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**Title:** **Development of Shades on Wool with *Alkanna tinctoria* (Alkanet), *Terminalia chebula* (Harda), and *Tagetes erecta* (Marigold) Natural Dyes and their Characteristics Evaluation**

## ABSTRACT

Natural dyes, obtained from plants, insects/animals and minerals, without any chemical processing are renewable and sustainable bio-resource products with minimum environmental impact and known since antiquity for their use, not only in colouration of textiles but also used as food and cosmetic colourants. Eco-friendliness, biodegradability, eco-safety and their increasing popularity in the development of multifunctional textiles, developed a recent upsurge in the research and advancements in natural dye production and application. A large group of plants, animals/insects and minerals were discovered to enhance the research and application area of natural colourants for the mankind.

**Chapter 1** provides a comprehensive and upto-date systematic literature review on natural dyes, their classification and sources, common textile fibers, mordants and mordanting methods, extraction of natural colourants, chemical and physical aspects of wool dyeing, and innovative functional finishing of textile materials with natural dyes.

**Chapter 2** describes materials and methodologies used in this research work. Materials section comprises of description of structure and properties of wool, mordants and its types, and details of natural dyes used in this research work. Methods section comprises of detailed overview of mordanting, dyeing, and procedure of evaluating colour (CIEL*a*b* and colour strength values (K/S)), fastness characteristics and antimicrobial properties of developed shades.

**Chapter 3** focuses on the utilization of metals as well as natural plant based mordants to develop shade range on wool with *Alkanna tinctoria* natural dye. Effective and comparable results of biomordants suggest them as an eco-friendly alternate to metallic mordants.

**Chapter 4** is aimed to explore the dyeing potential of *Terminalia chebula* on wool fibre with the evaluations of adsorption and kinetic characteristics. Monolayer chemisorption process was found as mechanism of adsorption of *T. chebula* onto wool with high correlation coefficient of *pseudo second order* model and Langmuir adsorption model.

**Chapter 5** deals with the utilization of *Tagetes erecta* (Marigold) flowers to develop a range of shades on wool. Colouration property of *Tagetes erecta* flowers with metal mordants and their combinations is evaluated and a data bank of shades obtained.

**Chapter 6** was to explore antibacterial finishing of woollen yarn with natural dyes as an ecofriendly substitute to most of the presently used synthetic antibacterial agents. Among the bacterial isolates highest activity of dyed woollen yarn was shown against *B. subtilis* followed by *S. aureus*, *E. coli* and *P. aeruginosa*.

**Chapter 7** encompasses the findings of present research work along with concluding remarks and future perspectives. All the physiochemical parameters such as light, wash and rub fastness have been studied with good results with natural dyes on wool. Successful results of biomordants suggested them as ecofriendly alternative to metallic mordants, and shade range broadened simultaneously. Adsorption and kinetic investigations were suggestive of the operative forces during dyeing processes. Phytoconstituents present in these natural dyes were explored for promising antibacterial activity to wool substrate. The findings reported in present work demonstrates an exciting opportunity for the *A. tinctoria*, *T. chebula* and *T. erecta* dyed textiles as a potential perspective in developing naturally coloured protective clothing and other textile products for various fields of application.