Supplementary Information

Sustainable dyeing of ramie fiber with ternary reactive dye mixtures in liquid ammonia

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The light absorbance curves of R195, Y145, B194 from 380-800 nm are displayed in Fig. S1, and the maximum absorption wavelengths of R195, Y145, and B194 are 542 nm, 418 nm, and 600 nm, respectively. The standard curves of these three dyes, i.e. a plot of dye concentration VS light absorbance, are shown in Fig. S2, and the correlative linear equations are listed in Table S1. The Eq. S2, Eq. S4, and Eq. S9 were used to work out the dye concentration in the R195, Y145, and B194 dye solutions respectively. In calculation of each dye concentration in binary mixture and in ternary mixture, the correlative equations are listed in Table S2. The color triangles of dyed ramie fibers using R195, Y145, and B194 in LA and in water with various dye mass ratios are shown in Fig. S3 and Fig. S4, respectively. The color triangle of the LA-dyed ramie fibers treated by the dye fixation process is shown in Fig. S5.

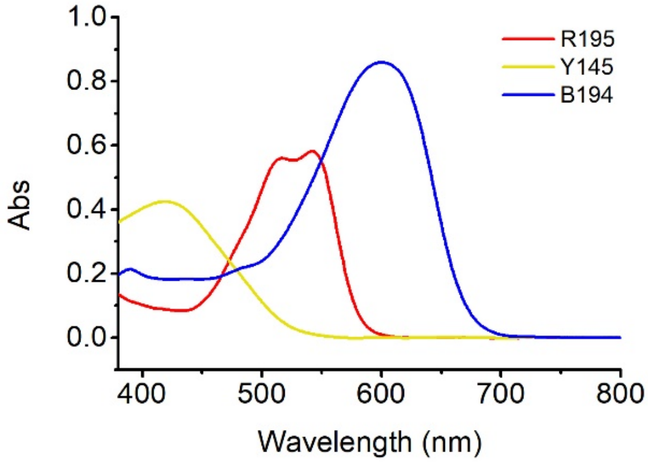

Fig. S1 Light absorbance curves of R195, Y145, and B194

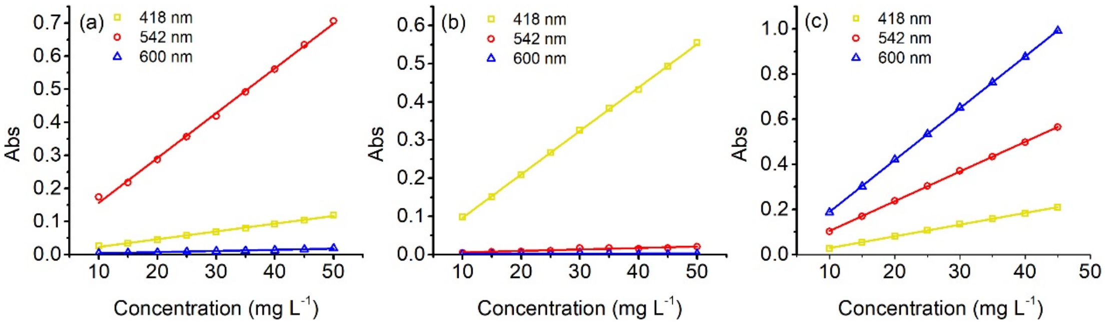

Fig. S2 The standard curves of (a) R195, (b) Y145, and (c) B194 at 418 nm, 542 nm, and 600 nm

Fig. S3 Color triangle of dyed ramie fibers using R195, Y145, and B194 in LA with various dye mass ratios

Fig. S4 Color triangle of the dyed ramie fibers using R195, Y145, and B194 in water with various dye mass ratios

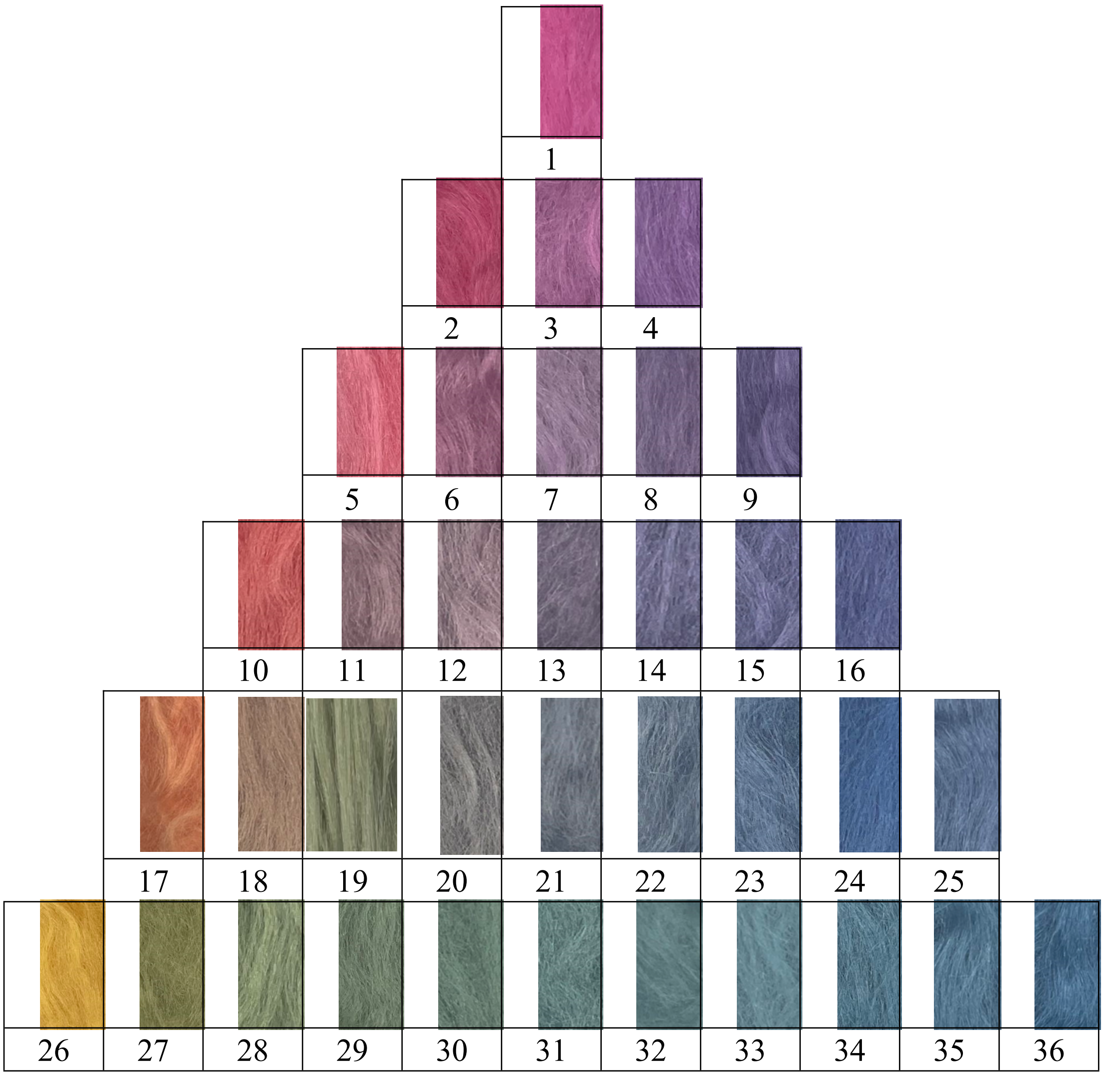

Fig. S5 Color triangle of the LA-dyed ramie fibers treated by the dye fixation process

Table S1 The linear equation of the standard curves of R195, Y145, and B194

Dye	Wavelength (nm)	Equation	Equation number	R^2
R195	418	$A_{R\text{-}418} = 0.00235\mathbf{C_R} - 0.00101$	S1	0.9958
	542	$A_{R\text{-}542} = 0.01355\mathbf{C_R} + 0.02065$	S2	0.9979
	600	$A_{R\text{-}600} = 0.0003523\mathbf{C_R} - 0.0002922$	S3	0.9788
Y145	418	$A_{Y\text{-}418} = 0.01137\mathbf{C_Y} - 0.01758$	S4	0.9997
	542	$A_{Y\text{-}542} = 0.00038667\mathbf{C_Y} + 0.00129$	S5	0.8703
	600	$A_{Y\text{-}600} = 0.000018667\mathbf{C_Y} - 0.00128$	S6	0.02106
B194	418	$A_{B\text{-}418} = 0.00518\mathbf{C_B} - 0.02336$	S7	0.9998
	542	$A_{B\text{-}542} = 0.01319\mathbf{C_B} - 0.02756$	S8	0.9999
	600	$A_{B\text{-}600} = 0.02298\mathbf{C_B} - 0.0411$	S9	1.0000

Table S2 Equations of binary mixture and ternary mixture

Dye	Equation	Equation number
Binary mixture		
R195+Y145	$A_{RY\text{-}542} = A_{R\text{-}542} + A_{Y\text{-}542}$ $= 0.01355\mathbf{C}_R + 0.0003867\mathbf{C}_Y + 0.02194$	S10
	$A_{RY\text{-}418}=A_{R\text{-}418}+A_{Y\text{-}418}$ $= 0.00235\mathbf{C}_R + 0.01137\mathbf{C}_Y - 0.01859$	S11
R195+B194	$A_{RB\text{-}542} = A_{R\text{-}542} + A_{B\text{-}542}$ $= 0.01355\mathbf{C}_R + 0.01319\mathbf{C}_B - 0.00691$	S12
	$A_{RB\text{-}600} = A_{R\text{-}600} + A_{B\text{-}600}$ $= 0.0003523C_R + 0.02298\mathbf{C}_B - 0.0413922$	S13
Y145+B194	$A_{YB\text{-}418} = A_{Y\text{-}418} + A_{B\text{-}418}$ $=0.01137\mathbf{C}_Y + 0,00518\mathbf{C}_B - 0.04094$	S14
	$A_{YB\text{-}600} = A_{Y\text{-}600} + A_{B\text{-}600}$ $=0.00001867\mathbf{C}_Y +0.02298\mathbf{C}_{\mathbf{B}} - 0.04238$	S15
Ternary mixture		
R195+Y145 +B194	$A_{RYB\text{-}542} = A_{R\text{-}542} + A_{Y\text{-}542} + A_{B\text{-}542}$ $= 0.01355\mathbf{C}_R + 0.0003867\mathbf{C}_Y + 0.01319\mathbf{C}_B -0.00562$	S16
	$A_{RYB\text{-}418} = A_{R\text{-}418}+A_{Y\text{-}418}+A_{B\text{-}418}$ $= 0.00235\mathbf{C}_R + 0.01137\mathbf{C}_Y + 0.00518\mathbf{C}_B -0.04195$	S17
	$A_{RYB\text{-}600} = A_{R\text{-}600}+A_{Y\text{-}600}+A_{B\text{-}600}$ $= 0.0003523\mathbf{C}_R + 0.00001867\mathbf{C}_Y + 0.02298\mathbf{C}_B - 0.0426722$	S18