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Title: Development of shades on wool with *Caesalpinia sappan* (Sappanwood), *Juglans regia* (Walnut/Akhrot) and *Cassia fistula* (Amaltas) natural dyes and their characteristics evaluation

ABSTRACT

Large consumption of textiles from last several decades has created immense pressure on textile manufacturing and processing sectors to develop highly competitive, efficient, low cost and sustainable technologies to meet consumer demands of eco-friendly and hygienic textile products. Throughout the processing of these eco-friendly and hygienic textile products effluents are released which are highly-coloured, contains substantial concentrations of organic and inorganic chemicals such as finishing agents, surfactants, inhibitor compounds, active substances, chlorine compounds, salts, dyeing substances, total phosphate, dissolved solids, suspended solids and total solids. These effluents from textile industries are posing threat to the environment and have become the major problem in the world. Considering environmental awareness, researchers all over the world has paid much more attention towards the development of cleaner production strategies for making cost-effective value-added textile products. Therefore, a great deal of research is being under taken all over the world on the application and substitution of chemicals having lower hazard potential for chemicals having higher hazard potential.

Chapter 1: 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: 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, fastness characteristics and antimicrobial properties of developed shades

Chapter 3: Chapter 3 focuses on the utilization of metals as mordants to develop shade range on wool with *Caesalpinia sappan* natural dye. Colouration property of *Caesalpinia sappan* wood with metal mordants is evaluated and a data bank of shades obtained. Effect of the dye concentration, metal mordants such as alum, ferrous sulphate, stannous chloride and their combinations on colour characteristics of developed shades and their fastness properties are studied.

Chapter 4: Chapter 4 focussed on dyeing of wool fibers with a natural colorant extracted from walnut bark in presence and absence of mordants. The effect of aluminium sulphate, ferrous sulphate and stannous chloride mordants on colorimetric and fastness properties of wool fibers was investigated.

Chapter 5: This chapter focuses on the effect of different combinations of metal mordants on color characteristics and fastness properties of natural dye extracted from *Juglans regia* bark powder. The influence of different types of mordant combinations such as alum + ferrous sulphate, alum + stannous chloride, ferrous sulphate + stannous chloride and alum + ferrous sulphate + stannous chloride on color parameters and fastness properties has been investigated.

Chapter 6: Chapter 6 is aimed to investigate the dyeing and fastness properties of *Cassia fistula* natural dye on wool in conjunction with small amounts of metallic mordants (ferrous sulphate, alum and stannous chloride).

Chapter 7: Chapter 7 encompasses the findings of present research work along with concluding remarks and future perspectives. All the physiochemical parameters such as light fastness, wash and rub fastness have been studied with good results obtained with *Caesalpinia sappan*, *Juglans regia* and *Cassia fistula* natural dyes on wool. Beautiful red colour shades with different hue and tones were obtained in case of sappan wood dye in presence and absence of different metal mordants. In case of walnut dye, novel and fashionable hues such as light and bright brown shades were observed in alum mordanted dyed samples, reddish brown shades are observed in stannous chloride mordanted dyed samples and dark brown shades were observed in ferrous sulphate mordanted dyed samples. Dyeing with *Cassia fistula* natural dye on woolen yarn in presence and absence with different mordants resulted in beautiful array of shades of different colours with satisfactory colorimetric and fastness characteristics. Changing the concentration of dyes and mordants is a way to produce substantial change in colour appearance of shades. The choice of mordants is very important factor for obtaining shades with desirable colour characteristics. Mordanting with metallic salt mordants and their combinations led to marked improvement in colour strength as well as significant change in colour values. The findings reported in present work demonstrate an exciting opportunity for the *Caesalpinia sappan*, *Juglans regia* and *Cassia fistula* dyed textiles as a potential perspective in developing naturally coloured protective clothing and other textile products for various fields of application.