SCREENING OF DYE YIELDING PLANTS OF TIRUVANNAMALAI DISTRICT., TAMIL NADU, INDIA.

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ABSTRACT:

The present study aims to know the dye-yielding plants in and around the Tiruvannamalai district. A total sixty-three plant species were screened out and their dye-yielding behaviour from leaf, flower, fruit, seed, stem, bark, rhizome, and root. Among these plants, a few plants yielded more than one colour in combination were black and blue; black and brown; black and yellow; blue and red; brown and green; brown and yellow; green and red; brown, red, and yellow. All this data was represented in a table and a graph.

KEYWORDS: Aromatic Plants, Colorogram, Dye, Medicinal plants, Natural dye, Toxic, nontoxic, Tiruvannamalai.

1. Introduction:

The main idea of extracting dyes from plant sources is to avoid environmental pollution. Natural dyes derived from flora and fauna are believed to be safe because of their nontoxic, non-carcinogenic, and biodegradable nature (Cristea and Vilarem, 2003). Natural dyes are nowadays in demand not only in the textile industry but also in cosmetics, leather, food, and pharmaceuticals. The rich biodiversity of our country has provided us with plenty of raw materials, yet a sustainable linkage must be developed between cultivation, collection, and their use (Gokhale et al., 2004).

Nearly 450 plants are known to yield dyes (Siva and Krishnamurthy, 2005). In generally, plants are used not only for the basic needs of life such as food, fibre, clothes and shelter but also as sources of natural dyes for dying clothes (Pigushkanti das and Amal Kumar, 2012). The plant parts used for extracting dyes are seeds, flower, stem, leaves, bark and root. Some of the plant parts yielded more than one colour varied depending on the seasons and the soil conditions (Mahesh et al., 2015). The flowers which contain much of tannin are flame coloured and yield red/ pink/ brown/ flame coloured shades of dye in large amounts; therefore, utilized throughout India for dying silk and fabrics on a commercial scale. India was a major exporter of herbal dyes but not so recently because of the ban on production of some of the synthetic dyes and intermediates in the developed countries due to pollution problem (Gaur, 2008).

The natural plant-based dyes have played an important role in the cultural heritage of human civilizations. Therefore, nowadays there is a great demand for these natural colours (Balandrin et al., 1985; Bechtold et al., 2003; Samanta and Agarwal, 2009). The plants such as *Curcuma longa* (turmeric), *Selaginella catechu* is primarily used for condiments, medicines and are also identified as natural dyes used for textiles. The other class of plants, which are grown for some other purpose but their unused parts can be viable source of natural dyes. (Eg. *Punica granatum, Juglan regia)*. However, if the source of dye is derived from some plant parts like heart wood, root or stem, then this will destroy the whole plant, also the over propagation of some of these plants is quite difficult. Therefore, choosing suitable plant organs is an important part to avoid environmental degradation for the sustainable production of the dye (Saxena and Raja, 2014; Walts, 1972).

2. Materials and methods

2.1. Materials

Totally sixty three plants were collected from in and around of Tiruvannamalai Town, Tiruvannamalai district, Tamil Nadu, India. In the present study, the selected medicinal and aromatic plants containing dye-yielding properties were screened through the tissue absorbent method from the following plants such as *Acacia nilotica* L.Willd.ex Delile., *Achyranthes aspera* L., *Adhatoda vasica* Nees., *Aegle marmelos* (L.) Correa., *Aloe barbadensis* Mill., *Alpinia galanga* (L.)Willd., *Althaea rosea* (L.) Cav., *Anacardium occidentale* L., *Artocarpus*

heterophyllus Lam., *Azadirachta indica* A.Juzz., *Barleria cristata* L., *Barleria prionitis* L., *Bauhinia tomentosa* L., *Bauhinia variegata* (L.) Benth., *Betula utilis* D.Don., *Biancaea sappan* L., *Bixa orellana* L., *Butea monosperma* (Lam.) Taub., *Carthamus tinctorius* L., *Cassia fistula* L., *Casuarina equisetifolia* L., *Catharanthus roseus* (L.) G.Don., *Citrus medica* L., *Clitoria ternatea* L., *Cnidoscolus aconitifolius* (Mill.) I.M.Johnst., *Coccinia grandis* (L.) Voigt, *Crossandra infundibulformis* (L.) Nees., *Curcuma longa* L., *Dendranthema grandiflorum* (Ramat.) Kitam*., Dipterocarpus turbinatus* C.F. Gaertn., *Eucalyptus globulus* Labill., *Euphorbia tirucalli* L., *Gardenia jasminoides* J.Ellis., *Geranium wallichianum* Oliv., *Helianthus annuus* L., *Heliotropium strigosum* Willd., *Hibiscus rosa-sinensis* L., *Indigofera tinctoria* L., *Jatropha curcas* L., *Lawsonia inermis* L., *Mallotus philippensis* (Lam.)Muell.Arg., *Malpighia glabra* L., *Mangifera indica* L., *Michelia champaca* L., *Morinda citrifolia* L., *Nyctanthes arbortristis* L., *Oldenlandia umbellata* L., *Oxalis corniculata* L., *Papavar rhoeas* L., *Peltophorum pterocarpum* (DC.) K.Heyne., *Phyllanthus acidus* (L.) Skeels, *Phyllanthus emblica* L., *Phyllanthus reticulatus* (poir.), *Piper betle* L., *Psidium guajava* L., *Punica granatum* L., *Senna ariculata* (L.) Roxb., *Senna occidentalis* (L.) Link., *Solanum nigrum* L., *Syzygium cumini* (L.) Skeels., *Tectona grandis* L.f., *Terminalia chebula* Retz., *Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J.Wen .

In this study, a total sixty three angiosperm plants species belonging to thirty-two families of dicotyledonous plants and three families of monocotyledonous plants have been identified and documented. The collected plant specimens have been identified by using standard floras (Gamble and Fischer, 1936; Matthew, 1983; Nair and Henry, 1983; Henry et al., 1989).

The dye-yielding plants were arranged in alphabetical order, with botanical name, toxic or nontoxic, family, used parts, and dye yielded as table- 1.

2.2. Methods

The selected medicinal plants were washed with the help of running tap water, and after that, 10g of leaves were homogenized with a few ml of sterile distilled water and ethyl acetate through a pestle and mortar.

Well-homogenized plant pastes were applied on the well-cleaned white blotting paper or cloth for 24 hours at room temperature, which are good absorbent materials in nature. After 24 hours, the dried plant paste was removed from the absorbent materials. These materials showed various color grams on the plant pastes applied areas, which were photographed.

3. Result

In this study, a total of 63 Angiosperm plant species belonging to 35 families have been identified, and dye behavior was screened from these plants and then documented. The dye-yielding plants were arranged in alphabetical order with binomial name, toxic or nontoxic, family, parts used, and their dye. Most of the dye-yielding plant parts such as Seeds- 4, Flowers-18, Fruit- 10, Leaves-16, Bark- 14, Rhizome- 2, Root- 5, Stem-1, Wood- 3, Whole plant- 2 (Graph-1). Habit-wise used dye-yielding plants such as Tree-34, Shrub-13, Small Shrub- 1, Climbing Shrub- 1, Herb-11, Climber-2, Creeper-1 (Graph-3), the plants exhibited colours that were black, blue, brown, green, orange, pink, red, and yellow, which were tabulated in Table 1, Graph-2, and Figure-1.

Table-1

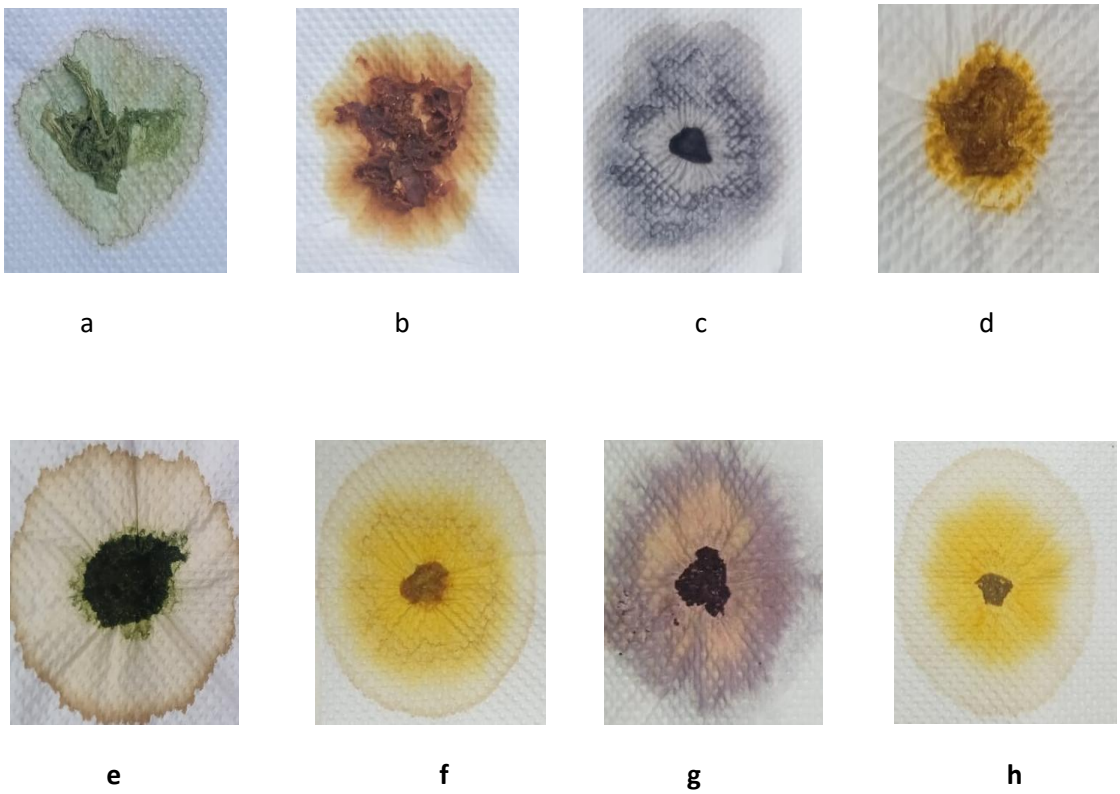
S.No.	Binomial Name	Toxic/ Nontoxic	Family	Parts Used	Dye Yielded
1.	*Acacia nilotica* L.Willd.ex Delile	Toxic	Fabaceae	Seeds	Black and Brown
2.	*Achyranthes aspera* L.	Nontoxic	Amaranthaceae	Whole Plant	Olive green
3.	*Adhatoda vasica* Nees	Nontoxic	Acanthaceae	Leaves	Yellow
4.	*Aegle marmelos* (L.) Correa	Nontoxic	Rutaceae	Fruit	Yellow
5.	*Aloe barbadensis* Mill.	Nontoxic	Asphodelaceae	Leaves	Light green
6.	*Alpinia galanga* (L.)Willd.	Nontoxic	Zingiberaceae	Rhizome and Leaves	Green and Red
7.	*Althaea rosea* (L.) Cav.	Toxic	Malvaceae	Flower	Red
8.	*Anacardium occidentale* L.	Nontoxic	Anacardiaceae	Flower	Brown
9.	*Artocarpus heterophyllus* Lam.	Nontoxic	Moraceae	Wood	Yellow
10.	*Azadirachta indica* A.Juzz	Nontoxic	Meliaceae	Leaves and Bark	Brown and Green

11.	*Barleria cristata* L.	Nontoxic	Acanthaceae	Flower	Yale blue
12.	*Barleria prionitis* L.	Toxic	Acanthaceae	Flower	Yellow
13.	*Bauhinia tomentosa* L.	Nontoxic	Fabaceae	Leaves	Yellow
14.	*Bauhinia variegata* (L.) Benth.	Nontoxic	Fabaceae	Bark	Yellow
15.	*Betula utilis* D.Don	Nontoxic	Betulaceae	Whole plant	Brown
16.	*Biancaea sappan* L.	Nontoxic	Fabaceae	Wood and Bark	Red
17.	*Bixa orellana* L.	Nontoxic	Bixaceae	Seeds	Red or Pink
18.	*Butea monosperma* (Lam.) Taub.	Nontoxic	Fabaceaee	Flower	Yellow
19.	*Carthamus tinctorius* L.	Toxic	Asteraceae	Flower	Red and Yellow
20.	*Cassia fistula* L.	Nontoxic	Fabaceae	Tree bark	Brown
21.	*Casuarina equisetifolia* L.	Nontoxic	Casuarinaceae	Bark	Red
22.	*Catharanthus roseus* (L.) G.Don	Toxic	Apocynaceae	Flower	Mellow Yellow
23.	*Citrus medica* L.	Nontoxic	Rutaceae	Bark	Black
24.	*Clitoria ternatea* L.	Nontoxic	Fabaceae	Flower	Blue
25.	*Cnidoscolus aconitifolius* (Mill.) I.M.Johnst.	Nontoxic	Euphorbiaceae	Leaves	Green
26.	*Coccinia grandis* (L.) Voigt	Nontoxic	Cucurbitaceae	Leaves	Peanut brown
27.	*Crossandra infundibulformis* (L.) Nees	Nontoxic	Acanthaceae	Flower	Fire brick Red
28.	*Curcuma longa* L.	Nontoxic	Zingiberaceae	Rhizome	Yellow

29.	*Dendranthema grandiflorum* (Ramat.) Kitam	Toxic	Asteraceae	Flower	Light Moss Brown
30.	*Dipterocarpus turbinatus* C.F. Gaertn.	Toxic	Dipterocarpaceae	Bark	Brown and Yellow
31.	*Eucalyptus globulus* Labill.	Toxic	Myrtaceae	Bark	Dark green
32.	*Euphorbia tirucalli* L.	Toxic	Euphorbiaceae	Stem	Red
33.	*Gardenia jasminoides* J.Ellis.	Toxic	Rubiaceae	Fruit	Yellow
34.	*Geranium wallichianum* Oliv.	Toxic	Geraniaceae	Fruit and Root	Brown, Red and Yellow
35.	*Helianthus annuus* L.	Nontoxic	Asteraceae	Flower	Light tangerine Orange
36.	*Heliotropium strigosum* Willd.	Toxic	Boraginaceae	Leaf	Black
37.	*Hibiscus rosa-sinensis* L.	Nontoxic	Malvaceae	Flower	Red
38.	*Indigofera tinctoria* L.	Nontoxic	Fabaceae	Leaf and Flowers	Black and Blue
39.	*Jatropha curcas* L.	Toxic	Euphorbiaceae	Bark and Leaves	Blue
40.	*Lawsonia inermis* L.	Toxic	Lythraceae	Leaf	Orange and Red
41.	*Mallotus philippensis* (Lam.)Muell.Arg.	Nontoxic	Euphorbiaceae	Fruit	Orange
42.	*Malpighia glabra* L.	Nontoxic	Malpighiaceae	Fruit	Light Pink or Red
43.	*Mangifera indica* L.	Nontoxic	Anacardiaceae	Bark	Apricot orange
44.	*Michelia champaca* L.	Nontoxic	Magnoliaceae	Flower	Yellow
45.	*Morinda citrifolia* L.	Nontoxic	Rubiaceae	Root	Red and Yellow
46.	*Nyctanthes arbortristis* L.	Nontoxic	Oleaceae	Flower	Yellow

47.	*Oldenlandia umbellata* L.	Nontoxic	Rubiaceae	Root	Red
48.	*Oxalis corniculata* L.	Toxic	Oxalidaceae	Leaf	Blue
49.	*Papavar rhoeas* L.	Toxic	Papavaraceae	Flower	Red
50.	*Peltophorum pterocarpum* (DC.) K.Heyne	Nontoxic	Fabaceae	Leaf and Wood	Black and Brown
51.	*Phyllanthus acidus (*L.) Skeels	Nontoxic	Phyllanthaceae	Fruit	Egg nog Yellow
52.	*Phyllanthus emblica* L.	Nontoxic	Phyllanthaceae	Bark	Blue
53.	*Phyllanthus reticulatus* poir.	Nontoxic	Phyllanthaceae	Bark and root	Red
54.	*Piper betle* L.	Nontoxic	Piperaceae	Leaves	Light Brown
55.	*Psidium guajava* L.	Nontoxic	Myrtaceae	Fruit	Light Mustard
56.	*Punica granatum* L.	Nontoxic	Lythraceae	Flowers	Yellow
57.	*Senna ariculata* (L.) Roxb.	Nontoxic	Fabaceae	Flower and Seed	Yellow
58.	*Senna occidentalis* (L.) Link	Toxic	Fabaceae	Seed	Brown
59.	*Solanum nigrum* L.	Nontoxic	Solanaceae	Fruit	Light Mustard
60.	*Syzygium cumini* (L.) Skeels.	Nontoxic	Myrtaceae	Bark, Leaf and Fruit	Blue and Red
61.	*Tectona grandis* L.f.	Nontoxic	Lamiaceae	Leaf and Bark	Black and Yellow
62.	*Terminalia chebula* Retz.	Nontoxic	Combretaceae	Fruit	Black and Yellow
63.	*Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J.Wen	Mulakaranai	Rutaceae	Root	Yellow

Figure 1



a b c d

e f g h

a- ***Achyranthes aspera*** **L. - Ethyl acetate**

b- ***Aegle marmelos*** **(L.) Correa - Ethyl acetate**

c- ***Barleria cristata*** **L. - Aqueous extract**

d- ***Senna ariculata*** **(L.) Roxb. - Aqueous extract**

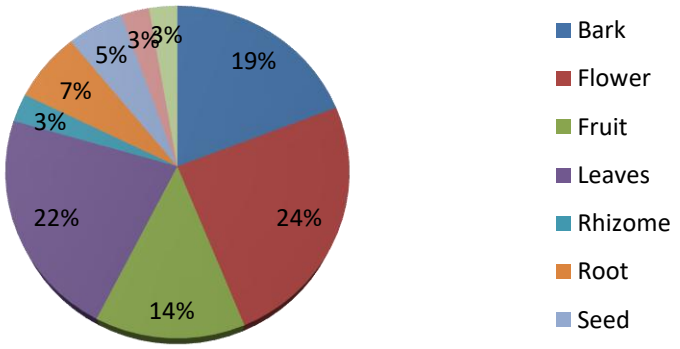
e- ***Coccinia grandis*** **(L.) Voigt - Aqueous extract**

f- ***Nyctanthes arbortristis*** **L. - Aqueous extract**

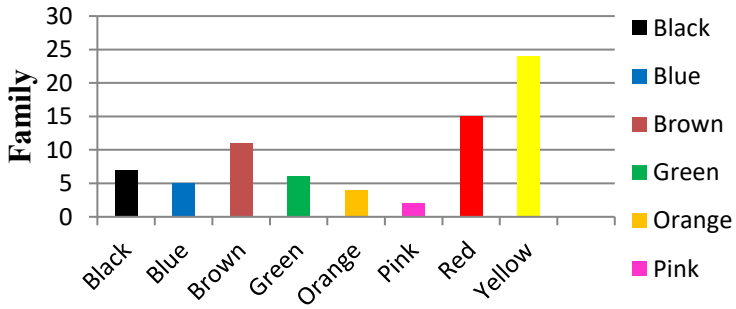
g- ***Punica granatum*** **L. - Ethyl acetate**

h- ***Nyctanthes arbortristis*** **L. - Ethyl acetate**

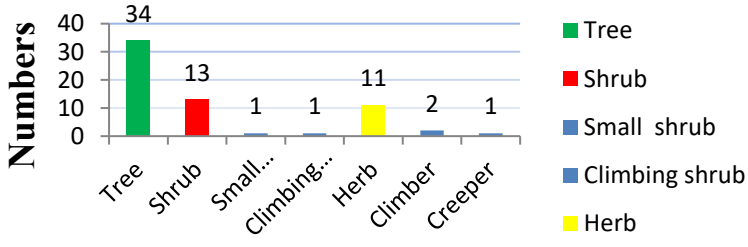
Graph 1
Natural dye yielding plant parts (%)



Graph 2 Various dye represented by.



Graph 3 Habit of dye yielding plants



4. Discussion

The present study of dye-yielding plants was carried out during January to March of 2024, especially in and around the town of Tiruvannamalai district, TamilNadu, India. The assessment of this research work is based on the collection made during the present work and previous reports by various investigations. Regular and periodical visits to different habitats were made during these years of intensive survey. The present work identifies 63 species having a place with 59 genera and 35 families of dye-yielding plants from Tiruvannamalai District.

The close interaction of local communities with the forests and various products is the vital reason for the continued survival of forests. The invention of Indigo, the most important Indian Natural dye, is as old as textile making itself. History reveals that the Chinese have recorded the use of dyestuff even before 2600BC (Susan, 1982).

Herbal dyes were used to colour clothing or other textiles, but by the mid-1800s, chemists began producing synthetic substitutes for them. By the early 20th century, only a small percentage of textile dyes were extracted from plants. Latterly, there has been increasing interest in herbal dyes, as consumers have become aware of ecological and environmental problems related to the use of synthetic dyes (Anonymous, 1991).

The most common herbal parts used for extracting dyes are seeds, flowers, leaves, berries, stems, barks, and roots. Some parts may have more than one colour depending on which part of the plant is used. The shade of colour a plant produces will vary according to the season at which the plant is picked, how it was grown, soil conditions, etc. (Padma and Vankar, 2000), and a combination of these. The dyeing process based on herbal resources includes three major steps, first being the extraction of colouring matter from the plant part, second is creating a bond

between the colouring matter and the fibre to be dyed and the last is actual dyeing. The colour extraction is usually done by powdering the material, then boiling it in water for 10-20 minutes. The yarn or fabric to be dyed is first washed well, then heated in the extract at different temperatures, normally for about 30-40 minutes.

5. Conclusion

The native plants containing aromatic substances, especially colorant behavior screened from our native sixty-three flowering plants, which belong to angiosperms. Among these plants, yellow colour (*Adhatoda vasica* Nees., *Aegle marmelos* (L.) Correa, *Artocarpus heterophyllus* Lam., *Barleria prionitis* L., *Bauhinia tomentosa* L., *Bauhinia variegata* (L.) Benth., *Butea monosperma* (Lam.) Taub., *Carthamus tinctorius* L., *Senna ariculata* (L.) Roxb., *Catharanthus roseus* (L.) G.Don., *Curcuma longa* L., *Dipterocarpus turbinatus* C.F. Gaertn., *Gardenia jasminoides*., J.Ellis., *Phyllanthus emblica* L., *Punica granatum* L., *Psidium guajava* L., *Solanum nigrum* L., *Tectona grandis* L.f., *Terminalia chebula* Retz., *Zanthoxylum asiaticum* (L.) Appelhans, Groppo &J.Wen.,) were observed to be higher than other colours.

Green colour was screened from *Achyranthes aspera* L., *Aloe barbadensis* Mill., *Alpinia galanga* (L.)Willd., *Azadirachta indica* A. Juzz., *Cnidoscolus aconitifolius* (Mill.) I.M.Johnst., and *Eucalyptus globulus* Labill.

Brown colour was observed from *Acacia nilotica* L.Willd.ex Delile., *Aegle marmelos* (L.) Correa., *Anacardium occidentale* L., *Areca catechu* L., *Azadirachta indica* A.Juzz., *Betula utilis* D.Don., *Cassia fistula* L., *Cassia occidentalis* L., *Coccinia grandis* L., *Dendranthema grandiflorum* L., *Dipterocarpus turbinatus* C.F. Gaertn., *Geranium wallichianum* D.Don., *Hibiscus* rosa-*sinensis* L., *Peltophorum pterocarpum* (DC.) K.Heyne., and *Piper betle* L.

Orange colour was remarked from *Helianthus annuus* L., *Lawsonia inermis* L., *Mallotus philippensis* (Lam.) Muell.Arg., and *Mangifera indica* L.

Red colour was recognized from *Alpinia galanga* (L.)Willd., *Althaea rosea* (L.) Cav., *Bixa orellana* L., *Biancaea sappan* L., *Carthamus tinctorius* L., *Casuarina equisetifolia* L., *Crossandra infundibulformis* (L.) Nees., *Euphorbia tirucalli* L., *Geranium wallichianum* Oliv., *Hibiscus rosa-sinensis* L., *Lawsonia inermis* L., *Malpighia glabra* L., *Morinda citrifolia* L., *Oldenlandia umbellata* L., *Papavar rhoeas* L., *Phyllanthus reticulatus* Poir. and *Syzygium cumini* (L.) Skeels.

Blue colour was noticed from *Barleria cristata* L., *Clitoria ternatea* L., *Eugenia jambolama* Lam., *Indigofera tinctoria* L., *Jatropha curcas* L., *Oxalis corniculata* L., *Phyllanthus emblica* L., and *Syzygium cumini* (L.) Skeels.

Black colour was detected from *Acacia nilotica* L.Willd.ex Delile., *Areca catechu* L., *Citrus medica* L., *Heliotropium strigosum* Willd., *Indigofera tinctoria* L., *Peltophorum pterocarpum* (DC.) K.Heyne., *Tectona grandis* L.f., and *Terminalia chebula* Retz.

Pink colour was obtained from the very least number of plants (*Bixa orellana* L., and *Malpighia glabra* L.).

Dye-bearing plants are classified into two categories they were toxin and non-toxin. Nontoxic plants are mostly edible, so their dyes are also nontoxic. it can be used in the food industry, cosmetics, paper industry, paint industry, textile industry, leather industry, and pharma industry in the future, but toxic plant dyes are used only leather, paper, and paint industries.

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