**Natural Dye yielding plants in India and Renascence of Traditional Dyeing Techniques**

**Abstract:**

Green in most leaves is surely the most ubiquitous plantcolour. The green pigment chlorophyll in leaves helps capture the sun’s energy and converts it to chemical energy, which is then stored and used as food for the plant. Coloursin flowers are adaptations that attract insects and other animals that in turn pollinate and help the plants reproduce.Some plants have colourful fruits that attract animals toeat them, thus inadvertently spreading the plant’s seeds asthey do so. Scientists believe that other pigments may help protect plants from diseases. Despite what we know about the role of a few of the thousands of plant pigments, the role of most colours in plants remains a mystery to us till date.Although plants exhibit a wide range of colours, not all of these pigments can be used as dyes. Some do not dissolve in water, some cannot be adsorbed on-to fibres, whereasothers fade when washed or exposed to air or sunlight. Itremains a mystery, why plants reward us with vibrant dyes.India has a rich biodiversity and it is not only one of the world’s twelve megadiversity countries, but also oneof the eight major centres of origin and diversification of domesticated taxa. It has approximately 490,000 plantspecies of which about 17,500 are angiosperms; more than400 are domesticated crop species and almost an equal num- ber their wild relatives. In the most recent research, traditional methods and plants that produce dye in India were evaluated.

**Key Words:** Natural Dyes, Different Dye yielding plants, Traditional Knowledge, Medicinal uses.

**I. INTRODUCTION**

**A. History of Natural Dyes:**

Dyeing was known by the men of Neolithic age (i.e..,) as far back as 10,000 BC to 5000 BC at the time the common colours in use were red, yellow, brown, purple and grey. Studies in the analysis of natural colourants in textile are a fascinating subject, which started as early as 1930’ s. One of the first chemists to analyze natural dye stuffs was the French chemist pfister, until the middle of last century colouring matter of natural orgin were in use. By the 4th century AD, dyes such as woad, madder, weld, brazilwood, indigo and a dark reddish- purple were known. Brazil was named after the woad found there [1]. Henna was used even before 2500 BC, while saffron is mentioned in the bible [2].

Birth of synthetic dyestuffs in the year 1856 attracted the dyeing industry because of its bright colours and good fastness properties cost resulting in replacement the natural dyes. Long use of dyes have created many health hazards and found to be highly mutagenic. This awareness has necessitated a need to look at alternative but safe colouring matter derived from plant and animal origins. Earlier these colouring matters were discarded because of poor tinctorial value, complexity of application produces and relatively poor fastness properties (wash, light, perspiration). Dyes might have been discovered accidentally, but their use has become so much a part of man’s customs that it is difficult to imagine a modern world without dyes. The art of dyeing spread widely as civilization advanced [3]. However the health hazards associated with all classes of synthetic dyes has necessitated second look at these natural colouring materials with new interest.

The efforts that needed to focus attention on dyes:

* Improved application procedures.
* Natural mordants.
* Economic extraction (dye) processes.
* After treatment to improve fastness properties.

Many centuries including germany have banned the use of synthetic dyes especially those derived from azo series. Hence to look for textile dyes with natural dyes. Natural dyes being based on raw materials that are biocompatible arid biodegradable, do not create any pollution problem. The waste in process becomes an ideal fertilizer for use in agriculture fields.

**II Studies on Natural Dyes:**

In the last fifteen to twenty years many scientific research studies on natural dyes have been carried out very systematically. These studies mainly deal with identification of dye, extraction procedure standardization, application method and colour fastness test. Some important ones are grouped and summarized below.

**A. Natural dyes for cellulosic fibre:**

Study on cotton fabric using *Eclipta* as natural dye in both conventional and sonicator methods has been reported by [4].The effects of dyeing showed higher color strength values obtained by the latter. Dyeing kinetics of cotton fabrics were compared for both the methods. The time/dye uptake reveals the enhanced dye uptake showing sonicator efficiency. The results of fastness properties of the dyed fabrics were fair to good. CIELAB values have also been evaluated.

Studied the use of marigold flower as floral dye because huge amount of unsold flowers are wasted every day. These unsold flower create a big problem for disposal as well as these can create environment pollution also. These unsold flowers can be used for dyeing purpose for cotton fibre and residuals after dyeing can be used as bio – fertilizer [5]. In the study cotton was mordanting before dyeing . For mordanting, low concentration of eco – friendly mordanting agents: Alum, Copper, Sulphate, Ferrous sulphate, Stannous chloride were used. The mordanted samples were immersed in dye bath for 2 hours at a temperature range of 80oc. After dyeing, soaping was done with 2g/l non – ionic soap at room temperature for 10 minute and then dried in shade. Various shades of yellow, brown, grey, grey black were obtained using different mordant’s. Good wash fastness properties were noted and so the flowers were recommended for use in industry. This floral dye has no side effect on environment also.

The ultrasonic dyeing of cotton with Nerium oleander flower. The scoured fabric was soaked in clean water for 30 min prior to dyeing and mordanting. Mordanting with metal salt such as FeSo4, SnCl2, CuSo4, K2Cr2O7 & alum was carried out at 60oc for 30 mins. Cotton was then dyed with dye extract, keeping M:L ratio as 1:30 & pH was maintained at 4 by adding buffer solution. It was concluded that aqueous extract of nerium flowers yield cream to green to purple shades on cotton fabrics with good particularly for cotton mordanted by stannic chloride. The dye showed good scope in commercial dyeing of cotton fabric for garment industry [6].

**B. Natural dyes for protein fibre**

Itobtained natural mordant from concentrating the aqueous solution extract of banana flower petaloide under reduced pressure and evaporating it to dryness. Bharat merino sheep wool yarn dyed with turmeric (*Curcuma longa*) was subjected to mordanting separating with natural mordant and chromium under identical condition. Out of the different concentration of the mordants used 3.5% natural mordant and 1.55 % chromium on the weight of yarn show similar color fastness, reflectance, color shade and K/S values. The chromium mordant in high concentration damaged wool while natural mordant does not cause damage to wool. Since the nature of turmeric colourant and banana petaloids is ecofriendly, their use in dyeing and mordanting will not cause any harm to the environment [7].

Identified *Eclipta prostrata*, a common weed found in most of the fields in Andhra Pradesh as a good source of natural dye for silk for production of green shades. Alkaline medium was suitable for extraction of dye from the plant and pleasant yellowish-green shades were obtained on silk. The extraction and dyeing procedures were standardized based on the optical density before and after dyeing silk and visual appearance judged by a panel of 30 scientists. All four mordants namely alum, chrome, copper sulphate and ferrous sulphate were found to be suitable for application on silk. 15% and 20% of alum, 3% of chrome, 2% of copper sulphate and 1 and 2% of ferrous sulphate were found to produce fast yellowish green shades on silk Mostly dark shades were obtained by post mordanting method, followed by simultaneous and premordanting methods. Exposure to alkali had either deepened the hue or added green tinge to the silk samples when subjected to washing and alkali perspiration. Loss of colour was found with acidic perspiration. Excellent to outstanding fastness to sunlight was found in all mordanted samples. There was no absolute staining for washing. Colour change was not found in samples subjected to crocking in dry and wet conditions. Only slight staining was found. This dye can easily be recommended for use on silk fabrics for producing light green shades [8].

It studied ultrasonic dyeing of silk with *Nerium oleander* flower. Mordanting with metal salts such as FeSO4, SnCl2, CuSO4, SnCl4, K2Cr2O7and alum was carried out at 60ºC for 30 minute. Silk was dyed with dye extract, keeping M:L ratio as 1:40 and pH was maintained at 4 by adding buffer solution [9]. It was concluded that aqueous extract of nerium flowers yield cream to green to purple shades on silk fabrics with good fastness properties the colour strength (K/S value) were good particularly for silk mordanted by ferrous sulphate. The dye showed good scope in commercial dyeing of silk fabric for garment industry. Waste leaves of *Tectona grandis* as a suitable natural dye for textile has been studied by [10]. Process development for the extraction of natural dye from the waste leaves of teak plant (*Tectona grandis*) and their application on silk yarns has been carried out successfully using following condition. Silk yarn (0.5 g) was treated in 20 ml of prepared mordant solution. at 1:30 MLR (material to liquor ratio) at 60-70 °C for 30-45 min. Then the mordanted yarn was air dried for 15 minutes.

**C. Natural dyes for polyamide fibre**

It have studied dyeing of nylon with natural colourants, the research mainly focuses on application of natural dyes such as turmeric, madder, catechu, Indian rhubarb, heena, tea and pomegranate rind on nylon. Three different methods of application namely pre-mordanting, meta mordanting and post- mordanting were used in which case contribution of copper sulphate, ferrous sulphate, Potassium dichromate and Tannic acids was studied in terms of enhancement in depth of dying. These dyes have affinity for nylon and bright deep shades of yellow, grey, and black were obtained Moreover, toxicity of ferrous sulphate as compared to copper sulphate and potassium dichromate is very less and tannic acid is also biodegradable in nature. Therefore in other words the process of dying of synthetic fibers with selected natural dyes has potential of becoming environmentally safe process [11].

**D. Natural dyes for printing**

Explained the suitability of turmeric in the fine powder form as natural dye in printing cotton, polyester and their blended fabrics using pigment-printing technique. Variable studied included concentration of the colour, nature of thickening agent, type of fixation and pH of the printing paste. The printed goods were evaluated by measuring the K/S and the overall fastness properties. The data obtained indicated that regardless of the nature of the fabrics used, type of fixation or of the time elapsed before commencing printing, the K/S increased by increasing the concentration of turmeric and/or decreasing the pH to 6.3. Thermo fixation is more suitable than steaming. It can be concluded that turmeric can be used as natural dye for printing successfully. Tab;1shows a dyeing parameters [12].

**Table: 1 Parameters for Dye Printing**

|  |  |
| --- | --- |
| Dye Marterials | 5g |
| Water | 100 ml |
| Temperature | 60oc ( as per the experiment conducted) |
| Time | 60 min (as per the experiment conducted) |
| Mordants | FeSo4, Tannic acid & alum, Post mordanting 45 min. at 90oc. |
| Dye extraction time | 45 min |
| Dye materials concentration | 20ml/150ml of H2o |
| Mordanting time | 60 min |
| Mordanting temperature | 60 oc |
| Dyeing time | 60 min |
| Dyeing temperature | 60 - 75 oc |

**E. Natural Dyes Obtained From Plants:**

Many natural dyestuff and stains were obtained mainly from plants and dominated as sources of natural dyes, producing different colours like red, yellow, blue, black, brown and a combination of these. Almost all parts of the plants like roots, bark, leaf, fruit, wood, seed, flower, etc.., produce dyes. It is interesting to note that over 2000 pigmentsare synthesized by various parts of plants of which only about 150 have been commercially exploited. Nearly 450 taxa are known to yield dyes in India alone by [13] of which 50 are considered to be the most important; roots, barks, leaves, flowers, fruits, seeds, wood [14].

The increasing market demand for dyes and the dwindling number of dye- yielding plants forced the emergence of synthetic dyes like aniline and coal- tar, which threatened total replacement of natural dyes. Even today, some dyes continue to be derived from natural sources. The content or amount of dye present in the plants varies greatly depending on the season as well as age of the plants. The wealth of India 2003. There are also several factors which influence the content of the dye in each dye –yielding plant. In some cases, the dye content has not been thoroughly studied so far.

**III Medicinal Properties of Natural Dyes:**

The antimicrobial activities of the methanol extracts of the leaf, stems, flower, seed and roots of *Clitoria ternatea* were tested in vitro against 12 bacterial species, 2 yeast species, and 3 filamentous fungi by the agar diffusion and broth dilution methods. The leaf and root extracts were found to be most effective against all of the tested organisms

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**A. Antiparasitic and insecticidal effects:**

The ethanolic extract of *Clitoria ternatea* (100mg/ml) bring paralysis within 15-20 min and bring death within 28-30 min to the Indian earthworm *Pheritima posthuma*. However, the anthelmintic activity of ethanolic extracts of flowers, leaves, stems and roots of *Clitoria ternatea* were also evaluated on adult Indian earthworms *Pheretima posthuma.* Results showed that roots of the *Clitoria ternatea* took less time to paralyze and death of the earthworms. Roots were further extracted successively with petroleum ether, chloroform, ethyl acetate and methanol and these extracts were screened for anthelmintic activity. Results showed that methanol extract of *Clitoria ternatea* root is the more potent [16].

**B. Anti inflammatory antipyretic and analgesic effects:**

Ethanol extract of *Clitoria ternatea* root (ECTR) at doses 100, 125 and 150 mg/kg ip were evaluated for antihistaminic activity using clonidine and haloperidol induced catalepsy in mice. Results showed that chlorpheniramine maleate (CPM) and ECTR inhibit clonidine induced catalepsy significantly (P<0.001) when compare to control group, while CPM and ECTR fail to inhibit haloperidol induced catalepsy [17].

**C. Anticancer effect:**

The invitro cytotoxic effect of petroleum ether and Ethanolic flower extracts (10,50,100,200,500 µg/ml) of Clitoria ternatea was studied using trypan blue dye exclusion method. Both extracts exhibited significant dose dependent cell cytotoxic activity. For petroleum ether extract the concentration 10 µg/ml showed 8% reduction in cell count, however, 100% reduction was observed at 500 µg/ml. In case of Ethanolic extract, 10 µg/ml concentration possessed 1.33% reduction in cell count,While, at 500 µg/ml 80% reduction in cell count was observed by [18].

Antioxidant activity assay the DPPH scavenging activity of leaf and seed extracts was determined using the method. Antioxidant activity of *Basella alba* was evolved using DPPH free radical scavenging assay. DPPH free radical scavenging activity of leaf and seed of *B.alba* along with standard BHT.

As control antibiotics commonly used for the test organisms, there susceptibility was determined along with the extract of *Bougainvillea glabra*. Antibiotic sensitivity of test strains was determined by the standard disc diffusion method of [19].

**D. Trypsin inhibitory activity:**

Soxhlet ethanol extract of *Lawsonia innermis* (yield 18.5 dried weight). Preliminary phytochemical screening of the extract gave positive tests for Lawsone (naphtoquinone), sugars and tannins. Lawsonia innermis alcoholic extracts and lawsone have shown a significant Trypsin inhibitory effect [20].

**E. Wound healing activity:**

The ethanol extract of *Lawsonia innermis* (200 mg/kg/day) was used to evaluate the wound healing activity on rats using excisions, incision and dead space wound models. The animals were divided in to three groups of six each in the excision model and two groups of six each in the incision models and dead space models. The topical application was made in the case of excision want model, whereas, oral treatment was done with incision and dead space want models. The extracts treated animals showed 71% reduction in the wound area when compared with controls which was 58%. Enhanced wound contraction, increased skin breaking strength, hydroxyproline and histological findings suggest the use of Lawsonia innermis in the management of wound healing [21].

**F. Anticorrosion activity:**

The inhibitive action of Henna extracts (*Lawsonia innermis*) and its main constituents (Lawsone, Gallic acid, α – D- glucose and tannic acid on corrosion of mild steel in 1M HCL solution was investigated through electrochemical techniques and surfaces analysis ( SEM / EDS). Polarization measurements indicate that all the examined compounds act as a mixed inhibitor and inhibition efficiency increases with inhibitor concentration. Maximum inhabitation efficiency (92.06 %) is obtained at 1.2 g/1 henna extract. Inhabitation efficiency increases in the order. Lawsone > α – D- glucose > tannic acid. Also, inhabitation mechanism and thermodynamic parameters are discussed [22].

**G. Antiparasitic activity:**

During an ethno pharmacological survey of antiparasitic medicinal plants used in ivory coast, 17 plants were identified and collected. Polar, non- polar and alkaloidal extract of various parts of these species were evaluated in vitro in an antiparasitic drug screening. Antimalarial, leishmanicidal, trypanocidal, antihelminthiasis and antiscapies activities were determinate. Among the selected plants, *L.innermis* L. showed interesting trypanocidal activities [23].

**H. Tuberculostatic activity:**

Thetuberculostatic activity of henna was test in – vitro and in –vivo. On Lowenstein Jensen medium, the growth of tubercle bacilli from sputum and of mycobacterium tuberculosis H37Rv was inhibited by 6 µg/ml of the herb. In vivo studies on guinea pigs and mice showed that the herb at a dose of 5 mg/kg body weight led to a significant resolution of experimental tuberculosis following infection with *Mycobacterium tuberculosis* H37RV [24].

**I. Antibacterial assay:**

Antibacterial activity was carried out *Acalypha indica* using disc – diffusion method [25]. Petri plates were prepared with 20 ml of sterile Muller Hinton agar (MHA) (HIMEDIA, Mumbai, India). The test cultured were swabbed on the top of the solidified media and allowed to dry for 10 min. The test were conducted at three different concentration of the crude extracts (5, 2.5 and 1.25 mg per disc) with three replication. The loaded discs were placed on the surface of the medium and left for 30 min at the room temperature for compound diffusion. Negative control was prepared using respective solvent. Streptomycin (10 µg/disc ) was used as positive control. The plates were incubated for 24h at 37oc. zone of inhibition was recorded in millimeters and the experiment was repeated three replicates. The leaf extracts of *Tectona grandis* found to contain two quinones: naphthotectone and anthratectone that were mainly responsible for the antibacterial activity and good antiradical properties [26], [27].

**J. Antioxidant activity:**

The antioxidant activity of the *Syzygium cumini* extracts was evaluated by using the 2.2’ diphenylpicrylhydrazyl (DPPH) assay [28], [29].

The total antioxidant activity of *E. prostrata* was evaluated by following the method of [30]. Plant extract of different concentrations ranging from 25-100 µg/ml in ethanol was used for the estimation. [31], [32].

**Antibacterial activity:**

The antibacterial activity of different solvent extracted samples of turmeric was carried by disc diffusion assay and antifungal activity by [33].

**Characterization of dyes:**

A dye can be defined as a highly coloured substance used to impart colour to an infinite variety of materials like textiles, paper, wood, varnishes, leather, ink, fur, food – stuff, cosmetics, medicine, toothpaste etc.., As far as the chemistry of dyes is concerned, a dye molecule has two principal chemical groups, viz. chromophores and auxochromes. The chromophore, usually an aromatic ring, is associated with the colouring property. It has unsaturated bonds such as –C=C, =C=O, -C-S, =C-NH, -CH=N-, -N=N- and –N=O, whose number decides the intensity of the colour. The auxochrome helps the dye molecule to combine with the substrate, thus imparting colour to the latter [34].

**Studies of ecofriendly finishes on dyed fabric:**

Textile fiber or fabrics are deficient in one or more properties or improved properties are desired for the fiber or fabric. Textile finishing provides a method whereby deficiencies in the textile can be corrected or specific properties can be introduced. A finish is a treatment given to a fabric, to change its appearance, handling /touch or performance. Its purpose is to make the fabric more suitable for its end use [35] . To improve those performance properties, cotton fabric often are given a chemical treatment called durable press finishing. This treatment involves the use of crosslinking agents. Most important ecofriendly crosslinking agents are butanetetracarboxylic acid (BTCA) and citric acid (CA). Many research studies on durable press finishing with ecofriendly crosslinking agents have been carried out. Few studies are given below. It used polycarboxylic acids 1,2,3,4- butanetetracarboxylic acid and citric acid as non-formaldehyde durable press finishing agents instead of formaldehyde-releasing *N*-methylol compounds [36].

In this study, isocratic HPLC is applied in an attempt to quantify the polycarboxylic acids that react with cellulosic material dyed with CI Reactive Red 195, CI Reactive Yellow 145 and CI Reactive Blue 221. Subsequently, the fabrics were cured with formulations containing butanetetracarboxylic acid and citric acid or a combination of both. The pre-weighed, dyed fabric was impregnated in a treatment bath containing a cross linking agent and a catalyst. No softener was used. The catalyst was added to the formulation immediately before application. Subsequently, the sample (30 × 50 cm) was passed through a two-roll laboratory padder (air pressure 1 bar, fabric speed 3 m/min). This treatment gave a wet pick-up of about 100–109%, depending on the original weight of the fabric treated. After drying (2 min, 100 °C) the fabric was cured for a specified time at 180 °C in a laboratory dryer, washed with occasional stirring (sodium carbonate 1 g/l, 10 min, 50 °C, wash liquor 1 l) and finally dried again (3 min, 80 °C). The chromatographic determination reveals that an increase in the depth of shade results in a decrease of the amount of butanetetracarboxylic acid, except in the case when cotton is dyed with CI Reactive Blue 221, a copper formazan complex-based dyestuff. Colour measurements indicate that the Δ*E*\* values decrease in the order CI Reactive Yellow 145, CI Reactive Red 195 and CI Reactive Blue 221. The dyestuffs react with the hydroxyl groups of the cellulose and consequently fewer hydroxyl groups are available for the esterification reaction with polycarboxylic acids. This phenomenon is confirmed by the fact that the application of higher depths of shade results in a decrease in the amount of cotton-bound PCA, except with CI Reactive Blue 221. Concurrent dyeing and finishing of cotton with natural colour and citric acid in the presence of NaH2PO4 as catalyst under thermal treatment . Cotton fabric was simultaneously modified and dyed with citric acid and *Camellia sinensis*, and citric acid and *Punica granatum* in the presence of sodium di-hydrogen phosphate (NaH2PO4) as the catalyst using a pad–dry–cure technique. Treatment with 10% citric acid, 15% NaH2PO4 and dye at 100% wet pickup, followed by drying at 95°C for 5 min and curing of the dried fabric at 140°C for 5 min produced most balanced improvements in respect of the depth of shade, wrinkle recovery and colour fastness to light, wash and rubbing with retention of more than 70% of the original strength. Infrared analysis of the dyed cotton fabric indicated that the treatment of cotton with citric acid and either *Camellia sinensis* or *Punica granatum* under the influence of an esterification catalyst led to the esterification of carboxyl groups of citric acid and of hydroxyl groups of cotton cellulose and with that of both the dyes. The said process also led to some degree of cross-linking of polymeric chains of cotton. Effect of different cross-linking agents on cotton fabric dyed with caspian natural dyes was studied by [37].

Mill bleached mercerized cotton fabric was used. The fabric was pretreated with potash alum, stannous chloride or tartaric acid at 80ºC for 30 minutes at M:L 1:20. Undyed and dyed fabrics were padded with conventionally used dimethyl dihydroxyethylene urea. Color depth and color difference of dyed and crosslinked fabric was measured on a Macbeth Colour Eye 7000A. The results observed that the color difference of differently cross-linked fabric was comparable of slightly higher than that for conventionally used DMDHEU cross-linked fabric. Trisuccinimidyl citrate (TSC) fabrics showed drastic change in shade, while very low formaldehyde (VLF) cross-linked fabric showed less comparable color difference to that of DMDHEU depending on type of mordant used during dyeing. Wrinkle recovery angle was found to be between 233-258. While tear and tensile strength retention was between 51- 100 depending on type of mordant used during dyeing and type of crosslinking agent applied. Generally, from the results obtained it was found that in case of most of the natural dyes and different mordants when dyed on cotton fabric and cross-linked with organic acid in presence of trisodium citrate, color difference was higher than that for conventionally used cross-linked fabric. Influence of microwaves on non-formaldehyde DP finished dyed cotton fabrics has been reported by [38].

An alternative approach to the application of formaldehyde releasing conventional Nmethylol compounds is based upon the use of non-formaldehyde Durable Press (DP) finishing agents – polycarboxlic acids (PCA). The application of microwave energy to impart durable crease resistance to dyed cotton fabric. Bifunctional dyes: C.I. Reactive Red 195, C.I. Reactive Yellow 145 and C.I. Reactive Blue 221 were applied in the study. Isocratic HPLC method was applied to quantify the PCA reacted with the cellulosic material under two different curing procedures.Microwave way of curing imparts higher levels of wrinkle resistance of dyed as well as of undyed cotton materials treated with PCA. General trend noticed when microwave curing is used a lower amount of PCA bound. This opposite trend between elastic recovery and quantity of PCA bound can be attributed to a greater number of least di-ester linkages which can improve DP properties and cannot be distinguished from mono-ester linkages with the HPLC technique. The chromatographic determination reveals the decrease in PCA, in almost all the cases studied, caused by the increase in shade depth with both ways of curing. These results confirmed the reduced cellulose affinity for further crosslinking with PCA molecules, because of the partial blockage of cellulose reactive groups with the dye molecules. Regarding the evaluation of the color differences, they are more prominent when microwave treatment is included in the experiment. Shade changes are primarly caused by the catalyst applied, which is a strong reducing agent. Azo chromogen is decomposed by the action of the reducing agent which causes most prominent shade changes, particularly with yellow hue. Primarily in the wrinkle recovery and resistance to deformation microwave way of curing offers must better results.

**Dye Yielding Plants:**

The study report 30 dye yielding plant species belong to 20 families. Along with their botanical name,common name, family, general description, season of flowering & fruiting, traditional uses, plant parts used, colour and application of dye used shown in Table : 2.

**Table: 2 Shows a Different Dye- Yielding Plants:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Botanical Name** | **Common Name** | **Family & Parts Used** | **General**  **Description** | **Season of Flowering& Fruiting** | **Dye Colour & Traditional Uses** |
| 1. | *Aesculus hippocastanum L* | Horse-chesnut | Sapindaceae Wood | It is a Herbaceous Annual, It grows up to 60cm tall | Throughtout the year | Yellow dye for leather, used in the treatment of haemorrhoids, varicose veins, diarrhoea, and enlarged prostate &  anti-pyretic,anti  inflammatory&cancer. |
| 2. | *Adhatoda vasica Nees* | Malabar Nut | Acanthaceae  Leaves | Perennial,Evergreen Shrub,1-3 feet (hgt) | Throughtout the year | Dyeing woolen cloth & Bronchitis, leprosy, blood disorder |
| 3. | *Aegle marmelos* | Beli Fruit | Rutaceae  Fruit | Medium sized Deciduous tree,12m(hgt) | May- June | Yellow to dye cotton &  To treat deafness, piles, laxative, good for heart & brain |
| 4. | *Aloe barbadensis* | Aloea | Asphodelaceae  Whole Plant | Perennial Succulent 30-61 cm (hgt) Plant, | July- Sep | Red dye & Antioxidant, antibacterial, antibiotic, antiseptic |
| 5. | *Barleria cristata* | December Flower | Acanthaceae  Flower | It grows as a Shrub, 60-100cm (hgt) | December | Dye used to apply in cosmetics product & Diuretic, blood purifier |
| 6. | *Basella alba* | Inkberry | Basellaceae  Fruit | 10m (hgt), Perennial ,  Climbing herb | Flower – May- Sep,  Fruits ripen- July- Oct | Maroon tore dye silk and cotton & Good herbal remedy for rheumatic pain |
| 7. | *Bougainvillea glabra* | Paper Flower | Nyctaginaceae  Flower | Perinnial, Climbing Shrub, 30 feet(hgt) | Throughtout the year | It is used to commercial dye products & It used to cure diarrhea, Cough,flower is used |
| 8. | *Caesalpinia pulcherima* | Caesalpinia | Fabaceae  Flower | Tree,5m tall | Throughtout the year | Dye colour also used in cooking oil & Ulcers, inflammation, fevers, tumors,antimicrobial agent |
| 9. | *Carica papaya* | Papaya | Caricaceae  Leaves, Fruit | Tree like Herb,2-10m tall | Throughtout the year | Dyeing with *Carica* leaf dry powder extract can be a good alternative for medical textiles & Blood pressure, dyspepsia |
| 10. | *Catharanthus roseus* | Graveyard | Apocynaceae  Flower | Perennial, Sub Shrub | Jul- Sep | Colour is used as medical aspect & Relieving muscle pain, Diuretic |
| 11. | *Chrysanthemum indicum* | Chrysanthemum | Asteraceae  Flower | Perennial Herb, It grows up to 0.6m | Flower – Aug- Sep | It produces a congo red dye and it also act as a insecticide & Inflammation of throat, itchiness of the skin and hypertension |
| 12. | *Chrysopogon zizanioides* | Bunch Grass | Poaceae  Fruit | 2- 5m(hgt), It is a Perennial bunch Grass | Rainy Season | It is a source of essential oil & Blood purifier, skin disorder |
| 13. | *Clitoria ternatea* | Butterfly Pea | Fabaceae  Flower | Perennial twining herb,3cm | July-Dec | Traditionlly it is used as a Food Colourants & Antistrees,Anxiolytic, antidepressant, anticonvulsant |
| 14. | *Cordia sebestena* | Scarlet Cordia | Boraginaceae  Leaves | It is a Small to Moderate Sized  deciduous tree,Stem Bark is grayish brown | Throughtout the year | Dyeing of Cotton & Gastrointestinal disorders, antibacterial, |
| 15. | *Curcuma longa* | Turmeric | Zingiberaceae  Rhizomes  (underground  stem) | Perennial Herb,  1m(hgt) | Flowering July- Nov | Rhizomes are used as yellow to cotton and silk condiment;also used as stomavhic, tonic, blood purifier,antiseptic |
| 16. | *Eclipta prostrate* | False Daisy | Asteraceae  Whole Plant | Annual Herb, 75cm (hgt) | Flower- August | To dye hair and treat skin, fever, wounds, etc. & Leaf extract is used powerful liver tonic and especially good for the hair and skin |
| 17. | *Eucalyptus globules* | Eucalyptus | Myrtaceae  Young leaves | Tall Evergreen Tree,150- 180 feet(hgt) | Jan- Aug | Dye is treat with medicals & It used to cure cough, astringent. |
| 18. | *Hemidesmus indicus* | Nannari | Apocynaceae  Whole Plant | Prostrate (or)  Semi- erect Shrub, Roots are woody & Aromatic | Rainy Season | Dye is used in food colouring agent & Astringent, diuretic, anti-pyretic, skin diseases,  asthma,urinary  diseases |
| 19. | *Hibiscus*  *rosa-sinensis* | Hibiscus | Malvaceae  Flower | Perinnial Shrub,2.5m (feet),Annual | Throughtout the year | Yield a dye formerly employed for blackening shoes, hair and eyebrows. & To treat of excessive and painful menstruation, cystitis, coughs |
| 20. | *Indigofera tinctoria* L. | True indigo | Fabaceae  Leaves |  |  | Yield blue colour to dye silk and cotton |
| 21. | *Jatropha curcas* | Angular Leaved | Euphorbiaceae  Seed | Large Shrub or Small tree,Perennial 5m tall | Rainy Season | A dark blue dye used for dyeing cloth, fishing-nets and lines & It is used to treat eczema, scabies, ringworm, gonorrhea, dysentery, diarrhea |
| 22. | *Lawsonia innermis* | Henna | Lythraceae  Leaves | Branched Shrub,  7m(hgt),  Annual plant | Flowering April  Fruiting- December | Used for colouring palms of hands, soles and hair, also used for colouring leather, silk, cotton and wool & Leaf is used for jaundice,astringent,diuretic, wounds,ulcers,leprosy & anemia |
| 23. | *Mentha aquatic* L | Water Mint | Lamiaceae  Leaves | Perennial Herb, 20-80cm | Winter Season | Medicinal but yield green dye & It is used to rheumatic pains, arthritis and remedy for inflamed joints |
| 24. | *Mirabilis jalapa* | Mirabilis | Nyctaginaceae  Flower | Herb, 2m(hgt), Perennial | Summer | Red to dye cotton & Diuretic, purgative, wound healing, reduce inflammation |
| 25. | *Nerium oleander* | Nerium | Apocynaceae  Flower | Small tree(or) Shrub,  2-6m(hgt), Perennial | Flower- June-Sep | Dyeing colour in cosmetics & It is used to cure asthma, epilepsy, cancer, painful menstrual periods, leprosy |
| 26. | *Nyctanthes arbor-tristis* | Night-Flowering Jasmine | Oleaceae  Flower | Small sized tree,10m(hgt) | Sep-Dec | Dyeing orange on silk and cotton & Fever, enlargement of the spleen, malaria, blood dysentery, cough and gastritis |
| 27. | *Punica granatum* | Pomegranate | Lythraceae  Friut | Annual Shrub, 3-4.5m in (hgt) | Throughtout the year | Used to treat cloth and crafts & To treat sore throats, cough, urinary infections, skin disorder, arthritis |
| 28. | *Rosa hybrid* | Rose | Rosaceae  Flower | Shrub,  Perennial Flowering Plant, 118.50 cm(hgt) | Flower – Summer | Used in Cosmetics and food colouring agent & It is used to cure stomach problems and are being investigated for controlling cancer growth |
| 29. | *Syzygium cumini* | Black Plum | Myrtaceae  Fruit | Large Evergreen Tree, 30m in (hgt) | Flower- Mar- April; Fruit ripens in Jun- Aug | Black on cotton and silk & Relieve stomach pain, carminative, anti-scorbutic and diuretic |
| 30. | *Tectona grandis* | Teak Wood | Lamiaceae  Leaves | Large Deciduous Tree | July-Jan | The flame scarlet colour on silk, cotton, crafts etc., & Leaves are used in skin diseases,bronchitis, paste applied to cure ringworm |

**Conclusion:**

Even though the Indian subcontinent has abundant plant resources, very little of it has been used up to this point. To evaluate the true potential and availability of naturally occurring dye-producing resources and to propagate spices that are in high demand on a commercial scale, more thorough research is required. Unfortunately, no real attempts have been made to record and conserve this enormous treasure of traditional knowledge of natural dye - manufacturing related with the indigenous people, claims this study endeavour. The depletion of these priceless resources could also result from a lack of a targeted conservation strategy.

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