Title : Eco-friendly Surface Treatment of Cotton Fabric using Fish Scale Gelatin and Ultrasonic-assisted Process for Enhancing the Color Performance and Fastness of Lac Natural Dye

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ABSTRACT

In recent years, the application of natural dyes in textile coloration has attracted significant research interest. This study investigates an eco-friendly approach to enhancing the dyeing performance and functional properties of cotton fabrics using lac natural dye. The research integrates ultrasonic-assisted extraction and dyeing processes with surface modification using fish scale gelatin. The optimal extraction parameters, including temperature, duration, and pH, were evaluated using UV–Vis spectrophotometry. The results indicated that ultrasonic assistance significantly improved colorant extraction efficiency at elevated temperatures. Dyeing at pH 7 yielded color strength (K/S) values ranging from 1.22 to 1.69. The application of an aluminum mordant in conjunction with ultrasonic power markedly enhanced the K/S values to 1.90–3.46, depending on the mordant concentration. Furthermore, fabrics pretreated with fish scale gelatin, with and without citric acid as a cross-linking agent, exhibited K/S values ranging from 1.70 to 1.78. Characterization of the dyed fabrics using scanning electron microscopy (SEM) confirmed changes in surface morphology and chemical structure. Assessment of colorfastness revealed that aluminum mordanting improved washing fastness from grades 1–2 to 2–3, however, gelatin-treated fabrics demonstrated improved light fastness. Additionally, the dyed fabrics exhibited functional properties, showing UV protection improvement in the range of 64.4–82.4%. These findings suggest that the developed lac dyeing process represents a viable and sustainable alternative to synthetic dyes, adding multifunctional value to textiles and supporting green manufacturing processes.

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