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 materialsis evident with the wall paintings of Ajanta, Ellora and Sithannvasal 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.
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.

- **Dulling mordants –**

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 :

Sl. No.	Botanical name & Family	Parts used	Colouring components	Use & colour with mordant
1	*Acacia catechu* Willd. var. sundra Train (Mimosaceae)	Wood	Catechin, Catechin red	Dyeing cotton, silk and incalico printing (Reddish brown)
2	*Acacia nilotica* (L.) Delile (Mimosaceae)	Bark & Pods	Catechin	Dyeing textiles, (Light yellow) Alum, (Yellowish brown) Copper sulphate, (Dark gray) Ferric sulphate, Calico printing (Reddish brown)
3	*Adhatoda vasica* Nees (Acanthaceae)	Leaves	2-pyridyl methyl amine	Alum (Yellow), Copper sulphate (Light yellow), Ferrous sulphate (Gray)
4	*Aegle marmelos* Correa ex Roxb. (Rutaceae)	Rind of the fruit	Marmalosin	In calico printing (Reddish)
5	*Anacardium occidentale* L. (Anacardiaceae)	Pericarp	Phenolic constituents	Tan or colour fishing nets. Indelible marking ink (Light red)
7	*Annona reticulate* L. (Annonaceae)	Fruit, shoots	Catechin	Dyeing textiles (Bluish black)
8	*Bauhinia purpurea* L. (Caesalpiniaceae)	Bark	Chalcone, Butein	For dyeing & tanning (Purple colour)
9	*Bixa orellana* L. (Bixaceae)	Pulp (aril) surrounding the seeds	Bixin, Orellin, Methyl Bixin, Beta-carotene, Cryptoxanthine	Colouring silk & cotton (Orange yellow)
10	*Butea monosperma* (Lam.) Kuntze (Fabaceae)	Dried flowers	Butin, Butein, Butrin, Isobutrin, Palasitrin, Coreopsin	Colouring sarees (Brilliant yellow dye)
11	*Caesalpinia sappan* L. (Caesalpiniaceae)	Wood & Pods	Brazilin, Sappan red	Used with alum to yield black colour (Red dye)

12	*Carthamus tinctorius* L. (Asteraceae)	Flowers	Carthamin (Scarlet red), Carthamon	Dyeing wool, silk and food (Red & Yellow)
13	*Cassia fistula* L. (Caesalpiniaceae)	Bark & Sapwood	Leuco anthocynidins	(Red)
14	*Cassia tora* L. (Caesalpiniaceae)	Seeds	Rubrofusarin	Dyeing & tanning (Blue)
15	*Casuarina equisetifolia* Forst. (Casuarinaceae)	Bark	Casuarin	As mordant (Light reddish)
16	*Commelina benghalensis* L. (Commelinaceae)	Juice of the flower	-	Pigment for painting on transparencies (Blue)
17	*Curcuma longa* L. (Zingiberaceae)	Rhizome	Curcuminoids, Curcumin	Dyeing
18	*Dipterocarpus* spp. (Dipterocarpaceae)	Bark	Oleanolic acid	(Light brown) Alum, (Brown) copper sulphate, (Grey) Ferrous sulphate
19	*Haematoxylon campechianum* L. (Caesalpiniaceae)	Heartwood	Haematoxylin	Manufacturing of ink & dyeing woolen & silk goods
20	*Indigofera tinctoria* L. (Fabaceae)	Green crop	Indigotin	Dyeing clothes (Blue)
21	*Isatis tinctoria* L. (Brassicaceae)	Leaves	Indican	Deep black, Dark blue
22	*Lawsoni aalba* L. (Lythraceae)	Leaves	Lawsone	Dyeing clothes, staining fingers, hands & dyeing hairs (Brown)
23	*Madhuca indica* J.F. Gmel. (Sapotaceae)	Bark	Quercetin, Dihydro quercetin	Dyeing (Reddish-yellow)
24	*Mallotus philippensis* Muell.-Arg.(Euphorbiaceae)	Fruits	Rottlerin, Isorottlerin	Dyeing silk (Red)
25	*Mangifera indica* L. (Anacardiaceae)	Bark & Leaves	Mangiferin	Mordant & dyeing silk (Yellow)
26	*Morinda citrifolia* L. (Rubiaceae)	Root bark	Morindone	Dyeing (Dullred)
27	*Nyctanthes arbor-tristis* L. (Oleaceae)	Flower	Nyctanthin, Iridoid glycoside	Chrome (Yellow)
28	*Nymphaea alba* L. (Nymphaceae)	Rhizome	Tannins & Myricetrin flavonoids glycosides	Blue

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

KHAIR
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 fruticosa Kurz
Brick red dye from Flowers

SEULI
Nyctanthes arbor-tristis L.
Orange dye from Flowers

KUSUM
Carthamus tinctorius L.
Reddish yellow dye from Flowers

TEAK
Tectona grandis L.f.
Deep orange dye from Leaves

MARIGOLD
Tagetes erecta L.
Yellow 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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