Dual fermentation of silk yarn and hibiscus rosa-sinensis dye extract for enhanced colour strength and intensity in silk dyeing

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Abstract

Natural dyes offer an environmentally friendly alternative to synthetic dyes, but their broader use in textiles is constrained by low dye uptake and poor colour fastness. The effect of fermenting both silk yarn and Hibiscus rosa-sinensis dye extract on colour performance has not been systematically studied. This study examines the effects of fermentation pre-treatment on the dyeing performance of silk yarn dyed with H. rosa-sinensis flower extract. Two strategies were employed: pre-treatment of silk yarn with yeast, alum, or a combination of both, and fermentation of the flower extracts using symplocos or alum immersion. Dyed samples were evaluated for colour intensity (C*) and colour strength (K/S) using spectrocolourimetric methods. The highest colour intensity (C* = 26.65) and colour strength (K/S = 15.03) were obtained using yeast-fermented silk yarn dyed with alum-assisted

dye extract, indicating enhanced dye penetration and fixation. Post-dyeing fixation with tannin and N-cetyltrimethylammonium bromide (CTAB), although intended to improve fastness, reduced the colour intensity, likely due to competitive binding or electrostatic repulsion with anthocyanins. Fermentation appears to promote structural or chemical changes in both fibre and dye, improving dye affinity and stability. The combined fermentation of yarn and extract presents a promising method for enhancing the natural silk dyeing performance.

Author keywords

Anthocyanin pigments; Dye–fibre interactions; Microbial fermentation; Natural colourants; Sustainable dyeing

Indexed keywords

Engineering controlled terms

Anthocyanins; Color; Color fastness; Extraction; Fermentation; Silk; Vat dyes; Wool; Yarn; Yeast

Engineering uncontrolled terms

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