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Extraction and analysis of natural dye

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ABSTRACT

Natural dyes produce an extraordinary variety of products and complex colors that complements each other. Straight off a day synthetic leads to high environmental pollution. In recent year, the interest of researchers has changed over on utilizing natural dyes in textiles, food and cosmetics industries. Natural dye sources are eco-friendly and permanent in fabrics. The present study focused on the extraction of dyes from ten plant materials such as leaves, tubers and flower plants, namely Beta vulgaris, capsicum annum, Clitoria ternate, Ixora coccinea, Impatiens baisomia, Tageta erecta (Yellow and Orange), Lawsonia inermis, Rosa rubiginosa, Pletophorum pterocarpum. The obtained dyes yield a variety of colors and are processed with different types of mordants such as potassium dichromate, vinegar and sodium chloride. The cotton and jute yarns treated with sodium chloride provided best results and showed less wash fastness. Natural dyes worldwide should be increased to prevent us from pollution and other harmful effects.

Keywords: Plant extract, Mordants, Threads, Wash fastness

INTRODUCTION

The art of dying is as old as our civilization. Dyed textile remnants found during archaeological excavations at different places all over the world provide evidence to the practice of dying in ancient civilizations. Natural dyes were used only for the coloring of textiles from ancient times till the nineteenth century. As the name suggests, natural dyes are derived from natural resources. Primitive dyeing techniques included sticking plants to fabric or rubbing crushed pigments into cloth [1]. Coloring materials obtained from natural resources of plant, animal, mineral and microbial origins were used for coloration of various textile materials. The textile industry plays a major role in the economy of Asian and other countries. In India, it accounts for the largest consumption of dyestuff at 80% [2], taking in every type of dye and pigment produced, this amounts to close to 80,000 t. India is the second largest exporter of dyestuff, after China. Different regions of the world had their own natural dyeing traditions utilizing the natural resources available in that region.

In the early 21st century, the market for natural dyes in the fashion industry is experiencing a resurgence. Western consumers have become more concerned about the health and environmental impact of synthetic dyes in manufacturing and there is a growing demand for products that use natural dyes.

Nature has gifted us more than 500 dye-yielding plant species. Coloring agents of these plants are derived from roots, leaves, barks, trunks or fruits. All colors of the rainbow are obtained from plants (Cage). Natural dyes have better biodegradability and generally have a higher compatibility with the environment [3]. Today, dying is a complex, specialized science. Nearly all dyestuff is now produced from synthetic compounds. Natural dye produces very uncommon, soothing and soft shades as compared to synthetic dyes. On the other hand, many commercial practitioners feel that natural dyes are non-viable on grounds of both quality and economics.

Natural dyes are most beneficial when compared to the synthetic dyes. Natural dyes on textile materials have been attracting more of the following reasons;

- The wide viability of natural dyes and their huge potential.

- Availability of experimental evidence for allergic and toxic effects of synthetic dyes and non-toxic and non-allergic effects of natural dyes.

OBJECTIVE

- To isolation of natural dyes from flowers, leaves and tubers
- To find the use of different type of mordants
- To find the efficiency of dyes on different cloth material.

MATERIALS AND METHODS

Collection of plant material

The floral parts of *Clitoria ternatea* L., *Ixora coccinea* L., *Tagata erecta* L., *Impatiens balsamina* L., *Peltophorum pterocarpum*.(Dc.)., *Lawsomia inermis* L., *Rosa rubi ginosa* L. and the leaves of *Croton versicolor* (L) R.Br., and fruits of red chili (*Capsicum annum* L.) and tubers of Beetroot (*Beta vulgaris* L.) were collected from in and around Madurai.

Dye extraction

The collected plant materials used for extraction dye. The cleaned samples (50g) were crushed, dissolved in deionized water (500 ml) and then boiled for 2 hours in a hot water bath for quick extraction. At the end of 2 hours, the total color was extracted. The solution was then double filtered and used to carry out our study.

Dyeing materials

Cotton (2mm size), jute (0.5 cm size) and woolen (3mm size) yarns were used to test the dyeing ability of extracts.

Premordant Dyeing

Different mordants like cooking salt, vinegar and potassium dichromate were used as mordants. The extracts obtained were filtered and used for dyeing textile material. The textile materials used for dyeing were first washed with water. Then the threads were transferred to 0.2% potassium dichromate/ 6.25% salt/ 25% vinegar and allowed to boil for one hour at 600C. After this, the threads were transferred to 300C dye bath for one hour and then dried in sunlight. The sun-dried threads are further evaluated for its color and wash fastness. Wash fastness was tested by washing with soapy water (10% w/v).

RESULT AND DISCUSSION

Dying is an antediluvian art, which predates written records. It is the most important part in the production of fabric. But the use of natural dyes for textile dyeing purposes decreased to a large extent after the discovery of synthetic dyes in 1856. The global consumption of textiles is estimated at around 30 million tonnes, which is expected to grow at the rate of 3% per annum. The coloration of this huge quantity of textiles needs around 700,000 tonnes of dyes which causes the release of a vast amount of unused and unfixed synthetic colorants in the environment [4]. Synthetic dyes are substituted by natural color additives and growing at around 2 % yearly. Natural colors are easier to metabolize than synthetic counterparts.

Dyeing textile using natural dyes was found to yield poor color, have inadequate fastness properties. To overcome such hassle mordants are used. Metal ions of mordants act as electron accepts for electron donors form coordination bonds with the dye molecule, making them insoluble in water [5].

In the present study, the flowers of Ixora produced red color extract and of dying, it produced a range of red to violet shades on different textile material studied (Plate 1). Among the mordant used the best color developed in salt and it gave beet-root color in jute. The salt and vinegar treated dyes were tolerant to washing and showed good washing

fastness compared to potassium dichromate. The flowers of *P. pterocarpum* yield a yellow color dye. When treated with mordants and tested on textile materials it was found that the dye produced varies shades of yellow (Plate 2). Good washing fastness observed in cotton yarn treated with salt.

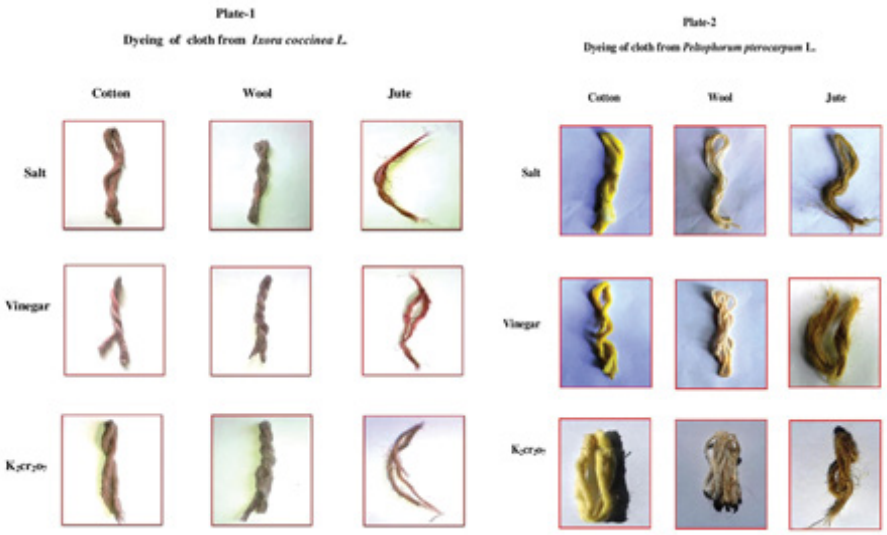

Figure 1: Dyeing of cloths from 1- *Ixora coccinea*., 2- *Peltophorum pterocarpum*

The Orangish yellow color dye was obtained from marrie gold, orange flowers and it developed varies shades ranged from yellow to green (Plate 3). Both salt and vinegar treated dyes showed good wash fastness on cotton and jute yarns. Whereas the yellow colored flowers of marrie gold produced light yellow colored dye and gave different shades of lemon yellow to brown (Plate 4). Good wash fastness observed in salt.

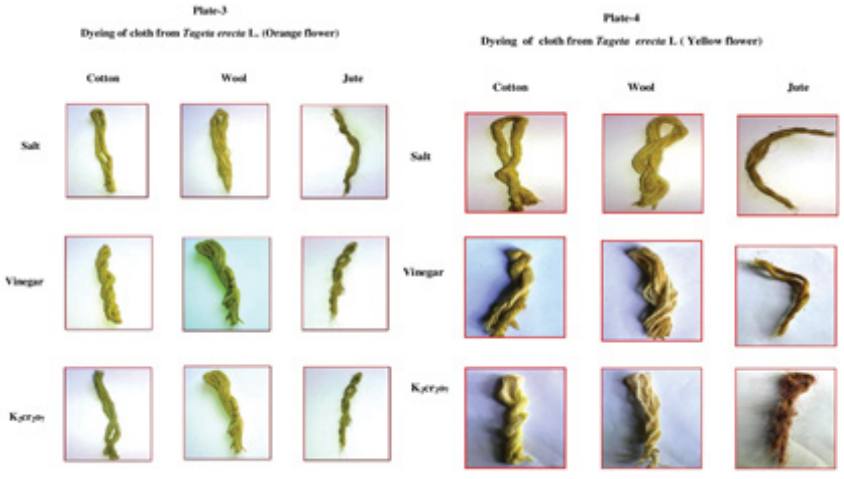

Figure 2: Dyeing of cloths from 3 & 4 *Tageta erecta* L (Orange & Yellow flower)

From flowers of *C. ternatea* blue color dye was obtained. Mostly dark green shade was observed (Plate 5) in the yarns tested. Moderate washing fastness observed in salt and vinegar treated yarns.

The Red colored dye was extracted from balsam flowers. Different shades of brown color obtained from the dye (Plate 6). Vinegar treated yarns showed good washing fastness.

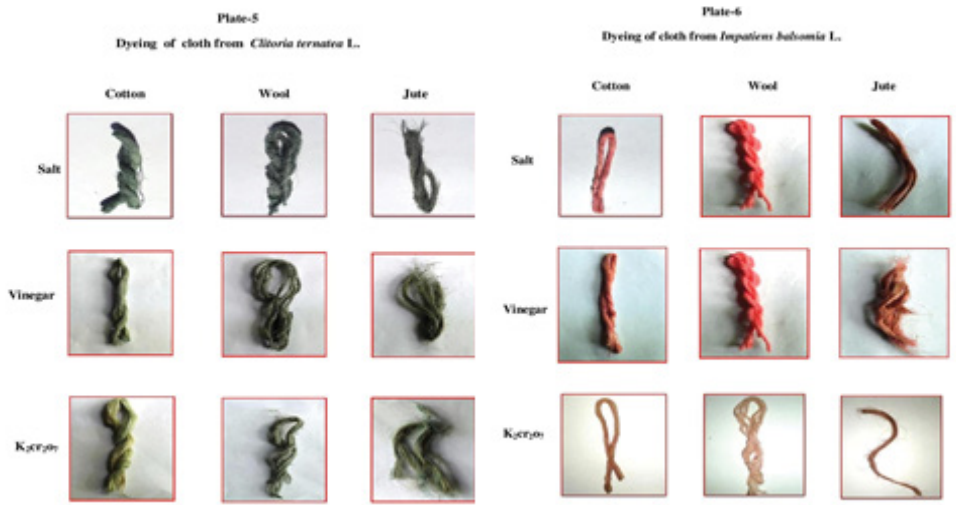

Figure 3: Dyeing of cloths from 5- *Clitoria ternatea*., 6- *Impatiens balsomia*

Different shades of pink-red-brown shades were obtained from a red dye extracted from rose flowers (Plate 7). But washing fastness was found to be less in all the mordants.

The Beta vulgaris tubers yield a dark pink color dye. Various shades of pink were observed in studying materials (Plate 8). All the mordants showed moderate washing fastness except the wool treated with salt and potassium dichromate showed poor fastness.

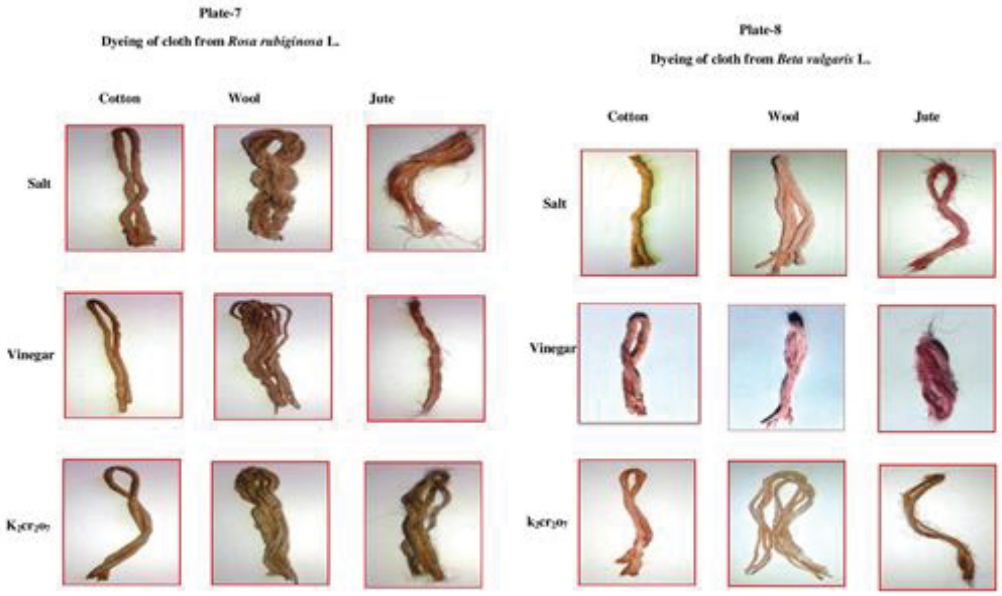

Figure 4: Dyeing of cloths from 7- *Rosa rubiginosa*., 8- *Beta vulgaris*

The leaves of L. *inermis* yield a brown colored dye. Various shades of brown color were observed in cotton and woolen yarns, but there is no color developed in jute treated with salt and potassium dichromate except vinegar treated jute yarn exhibited coffee brown shade (Plate 9). Good fastness observed in cotton treated with salt. Another brown colored dye was obtained from leaves of C. *versicolor* and produced brown to green shades (Plate 9). Vinegar and salt- treated yarns showed good washing fastness.

The fruits of *C. annum* (red) produced red colored dye. The dye developed different shades of orange on cotton, wool and jute yarns. Moderate washing fastness was observed in all the treated mordants (Plate 10).

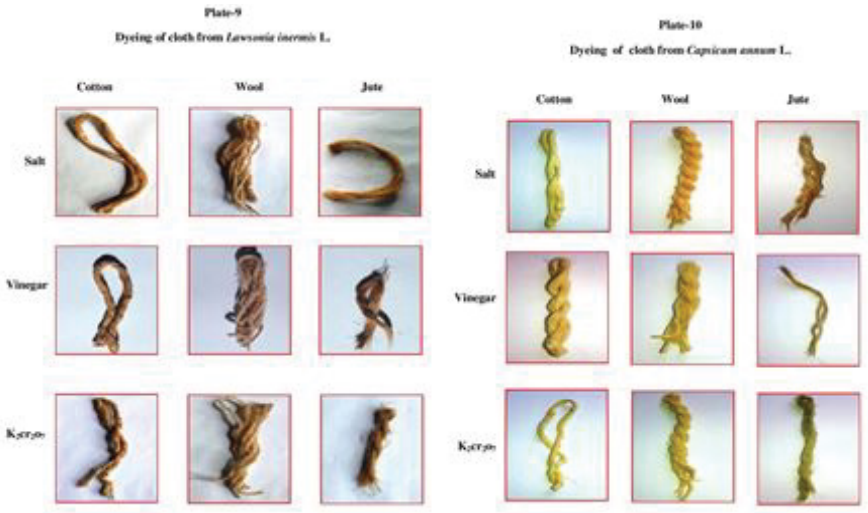

Figure 5: Dyeing of cloths from 9- *Lawsonia inermis*., 10- *Capsicum annum*

Based on the results an observation made that the cotton, wool and jute yarns developed good colors and also showed good washing fastness compared to potassium dichromate mordant. These different shades obtained from a single dye might be due to using different mordants like Copper sulphate, Ferrous sulphate, Ferric chloride, Potassium dichromate, myrobolan and cow dung [6]. Mordants resulted in different shades of the fabric. It has been observed that the washing conditions also caused shade changes on dyed fabrics.

Table 1: Plant synthesized color compounds

S.No	Plant Name	Yarns	COOKING SALT	VINEGAR	K2cr2o7
1	Impatients balsamia L.	Cotton	Light brown	Light brown	Light brown
		Wool	Light rose	Light brown	Light brown
		Jute	Light brown	Light brown	Thick brown
2	Beta vulgaris L.	Cotton	Light brown	Milk rose	Light brown
		Wool	Milk rose	Milk rose	Light sandal
		Jute	Pink	Pink	Light coffee brown
3	Clitoria ternatea L.	Cotton	Thick green	Thick green	Light green
		Wool	Thick green	Thick green	Yellowish green
		Jute	Light green	Light green	Light green
4	Peltophorum pterocarpum. (Dc.)	Cotton	Golden yellow	Light yellow	Lime yellow
		Wool	Dull orange	Orangish yellow	Light orange
		Jute	Light green	Brownish	Brownish yellow
5	Capsicum annum L.	Cotton	Light orange	Sandalwood	Orange
		Wool	Orange	Light orange	Light orange
		Jute	Golden orange	Light brown	Yellowish orange
6	Lawsomia inermis L.	Cotton	Coffee brown	Coffee brown	Orangish brown
		Wool	Light red	Light brown	Sandal yellow
		Jute	No coloring	Coffee brown	No coloring
7	Ixora coccinea L.	Cotton	Light violet	Violet	Pale rose
		Wool	Violet	Violet	Violet
		Jute	Beet root color	Pale rose	Pale rose
8	Rosa rubiginosa L.	Cotton	Brown	Light brown	Coffee brown
		Wool	Light red	Brownish red	Yellowish red
		Jute	Pink	Light pink	Coffee brown

9	Tagata erecta L. (orange flower)	Cotton	Lime yellow	Light green	Lime yellow
		Wool	Milky white	Apple green	Apple green
		Jute	Light green	Leaf green	Light green
10	Tagata erecta L. (Yellow flower)	Cotton	Sandal Yellow	Lemon yellow	Light yellow
		Wool	Sandal Yellow	Light sandal	Light sandal
		Jute	Light brown	Brownish yellow	Coffee brown

Washing fastness of natural dyes

Used ten plant materials for dyeing of cotton, wool and jute threads with salt, vinegar and K2Cr2O7. After finishing, dyeing salt was most favorable for dyeing Vinegar is moderate for dyeing K2Cr2O7 results poor for dyeing Instead of using chemicals like K2Cr2O7 salt and vinegar are the best for the dying process. Among the three types of threads i.e. cotton, jute and wool, Cotton are highly favorable Wool is also favorable Jute results moderate. Therefore, using of cotton clothes is better than using if wool or jute. Washing using of water results most favorable Washing using of soap oil or other detergents results in moderate Therefore, washing using is better than using of soap oil or other detergents. Washing fastness effect compares to geographically as given bellow.

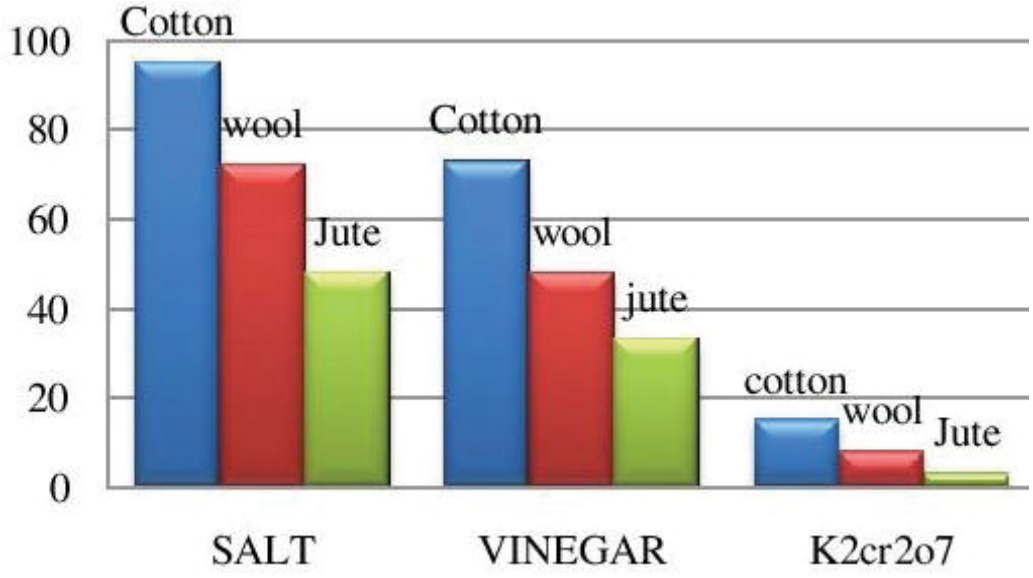

Figure 6: Washing fastness effect comparable to the different Mordants

Natural dyes are gotten from plants, creatures, organic products, bugs, minerals and other regular assets. That is the reason regular colors are normally seen as safe and safe for the earth. Notwithstanding, that is not the case constantly. Most common colors are sheltered and safe. Be that as it may, they can be harmful because of the severe utilized as a part of their application.

CONCLUSION

In the present study of various ranges of dyes extracted from ten plant materials. Among the plants *Impatients balsamia*, (brown)., *Clitoria ternatea*, (Green)., *Peltophrum pterocarpum*, (Yellow)., *Beta vulgaris*, (light brown)., *Tagetes erecta*, (sandal yellow)., yielding bright coloring dyes. The dyes treated with salt as mordant provides good colors and wash fastness. Cotton threads retain their color after a wash of 10 to 15 times with fresh water more than 90 percent when compared to jute and woolen threads. Woolen threads do not retain the color after many washes. This shows the retaining capacity of natural dye. Finally, I conclude that the use of natural dyes worldwide should be increased to prevent synthetic dyes, pollution, and other harmful effects.

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