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Studies on Diversity of Natural Dye Yielding Plants of Birbhum and Burdwan Districts of West Bengal, India

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Abstract

The present study is based on extensive survey, collection of ethnobotanical information, indigenous knowledge and review of relevant literature on the traditional dye yielding plant resources used by the different tribal and rural peoples of Birbhum and Burdwan districts of West Bengal. Field investigation was carried out in different villages and adjacent forest pockets in these districts. Total 32 natural dye yielding plants were reported. These 32 taxa spread over 30 species, 29 genera and 22 families of dicotyledons and 2 species, 2 genera and 2 families of monocotyledons. Among the recorded plant species, 26 are found in wild and 6 are grown as cultivated crops and as garden plants. The investigated plants have been enumerated alphabetically depending upon their botanical names along with their local and tribal names, parts used, name of the dye etc. Some noteworthy dye yielding plants are- *Bixa orellana*, *Butea monosperma*, *Calotropis gigantea*, *Carthamus tinctorius*, *Curcuma longa*, *Lawsonia inermis* and *Nyctanthes arbor-tristis*. The data of this study can further be exploited by the workers in the fields of phytochemistry, genetics, food and textile industries, conservation biology, etc.

Keywords: Dye yielding plants, ethnobotanical information, natural products

1. Introduction

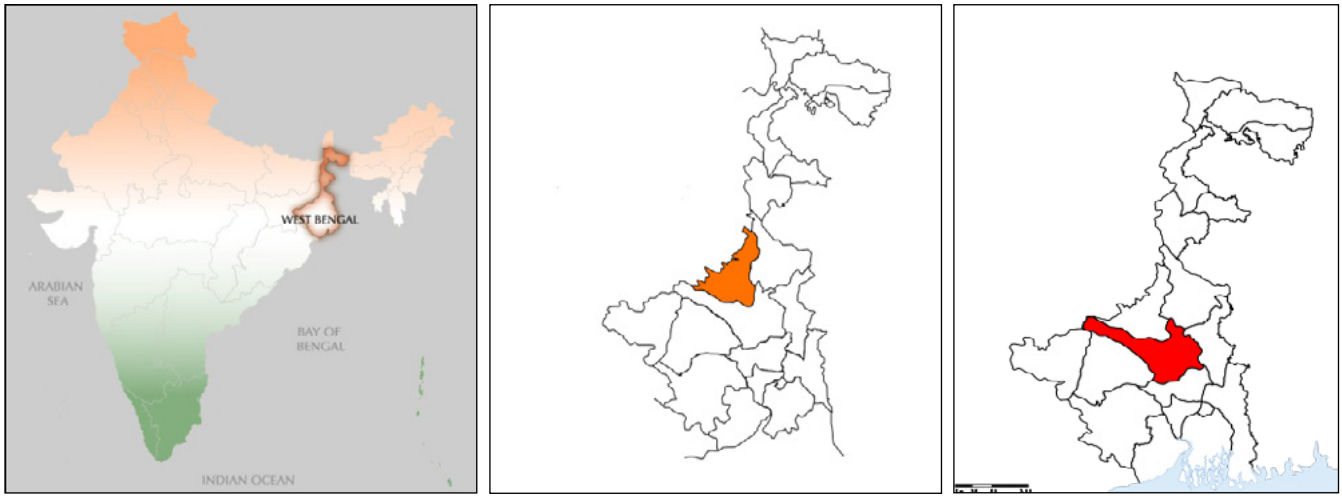
The relation between man and plants originated with the prehistoric human civilization to modern human civilization. The plants are used not only for maintaining the basic life sustaining needs like food, fuel, shelter, but also for making clothes and natural dye to fabric clothes (Das and Mondal, 2012). Natural dyes occupy an important place in human culture and dye yielding plants were probably discovered early through human curiosity, use, reuse and trials (Cannon and Cannon, 2003; Dogan et al., 2008). Indigenous traditional knowledge on dye yielding plants is very essential for community-based development, future bioprospecting and eco-friendly products. India has a great opportunity for export of natural dyes due to its vast plant wealth and rich traditional knowledge of using natural colorants as dye. Probably the earlier known dyes were indigo (blue dye) and alizarin (red dye) obtained from plants (Bechtold and Mussak, 2009).

In recent times, most of the natural dyes have been replaced by synthetic ones which are used in large scale for coloring the foodstuffs and fabrics. It results in the release of pollutants from the textile and fast-food units. This is one of the major causes for serious health hazards and environmental pollution. There has been an alarming outbreak of a number of diseases and disorders due to over use of synthetic dyes in the industries of food, textile, drug, etc. Therefore, the need of the hour is to screen natural dyes from the plant sources and select the biodegradable and environment friendly ones for use in the industries.

In this context, the present study has been carried out to provide the significant information regarding the diversity of dye yielding plant resources of Birbhum and Burdwan districts, West Bengal which will enrich data bank of the existing inventory of Indian dye yielding plants.

2. Materials and Methods

The district Birbhum is quite rich in natural resources. It extends over about 4528.61 sq km and is situated between 87°10' and 88° 2' East longitude and between 23°33' and 24°35' North latitude. The district is triangular in shape. The western part of the district is bounded by the forest area of Jharkhand where many tribal people reside. The district Burdwan extends over about 7024 sq km and it is situated between 87°54' and 87°90' East longitude and between 23°04' and 23°06' North latitude (Figure 1). It is bounded on the north by Birbhum and Murshidabad districts, on the east by Nadia District, on the southeast by Hooghly District and on the southwest by Bankura and Purulia districts. The northwest part of the district is bounded by Dhanbad district of Jharkhand. The tribal



India with West Bengal | Birbhum district of W.B. | Burdwna district of W.B.

Figure 1: Map of the study area

people of these two districts are to some extent dependent upon the forest flora for their livelihood and use the plant resources in various ways like for their primary health care, food, fibres, shelter, dye, household implements, etc.

Field investigations were conducted for documentation of dye yielding plants in different villages and adjacent forest areas of Birbhum and Burdwan districts, West Bengal following the methods of Jain (1987) and Jain and Mudgal (1999). To confirm the authenticity of the collected data it has always been crosschecked by interviewing other persons of the same and different localities. The specimens were collected from the adjacent forest area with the help of local informant. The collected plant species have been carefully identified with the help of different Floras (Guha Bakshi, 1984; Maheshwari, 2000; Manilal and Sivarajan, 1982; Panigrahi and Murthy, 1989; Saldanha and Nicolson, 1976; Sanyal, 1994; Varma, 1981). The collected plant specimens have been preserved as herbarium specimen following the method of Jain and Rao (1977).

Perusal of literature reveals that many plants grown in the districts may be of the promising sources of dyes (Agarwala, 1986; Ambasta et al., 2000; Anonymous, 1992; 1997; Das and Rahaman, 2014; Uphof, 2001; Watt, 1889–1893). Those plants have also been included here in this investigation.

3. Results and Discussion

Total 32 plants were recorded from the Birbhum and Burdwan districts of West Bengal used by tribal and rural people in the preparation of 8 different types of dyes which are of great importance as promising resources of natural colorants. These 32 recorded plant taxa spread over 30 species, 29 genera and 22 families of dicotyledons and 2 species, 2 genera and 2 families of monocotyledons (Table 1). Among recorded plant species, 26 plants (81.25%) are found in wild and 6 plants (18.75%) are grown as cultivated crops and as garden

Table 1: Percentage composition of the recorded plant species and their groups

Taxa	Dicotyledons		Monocotyledons	
	No.	Percentage (%)	No.	Percentage (%)
Family	22	68.75	2	6.25
Genus	29	90.62	2	6.25
Species	30	93.75	2	6.25

plants (Figure 2). Considering the habit, the investigated taxa are grouped into – climbers in 2 cases (6.25%), herbs in

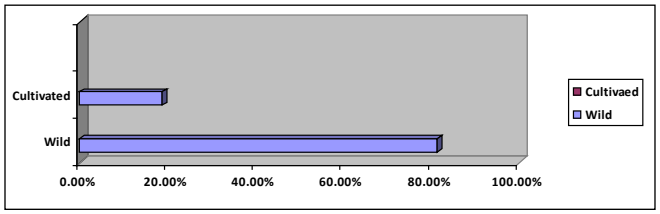


Figure 2: Percentage composition of sources of the recorded plants

3 cases (9.37%), shrubs in 7 cases (21.87%) and trees in 20 cases (62.50%) (Figure 3). The different plant parts like barks (18.75%), flowers (28.12%), fruits (28.12%), latex (3.12%),

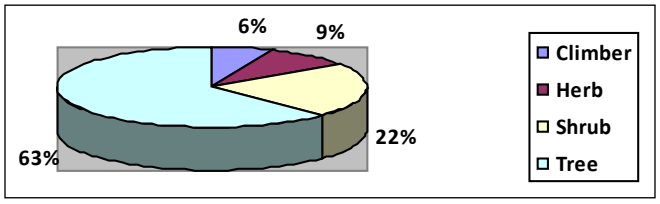


Figure 3: Incidence of plants based on habit

leaves (9.37%), rhizome (3.12%), seeds (6.25%) and wood (3.12%) are in preparation of 8 different types of dye (Table 2). Various natural dye obtained from the investigated plants like black from 5 plants, blue from 1 plant, brown from 4 plants, grey from 1 plant, purple from 1 plant, red from 5 plants,

Table 2: Percentage composition of plant parts used in dye preparation

Plant parts	Percentage (%)	Total No.
Bark	06	18.75
Flowers	09	28.12
Fruits	09	28.12
Latex	01	3.12
Leaves	03	9.37
Rhizome	01	3.12
Seeds	02	6.25
Wood	01	3.12

violet from 1 plant and yellow from 14 plants (Table 3). The investigated plants have been enumerated alphabetically depending upon their botanical names, along with their local and tribal names, parts used, names of the dyes, their uses and frequency of occurrence (Table 4).

Table 3: Percentage composition of colour obtained from the investigated plants

Colour obtained	Total No.	Percentage (%)
Black	5	15.62
Blue	1	3.12
Brown	4	12.50
Grey	1	3.12
Purple	1	3.12
Red	5	15.62
Violet	1	3.12
Yellow	14	43.75

Table 4: Enumeration of the recorded taxa

Botanical name and Family	Local/Tribal Name	Parts used	Colour of the dye	Occurrence	Chemical constituents
Acacia nilotica (Lam.) Willd ex Del. subsp. *indica* (Benth.) Brenan (Mimosaceae)	Babla/ Kikar	Fruits	Black	Common	Tannins (12.19–20%), galloylated and tetrahydroxyflavan-3,4-diols, amino acids and ascorbic acids
Adhatoda vasica L. (Acanthaceae)	Basak/Arandi-ba	Leaves	Yellow	Uncommon	Vasicine, vasicinine, vasicinol, vasicinone, vasicol, essential oil (0.076%)
Aegle marmelos (L.) Corr. ex Roxb. (Rutaceae)	Bel	Fruits	Yellow	Common	Alkaloids, amino acids, anthocyanins, lecoanthocyanins, carbohydrates, carotene, essential oils, fatty acids, sterols, tannic acid, tannins and vitamins
Areca catechu L. (Arecaceae)	Superi	Fruits	Red	Occasional in Garden	Amino acids, alkaloids, catechin, procyanidins, arecoline, sitosterol, leucocyanidins and tannins
Artocarpus heterophyllus Lam. (Moraceae)	Kanthal	Wood	Yellow	Common	Cycloarten group of tetracyclic triterpenoids, carbohydrates and essential amino acids, carotenes, ursolic acid, sitosterol and flavonoids
Azadirachta indica A. Juss. (Meliaceae)	Neem / Bokom-dare	Bark	Red	Common	Diterpenoids notably nimbin, nimbidine, azadirachtin and their derivatives, flavonoids, sterols, triterpenoids, tannins, proteins, etc
Basella alba L. (Basellaceae)	Puin shak	Fruits	Violate	Common	Iodine, fluorine, carotenoids, several vitamins, calcium, iron, oxalates, zinc, magnesium, sodium, manganese, sulphur and bi-flavonoids etc.
Bixa orellana L. (Bixaceae)	Sinduri / Kong	Seeds	Yellow	Occasional in Garden	Coloring matter bixin, fatty oil and bixol, etc.
Butea monosperma (Lam.) Kuntze (Fabaceae)	Palas / Palas - baha	Flowers	Yellow	Common	Chalcone and aurones, imidazole derivatives, anthocyanidin, monospermin, fatty acids, sitosterol and amyrin

Table 4: continue...

Botanical name and family	Local/Tribal Name	Parts used	Colour of the dye	Occurrence	Chemical constituents
Calotropis gigantea (L.) R.Br. ex Ait. (Asclepiadaceae)	Akanda / Ark, Parkha	Latex	Yellow	Common	Cardiac glycosides e.g., calotropin, a-calatinic acid, b-calotropol, b-amyrin, calcium oxalate and gigantin
Carthamus tinctorius L. (Asteraceae)	Kusum	Flowers	Yellow	Cultivated occasionally	Carthamin, essential oil (20-30%), etc
Cassia fistula L. (Caesalpiniaceae)	Bandarlathi / Bero - Hari	Bark	Red	Common	Sugars, anthocyanidins, anthraquinones, glucosides, bi- and tri- flavonoids, tannins (3.18%) etc
Clitoria ternatea L. (Fabaceae)	Aparajita	Seeds	Blue	Common	Flavonoids and their glycosides, anthocyanins, triterpenoids, sterol and fatty acids
Curcuma longa L. (Zingiberaceae)	Halud, Haldi	Rhizome	Yellow	Cultivated occasionally	Curcurmin oils, mainly curcumin, genistein, oils, proteins and anti -venom substances
Erythrina variegata L. (Fabaceae)	Palita madar, Mandar	Flowers	Red	Uncommon	Erythraline, erythrinine, erysovine, flavonoids, phytosterol, fatty acids and alcohols
Ficus racemosa L. (Moraceae)	Jaggya Dumur	Bark	Black	Uncommon	Glycosides, tannins, psoralen, cerylbehenate, lupeol and its acetate, stigmasterol, gluanol acetate and phytosterols, etc
Gmelina arborea L. (Verbenaceae)	Gamar, Gumbar	Fruits	Yellow	Uncommon	Butyric acid, tartaric acid, resinous substances and saccharine
Gossypium herbaceum L. (Malvaceae)	Kapas tula	Flowers	Yellow	Occasional in Garden	Betaine, choline, salicyclic acid, etc
Hibiscus rosa-sinensis L.(Malvaceae)	Jaba	Flowers	Dark purplish	Common in garden	Cyanidin diglycoside, tetraxeryl acetate, calcium oxalate, vitamin, flavonoids and their glycosides
Lowsonia inermis L. (Lythraceae)	Mehedi / Hena	Leaves	Reddish brown	Rare	Lawson (2-napthoquinone), flavone glycosides, triterpenoids, fatty acids, essential oil, coumarins and xanthones, etc
Mangifera indica L. (Anacardiaceae)	Aam / Uli-daru	Bark	Yellow	Very common	Potassium and vitamin A, carotine, xanthophylls, carbohydrates, sucrose, glucose, fructose, acids (0.18-3.66%), etc
Michelia champaca L. (Magnoliaceae)	Champa, Swarna champa,	Flowers	Yellow	Uncommon in garden	Mono- and sesquiterpenes (essential oil), sitosterol and its glucoside, parthenolide, germacranolide and constunolide, etc
Mimusops elengi L. (Sapotaceae)	Bakul / Bohur	Bark	Brown	Common	Triterpenoid saponins and essential oils
Nyctanthes arbor-tristis L. (Oleaceae)	Sheuli, Sephalika	Flowers	Brown	Common in garden	d-manitol, tannin, glucose, oil consist of glycerides, sitosterol, etc.
Phyllanthus emblica L. (Euphorbiaceae)	Amlaki / Miral daru	Fruits	Blackish grey	Common	Ascorbic acid, phyllembelic acid, gallic acid, indole acetic acid, auxins (a1, a3, a5. A5), the growth inhibitors R1 & R2, etc
Psidium guajava L. (Myrtaceae)	Peyara / Tamras	Bark	Black	Common	Leucocyanidin, flavonoids e.g., quercetin, phytosterols, carotenes, tannins, saponins, vitamin C and B6, carbohydrates, diethoxy alkanes as flavor component
Punica granatum L. (Punicaceae)	Dalim, Bedana	Fruits	Yellowish brown	Uncommon	Alkaloids e.g., pelletierine, estrone, tannins, fatty acids, carbohydrates, triterpenoids and phytosterols, etc.

Table 4: continue...

Botanical name and family	Local/Tribal Name	Parts used	Colour of the dye	Occurrence	Chemical constituents
Tagetes erecta L. (Asteraceae)	Ganda	Flowers	Yellow	Common in garden	Essential oil, flavonoids e.g., quercetagetrin and quercetagetin, cardenolides and helenien, etc.
Tectona grandis L. f. (Verbenaceae)	Segun / Sagoan	Leaves	Red	Common	Anthraquinones, e.g., tectoquinone, napthouinones, lapachones, napthachromans, tectograndone, triterpenoids, fatty acids, carbohydrates, and phytosterols, etc.
Terminalia bellirica Roxb. (Combretaceae)	Bahera / Michra	Fruits	Black	Very common	Tannin (25%), gum, a green fixed oil, phyllembin and gallic acids
Terminalia chebula Retz. (Combretaceae)	Haritaki / Rola-daru	Fruits	Black	Common	About 30% of astringent substances, e.g., chebulinic acid, tannic acid, gallic acid, chebulagic acid, resin, anthraquinone and sennoside.
Thespesia populnea Soland. ex Correa (Malvaceae)	Parash, Parisha	Flowers	Yellow	Very uncommon	Populnin (0.33%), populnetin (0.07%) and herbacetin, etc.

Twenty plant species, 20 plant genera, 19 plant family were identified as dye yielding plants by Pathania et al. (2021). A total of 17 species of dye yielding plants belonging to 13 families and 17 genera were recorded. These species are used for dyeing clothes and other items. Different plant parts were utilized, of which fruit (07 spp.) was used in the majority, followed by flowers (05 spp.); bark (04 spp.) and leaves (03 spp.) (Kumari et al., 2019).

4. Conclusion

Natural dye yielding plants have immense significance in the socio-economic and socio-cultural life of indigenous ethnic people. The data documented in this study will be helpful to prepare the district as well as state level inventory on dye yielding plant resources. It will help in exploring the promising new sources of natural dyes from the district which may be brought under large scale cultivation for commercial purposes.

5. Acknowledgement

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