Phytochemical active compound its biological sources and uses of herbal plants containing dye containing properties - review

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Abstract: Every plant can be used to make dye. Natural dyes being natural tend to be softer and their range of tones is very pleasant. The term "dyes" refers to compounds that can be used to add color to many things, including paper, textiles, and food. In general, a dye is a coloured substance that has an affinity for the substrate to which it is applied. A notable trend in recent years has been the adoption of eco-friendly and sustainable products in a variety of industries, such as food, textiles, cosmetics, and pharmaceuticals. Growing public awareness of environmental issues and a growing desire for natural and organic products are the driving forces behind this movement. The most often employed herbal elements for dye extraction include stems, barks, roots, berries, leaves, flowers, and seeds. Depending on which portion of the plant is used, some components may have many colors. These colors are due to the presence of different types of chemical compounds present in herbal plants like tannins, flavonoids, alkaloids, anthraquinone, glycosides, iso coumarins, catechin, rutin, saponin, carotene, etc. There are various benefits of natural dyes in human life and it is also eco-friendly.

Keywords :- Dye yielding plants , Natural plants , Eco friendly .

Introduction

All dyes and pigments obtained from natural resources, such as plants, are referred to as natural dyes [Prabhu, K. H., and Aniket S. Bhute (2012)][1]. Three fundamental questions must be answered in order to comprehend the ideas of natural dyes and plants that produce dyes: Why can only some plants produce dyes? In what ways does the production of dyes assist the plant? What evolutionary theory explains dye production? Two more

questions: “Why are plants so many colours?” and “What purpose might they serve for the plant?” Supporting the answers to the first two questions is possible. The most common plant colour is undoubtedly green, which appears on most leaves. The green pigment chlorophyll in leaves aids in absorbing solar energy and transforming it into chemical energy, which the plant can store and use as food [Siva, Ramamoorthy, (2007)][2]

The term "dyes" refers to compounds that can be used to add colour to many things, including paper, textiles, and food. In general, a dye is a colored substance that has an affinity for the substrate to which it is applied. [Rajesh, Yadav, et al. (2014)][3]

A notable trend in recent years has been the adoption of eco-friendly and sustainable products in a variety of industries, such as food, textiles, cosmetics, and pharmaceuticals. Growing public awareness of environmental issues and a growing desire for natural and organic products are the driving forces behind this movement. The use of natural colorants as substitutes for synthetic dyes is a crucial aspect of this change.

Natural colorants, which come from fruits, vegetables, minerals, and microbes, have a number of advantages over synthetic ones, including non-toxicity, biodegradability, and extra health advantages. In general, natural colorants are safer for the environment and people.

Beyond their ability to color, they have inherent qualities like antibacterial, anti-inflammatory, and antioxidant characteristics. In order to increase attractiveness and draw in customers, color is essential in the marketing of a variety of goods, including medications, food additives, and cosmetics. [Raslamol, K., et al.][4]

Because the textile industry uses a lot of chemicals for dyeing and printing, environmental protection has become a problem for it these days. These substances are bad for the environment and for people. Synthetic dyes have a number of disadvantages. A number of synthetic colors that are even mutagenic and carcinogenic have been outlawed. Natural dyes have gained popularity in this age of environmentally conscious consumers, mostly due to their shown eco-friendly and health-promoting qualities. [Singh, Renu, (2017)][5]

Plant pigments

The vibrant colors present in many plant sections, including leaves, flowers, fruits, and stems, are caused by natural substances called plant pigments. These pigments, which include lycopene, anthocyanins, carotenoids, betalains, flavones, and chlorophylls, are essential for photosynthesis, UV protection, and pollinator attraction. Plant pigments have uses outside of biology and are used in many sectors.

They are valued for their anti-inflammatory, antioxidant, and other health-promoting qualities in the pharmaceutical and cosmetics sectors, and they are utilized as natural colorants in the food industry. Plant pigments are a desirable substitute for synthetic colors due to their natural origin and numerous uses. [Singh, Renu, (2017)][5]

Dye preparation

The most often employed herbal elements for dye extraction include stems, barks, roots, berries, leaves, flowers, and seeds. Depending on which portion of the plant is used, some components may have many colors. [Gokhale, S. B., et al. (2004)][6]

The crushed powder is usually boiled with water to make the color, but occasionally it is steeped in cold water. Coarse cotton fabrics are typically dyed using the resulting solution. The material is steeped in a hot or cold flower decoction for coloring purposes. Either alum and wood ash are added to the dye bath or the cloth is previously prepared with them to provide a more lasting color. [Siva, Ramamoorthy (2007)][2]

NATURAL DYES' BENEFITS [Singh, Renu, (2017)][5]

1. Skin-friendly
2. Non-toxic
3. Properties of antioxidants
4. Inhibition of Inflammation
5. rich in nutrients
6. Eco-Friendly
7. an adaptable color scheme.
8. Harmony with Various Formulations

THE DRAWBACKS OF NATURAL DYES

1. Restricted Color Selection
2. Variability of Color
3. Problems with stability
4. pH Sensitivity
5. Disguising aroma and flavor
6. Limited Solubility
7. Processing Sensitivity
8. Purchasing and Availability

APPLICATIONS

1. Cosmetics
2. Pharmaceuticals
3. Histological Staining
4. pH Indicator
5. Dye-sensitized solar cells
6. Beverages and food
7. Leather Industry

Table: List of dye yielding/containg plants [7-128]

S. No.	Plant Name	Biological Source	Family	Images	Used part	Coloring constituents	Color	Uses	Reference
1.	**Akalbir, Hemp**	*Datisca cannabina*	*Datiscaceae*		Root	Datisdirin, Tectochrysine, Cearoin, Sideroxyline	Yellow	Textile dye (wool, silk)	Gedik, Görkem, and Ozan Avinc [2022]

2.	**Alder**	*Alnus glutinosa*	*Betulaceae*		Bark	Tannins & anthraquinones	Black	Textile dye	Tsouka, Niki, et al. [2015]
3.	**Alnus**	*Alnus sieboldiana*	*Betulaceae*		Fruit	Ellagitannins alnusiin, Tellimagrandin i, Pedunculagin	Red	Textile dye	Ha,Young kab, & Jeong Sook Lee [2017]
4.	**Aloe**	*Aloe barbadensis*	*Liliaceae*		Leaves	Anthraquinone (aloenin, aloeresin E)	Yellow	Textile dye	Srivastava, A.V.E.R.N.I.T. A.&T.G. Singh [2011]
5.	**Amaranth**	*Amaranthus viridis*	*Amaranthaceae*		Leaves, feathery tops	Beta –xanthins, Betalains, Beta-carotene	Red & Green	Food & fabric dye	Uddin, Jasmin, et al. [2015]
6.	**Amla**	*Phyllanthus emblica*	*Euphorbiaceae*		Bark	Tannin, Coumarins, Terpenes	Brown, Red	Textile dye	Gupta, Pratik, Yogesh Tiwari, and Sayantan Mukopadayay

7.	**Annatto**	*Bixa orellana*	*Bixaceae*		Pulp (aril) Surrounding the seeds	Bixin, orellin, methyl Bixin, beta-carotene	Orange yellow dye	Coloring silk, Food & Cotton	Scotter, Michael [2009]
8.	**Aringudi**	*Ardisia humilis*	*Myrsinaceae*		Fruit	Isocoumarins, Quinines, Saponins	Yellowish	Textile dye	Prabhu, K.H. & Aniket S. Bhute [2012]
9.	**Arjuna**	*Terminalia arjuna*	*combretaceae*		Bark	Arjunic acid, Tannins, Flavonoids	Light brown	Textile dye	Amutha, K.S.G.A. & N. Sudhapriya [2020]
10.	**Bael, Brel tree**	*Aegle marmelos*	*Rutaceae*		Fruit, leaves	Coumarin, Xanthotoxol, Aegeline, Marmeline	Yellow	Food colorant	Alhorani, Samah, et al [2021]
11.	**Bakul, Spanish Cherry**	*Mimuopselengi*	*Sapotaceae*		Bark	Tannins, Caoutchouc, Alkaloids	Brown	Textile dye	Hossain, Shahin, et al. [2021]

12.	**Balonda**	*Caesulia , auriculata*	*Asteraceae*		Plant	Flavones, Flavonoids, Alatinon	Yellow	Textile dye	Prabhu, K.H. & Aniket S. Bhute [2012]
13.	**Baptisia**	*Baptisia australis*	*Fabaceae*		Flower	Alkaloids, Triterpenoid saponins	Yellowish	Textile dye	Moore, Cheyenne L., et al [2018]
14.	**Ber**	*Ziziphus manzitiana lam*	*Rhamnacae*		Bark, Fruit	Tannins, Flavonoids, Terpenoids	Pink, red	Fabric dye, silk, wool	Chungkrang, Liza Moni, et al. [2018]
15.	**Birds foot trefoil**	*Lotus corniculatus*	*Fabaceae*		Flower/Leaf	P-coumaric acid, Naringenin	Orange, Yellow	Textile dye	Prabhu, K.H. & Aniket S. Bhute [2012]
16.	**Blackberry**	*Rubus fructicosus*	*Rosaceae*		Berries	Carotene, Tannins, Glycosides	Red-purple	Food & Textile dye	Porrykov, D.O., A. M. Berdiyeva, et al. [2022]

17.	**Bougainvillea**	*Bougainvillea glabra choisy*	*Nyctaginaceae*		Flower with ivory white bracts	Querceti – xyloside Betacyanin	Yellow, Pink, Brown	Food, Medicinal	Rasool, Warda, et al. [2023]
18.	**Branzilian Ginseng**	*Pfaffia iresinoides*	*Amaranthaceae*		Roots	Iresinoside, Ecdysterone,	Yellow	Textile dye	Junior, C. C., & L.C. Ming [2004]
19.	**Chebulic Myrobalan (Harda)**	*Terminalia chebula*	*Combretaceae*		Bark, ripe & unripe fruit	Chebulinic acid	Pink, Yellow, Brown	Textile dye	Onial, Praveen, et al. [2015]
20.	**Chicrkasi**	*Chikorisatubularis*	*Maliaceae*		Flower	Flavones,	Red yellow	Textile dye	Prabhu, K.H. & Aniket S. Bhute [2012]
21.	**Comosa**	*Scutellaria comosa*	*Labiatae*		Roots	Flavonoids - aicalein, baicalin, wogonoside, norwogonin, chrysin 7-glucuronide	Yellow	Textile dye	Yusupova, B., et al. [1995]

22.	**Coreopsis**	*Coreopsis tinctoria*	*Asteraceae*		Flower	Flavonoids, Polyacetylene glycosides	Yellowish	Textile dye	Wu, Junling, Longfei Sun, et al. [2023]
23.	**Cotton**	*Gossypium herbaceum*	*Malvaceae*		Flower	Tannins, Flavonoids, Alkaloids	Yellow	Textile dye	Perkin, Arthur George. [1899]
24.	**Cutch**	*Acacia Catechu*	*Mimosaceae*		Heart wood	Catechin, Catechutannic, Rutin, Coumaric acid	Red	Textile dye, calico printing	Waly, A. I., et al. [2017]
25.	**Dahlia**	*Dahlia indica*	*Asteraceae*		Petals	Flavonoids, Phenolic acids	Peech gold	Textile dye	Mishra, Pradeep K., et al [2012]

26.	**Daisies**	*Bellis perennis*	*Asteraceae*		Petals & Leaves	Anthocyanins	White, Pink, Yellow	Textile dye	Gogoi, Minti, et al [2019]
27.	**Daru haldi**	*Berberis aristava*	*Barbidaceae*		Rhizomes	Berberin, Berbamine, Oxyberberine	Yellow	Fabric dye	Kumar, Praveen, [2011]
28.	**Dolu(Himalayan rhubarb)**	*Rheum Emodi*	*Polygonaceae*		Rhizome	Anthraquinone derivatives, Emodin	Reddish yellow	Textile dye	Srivastava, M., D. Mogra, and P. Gupta [2015]
29.	**Dyer's alkanet**	*Alkanna tinctoria*	*Boraginaceae*		Root	Flavonoids, Alkaloids, Tannins	Purple	Pharmaceutical colorant	Adeel, Shahid, et al. [2023]

30.	**Dyer's chamomile**	*Anthemis tinctoria*	*Asteraceae*		Flower	Flavonoids, Phenolic compound	Yellowish	Hair dye, textile	Menegazzo, Maira Amanda Benedet, et al. [2020]
31.	**Dyer's Green Weed**	*Genista tinctoria*	*Fabaceae*		Flower	Quinolizidinealkaloids- anagyrin, cytisine	Yellow	Textile dye	Troalen, Lore G., et al. [2014]
32.	**European lily**	*Convallaria majalis*	*Aspragaeceae*		Leaves, rhizomes	Flavanoids	Green	Many disease	Demir, Nazan, et al. [2022]
33.	**European madder**	*Rubia tinctorium*	*Rubiacae*		Root	Anthraquinones-1,3-dihydroanthaquinones	Red	Textile dye	Ozdemir, Muge Burcu, & Recep Karadag [2023]

34.	**False pepper**	*Embelliaribes*	*Myrstaceae*		Fruits	Embelin	Red	Textile dye	Kale, Sunita & Manisha Karhale [2019]
35.	**Fireflame blush**	*Woodfordia fruticosa*	*Lytharceae*		Leaves, twigs	Lawsone, hydroxylnephthoquinone	Pink, red	Fire printing	Grover, Neha, and Vidya Patni [2011]
36.	**Galangal**	*Alpinia galanga*	*Zingiberaceae*		Root, Stalk	Galangin, Dioxyflavonol	Yellow – brown	In calico printing	Koçak, Ömer Faruk, and Fazlıhan Yılmaz [2022]
37.	**Gallnut, Majuphal**	*Quercus Infectoria*	*Fagaceae*		Oak gal	Tannins, Flavonoids, Phenolic compound	Khaki, yellowish	Textile dye	Güzel, Emine Torgan, and Recep Karadag [2021]

38.	**Gandhraj , Cape jasmine**	*Gardenia jasminoides*	*Rubiaceae*		Fruit	Linalool, Iridods, Jasminoides	Yellow	Textile dye, Food colorant	Jiang, Huiyu, et al. [2021]
39.	**Gaub tree**	*Diospyros malabarica*	*Ebenaceae*		Unripe fruit	Tannins, Flavonoids, trans-α-methyl isoeugenol	Brown	Textile dye& Tanning	Hossain, Md A., and A. K. Samanta [2018]
40.	**Ghogar**	*Garuga pinnata*	*Burseraceae*		Leaf	Tannins, Flavonoids, Alkaloids	Red	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]
41.	**Ginger**	*Zingiber officinate*	*zingiberaceae*		Rhizome	Carotenoid & flavonoid	Brown	Textile dye	Sudhakaran, Archana, Kaveri et al. [2018]

42.	**Girardinia**	*Girardinia diversifolia*	*Urticaceae*		Fiber	β-sitosterol, 7-hydroxysitosterol and 3-hydroxystigmast-5-en-7-one	Blue	Textile dye	Bhandari, Babita, and Anita Rani [2021]
43.	**Goat willow**	*Salix caprea*	*Salicaceae*		Bark	Flavonoids, Phenolic compounds, Rutin	Pink	Textile dye	Puttoo, B. L. [2010]
44.	**Golden shower tree**	*Cassia fistula*	*Caesalpiniaceae*		Bark, sapwood	Leucoanthocynidins	Red dye	Textile dye	Hanif, Muhammad Asif, et al [2007]
45.	**Goldenrod**	*Solidago Canadensis*	*Asetraceae*		Plant	Flavonoid(hperoside)	Golden yellow	Textile dye	Leitner, Peter, et al [2012]
46.	**Guljali, Larkspur**	*Delphinium zalil*	*Ranunculaceae*		Flower	*Diterpenoid alkaloid*	Yellow	Textile dye & Calicoprinting	Prabhu, K. H., and Aniket S. Bhute [2012]

47.	**Gulmohar**	*Delonix regia*	*Fabeaceae*		Flower	Flavanoids, leucocynin	Deep crimson	Textile dye	Dhanalakshmi, P., and R. I. Sathya
48.	**Gumbnfong**	*Pleosprmum spinosum*	*Moraceae*		Bark, Wood	Flavonoids, Alkaloids, Tannins	Yellow	Textile dye (silk)	Prabhu, K. H., and Aniket S. Bhute [2012]
49.	**Henna**	*Lawsonia inermis*	*lythraceae*		Leaves	Lawsone,2hydrroxy 1,4quinone	Reddish orange	Hair dye, textile dye	Alam, M. M., M. L. Rahman, and M. Z. Haque [2007]
50.	**Hibiscus (gudhal)**	*Hibiscus rosa sinensis*	*Malvaceae*		Flower (calyces)	Anthocynins, Flavonoids, Tannins	Red	Textile dye, Food color	Vankar, Padma S., and Dhara Shukla [2011]
51.	**Hollyhock**	*Alcea rosea*	*Malvaceae*		Flower	Dihydrokaempferol-4'-O-β-D-glucopyranoside	Red	Food colorant	Shehzad, Muhammad Raffi, et al [2020]

52.	**Indian Almond**	*Terminalia Catappa*	*Combretaceae*		Bark	Tannin, Flavonoid	Pinkish red	Textile dye	Kumarmath, Preeti, Anusha Kawatal [2022]
53.	**Indian madder (Manjit)**	*Rubia cordifolia*	*Rubiaceae*		Root	Anthraquinones - 1, 5-dihydroxy-2-methylanthraquinone	Brick red	Textile dye (Blanket, Carpet)	Blackburn, Richard S [2017]
54.	**Indigo**	*Indigofera tinctoria*	*Fabeacae*		Leaves	Indigoids	Blue	Textile dye, food	Chakraborty, J. N., and R. B. Chavan [2004]
55.	**Iron wood tree**	*Memecylon umbllatum*	*Melastomataceae*		Flower, Leaf	Terpenoids, Flavonoids, Tannins	Yellow	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]
56.	**Ivy**	*Hedera nepalensis*	*Araliaceae*		Bark	Triterpenoids, Phenolic compound, Tannins	Yellow	Textile dye	Raslamol, K., Jobi, S., Joy, S., et al.

57.	**Jamun**	*Szygiumcumini*	*Myrtaceae*		Fruits	Anthocynin, flavanoids	Purple	Culinary arts, wood craft	Maran, J. P., Sivakumar, V., et al. [2015]
58.	**Janglisaru, Beef wood**	*Casuarina equisetifolia*	*Casaurinaceae*		Bark	Flavonoids, Tannins, Terpenoids	Brown	Textile dye	Oo, Zin Mar, Mya Theingi, and Nwe Nwe Aung
59.	**Jujube (Chinese date)**	*Ziziphus jujuba*	*Rhamnaceae*		Fruit	Carotene, Tannins	Reddish pink	Mordant dyeing in silk	Chungkrang, Liza Moni, Ava Rani Phukan, et al. [2018]
60.	**Kaju (cashew)**	*Anacardium occidentale*	*Anacardiaceae*		Pericarp	Phenolic compound	Light red	Tan or color fishing net	Muhammadu, A. B., H. B. Muhammadu, et al. [2017]

61.	**Kandal, true mangrove**	*Rhizophora Mucronata*	*Rhizophoraceae*		Bark	Tannins	Chocolate	Textile dye	Punrattanasin, Nattaya, et al [2013]
62.	**Kashmal**	*Berberis vulgaris*	*Berberidaceae*		Root, Bark	Berberin, b Berberbamin, Oxyacanthine	Yellowish	Food &Textile	Haji, Aminoddin
63.	**Kathal**	*Artocarpus heterophyllus*	*Moraeceae*		Stem, Root	Carotenoids- all-trans-lutein	Yellow	Textile dye (silk)	Qadariyah, Lailatul, et al. [2017]
64.	**Lady buck-wheet, kota**	*Fagopyrum esculentum*	*Polygonaceae*		Grain	Rutin, Tannins, Fagopyrins	Yellow	Textile dye	Shitiz, Kirti, et al. [2023]

65.	**Ladybeds traw**	*Galium verum*			Root	Grioids	Red	Textile dye	Thompson, Amanda Jo, and Kathryn A. Jakes [2002]
66.	**Lavender**	*Lavandula*	*Lamiaceae*		Flower	Anthocynins	Purple, Gray	Textile dye	Karaboyacı, Mustafa, and Şule S. Uğur [2014]
67.	**Lodh**	*Symplocos racemosa*	*Symplocaceae*		Leaf, bark	Tannins, Loturine	Yellow	Silk	Singh, Shyam Vir, and M. C. Purohit [2014]
68.	**Longwood / Blood wood**	*Haematoxylum campechianum*	*Fabaceae*		Heart wood	Haematoxylin, Haematein, Tannins	Violet-Purple	Textile dye	El-Zawahry, Manal, and Hager Gamal [2024]
69.	**Lumb**	*Bidens pilosa*	*Asteracae*		Leaf	Indigo, flavones	Yellow	Textile dye	Janani, Loum, and P. A. G. Wanyama

70.	**Madder**	*Adhatoda vasica nees*	*Acanthaceae*		Leaves	2-pyridyl methyl amine	Alum(yellow), Gray	Textile dye	Rather, Luqman Jameel, et al. [2016]
71.	**Makola**	*Coriarianepalensis*	*Coriariaceae*		Wood	Tannins	Red	Textile dye	Fan, Yanxiao, et al. [2018]
72.	**Malabar spanich**	*Basella alba*	*Basellaceae*		Fruit	Betacyanin	Red - Purple	Textile dye, Food colorant	Mitra, Asish, and Sanat Kumar Das [2015]
73.	**Mango bark**	*Mangofera indica*	*Anacardiacae*		Leaves, peels	Mangiferin	Yellow	Dyirngcotton,fabric	Sutrisna, Putu Doddy, et al. [2020]
74.	**Maple**	*Acer saccharum*	*Sapindaceae*		Seeds & Leaf	Anthocyonidines, tannins	Orange red	Textile dye	Hu, Jihang, et al. [2016]

75.	**Marking nut tree**	*Semecarps Anacardium*	*Anacardiacea e*		Bark, Nut	Biflavoids – biflavones, A, C, A1 & A2	Black	Textile dye	Kaundal, Parinita, and Sanjeev kumar Ranote [24]
76.	**Merigold**	*Togester erecta*	*Asteraceae*		Petal	Carotonoid	Yellow	Silk dye	Sowbhagya, H. B., S. R. Sampathu, and N. Krishnamurthy [2004]
77.	**Mint weed**	*Salvia reflexa*	*Labitae*		Plant	Anthocynins	Yellow	Textile dye	Uysal, Imran, et al. [2023]
78.	**Mulberry (India)**	*Morinda citrifolia*	*Rubiaceae*		Root, Bark	Morin, Isorhamnetin,Kaempferol, Quercetin, Myricetin	Red, yellow	Textile dye	Wang, Huayin, Zhirong Tang, and Wenlong Zhou [2016]

79.	**Niala**	*Polygonum tictorium*	*Polygonceae*		Flower	Glycosides, Indican	Yellow	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]
80.	**Night jasmine**	*Nyctnthes Arbor-tristis*	*Oleaceae*		Flower (corolla)	Flavonoids, Glycosides, Oleanic acid	Bright orange	Textile dye	Rani, Champa, et al [2012]
81.	**Onion**	*Allium sepa*	*Liliacae*		Skin(peels)	Antrocynin	Orange	Textile dye	Deveoglu, Ozan [2022]
82.	**Orchid tree**	*Bauhinia purpurea*	*Caesalpiniaceae*		Bark	Chalcone, Butein	Purple color	For dyeing & Tanning	Aggarwal, Shilpi [2021]

83.	**Osage orange**	*Maclura pomifera*	*Moraeae*		Wood, Bark, Fruit	Maclurin	Yellow	Textile dye & tanning	Prabhu, K. H., and Aniket S. Bhute [2012]
84.	**Palash**	*Butea monosperma*	*Fabaceae*		Dried flower	Butin,Butein, Butrin, Isobuterin	Brilliant yellow	Textile dye	Burli, D. A., and A. B. Khade [2007]
85.	**Palm**	*Phoenix dactylifera*	*Arecaceae*		Nuts, Leaves	Cellulose, Hemicellulose, Lignin	Brown, Reddish, Gray	Fabric dye	Alharbi, Hattan A., et al [2022]
86.	**Peach**	*Prunus persica*	*Rosaceae*		Ripen fruits	Leucoanthocynin, tannins	Peach	Food, fabric	Singh, Renu, and Sangita Srivastava [2017]

87.	**Pitti(Toothed leaf red creper)**	*Ventilago denticulate*	*Rhamnaceae*		Bark, Root	Ventilagin, Flavonoid	Red	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]
88.	**Plum**	*Prunus domestica*	*Rosaceae*		Bark, Fruit, Seed	Anthocynin & Coumarins	Green, Yellow, Gray, Pink, Red	Textile dye & food colorant	Kulkarni, Sunil Jayant [2017]
89.	**Pomegranate**	*Prunica Granatum*	*Lythracae*		Rind	Anthocyanins	Yelowish Brown	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]
90.	**Prince feather**	*Amaranthus hypocondriacus*	*Amaranthaceae*		Arial parts	Tannins	Red	Food dye	Ruth, Olusanya N., et al [2021]

91.	**Ramaphal, bullock heart**	*Annona reticulate*	*Annanaceae*		Unripe fruit	Catechin	Bluish black	Hair dye, Textile	Jamkhande, Prasad G., et al. [2015]
92.	**Red beet**	*Beta vulgaris*	*Chenopordiaceae*		Roots	Betanin	Red yellow	Industrial food colorants	Sarkar, Tanmay, Mrinal Kanti Sen, and Suman Nihar [2015]
93.	**Red creeper**	*Ventilagoma draspatna*	*Rhamnaceae*		Bark, Root	Anthocyanins	Red	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]
94	**Red kamala tree**	*Mallotus philippensis*	*Euphorbiaceae*		Fruit	Rottlerin, Isorottlerin	Red color	Dyeing silk	Aggarwal, Shilpi [2021]

95.	**Red sandal wood**	*Pterocarpus santalinus*	*Fabaceae*		Wood	Santalin, Deoxysantalin	Red	Textile dye	Teixeira da Silva, Jaime A., et al [2019]
96	**Roses**	*Rosa rubiginosa*	*Rosaceae*		Petals & Leaves	Anthocyanins	Red, Pink Yellow	Food & Textile dye	Wang, Hsiuying [2024]
97.	**Safed arand, Barbados nut**	*Jatropha curcas*	*Euphorbiaceae*		Bark	HCN & Rotenone	Blue	Textile dyeing	Islam, A. K. M. A., Z. Yaakob, and N. Anuar [2011]
98.	**Safed kiker**	*Acacia leucophloea*	*Mimosacae*		Barks	Proanthrocynidin	Red	In, medicine fabric	Prabhu, K. H., and Aniket S. Bhute [2012]
99.	**Safflower**	*Carthamus tinctorium*	*Asteraceae*		Flower	Carthamin, Carthamon	Red, Yellow	Dyeing wool, Skin & Food	Knowles, Paulden F [1959]

100.	**Saffron**	*Crocus sativus*	*Iredaceae*		Stigma	Crosin	Yellow	Food, fabric dye	Gohari, Ahmad Reza, et al. [2013]
101.	**Sal**	*Shorea robusta*	*Dipterocarpaceae*		Bark	Oleoresin	Red, Black	Textile dye	Sahoo, Tusharbala, et al. [2015]
102.	**Salvia**	*Salvia officinalis*	*Lamiaceae*		Flowers	Anthocyanins, Flovonoids	Red, Pink, Purple	Silk & Cotton fabrics	Üzeri, Bu Renklerin Bazı Haslık Değerleri [2002]
103.	**Sappam**	*Casalpiniasappan*	*Fabeace*		Wood	Obiumsappano	Red	Textile dye	Nathan, Vinod Kumar, and Mary Esther Rani [2021]
104.	**Satin wood, Bhirra**	*Chloroxylon swietenia*	*Rutaceae*		Bark	Thymol, Carvacrol, P-cymene, Terpinene	Yellow	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]

105.	**Sausage tree, Kajela**	*Kigelia pinnata*	*Bignoniaceae*		Wood, Root	Coumarins, Anthraquinone	Grayish brown	Textile dye	Sharma, Kuldeep K., et al. [2013]
106.	**Sawwort**	*Serratula tinctoria*	*Asteraceae*		Whole plant except root	Luteolin, Apigenin	Yellow	Textile dye	Guinot, P., et al. [2009]
107.	**Semal**	*Bombax ceiba*	*Bombacaceae*		Bark	Naphthol, anthocyanin	Orange red	Textile dte	Vadwala, Yogesh, and Namrita Kola [2017]
108.	**Stinging nettle**	*Urtica dioiea*	*Urticaeae*		Roots, above parts	chlorophyll	Green	Hair dye, food, fabric	Eser, Ferda, and Adem Onal [2015]

109.	**Sweet indrzajao**	*Wrightia tinctoria*	*Apocynaceae*		Flowe, fruits	Inidigo glucoside	Blue	Fabric dye	Chandrasekaran, Kavitha [2020]
110.	**Tarwas**	*Cassia auriculata*	*Fabeace*		Flower	Auxochromes	Yellow	Textile dye	Siva, R., and K. V. Krishnamurthy [2005]
111.	**Teak**	*Tecona grandis*	*Verbenaceae*		Leaves	Teactoleafquinone	Pink	Fabric dye	Agrawal, Akshita, and Sheetal Chopra [2020]
112.	**Tora, sickle**	*Cassia tora*	*Caesalpiniaceae*		Seeds	Rubrofusarin	Blue dye	Dyeing & Tanning	Lee, Young-Hee, and Han-Do Kim [2004]

113.	**Tulips**	*Tulipa gesneriana*	*Liliaceae*		Petals	Anthocyanins	Red & pink	Food & textile dye	Arici, Muhammet, et al. [2016]
114.	**Tun (Red cedar)**	*Toona ciliate*	*Meliaceae*		Flower, Saw dust	Cedrelone, Coumarin	Red, Pink	Textile dye (cotton)	Prabhu, K. H., and Aniket S. Bhute [2012]
115.	**Turmeric**	*Curcuma longa*	*Zingiberaceae*		Rhizomes	curcumin	Yellow	Food, textile	Umbreen, Saima, et al. [2008]
116.	**Verbena**	*Verbena officinalis*	*Verbenaceae*		Arial part	Anthocyanins, Iridoids	Pink, Purple, White, Red	Fabric dye	Magalhães, Jéssica de Sousa [2021]
117.	**Wallflower**	*Cheiranthus cheiri*	*Brassicaceae*		Leaf, Petal	Isorhamnetin, Kaempferol	Yellow	Textile dye	Prabhu, K. H., and Aniket S. Bhute [2012]

118.	**Walnut**	*Juglans Regia*	*Juglandaeae*		Shell, Bark, Leaf	Juglone	Red	Hair dye supporter	Eser, Ferda, Ebru Aktas, and Adem Onal [2016]
119.	**Water lily**	*Nymphaea alba*	*Nymphaceae*		Rhizome	Tannins, Myricetrin, Flavonoids, Glycosides	Blue	Textile dye	Rajesh, Yadav, et al [2014]
120.	**Weld, dyer`s Rocket**	*Reseda luteola*	*Resedaceae*		Whole plant	Luteolin, Luteolin-7, Apigenin	Deep yellow	Textile dye	Gilbert, Kerry G., and David T. Cooke [2001]
121.	**Woad**	*Isatis tinctoria*	*Fabaceae*		Leaf	Isatan A & Isatan B	Blue	Textile dyeing	Osimani, Andrea, et al. [2012]
122.	**Young fustic**	*Cotinus coggygria*	*Anacardiaceae*		Wood, Leaf	Rutin, Quercetin, Kaempferol	Yellowish orange	Textile dye	Valianou, Lemonia, et al. [2009]

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