Effects of Selected Mordants and dyeing of Cotton cloth with Natural Dye Extracted From Red calico plant (amaranths leaves).

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Abstract **- Conventionally the dyeing of natural dyes from plant materials was done by boiling which requires longer time, higher temperature and metallic mordant to get good color fastness. Use of metallic mordants for dyeing posed some cruel effect to ecosystem. The Necessity of new natural dyes sources along with eco-friendly, easy availability and cost-effective technologies their processing and application have greatly aided in widening the scope of natural dyes in various traditional and advanced application disciplines. Numerous plant species are found to have an important role in our day-to-day life. In the present work, the Red calico plant (amaranths leaves) were used for the extraction of dye, dyeing of the selected fabrics at optimized conditions, using combination of mordant and evaluate the resultant colour fastness of the selected dyed samples to washing, rubbing, and light.**

keywords **- Red calico plant (Alternanthera), Natural Dye , Colorfastness, Extraction, Mordant.**

I. INTRODUCTION

Textiles were dyed mainly by natural dyes up to the end of 19th century. As a result of the stringent environmental standards laid down by many countries due to toxic and allergic reactions of artificial dyes, interest in use of natural dyes has increase rapidly [1]. Natural dyes are thus regarded as all colures and dye pigments derived from plant, animal or insect matter without any chemical processing [2]. Scientific knowledge of chemistry on dyes and mechanism as well as technology of dyeing is inadequate. Natural dyes are chiefly mordant dyes, however, some acid, direct, pigment and vat types are also found. They are classified on the basis of structure and hue. In classification based on structure, the most commonly available natural dyes comprised of indigoids, anthraquinones, alpha napthoqinones, flavones, dihydropyrans, anthocyanidin and carotenoids (3).

The present trend of utilization of synthetic dyes in the textile industry is switching over towards the use of naturally occurring colorants (4). In the domestic and export markets, natural dye products are valued more for their novelty and beauty. Natural dyes provide more elegant, soothing and aesthetic colours to the fabric. They are supposed to have a multifold use, besides contributing to the effectiveness of measures to preserve the environment. The use of natural dyes can play role in minimizing pollution and risk to human health (5). As compared to their synthetic counterparts, these dyes are easily biodegradable and highly compatible with the environment. They are non- carcinogenic and non-toxic by nature that is why these colorants are believed to be safer. Their major shortcomings are non-uniform shades and poor to moderate colour fastness (6). Due to the low colour fastness compared with synthetic dyes and the complex extraction and storage procedures, their commercial use is still limited. There are numerous plants that provide natural dyes, utilized in the textile industry. Some examples of plants used for producing natural dyes are; Alkanet, Balsam, Bougainvillea, Canna, Tulsi, Terminalia Arjuna, etc. (7). Certain problems with the use of natural dyes in textile dyeing are colour yield, complexibility of dying process, reproducibility results, limited shades, blending problems and inadequate fastness properties. But these problems can be overcome by using chemicals called as mordants (8). Mordants are metal salts which produce an affinity between the fabric and the dye. Mordants are essentially substances which are used to fix a dye to the fibres, they also improve the take-up quality of the fabric and help improve colour and light-fastness. Metal ions of mordants act as electron acceptors for electron donors to form coordination bonds with the dye molecule, making them insoluble in water Alum, chrome, stannous chloride, copper sulphate, ferrous sulphate etc (9).

Populations in North India depend on a number of vegetable crops of which Amaranthus species is the most important since it is the only crop available in the hot summer months when no other foliage crop grows in the field. The species used as vegetable type shave short plants with large smooth leaves, small auxiliary inflorescences, and succulent stems. The leaves of amaranth constitute an inexpensive and rich source of protein, carotenoid, vitamin C, and dietary fiber [10, 11]. Amaranthus is a genus (familyAmaranthaceae) consisting of more than 50 species and has recently gained importance as a promising food crop owing to its resistance to heat, drought, diseases and pests and the high nutritional value of its leaves and seeds. The name comes from the Greek amarantos, one green variety is named “pigweed”, the plants are commercially cultivated for their edible seeds where they are known as callaloo in the West Indies, chawli leaves in India and cow pea leaves in Africa. Red Amaranth leaves are more often used for their ornamental purposes or even to make red dye. (12-14) Amaranth is one of the most important leafy vegetables of tropical and sub-tropical parts of the world. The leaves and stems provide cheap but rich source of vitamins A and C and elements like N, P, K, Ca, Mg, Fe, Na and Zn. amaranth species can be classified into three categories, which represent more or less use-groups:

- Vegetable Amaranthus with for instance Amaranthus tricolor var. tricolor, Amaranthus tricolor var. tristis,

- Grain Amaranthus which includes Amaranthus hypochondriacus, Amaranthus caudatus, Amaranthus cruentus; and
- Weed Amaranthus with members such as Amaranthus spinosus, Amaranthus viridis, Amaranthus retroflexus, Amaranthus graecizans, Amaranthus dubius and Amaranthus hybridus.(15)

As compared to synthetic dyes, natural dyes are mostly biodegradable, eco-friendly and less allergic in nature. Research studies resulted that certain natural dyes have mutagenic effects e.g. safflower yellow; many mutagens leads to cancer; other like carmine can cause asthma by inhaling continuously. But it can be said that most of the natural dyes are safe and some even have curative effects e.g., curcumin in turmeric has antibacterial properties. They are very cheap and easy available. The shades produced by natural dyes/colorants are usually soft, lustrous and soothing to the human eye.

2. Materials and methods

Source: Red calico plant (Alternanthera).The dyeing of cotton/ synthetic fabric was carried out in three stages; Extraction of dyes from the plant sources, Mordanting and Dyeing.

2.1 Pre-Treatment of fabrics (Scouring)

Cotton and synthetic fabrics were washed in a solution containing 2g/l commercial (Tide) detergent at 50º C for 25 min, keeping the material to liquid ratio at 1:40. The scoured material was thoroughly washed with tap water and dried. Pieces of 10 cm x 10 cm were cut and used for the experiments.

2.2 Mordanting

Two natural mordant's namely harda and lemon juice were used. Mordanting was carried out in three stages: Pre-mordanting, Simultaneous mordanting and Post-mordanting.

2.3 Pre-mordanting

In this method the scored fabrics were first treated with both mordant separately and then dyed using extract of Red calico plant. The fabrics were treated with each of the mordant mentioned above at the concentration of 1:20 M:L ratio for 30minutes at 28 $_0$C. Then the mordanted fabric was used for dyeing.

2.4 Simultaneous mordanting

In this method the fabrics were immersed in equal mixture of the mordant and the dye extract for 30 min at 28$_0$C followed by washing and drying of the dyed fabrics.

2.5 Post-mordanting

In case of post-mordanting, the dyed fabric was treated with mordants at 28$_0$C for 60 min with M:L ratio 1:20.

2.6 Extraction of Dyes:-

Red calico leafs were cleaned by washing with water in order to remove dirt. The cleaned leafs were dried under direct sunlight. The leafs were grind into powder with the help of grinder and the powdered samples were used for the extraction of dyes. After all these, process, it is put in distilled water and heated in a breaker which in kept over a water bath for 40 minutes.

2.7 Dyeing

Experiments were performed in which dyeing was done at 28$_0$C and for 30 min.

2.8 Quality assurance tests of dyed fabric

Most dyes are organic compounds and are, therefore, vulnerable in varying degree to the action of destructive agents. A number of tests are necessary to cover all the important properties of any one dye because good fastness to one inference is not necessarily accompanied by equal fastness to other conditions. For characterization and evaluation, following tests were performed with selected dyed fabrics: Washing fastness, Rubbing fastness and Light fastness.

2.9 Washing Fastness

Dyed sample was placed between two pieces of non dyed white samples (control). These three pieces were held together by stitching round the edges. The pre heated soap solution (Tide, at 60°C) in the ratio of 1:50 i.e 0.5g/25 mL water, was taken in a vessel added 1.0 g of sandwiched fabric for 30 minutes Then the specimen was removed and rinsed in cold water. The colour fastness is usually rated by the presence of the colour in control sample.

2.10 Rubbing fastness

The rub fastness of the dyed fabrics was carried out by rubbing the fabrics manually and checking for fading of Color.

2.11 Light Fastness

The fabric was exposed to sun light for 24 h. The colour fastness to light was evaluated by comparison of colour change of the exposed portion to the unexposed original material.

3. Result and discussions

3.1 Red Calico plant (Lal Bhaji)

Calico plant is an herbaceous perennial plant that grows between 20 and 50 cm tall. The plant is found growing in open areas of degraded deciduous forest, wastelands and river margins. Normally the plant prefers an organically rich, consistently moist and well-drained soil. Stem is erect or creeping, much-branched, with the apical part of the stem quadrangular, and the basal part cylindrical. Few hairs are present at the nodes and the apex, as well as at the level of the short petioles.

3.2 Extraction of dye

The yield of the dye per 100 g of the plant specimen obtained under various extraction conditions are summarized in the Table 1.Yield of the dye can be improved by using techniques like rotary evaporator for concentration of the dye. Extraction of dye from Red Calico leaf employing aqueous solvent extraction method for 1 h/ 2.5 h resulted in 3.5 and 4.6 g per 100 g of the dry Leaf.

Figure 1 : Red Calico plant (Lal Bhaji)

3.3 Mordanting and Dyeing

The detailed results for the calico plant dye when applied to cotton fabric samples using various mordants and mordanting techniques are presented in the **Table 1**. Mordants play very important role in imparting color to the fabric. The mordants used in combination in different ratios gave varying shades. Better colour strength results are dependent on the metal salt used. The results indicates that there were many shade of colours obtained after dyeing the cotton fabric samples with Red calico plant using different mordants and mordanting techniques. Generally, natural mordant harda gave yellow colour and lemon gave pale yellow colour. After that we worked in post mordenting process in which cotton fabric dye with red calico plant it gives very light red color then we apply mordent harda and lemon it gives light red colour.

Table 1. Different colour Shade in different processes in Pre-Mordenting and Post-Mordenting

S.No.	Mordent Used	Pre-Mordenting			Post-Mordenting		
		Process	Colour Shade	Image	Process	Colour Shade	Image
1.	Harda	Harda	Pale yellow		Harda	Yellow	
2.		Dyed in calico plant	Dull yellow		Dyed in calico plant	Light pink	
3.		Dyed in calico plant+ castic soda + alum	Mustard yellow		Dyed in calico plant+ castic soda + alum	Dusty Pink	
4.	Lemon	Lemon	No changes		Lemon	Pink	
5.		Dyed in calico plant	Light red		Dyed in calico plant	Light pink	
6.		Dyed in calico plant+ castic soda + alum	Red		Dyed in calico plant+ castic soda + alum	Dusty Pink	

4. Conclusion

The present scenario is focused more towards the utilization of the vast diversity of natural resources of colour pigments for their use in food materials, pharmaceuticals and textiles, in place of their synthetic counterparts. From the work conducted it was demonstrated that Red calico(amaranth leaves) can be used to successfully dye cotton fabric, it is shown that a wide range of soft and light colours could be derived by using different mordants and mordanting techniques.

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