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Title of Thesis: "Development of shades on wool with Madder (*Rubia cordifolia*) and Henna (*Lawsonia inermis/Lawsonia alba*) and their characteristics evaluation"

ABSTRACT

It is an attempt to investigate the possibilities of dyeing woollen yarn samples with madder and henna natural dyes and also to standardize the dyeing recipe by varying the amount of both, mordants as well as dyes used and three hundred and consequently 360 shades were developed.

Chapter 1 deals with *introduction* which includes overview on the history of natural dyes; their limitations; reasons behind their sharp decline during nineteenth century and its revival and classification on the basis of sources, application and chemical classes and comprehensive literature review of natural dyes and their applications.

Chapter 2 deals with *materials and methods* describes materials and methodologies used in this research work including the structure and properties of wool, types of mordants used and discussion on procedure for mordanting, dyeing, tests conducted to evaluate the fastness properties with respect to light exposure, washing, rubbing/ crocking (dry & wet), recording of colourimetric parameters, colour strength (K/S) values, dye exhaustion, Scanning Electron Microscopy of woollen yarn samples showing surface morphology and antimicrobial activity of dyes alone as well as its dyed substrate have also been described.

Chapter 3 deals with *results and discussion* on shades obtained from madder (*Rubia cordifolia*). 180 beautiful and vibrant shades ranging from light orange-red to deep scarlet

colour were developed on wool by using different combinations of metal salt mordants and madder dye. The mordant especially ferrous sulphate gave the better colour depth of shades by enhancing dye uptake in comparison with unmordanted shades. Most of the shades have shown to possess commercially acceptable fastness properties. SEM pictures of unmordanted, mordanted and madder dyed woollen yarns shows that process of mordanting and dyeing has caused no damage to the surface morphology of wool. This effort shows that madder dye can be suitably used for producing environment friendly woollen apparel and other textile products to be washed in non-ionic detergent to fulfil the global needs of eco-friendly clothings and textiles.

Chapter 4 deals with *results and discussion* on shades obtained from henna (*Lawsonia inermis*). 180 shades of orange brown to yellowish brown colour were developed by using mordants and their combinations and henna leaves extract as a natural dye. Dyeing of mordanted woollen yarn samples considerably improved overall fastness values with slight change in hue and tone of the shades. Henna dye proved to be very effective against tested bacterial (gram-positive- *Staphylococcus aureus* and gram-negative- *Escherichia coli*) as well as fungal (*Candida albicans*) isolates in solution, and retained its antimicrobial activity after application on wool. Antimicrobial activity was found to be quiet durable after several laundering cycles. This effort shows that henna dye can be fruitfully used for producing naturally coloured textile materials with bio-active properties.

Chapter 5 deals with *summary and conclusion* of shades developed on woollen yarn samples dyed with madder as well as henna dyes and standardization of their recipe of mordanting, dyeing, fastness properties, colour characteristics and antimicrobial activity.