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# Effect of mordants on natural dye extracts

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***Abstract:*** *Natural dyes contain natural coloring matter which is neither harmful to humans nor hazardous to environment. Plants are able to give out vast array of colors .i.e. pigments, but only some of these pigments can be used as dyes. Natural dyes are eco-friendly, biodegradable, non toxic. Natural dyes are currently in demand not only in industry like textile but also in cosmetics, leather, food and pharmaceuticals. Mordants are the elements which introduce the chemical reaction that takes place between the dye and the fiber, so that the dye is soaked within the fabric. The majority of natural dyes need a mordanting agent (metal salt or tannins) to create an attachment between the fiber and dye. This review article states that, natural dye can be easily extracted from natural sources which show various effects when treated with different mordants.*

***Key words:*** *Mordants, Natural dye.*

## 1. INTRODUCTION:

All over the world, approximately 1.3 million tons of dye, pigments, and dye precursors are produced, which are mainly based on synthetic dyeing materials. This ultimately results into the production of toxic and hazardous chemical wastes, creating a threat to human health and environment. Due to these reasons, the use of natural dye is attracting more and more interests. [1] Natural dyes contain natural coloring matter which is neither harmful to humans nor hazardous to environment. [2]

Recently, use of natural dyes has been suggested for textile modification. [3] Textiles are largely produced and are used throughout the world for various purposes every day. [4] The development of natural dye is necessary for safety fibers due to its better biodegradability with the environment. [5] Natural dyes are normally obtained from plants and animals. [1] They can produce an extraordinary diversity of rich colors, making them exciting to use. [6] Plants are able to give out vast array of colors .i.e. pigments, but only some of these pigments can be used as dyes. Natural dyes are eco-friendly, biodegradable, non toxic, such as yellow dye from turmeric and blue dye from indigo. [7] The color of extracts from flowers having anthocyanins can be rich source for textile dyeing. [8] Increased environmental alertness and adverse impacts of hazardous synthetic dyes have reinvited the interest in the application of natural dyes. [9] Natural dyes are currently in demand not only in textile industry but in cosmetics, leather, food and pharmaceuticals. There is a growing demand for eco-friendly and non-toxic colorants, specifically for health related applications such as coloration of food and dyeing of textile and leather garments. [10] The rich biodiversity of India has given the large amount of raw materials, still sustainable relation must be developed between cultivation, collection and their use. Natural dye can be classified into two types (a) Plant derived dyes (Example; *Maddar).* The roots of *Rubia tinctorum* known as madder [11] and (b) Animal derived dyes (Example; *Cochineal*). [12] Research activities are trying to make pace (step) by developing more and more effective and safe solutions. [13] As research in the direction of overcoming the limitations of natural dyes continues, we may conclude by saying that natural, eco-friendly dyes are certainly welcome. [14] Finally, the use of natural dyes worldwide should be increased to prevent synthetic dyes, pollution, and other harmful effects. [15]

### 1.1. Mordants:

Mordants are the elements which introduce the chemical reaction that takes place between the dye and the fiber, so that the dye is soaked within the fabric. Some fabrics like silk and wool can be colored simply by being dipped in the dye, while others like cotton require a mordant. [7] Most of the natural dyes have no stability on fibers without the use of a mordant. The majority of natural dyes need a mordanting agent (metal salt or tannins) to create an attachment between the fiber and dye. [16] The making of bond between coloring matter and fiber is called mordating. [17]Metallic salts as mordant form metal complexes with the fibers and the dyes. After mordanting, the metal salts attract the dye to the fibers and finally creates the connecting link between the dye molecules and the fiber. [18] Aluminum sulphate or any metallic mordants fixed to any fiber, chemically combine with the specific mordantable functional groups present in the

dyes and bound by covalent bonds or hydrogen bonds and other interactional forces. [19] There are two types of mordants:
(a) Metallic mordants (Ex; Salts of Aluminum, Chromium, Copper, Iron, and Tin)
(b) Tannins (Ex; Myrobalan and Sumach). [7]

### 1.2. Techniques:

Different methods are used for extraction of dyes like; (1) Aqueous extraction, (2) Alkali or acid extraction, (3) Microwave and ultrasonic assisted extraction, (4) Fermentation, (5) Solvent extraction. [1] In aqueous extraction, the material is first broken into small pieces or powdered. It is then soaked with water in earthen, wooden, or metal vessels for a long time usually overnight to loosen the cell structure and then boiled to get the dye solution, which is filtered to remove non dye plant residues. The process of boiling and filtering is repeated to remove as much dye as possible. [20] In acid and alkali extraction the dyes are extracted under dilute acidic or alkaline conditions. The addition of the acid or alkali facilitates the hydrolysis of glycosides resulting in better extraction and higher yield of color.[21] In microwave and ultrasonic assisted extraction, extraction efficiency is increased by the use of ultrasound or microwaves, thus reducing the quantity of required solvent, time, and temperature of extraction. [22] Fermentation is method of extraction which uses the enzymes produced by the microorganisms present in the atmosphere for assisting the extraction process. Indigo extraction is the most common example for this type of extraction.[23] Solvent extraction is a method in which natural coloring materials depending upon their nature can also be extracted by using organic solvents such as acetone, petroleum ether, chloroform, ethanol, methanol, or a mixture of solvents such as mixture of ethanol and methanol, mixture of water with alcohol, etc. [20]

## 2. MATERIALS AND METHODOLOGY:

**Table no. 1 Plant dyes (Color of dyes)**

| Sr. No. | Plant Name | Plant Part | Technique | Solvent | Dye Color | Mordant | Reference |
|---|---|---|---|---|---|---|---|
| 1. | *Alium cepa* | Skin of the bulb | Solvent extraction | Distil water | Dark yellow | Alum | [16] |
| 2. | *Beta vulgaris* | Roots | Solvent extraction | Distil water | Magenta pink | Salt | [16] |
| 3. | *Bougainvillea sps.* | Flowers | Solvent extraction | Distil water | Dark pink | Alum and Cream of Tartar | [16] |
| 4. | *Brassica oleracea var. Capitata* | Leaves | Solvent extraction | Distil water | Purple | Vinegar | [16] |
| 5. | *Caesalpinia sps.* | Flower | Solvent extraction | Distil water | Violet | Vinegar | [16] |
| 6. | *Caesalpinia sappan* L. | Wood | Solvent extraction | Distil water | Red | Alum | [7] |
| 7. | *Carica papaya* | Leaves | Solvent extraction | Distil water | Dark green | Salt | [16] |
| 8. | *Carthamus tinctorius* L. | Flowers | Solvent extraction | Distil water | Red | Alum | [7] |
| 9. | *Julans nigra* | Husk of the nut | Solvent extraction | Distil water | Brown | Alum | [25] |
| 10. | *Maclura pomifera* | Barks of the root | Solvent extraction | Distil water | Khakhi tan | Alum | [25] |
| 11. | *Quercus velutina* | Barks of trunk | Solvent extraction | Distil water | Dark rose tan | Alum | [25] |
| 12. | *Rhus glabra* | Fruits | Solvent extraction | Distil water | Pink | Alum | [25] |
| 13. | *Rosa indica* | Flower petals | Solvent extraction | Distil water | Red | Alum<br>$CuSO_4$ | [26] |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | $FeSO_4$ | |
| 14. | *Rubia tinctorium*L. | Wood | Solvent extraction | Distil water | Red | Alum | [7] |
| 15. | *Rumex crispus* | Flowers | Solvent extraction | Distil water | Brown | Alum | [25] |
| 16. | *Sassafras varifolium* | Barks of the root | Solvent extraction | Distil water | Reddish brown | Alum | [25] |
| 17. | *Schranka uncinata* | Whole plant | Solvent extraction | Distil water | Bright yellow | Alum | [25] |
| 18. | *Solidago canddensi* | Whole plant | Solvent extraction | Distil water | Yellow green | Alum | [25] |
| 19. | *Tagetes Erecta* | Flowers | Solvent extraction | Distil water | Yellow | Alum<br>$CuSO_4$<br>$FeSO_4$<br>$SnCl_2$ | [27] |
| 20. | *Vitis doaniana* | Fruits | Solvent extraction | Distil water | Blue violet | Alum | [25] |
| 21. | *Woodfordia fruticosa* | Flowers | Solvent extraction | Distil water | Yellowish Brown | Myrobalan | [12] |

**Table no. 2 Animal dyes (Color of dyes)**

| Sr. No. | Animal Name | Part | Technique | Solvent | Color Obtained | Mordant | Reference |
|---|---|---|---|---|---|---|---|
| 1. | *Cochineal* | Whole body | Solvent extraction | Distil water | Pink | Alum | [28] |
| 2. | *Kermes* | Whole body | Solvent extraction | Distil water | Deep Red. | Alum | [29] |
| 3. | *Murex brandaris* | Piles | Solvent extraction | Distil water | Tyrian Purple | None | [30] |

## 3. RESULT AND DISCUSSION:

Water soluble extracts from plants and animal sources can be used as natural dyes in presence of mordants. Alum and $FeSO_4$ are most effective in dye absorption on cotton cloth. Here only water is used for extraction of dyes, and no other chemicals are used. So it is economically favourable and environment friendly. [31] Different colors of dye can be obtained using different mordants due to the formation of complexes between the polyphenols and organic compounds in the dye. [32] Different shades of color, enable us to make different color variety. [16] The intensity of color found on clothes by dyeing without mordants is slightly less than that obtained from mordants with dye. Hence to obtain the bright and perfect color of dye on fabrics, mordants are require. [12]

**Table no. 3 Plant dyes (color on fabric)**

| Sr no | Plant name | Dye color | Color on fabric when treated with mordant | Reference |
|---|---|---|---|---|
| 1. | *Alium cepa* | Dark yellow | Dark yellow | [16] |
| 2. | *Beta vulgaris* | Magenta pink | Magenta pink | [16] |
| 3. | *Bougainvillea sps.* | Dark pink | Bright pink | [16] |
| 4. | *Brassica oleracea var. capitata* | Purple | Dark purple | [16] |
| 5. | *Caesalpinia sps.* | Violet | Purple | [16] |
| 6. | *Caesalpinia sappan L.* | Red | Red | [7] |
| 7. | *Carica papaya* | Dark green | Emerald | [16] |
| 8. | *Carthamus tinctorius L.* | Red | Dark red | [7] |
| 9. | *Julans nigra* | Brown | Chocolate brown | [25] |
| 10. | *Maclura pomifera* | Khakhi tan | Bright Khakhi tan | [25] |

| | | | | |
|---|---|---|---|---|
| 11. | *Quercus velutina* | Dark rose tan | Rose tan | [25] |
| 12. | *Rhus glabra* | Pink | Dark Pink | [25] |
| 13. | *Rosa indica* | Red | Bright red | [26] |
| | | | Bright red | |
| | | | Violet | |
| 14.. | *Rubia tinctoriumL.* | Red | Dark red | [7] |
| 15 | *Rumex crispus* | Brown | Dark brown | [25] |
| 16. | *Sassafras varifolium* | Reddish brown | Reddish brown | [25] |
| 17. | *Schranka uncinata* | Bright yellow | Bright yellow | [25] |
| 18. | *Solidago canddensi* | Yellow green | Yellow green | [25] |
| 19. | *Tagetes erecta* | Yellow | Yellow | [27] |
| | | | Greenish yellow | |
| | | | Grey | |
| | | | Bright Yellow | |
| 20. | *Vitis doaniana* | Blue violet | Blue violet | [25] |
| 21. | *Woodfordia fruticosa* | Dark Yellowish Brown | Dark Yellowish Brown | [12] |

**Table no. 4 Animal dyes (Color on fabric)**

| Sr no | Animal name | Dye color | Color on fabric when treated with mordant | Reference |
|---|---|---|---|---|
| 1. | *Cochineal* | Pink | Magenta Pink | [28] |
| 2. | *Kermes* | Deep Red. | Deep Red | [29] |
| 3. | *Murex brandaris* | Tyrian Purple | Tyrian Purple | [30] |

## 4. CONCLUSION:

We found that plants and animals are the great source of natural dye extracts. Natural colorant can be extracted from them easily by means of solvent extraction techniques and can be utilized to color the cotton fabrics. By means of certain mordants, dye color can be altered and changed to various shades. They help dye to get fixed on the fabric perfectly. Mordants play major role in coloring of textile from natural dyes.

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