

Title: Recycling orange waste for the sustainable dyeing of polyester fabric

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Abstract: This research marks the first instance of employing an [orange peel](#) powder (OP) for the environmentally friendly one-bath extraction and dyeing of 100 % polyester fabric through the exhaust method. OP is an abundant, cost-effective, and readily available agricultural byproduct. Powder extract derived from [orange peel](#) (OP) was used to dye polyester fabrics in an Infrared (IR) dyeing machine. Here, the one-bath extraction and application method was adapted to contribute towards [sustainable development goals](#). Effects of dyeing parameters, including pH value, dyeing time, and concentration of OP extract powder on the colours of the dyed polyester fabrics, were studied. FTIR analysis of the orange peel powder revealed the presence of alcohol and ester functional groups. SEM and [EDS](#) spectroscopic techniques were employed to examine the morphological characteristics and elemental composition of both undyed and dyed fabrics. CIELAB and K/S values of the samples were recorded using a data colour spectrometer. The dyed samples exhibited exceptional washing fastness, with minimal staining (as observed on multifiber strips) and colour alteration. The optimal dyeing temperature, dyeing time, dye concentration, and pH were observed to [be 100](#) °C, 90 min, 20 %, and 5.5 respectively. Interestingly, the value of the UV-protection Factor (UPF) of the polyester fabric dyed with OP extracts was approximately 6 times higher than that of the undyed fabric. Furthermore, the dyed samples also revealed a good mosquito repellency. In general, the natural dye from OP could minimize [environmental pollution](#), save energy, and enhance the livelihoods of farmers. The recycling of this agricultural byproduct has significant potential as a natural textile dye for polyester fabrics, offering remarkable mosquito repellency and UV-protection properties.

Key words: Orange peel powder (OP) Natural dyeing Polyester fabric One-bath extraction method Sustainable textile processing Colour fastness

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