POTENTIAL DYE YIELDING PLANTS OF INDIA
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Introduction:

India has a rich biodiversity and it is not only one of the world’s twelve megadiversity countries, but also one of the eight major centres of origin and diversification of domesticated taxa. It has approximately 490,000 plant species of which about 17,500 are Angiosperms. Thus, India harbours a wealth of useful germplasm resources and there is no doubt that the plant kingdom is a treasure-house of diverse natural products. One such product from nature is Dye. A dye can be defined as a highly coloured material used for colouring of textiles, paper, wood, varnishes, leather, ink, foodstuff, cosmetics, medicines etc. Chemically a dye molecule has two principal chemical groups viz. Chromophores & Auxochromes. Indians have been considered as forerunners in the art of Natural Dyeing. In India, there are more than 450 plants that can yield dyes.

Origins:

Colors in the "ruddy" range of reds, browns and oranges are the first attested colors in a number of ancient textile sites ranging from the Neolithic to the Bronze Age across the Levant, Egypt, Mesopotamia and Europe, followed by evidence of blues and then yellows, with green appearing somewhat later. The earliest surviving evidence of textile dyeing was found at the large Neolithic settlement at Çatalhöyük in southern Anatolia, where traces of red dyes, possible from ochre (iron oxide pigments from clay), were found. Polychrome or multicolored fabrics seem to have been developed in the 3rd or 2nd millennium BCE. Textiles with a "red-brown warp and an ochre-yellow weft" were discovered in Egyptian pyramids of the Sixth Dynasty (2345–2180 BCE). Natural dyes, dyestuff and dyeing are as old as textiles themselves. Natural dyeing was practiced during the Bronze Age in Europe. It was known as early as in the Indus Valley period (2500 BC). The earliest written record of the use of natural dyes was found in China dated 2600 BC. In Egypt, mummies have been found wrapped in dyed cloth. By the 4th century AD, dyes such as madder, Brazilwood, indigo and a dark reddish-purple were known. Brazil was named after the wood (Brazilwood) found there that gives a red dye called Brazilin. Henna was used even before 2500 BC, while saffron is mentioned in the Bible. The first use of the blue dye, may have originated in Palestine. Our Vedas, the Atharvaveda carries description of natural dyes. The use of natural dyeing materials is evident with the wall paintings of Ajanta, Ellora and Sittannvasal and they still demonstrate the efficacy of dyeing craft that had been inherited from ancient times in India.

In 1856 William Henry Perkin, an English chemist, while attempting to synthesize quinine from aniline, a coal tar byproduct, accidentally produced and discovered "mauveine", a purple colour, the first synthetic dye. The color quickly became the favorite of royal family and a new industry was born-Dyestuff Industry. The advent of synthetic dyes and their immediate acceptability throughout the world due to wide range of colors and good color fastness properties resulted in the limited use of natural dyeing.

Types of Natural Dyes:
Natural dyes can be sorted into three categories:

- PLANTS
- ANIMALS / INSECTS
- MINERALS

Although some fabrics such as silk and wool can be colored simply by being dipped
in the dye, others such as cotton require a mordant.

**Mordant**: A mordant is an element, which aids the chemical reaction that takes place between the dye and the fiber so that the dye is absorbed. 

**Types of mordants**: Mordants can be classified into the following categories:

**Metallic mordants**:

They are generally metal salts of aluminium, chromium, iron, copper and tin. The metallic mordants are of two types:

- **Brightening mordants** –

  **Alum**: Easily available and safe to use mordant. It usually produces pale versions of the prevailing dye colour in the plant.

- **Dulling mordants** –

  **Chrome** *(potassium dichromate)*: It is also referred to as red chromate. The dichromate solution is light sensitive and therefore it changes colour under light exposure.

  **Tin** *(stannous chloride)*: It gives brighter colours than any other mordant. However, they are oxidized on exposure to air and may impart a stiff hand to the fabric.

**Copper** *(cupric sulphate)*: Known as blue vitriol, it is readily soluble in water and easy to apply. It gives some special effects in shades, which otherwise cannot be obtained.

**Iron** *(ferrous sulphate)*: It is also known as green vitriol and is readily soluble in water. It is used for darkening/browning and blackening of the colours/shades. It is easily available and one of the oldest mordants known. It is extensively used to get grey to black shades.

**Tannins**: Among the tannins, myrobalan (harda) and galls/sumach are most important.

**Oils type mordants**:

Vegetable oils or Turkey red oil (TRO) are such type of mordants. TRO as mordant is mainly used in the dyeing of deep red colour from madder. The main function of the TRO as oil mordant is to form a complex with alum when used as a main mordant. Sulphonated oil possesses better binding-capacity than the natural oils. Oil mordanted samples exhibit superior fastness and hue.

**Dye yielding plants of India**:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Botanical name &amp; Family</th>
<th>Parts used</th>
<th>Colouring components</th>
<th>Use &amp; colour with mordant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Acacia catechu</em> Willd. var. sundra Train (Mimosaceae)</td>
<td>Wood</td>
<td>Catechin, Catechin red</td>
<td>Dyeing cotton, silk and incalico printing (Reddish brown)</td>
</tr>
<tr>
<td>2</td>
<td><em>Acacia nilotica</em> (L.) Delie (Mimosaceae)</td>
<td>Bark &amp; Pods</td>
<td>Catechin</td>
<td>Dyeing textiles, (Light yellow) Alum, (Yellowish brown) Copper sulphate, (Dark gray) Ferric sulphate, Calico printing (Reddish brown)</td>
</tr>
<tr>
<td>3</td>
<td><em>Adhatoda vasica</em> Nees (Acanthaceae)</td>
<td>Leaves</td>
<td>2-pyridyl methyl amine</td>
<td>Alum (Yellow), Copper sulphate (Light yellow), Ferrous sulphate (Gray)</td>
</tr>
<tr>
<td>4</td>
<td><em>Aegle marmelos</em> Correa ex Roxb. (Rutaceae)</td>
<td>Rind of the fruit</td>
<td>Marmalosin</td>
<td>In calico printing (Reddish)</td>
</tr>
<tr>
<td>5</td>
<td><em>Anacardium occidentale</em> L. (Anacardiaceae)</td>
<td>Pericarp</td>
<td>Phenolic constituents</td>
<td>Tan or colour fishing nets, Indelible marking ink (Light red)</td>
</tr>
<tr>
<td>7</td>
<td><em>Annona reticulate</em> L. (Annonaceae)</td>
<td>Fruit, shoots</td>
<td>Catechin</td>
<td>Dyeing textiles (Bluish black)</td>
</tr>
<tr>
<td>8</td>
<td><em>Bauhinia purpurea</em> L. (Caesalpiniaecae)</td>
<td>Bark</td>
<td>Chalcone, Butein</td>
<td>For dyeing &amp; tanning (Purple colour)</td>
</tr>
<tr>
<td>9</td>
<td><em>Bixa orellana</em> L. (Bixaceae)</td>
<td>Pulp (aril) surrounding the seeds</td>
<td>Bixin, Orellin, Methyl Bixin, Beta-carotene, Cryptoxanthine</td>
<td>Colouring silk &amp; cotton (Orange yellow)</td>
</tr>
<tr>
<td>10</td>
<td><em>Butea monosperma</em> (Lam.) Kuntze (Fabaceae)</td>
<td>Dried flowers</td>
<td>Butin, Butein, Butrin, Isobutrin, Palasitrin, Coreopsin</td>
<td>Colouring sarees (Brilliant yellow dye)</td>
</tr>
<tr>
<td>11</td>
<td><em>Caesalpinia sappan</em> L. (Caesalpiniaecae)</td>
<td>Wood &amp; Pods</td>
<td>Brazilin, Sappan red</td>
<td>Used with alum to yield black colour (Red dye)</td>
</tr>
<tr>
<td>No.</td>
<td>Scientific Name</td>
<td>Parts Used</td>
<td>Chemical Constituents</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
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<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td><em>Carthamus tinctorius</em> L. (Asteraceae)</td>
<td>Flowers</td>
<td>Carthamin (Scarlet red), Carthamone</td>
<td>Dyeing wool, silk and food (Red &amp; Yellow)</td>
</tr>
<tr>
<td>13</td>
<td><em>Cassia fistula</em> L. (Caesalpinaceae)</td>
<td>Bark &amp; Sapwood</td>
<td>Leuco anthocyanidins</td>
<td>(Red)</td>
</tr>
<tr>
<td>14</td>
<td><em>Cassia tora</em> L. (Caesalpinaceae)</td>
<td>Seeds</td>
<td>Rubrofusarin</td>
<td>Dyeing &amp; tanning (Blue)</td>
</tr>
<tr>
<td>15</td>
<td><em>Casuarina equisetifolia</em> Forst. (Casuarinaceae)</td>
<td>Bark</td>
<td>Casuarin</td>
<td>As mordant (Light reddish)</td>
</tr>
<tr>
<td>16</td>
<td><em>Commelina benghalensis</em> L. (Commelinaceae)</td>
<td>Juice of the flower</td>
<td>-</td>
<td>Pigment for painting on transparencies (Blue)</td>
</tr>
<tr>
<td>17</td>
<td><em>Curcuma longa</em> L. (Zingiberaceae)</td>
<td>Rhizome</td>
<td>Curcuminoids, Curcumin</td>
<td>Dyeing</td>
</tr>
<tr>
<td>18</td>
<td><em>Dipterocarpus spp.</em> (Dipterocarpaceae)</td>
<td>Bark</td>
<td>Oleanolic acid</td>
<td>(Light brown) Alum, (Brown) copper sulphate, (Grey) Ferrous sulphate</td>
</tr>
<tr>
<td>19</td>
<td><em>Haematoxylin campechianum</em> L. (Caesalpinaceae)</td>
<td>Heartwood</td>
<td>Haematoxylin</td>
<td>Manufacturing of ink &amp; dyeing woolen &amp; silk goods</td>
</tr>
<tr>
<td>20</td>
<td><em>Indigofera tinctoria</em> L. (Fabaceae)</td>
<td>Green crop</td>
<td>Indigotin</td>
<td>Dyeing clothes (Blue)</td>
</tr>
<tr>
<td>21</td>
<td><em>Isatis tinctoria</em> L. (Brassicaceae)</td>
<td>Leaves</td>
<td>Indican</td>
<td>Deep black, Dark blue</td>
</tr>
<tr>
<td>22</td>
<td><em>Lawsonia alba</em> L. (Lythraceae)</td>
<td>Leaves</td>
<td>Lawson</td>
<td>Dyeing clothes, staining fingers, hands &amp; dyeing hairs (Brown)</td>
</tr>
<tr>
<td>23</td>
<td><em>Madhuca indica</em> J.F. Gmel. (Sapotaceae)</td>
<td>Bark</td>
<td>Quercetin, Dihydroquercetin</td>
<td>Dyeing (Reddish-yellow)</td>
</tr>
<tr>
<td>24</td>
<td><em>Mallotus philippensis</em> Mueil.-Arg.(Euphorbiaceae)</td>
<td>Fruits</td>
<td>Rottlerin, borottlerin</td>
<td>Dyeing silk (Red)</td>
</tr>
<tr>
<td>25</td>
<td><em>Mangifera indica</em> L. (Anacardiaceae)</td>
<td>Bark &amp; Leaves</td>
<td>Mangiferin</td>
<td>Mordant &amp; dyeing silk (Yellow)</td>
</tr>
<tr>
<td>26</td>
<td><em>Morinda citrifolia</em> L. (Rubiaceae)</td>
<td>Root bark</td>
<td>Morindone</td>
<td>Dyeing (DullRed)</td>
</tr>
<tr>
<td>27</td>
<td><em>Nycanthus arbor-tristis</em> L. (Oleaceae)</td>
<td>Flower</td>
<td>Nycanthin, Indoid glycoside</td>
<td>Chrome (Yellow)</td>
</tr>
<tr>
<td>28</td>
<td><em>Nymphaea alba</em> L. (Nymphaeaceae)</td>
<td>Rhizome</td>
<td>Tannins &amp; Myricetin flavonoids glycosides</td>
<td>Blue</td>
</tr>
</tbody>
</table>

Some common Indian plants with dye yielding potentiality:

**CHINA ROSE**
*Hibiscus rosa-sinensis* L.
Red dye from Flowers

**GULMOHAR**
*Delonix regia* (Hook.) Raf.
Red dye from Flowers

**LATKAN**
*Bixa orellana* L.
Orange-yellow dye from seeds

**KAHRAIR**
*Acacia catechu* Willd.
Brown dye from Wood

**TURMERIC**
*Curcuma longa* L.
Yellow dye from Rhizome

**HENNA**
*Lawsonia inermis* L.
Orange-red dye from Leaves

**PALAS**
*Butea monosperma* Taub.
Yellowish orange dye from Flowers

**DHATKI**
*Woodfordia fruticos* Kurz
Brick red dye from Flowers

**SEULI**
*Nycanthus arbor-tristis* L.
Orange dye from Flowers
Importance in Present Day:

In present scenario, from environmental point of view the traditional natural dyes might be an alternative pathway to developed eco-friendly products. Natural dyes are now-a-days in demand not only in textile industry but in cosmetics, leather, food and pharmaceuticals. Some of the natural colours are not only eco-safe, but also has added value for its medicinal effects on skin and can be used for producing various medicinal preparations. The rich biodiversity of our country has provided us a plenty of raw materials yet a sustainable linkage must be developed between the cultivation, collection and their use.

Advantages & Disadvantages of Natural Dyes:

Advantages: Natural dyes are less toxic, less polluting, less health hazardous, non-carcinogenic and non-poisonous. They harmonizing colours, gentle, soft and subtle and create a restful effect. Environment-friendly and can be recycled after use.

Disadvantages: Tedious & time consuming extraction of dye from the raw material, low colour value make the cost of natural dyeing considerably higher than that of synthetic dyeing. Dependency on the growing seasons of the dye plants for extraction. Natural dyes tend to fade faster than the synthetic dyes. Some of the metallic mordants are hazardous.

Conclusion:

Though there is a large plant resource base, little has been exploited so far. Due to lack of availability of precise technical knowledge on the extracting and dyeing technique, it has not commercially succeeded like the synthetic dyes. Although indigenous knowledge system has been practiced over the years in the past, the use of natural dyes has diminished over generations due to lack of documentation. Proper collection, documentation and protection should be needed for natural dye yielding plants otherwise we are supposed to lose our indigenous knowledge system.

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