

Title: Exploring Ultrasonic-Assisted Extraction and Eco-Friendly Dyeing of Organic Cotton using *Syzygium cumini* Leaf Extracts

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Abstract: The demand for natural dyes is increasing due to the negative environmental impacts of synthetic color. In fact, customers are becoming more concerned about their health and the environmentally friendly products. The aim of this research is to disclose the dye extraction process using the ultrasonic method and eco-friendly dyeing of organic cotton knitted fabric. Initially, 10 g of *Syzygium cumini* leaf powder was dissolved in 150 mL of purified water maintaining a 1 : 15 M : L ratio to extract the color. After that, the extracted dye solution was added to coloration bath following the M : L ratios of 1 : 16, 1 : 12, and 1 : 8 for producing dark, medium, and light shades, respectively. Post mordanting was done using natural lemon juice for colorfastness improvement. The color attributes were revealed by the spectrophotometric analysis. Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM) were used to comprehend the successful relationship that exists among SCL dyes and organic cotton fibers, and the TGA analysis confirmed that dyed fabric is more stable than undyed fabric. Moreover, the colored sample's pH, formaldehyde level, and presence of forbidden Azo groups (aromatic amines) were examined. The test results revealed that very good to excellent color fastness properties were obtained and no harmful chemicals were detected in the dyed samples.

Keywords: Natural dyes, *Syzygium cumini*, Ultrasonic extraction, Eco-friendly dyeing, Organic cotton, Colorfastness, Mordanting, Lemon juice, Spectrophotometric analysis

DOI: <https://doi.org/10.1002/slct.202400394>

<https://chemistry-europe.onlinelibrary.wiley.com/doi/abs/10.1002/slct.202400394>