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Isolation and characterization of natural dyes from *Persea americana* leaves and their application on polyamide fabrics

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Abstract. This research investigated the extraction, isolation, and characterization of natural dyes from *Persea americana* leaves for application on polyamide fabrics. The solvent extraction process was optimized through Response Surface Methodology using a Central Composite Design (RSM-CCD), while techniques such as Vacuum Liquid Chromatography (VLC) and preparative High-Performance Liquid Chromatography (HPLC) were applied for dye isolation and purification. Characterization techniques like UV-Vis spectrophotometry, HPLC, FTIR, and NMR spectroscopy were used to identify the compounds responsible for the dyes' colouring properties. The study evaluated physical properties such as light fastness, wash fastness, perspiration fastness, and dry and wet rubbing fastness on polyamide fabrics. Optimal dye extraction conditions were found to be 55.6 ℃ over 3 hours. UV-Vis spectrophotometry revealed the presence of chromophores like conjugated systems in the dye fraction (VLC 13), while HPLC identified key compounds, such as quercetin and isoquercetin. FTIR spectroscopy detected functional groups typical of natural dyes, such as O-H, C-O-C, and C-O, while NMR spectroscopy confirmed the structures of two key constituents (quercetin and isoquercetin) of the dye. Mordanted fabrics showed deeper colour strength and improved fastness ratings ranging from fair to excellent (4-8 for light fastness, 2-4 for wash fastness and 2-5 for others). In contrast, unmordanted fabrics exhibited lower ratings (3-6 for light fastness, 2-4 for others, and 1-4 for rubbing fastness). These findings highlight the potential of utilizing *Persea americana* leaves, an often-underutilized agricultural by-product, to create bio-based textile treatments that promote green chemistry and sustainable manufacturing.

***Keywords*:** extraction; natural dyes; Response Surface Methodology; *Persea americana*; leaves; polyamide; fabrics.

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