

## PREFACE

---

Natural dyes comprise those colourants (dyes and pigments) that are obtained from animal and vegetable matter without chemical processing. The colourant that are derived from plants, insects and minerals are all categorized as Natural Dyes. Also known as vegetable dyes, these are made from various plant, roots, leaves, tree bark, flowers and fruit rind. Natural dyes have found its application in textiles, paper, printing inks, food, drugs and cosmetics etc. The ability of natural dyes to colour textiles has been known since ancient times. With the development of civilization, man mastered the art of colouring. Natural dyes had been used in most of the ancient civilizations e.g. India, Egypt, Greece, Aztec and others. The earliest evidence of the use of natural dyes dates back to more than 5000 years old (3000 BC) with fragment of coarse Madder (*Rubia cordifolia*) dyed coarse cotton cloth found during the excavation of the ancient Harappan sites indicating that the people of Mohenjodaro used natural dye. However, the earliest written record of the use of natural dyes was found in China dated 2600 BC.

The development of natural dyes most probably took place at the same time after the technique of weaving had been discovered in about 5000 BC. In India, the use of natural dyes for dyeing, painting and printing goes to the pre-historic periods. The paintings on plasters of Ajanta dating as far back as 1<sup>st</sup> century AD are painted with natural dyes. The paintings are the evidence of the use of colourful garments by men and women alike.

Before the turn of the century natural dyes were the only source of colour available and, they were widely used and traded, providing a major source of

wealth creation around the globe. But with the advent of synthetic dyes, the influence of the synthetic dyes affected the scope and use of natural dyes in the middle of the nineteenth century. As such, the scenario of natural dyes changed for all taking a back seat drive after 1869 due to easy availability of synthetic dyes at a much lower price compared to the natural ones. Cloths dyed with synthetic colours instantly became popular as they promised a low price and colour fastness as compared to that of the dyed with natural, vegetable dyes. Research has shown that synthetic dyes are suspected to hazardous chemicals that are allergic, carcinogenic and detrimental to human health and as well as to the environment. Ironically, Germany that discovered synthetic Azo dyes, became the first country to impose ban on certain Azo dyes in 1996. Even after the ban of azo dyes, the textile processing units are one of the most polluting industries. The dyestuff industrial wastes from the textile processing units, in the form of atmospheric gases and wastewaters are one of the serious pollutants polluting the areas neighbouring these units. The pollution problem is the main inspiration behind the resurgence of natural dyeing materials. However, the increased awareness on ecological movements, biodiversity and environment responsibility has necessitated importance of natural dyes and its application.

Arunachal Pradesh, the largest state amongst the other northeastern states with its rich bio-diversity is recognized as one of the richest biodiversity "hotspot". The rich flora and fauna is the source of many resources that are available to the ethnic people of the state. In the past, at dawn of the civilization, the ethnic people of Arunachal Pradesh used natural colours derived from the plants for several applications. This gave birth to a new science of colors from natural origin. The ethnic tribal people of the state have traditionally been using natural dyes extracted from the locally available plant resources for dyeing cloths, carpets, cane and bamboo crafts, wood carving and potteries etc. The art

of natural dyeing was as old as human civilization. Despite being abundant with important plants, there has not been much attempts made to explore the Natural Dye yielding plant resources available in the state and document the traditional knowledge system associated with dyeing practices of the tribal people. The present investigations was undertaken during 2005-2007 to find out the availability and distribution of the Natural dye yielding plant resources in the different agro-climatic regions of Arunachal Pradesh and also to study, document the indigenous knowledge systems of natural dye preparation and dyeing processes associated with the different ethnic tribes and elucidation of structure of the colourants.

Ethno-forestry study carried out in the five selected districts of the state under this present research work have made possible to screen and record forty three (43) numbers of plant species included in thirty (30) families having good potentiality for yielding natural dyes. Some of the most important dye yielding plant species that are commonly found and used in traditional natural dyeing practices by different tribes of the state was found to be viz. *Rubia cordifolia* Linn., *Bischofia javanica* Bl., *Mahonia napaulensis* DC., *Symplocos spicata* Roxb., *Daphne papyraceae* Wall., *Illicium griffithii* Hook., *Woodfordia fruticosa* Kurz., *Colquhounia coccinea* Wall., and *Eurya acuminata* DC. etc. Photographs of some important dye yielding plant species of Arunachal Pradesh which were identified during the course of the investigation have been represented in the thesis.

The traditional method of dyeing has been to boil the fabric or yarn in dye bath, till the desired colour is obtained. Enormous amount of heat is consumed in terms of heating the dye bath. Some dyes, which are heat sensitive, cannot be used in conventional dyeing because prolonged heating decomposes the dye

molecules. The dye uptake by the fabric is also far from exhaustion, as a result fair amount of dye is wasted in traditional methods.

Technological advances have been made in recent times by use of ultrasonic energy towards dyeing of natural dyes. In case of ultrasonic dyeing, the most advantageous part is that at low energy dyeing is carried out (mostly at room temperature, no need for heating the dye bath). However, the use of ultrasonic energy in textile preparation is not a new idea, there exists considerable amounts of literature on the improvement and acceleration of numerous textile processes with the aid of ultrasound. Until recently research into this technology has been limited due to the expenses associated with the generation of ultrasonic energy. Technological advances in the areas of inexpensive and reliable ultrasound generators have therefore prompted increased interest into effects of ultrasonic energy applications in industry. Sonicator dyeing is a very innovative technique and fuel saver methodology. In this method ultrasound energy of 20 KHz frequencies is utilized. Sonicator has high energy sound waves, which increase ultrasonic cavitations. This releases considerable amount of energy. Particularly in India, this methodology is advantageous where energy resources are limited. Even heat sensitive dyes can be used in sonicator dyeing very comfortably without undergoing decomposition. The dye uptake is very good in sonicator dyeing. One advantage in sonicator dyeing is that the same dye bath can be recharged and reused.

The natural dyes extracted from the three selected plant species viz. *Bischofia javanica*, *Mahonia napaulensis*, *Symplocos spicata* was identified through characterization by using various techniques. *Eurya acuminata*, which was selected for studying its role as biomordant in application with *Rubia cordifolia* in traditional dyeing process being practiced by the Apatani dyers have been found to be complimentary to each other causing the better dye adherence. Thus, it may

be concluded that selected plant species was found to have good agronomic potential as a dye crop of Arunachal Pradesh. Metal mordant when used in conjunction with *Bischofia javanica*, *Mahonia napaulensis* and *Symplocos spicata* was found to enhance the dye-ability and fastness properties. The biomordant, *Eurya acuminata* DC. var *euprista* Karth. (Nausankhee) when used in conjunction with *R. cordifolia* was also found to enhance the dye-ability due to the Aluminum contents present in the leaves. So with the increasing awareness among people towards natural products as well as the present trend for use of eco-friendly textiles and the drive for environment, ecology and pollution controls, Natural dyes are the ideal choice of colourant for fabric since they are non toxic and can be handled very easily and safely.

The thesis entitled "*Natural dye yielding plant resources and indigenous knowledge system of dye preparation associated with ethnic tribes of Arunachal Pradesh and elucidation of structure of the colourants*" begins with an introductory chapter followed by Review of Literature containing a concise amount of review in the topic in the form of chapter II. Materials and Methods followed during the present investigation are provided in chapter III. Important experimental findings are discussed in the form of Results and Discussion in chapter IV. A brief account of Summary and Conclusion are critically arising out the findings are presented in chapter V followed by References in chapter VI.