Phycocyanin Dyeing of Wool – Chitosan and Genipin for Improved Colour Strength and Fastness

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Abstract

Klara Falling Iversen, Carin Backe*, Anneli Wärn, David Rehnlund Maibach, Veronica Malm Today most textile dyeing methods rely on petroleum-based synthetic dyes. In the process of moving towards a sustainable textile industry, the consequences of using such dyes include substantial environmental challenges. This includes high consumptions of water and chemicals as well as the subsequent production of toxic wastewater. Phycocyanin is a bio-based, biodegradable, non-toxic, and renewable pigment and as such presents a potential alternative to such conventional synthetic dyes. However, it poses some practical challenges due to its low affinity to textile fibres and high degree of water-solubility. It is also sensitive to light, high temperatures and low pH levels. To evaluate phycocyanin as a part of a sustainable dyeing system, this study focused on its application as a colourant for wool and whether the addition of biobased auxiliaries, specifically chitosan and genipin, increases colour uptake and improves colour fastness. Exhaust dyeing was performed at a temperature of 40∘C and pH 5.6, at the highest stability window of phycocyanin. Different combinations of phycocyanin and pre-treatment with chitosan (1.0 g/L) and/or post-treatment with genipin (0.3 g/L) generated blue and green colourations of the wool fabric. The dyeing system exhibited significant interaction effects between its components, resulting in improvements in colour strength but varying effects on colour fastness depending on the specific combination of treatments. These findings indicate that phycocyanin-based dyeing systems can be effectively modified, representing a step away from petroleum-based coloration technologies, although challenges in durability and scalability remain.

Keywords: Phycocyanin, Chitosan, Genipin, Wool, Bio, based dyeing, Sustainable dyeing

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