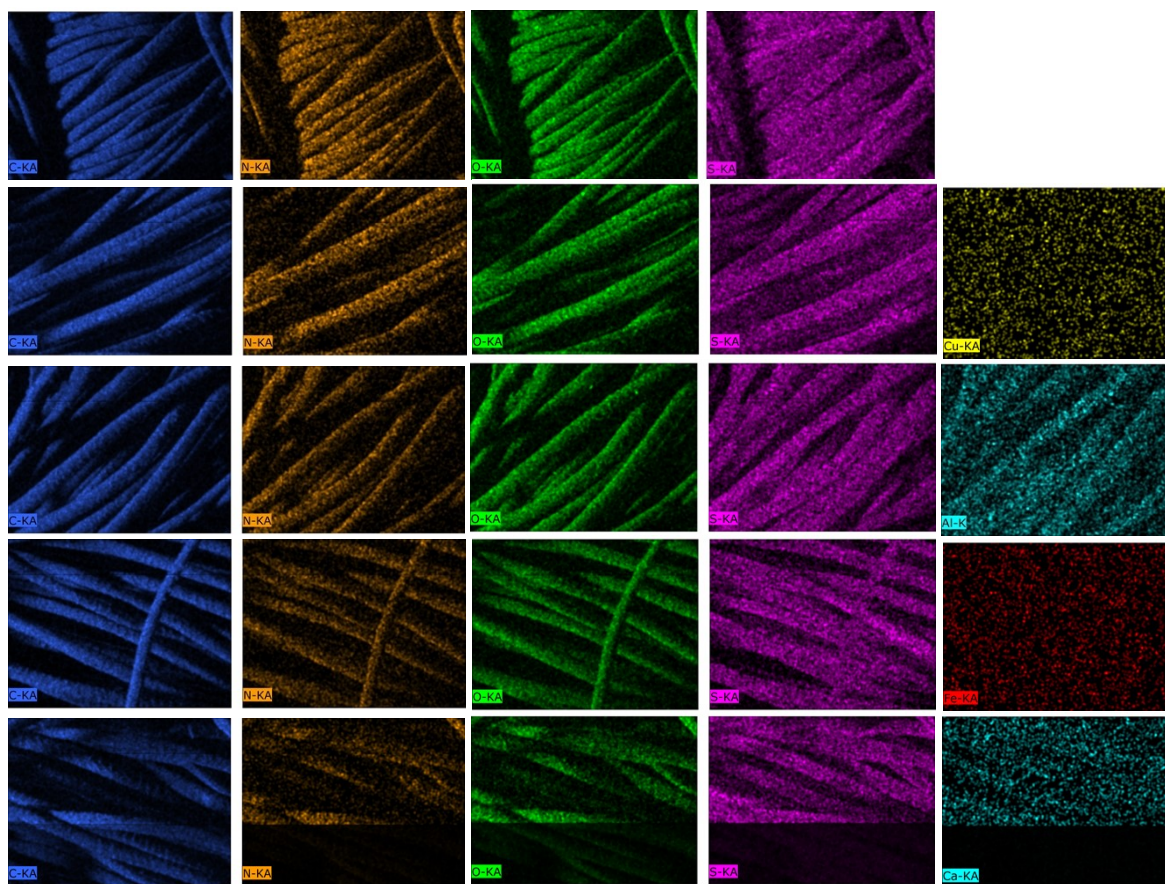


Fig. S3. Elemental distribution of C, N, O, S, and Al/Cu/Fe/Ca elements on wool fibre surface dyed with SL using various mordanting agents.

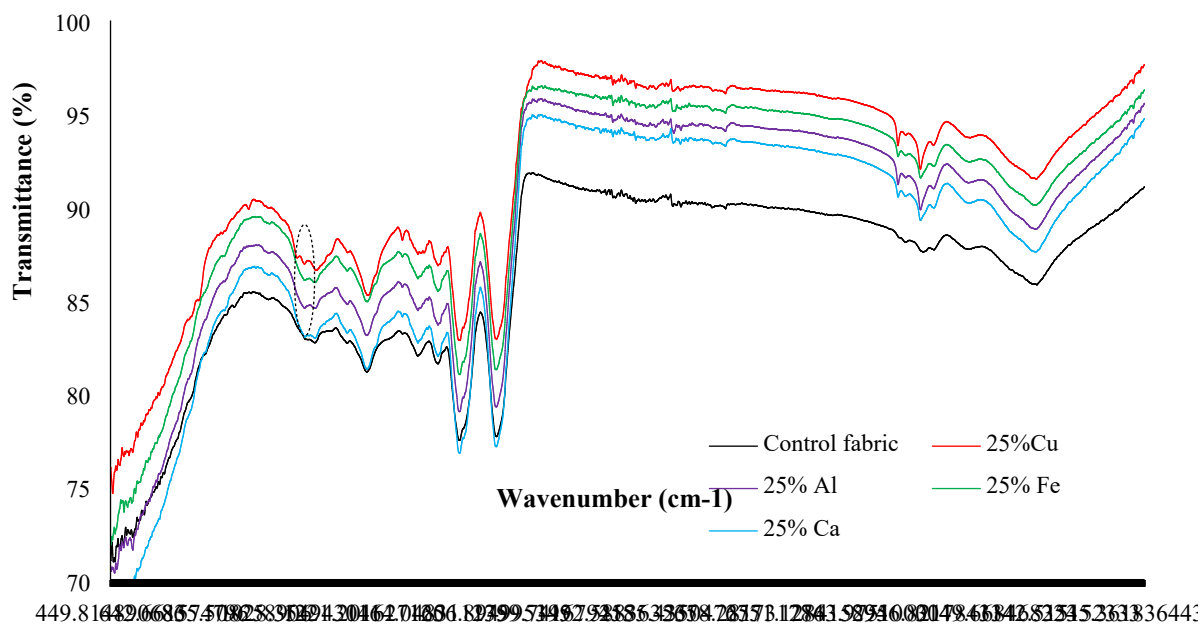


Fig. S4. ATR-FTIR spectra of wool fabric dyed with 1% (owf) SL in combination with various mordanting agents using their concentrations of 25% (ows).

Table. S1. Effect of mordanting agent concentration (%ows) on *CIE L*a*b** values and colour difference compared to the undyed control of wool fabrics dyed 3% (owf) SL at 98 °C for 60 min.

Mordanting agent (% ows)	Mordanting agent	<i>CIE L*a*b*</i> values			ΔE	Colour strength (K/S)
		<i>L*</i>	<i>a*</i>	<i>b*</i>		
25	Cu	67.36±0.12	1.89±0.07	21.37±0.08	26.82	3.13
35		65.44±0.10	0.54±0.05	21.48±0.05	28.69	3.28
45		66.90±0.14	1.07±0.07	21.30±0.06	27.69	3.60
25	Ca	74.84±0.09	6.08±0.04	24.22±0.07	21.80	2.16
35		74.81±0.11	6.35±0.05	24.67±0.04	22.20	2.20
45		74.75±0.15	6.45±0.03	25.06±0.05	22.46	2.30

Table S2. Colourfastness to washing of wool fabric treated with 3% (owf) SL at various conditions.

Mordants (% ows)	Colour change	Cellulose diacetate	Bleached cotton	Polyamide	Polyester	Acrylic	Silk
Cu							
25	4	4	4	4	4	4	4
35	4-5	4	4	4	4	4	4
45	4	4	4	4	4	4	4
Fe							
25	4	4	4	3-4	4-5	4	4-5
35	4	4	4	3-4	4-5	4	4-5
45	4-5	4	4	3-4	4-5	4	4-5