J. Mountain Res. P-ISSN: 0974-3030, E-ISSN: 2582-5011
Vol. 19(2), (2024), 239-248
DOI: https://doi.org/10.51220/jmr.v19-i2.25

A Survey of Some Floral Dye-Yielding Plants of District Nainital Uttarakhand, India

Anshul Kathayat[1] • Himanshu Pandey[2] • Nirmala Pargaien[1] • Ameeta Tiwari[2*]

[1]*Department of Botany, M. B. Govt. P. G. College Haldwani, Nainital, Uttarakhand, 263139*
[2] *Department of Chemistry, M. B. Govt. P. G. College Haldwani, Nainital, Uttarakhand, 263139*

*Corresponding author email id: ameetachemistry@gmail.com

Received: 13.05.2024 Revised: 4.11.2024 Accepted: 30.11.2024

Abstract: Taking into consideration the increased use of chemicals in every field of life and the increasing concern to protect biodiversity, this study focuses on the use of flowers in plants to extract natural dyes in Nainital district, Uttarakhand. The study presents reports on 21 plants whose flowers can be used to extract natural dyes, out of which the maximum plants belong to the family Fabaceae, the maximum colours obtained are yellow and pink, and the maximum plants belong to the shrub habit. The objective of this study is to address the concern regarding the increasing use of non-biodegradable, disease-causing chemicals in every field of life. The replacement of natural dyes with synthetic dyes is a bane to biodiversity. Hence, it is necessary to switch from a chemical life to a natural life. The current study focuses only on the use of flowers of the plant to extract natural dyes; this may give new life to the discarded flowers and may become a sustainable way to protect biodiversity.

Keywords: Flowers • Natural dyes • Biodegradable • Sustainable • Biodiversity • Nainital

Introduction

Dyes are agents that impart color to various substances. They are natural or synthetic based on manufacturing. They have 2 components - Auxochrome and Chromophore. Auxochrome helps dyes to bind with fabrics and chromophore increases its intensity. Natural dyes can be either extracted from animals, insects, or plants. The study focuses on the use of flowering plants to extract the dyes. Flowers are the most beautiful part of plants. They contain colorful petals that are a source to extract natural dyes. This will not cause any harm or loss to biodiversity. Nowadays there is an increased use of synthetic dyes that are non-biodegradable, non-eco-friendly, and can accumulate in an organism's body by bioaccumulation. Also, they produce poisonous waste that is dangerous to humans (Gulrajini 2001). Natural dyes are biodegradable in comparison to synthetic dyes hence they are eco-friendly. Natural dyes just have a single drawback in that they do not fix tightly with the fabrics and hence require a mordanting process. Mordants will increase the binding capability of natural dyes. Such as - Potassium sulfate, Potassium dichromate, Copper sulfate, Ferrous sulfate, and Stannous chloride (Krizova 2015). The history of natural dyes starts from 2600 BC and was first mentioned in Chinese documents. Traces were also found in Tutankhamun's tomb (Siva 2007). From the earlier period, the use of Turmeric, Kachnar, Marigold, and Henna was common. *Rhododendron* and onion skin (Conley and Lewis 1960), Elderberry, and Blueberry uses are mentioned to extract colors like red, blue, and purple dyes (Krizova 2015). The Introduction of Petroleum and coal tar dyes has reduced the use of natural dyes in today's world. Even after knowing that they are carcinogenic and allergic, their production is increasing rapidly worldwide. It is important to replace them with natural dyes as soon as possible to increase the health and integrity of our ecosystem. Dyes can be the most important uses of plants as they are associated with rituals, art, craft, fabrics and to satisfy personal embodiment however, the dye-yielding plants have not received significant attention. At the world level, the work is also contributed by some American publishers, Furry and Vinmont (1935), and Kierstead (1950), who provide extensive instructions on home dyeing. In India, the introduction to natural dyes was given by Gulrajini and Gupta (1992), Nishida and Kobayashi (1992); gives knowledge about the

dye-yielding capabilities of vegetable sources, Mahanta and Tiwari (2005) mentioned the dye-yielding plants of Arunachal Pradesh, Chandramouli (1995) mentioned sources of natural dyes in Chennai. An explanation on vegetable dyes from West Bengal by Ghosh (2003) and Rongmei and Yadav (2005) puts light on traditional dye yielding plants of Manipur. Various ethnobotanical studies have been carried out in Uttarakhand, but fewer concerns have been raised regarding the use of plants to extract natural dyes. A lot of work has been done in the Garhwal region of Uttarakhand as compared to the Kumaon region. In Uttarakhand, the introduction to natural dyes was given by Atkinson in 1882. He even included some plants from the Garhwal and Kumaon regions in the second part of "The Himalayan Gazetteer". In Uttarakhand plants like Kaphal, Burans, Akhrot, Dolu, and Tantri were used by the tribal communities from ancient times to yield natural dyes. The contribution given by several scientists i.e. Chandramouli (1995) in Chennai, Joshi and Pandey (1999) in Uttarakhand, Ghosh (2003) in West Bengal, Rongmei and Yadav (2005) in Manipur have promoted plants as a source to extract natural dyes. Other than this Duthie (1906), Osmaston (1927), Rau (1961), Raizada and Saxena (1978), Kala and Gaur (1982), Rajwar and Gupta (1988), Gaur and Bartwal (1995), Dayal and Dobhal (2001) are some of the notable contributors in Uttarakhand. Nainital shows a great diversity of flora and fauna. Hence, different plants can be spotted here whose flowers can be used to extract the natural dyes. The present study is an effort to record some information on the plants that produce floral dyes in the Nainital district, taking into consideration the significance of indigenous knowledge and the future prospects of natural dyes.

Material and Methods

The work presented is survey-based research conducted on plants of the Nainital district, whose flowers are used to extract natural dyes.

The survey was conducted for 9 months between January to September 2023 in different cities of the Nainital district. During this survey, various plant specimens were captured. The main aim of the study is to focus on those plants whose flowers are used to extract dyes, Hence, only those plants were noticed that were in their flowering stage. Between January to March, plants like *Rhododendron*, *Mallow*, *Jacaranda*, and *Delphinium* were captured and between April to September, plants like *Cassia*, *Caesalpinia*, and *Catharanthus* were observed.

After completion of the survey, plants were identified using local flora. Dye extraction was confirmed from the available literature (Gulrajani and Gupta 1992, Chandramouli 1995, Gosh 2003, Rongmei and Yadav 2005, Siva (2007). Various books, sites, and other available sources were also analyzed to confirm the dye extraction from the plants.

A herbarium was also prepared from the samples collected during this study period which also helped us in the identification of the collected species.

Study Area: Uttarakhand is called as the land of Gods or Devbhumi. It is rich in biodiversity. The state has 13 districts and Nainital is one of them. The district includes 8 tehsils, 1141 villages, and 11 towns. It covers an area of 4,251 sq Km. During the research work different cities of Nainital - Haldwani, Kathgodam, Lalkuan, Bhimtal, Nainital and Bhowali were explored to search for those plants whose flowers can be used to extract natural dyes.

Results and Discussion

A total of 21 plant species of 16 botanical families are selected whose flowers can be used to extract natural dyes. 3 plants belong to the family Fabaceae (Peacock flower, *Cassia*, Kachnar), 2 plants belong to family Apocynaceae (Periwinkle, Pink Kaner), Nyctaginaceae (*Bougainvillea*, *Mirabilis jalapa*) and Bignoniaceae (*Jacaranda*, *Tecoma stans*). Other plants were included in the family. Oleaceae, Balsaminaceae, Asteraceae, Combretaceae, Verbenaceae, Ranunculaceae, Portulaceae, Amaranthaceae, Ericaceae, Rosaceae, Cannaceae, Malvaceae (Fig 2).

J. Mountain Res. P-ISSN: 0974-3030, E-ISSN: 2582-5011 DOI: https://doi.org/10.51220/jmr.v19-i2.25
Vol. 19(2), (2024), 239-248

The maximum colors in dye extracted are pink and yellow from 9 plants, followed by red dye from 8 plants, brown and orange dye from 3 plants, and purple dye from 2 plants (Fig 3).

Habits of dye-yielding plants are shrubs (42.9%), trees (38.1%), climbers and vines (14.3%), and herbs (4.8%) (Fig 4).

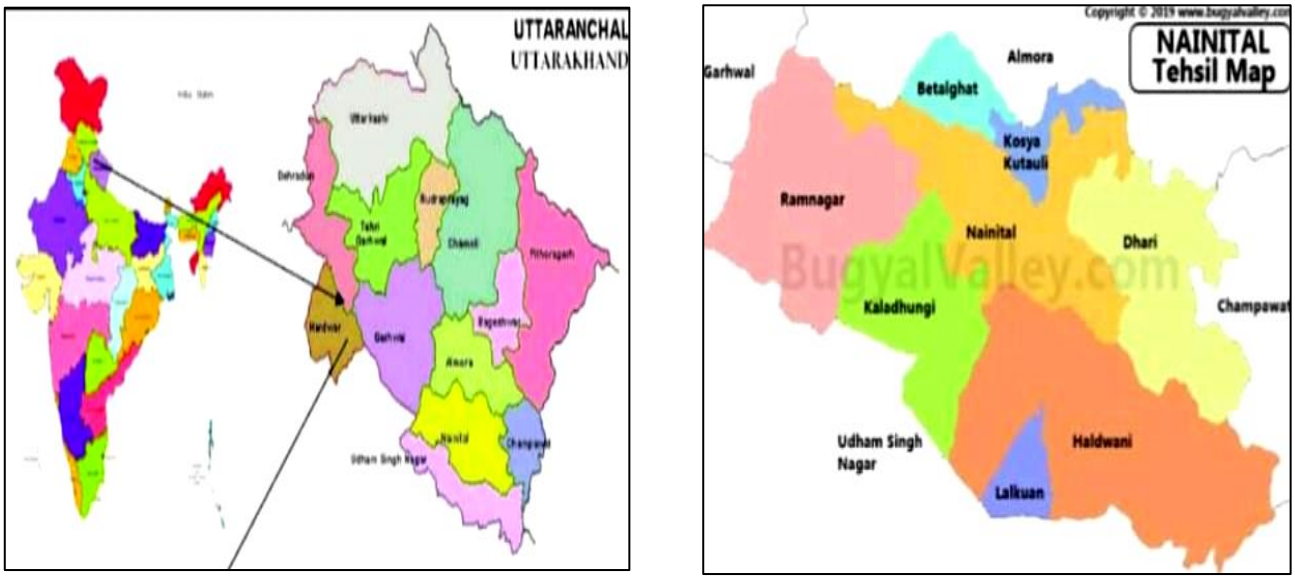

Fig 1. Study area

Table 1. Floral dye-yielding plants of District Nainital along with their Botanical name, Family, habitat, Dye extracted, and Medicinal values.

Botanical names	Plant name English/Local	Family/ (Habit)	Dye extracted	Medicinal uses	References
Bauhinia variegata	Mountain Ebony (Kachnar)	Fabaceae (Tree)	Purple	Abnormal menstruation, stem decoction cure piles, ulcer	(Sachin et al., 2021)
Caesalpinia pulcherrima	Paradise Flower (Peacock Flower)	Fabaceae (Tree)	Mustard	Treatment of cholera, diarrhea, dysentery, and malarial infection.	(Verenkar et al., 2017); (Jaikumar et al., 2017)
Cassia auriculata	Cassia (Senna)	Fabaceae (Tree)	Yellow	Seed cures eyes and root cures skin issues, Anti-Helminthic properties.	(Siva, 2007)
Bougainvillea glabra	Paper flower (Cherei)	Nyctanthaceae (Vines)	Green	Cure respiratory disorders, Anti-cancerous, Antidiabetic, cure wounds.	(Naik et al., 2019); (Vargas and Petricevich, 2018); (Soni and Sherawat, 2019)
Mirabilis Jalapa	4O'Clock Flower (Gulbaas)	Nyctanthaceae (Shrub)	Brown	Leaves cure bruises on the skin, and juice extract is mixed with water to cure jaundice.	(Verenkar et al., 2017); (Malakar and Biswas, 2021)
Nyctanthes arbor-tristis	Night Jasmine (Parijat)	Oleaceae (Tree)	Yellow-Orange	Leave kadha to cure mosquito fever, Hepato-protective, the flower is	(Rahmawati et al., 2020). (Tripathi et al.,

Botanical names	Plant name English/Local	Family/ (Habit)	Dye extracted	Medicinal uses	References
				antipyretic, cures piles, anti-inflammatory properties.	2021)
Impatiens balsamina	Garden Balsam (Glumehndi)	Balsaminaceae (Shrub)	Yellow Red	Cure foot disease, bruises on skin, rheumatism, Vit. C deficiency.	(Chul and Soon, 2003); (Qain et al., 2023)
Rosa indica	Rose (Gulab)	Rosaceae (Shrub)	Brown/ Yellow	Flower decoctions cure heavy menstrual flow, and show activity against HIV infection.	(Zumahi et al., 2018)
Tagetes erecta	Marigold (Genda)	Asteraceae (Shrub)	Yellowish-Orange	Flower and leaves decoction cures diuretics, and flower juice is a blood purifier and cures piles.	(Verenkar et al., 2017); (Shetty et al., 2015)
Malva sylvestris	Creeping Charlie (Mallow)	Malvaceae (Vines)	Purple, Pink	Leaf extract cures pain and discomfort, and root decoction cures urinary and respiratory disorders.	(Rushworth, 2015) (Mousavi et al., 2021)
Jacaranda mimosifolia	Blue Jacaranda (Neeli Glumohar)	Bignoniaceae (Tree)	Blue	Show antiseptic properties, and cures ulcers in the mouth and stomach.	(Ghosh, 2019); (Serra et al., 2020b)
Tecoma stans	Yellow trumpet (Yellow bells)	Bignoniaceae (Tree)	Yellow	Stem, leaf extracts are anti-diabetic, wound healing, and cancer curing.	(Verenkar et al., 2017); (V.S and Raj, 2020)
Combretum indicum	Rangoon Creeper (Madhumalti)	Combretaceae (Vines)	Pink Red	Root and stem extracts have anti-helminthic properties.	(Sahu et al., 2012)
Lantana camara	Wild sage (Ghaneri)	Verbanaceae (Shrub)	Reddish-yellow	Leaf extract cures rheumatism, ulcers, cancer, malaria, and tetanus.	(Datta et al., 2023); (Kalita et al., 2012)
Canna indica	Canna lily (Keli)	Cannaceae (Shrub)	Yellow	Rhizome cures dropsy and jaundice, leaves infusion treat malaria, and flowers prevent bleeding from wounds.	(Sahoo et al., 2020); (Hosur and Handral, 2021)
Nerium oleander	Dogbane (Pink Kaner)	Apocynaceae(Tree)	Creamy pinkish	Oil has anti-cancerous properties, root extract cures leprosy and skin disease, and peel powder cures ear pain.	(Verenkar et al., 2017); (Ghule et al., 2022)
Celosia argentea	Silver cockscomb	Amaranthaceae (Shrub)	Greenish	A folk medicine to cure Diabetes, diarrhea, and	(Zumahi et al., 2018); (Thorat,

Botanical names	Plant name English/Local	Family/ (Habit)	Dye extracted	Medicinal uses	References
	(Wool flower)			gonorrhea, seed cure wounds.	2018)
Portulaca oleracea	Purslane (Portulaca)	Portulaceae (Herb)	Yellow Pink	Neuroprotective substance cures ulcers in the mouth and stomach.	(Zhang et al., 2022); (Zhou et al., 2015)
Delphinium grandiflorum	Larks Claw (Larkspur)	Ranunculaceae (Shrub)	Purple, pink	Chinese folk medicine cures rheumatism, scabies, toothache, edema, and traumatic injury.	(Swami et al., 2020); (Yin et al., 2020)
Catharanthus roseus	Periwinkle (Sadabahar)	Apocynaceae (Shrub)	Pinkish red	Roots cure diabetes and dysentery, Leaves cure Hypertension and cancer, Cure insect bites.	(Islam et al., 2018)
Rhododendron arboretum	Buransh (Burans)	Ericaceae (Tree)	Reddish-Brown	Quercetin has anti-cancerous properties, and Cure skin problems, bad cholesterol.	(Kim et al., 2013); (Sharma et al., 2022); (Madhvi et al., 2019)

Table 2: Uses of Dyes in Different Fields

Dye Usage Fields	Plants Used	Dye Colour Extracted	References
WOOL (Fabrics)	*Portulaca oleracea* *Lantana camara* *Malva sylvestris* *Nyctanthes arbor-tristis* *Impatiens balsamina* *Celosia cristata*	Yellow, Pink Reddish-yellow Purple Pink Yellow Orange Olive Green Yellow, Green (Olive, Dull)	(Zhang et al., 2022) (Datta et al., 2023) (Rushworth, 2015) (Adeel et al., 2022) (Annapoorani and Divya, 2012) (Vankar and Shanker, 2008)
COTTON (Fabrics)	*Bougainville glabra* *Caesalpinia pulcherrima* *Mirabilis jalapa* *Rosa indica* *Cassia auriculata* *Tecoma stans*	Green Green Olive Brown, Pink Mustard, Green Yellow	(Naik et al., 2019) (Naik et al., 2019) (Annapoorani and Divya, 2014) (Patil et al., 2016) (Muruganandham et al., 2023) (Chandra et al., 2012)
SILK (Fabrics)	*Impatiens balsamina* *Nerium oleander* *Tagetes erecta* *Cassia auriculata* *Delphinium grandiflorum*	Yellow Red Creamy- Pinkish Yellow-Orangish Yellowish Purple, pink	(Chul and soon, 2003) (Vankar and Shanker, 2008) (Chavan and Ghosh, 2015) (Muruganandham et al., 2023) (Kiumarsi et al., 2016)
DSSC (Dye Sensitized Solar Cell)	*Catharanthus roseus* *Rhododendron arboretum* *Bauhinia purpurea* *Canna indica*	Pinkish red Reddish-Brown Purple Red, Yellow	(Islam et al., 2018) (Kim et al., 2013) (Sudhakar et al., 2016) (Sahoo et al., 2020);

DOI: https://doi.org/10.51220/jmr.v19-i2.25

LEATHER	*Cassia auriculata*	Brown, Green,	(Muruganandham et al., 2023)

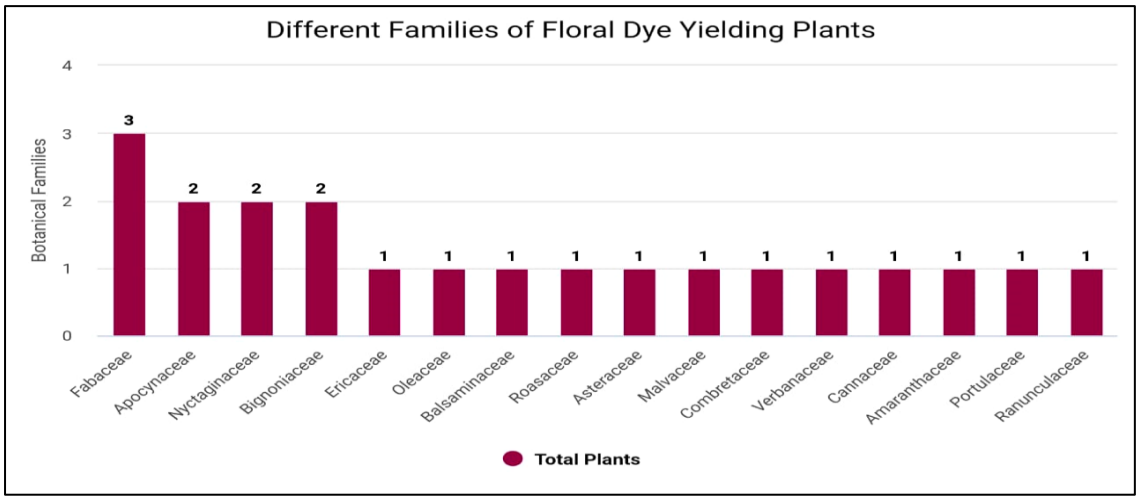

Fig 2. Different families of dye yielding plants

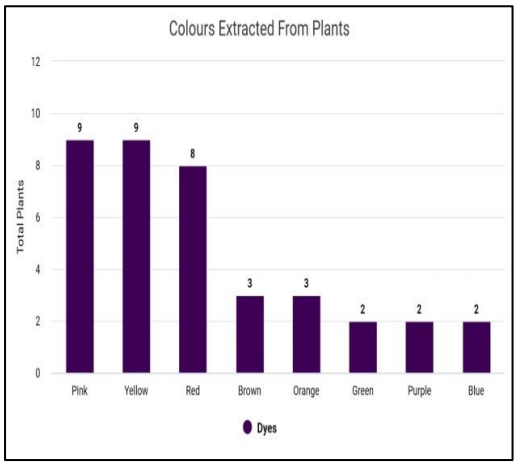

Fig 3. Colours extracted from plants.

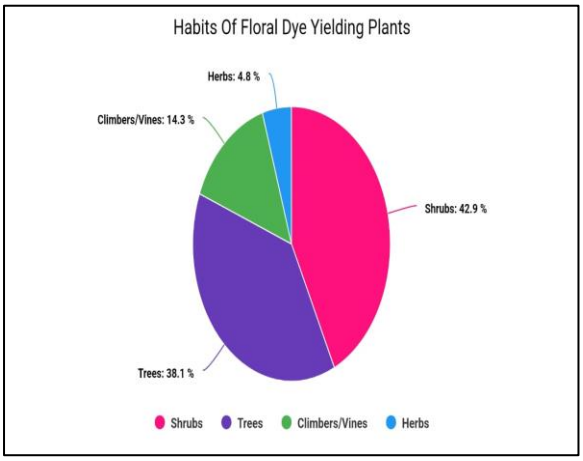

Fig 4. Habits of floral dye yielding plants

Conclusion

In order to find the flowering plants with dye-yielding capacity, a survey was conducted from January to September 2023 in the Nainital district of Uttarakhand. Nainital shows a vast range of biodiversity. Hence, a total of twenty-one plant species were selected whose flowers can be used to extract the natural dyes. The main objective behind the survey-based research work is the concern regarding the increased use of chemicals in every field of life. These chemicals are non-biodegradable and can accumulate in the organism's body, resulting in harmful diseases like cancer, lung disease, kidney disease, and CNS disorders. The dyes are mostly extracted from the flowers, and hence no harm is caused to the plant by the extraction of these dyes. These plants also carry immense medicinal value, such as anti-cancer, anti-diabetic, anti-ulcer, and hepatoprotective properties, and can also be used to cure anxiety and depression. The use of natural dyes from the flower will not cause any loss to biodiversity; it will also help in the protection of

biodiversity from the increasing use of non-biodegradable, polluting, and harmful chemicals.

Acknowledgements

The author is thankful to the Head, Department of Botany, M.B.G.P.G College, Haldwani, for providing essential facilities.

References

Adeel S, Ahmad S, Habib N, Rehman F, Rony M and Bulbul M (2022). Coloring efficacy of *Nyctanthes Arbor-tristis* based yellow natural dye for surface-modified wool. *Industrial Crops and Products*, 188, 115571.

Annapoorani G and Sundarraj D (2012). Dyeing of cotton and wool fabric using *Mirabilis jalapa* flower. *International Journal of Science and Research*, 3(7), pp. 1126-1129.

Chandra M, Thiripura S, Senthil KR and Thiyagarajan A. (2012). Dyeing of Cotton with Natural Dye Obtained from Flower of *Tecoma stans*. *Universal Journal of Environmental Research and Technology*, 2(1), pp. 41-46.

Chandramouli KV (1995). Sources of Natural Dyes in India: A Compendium with Regional Names, *PST Foundation* Adayar, Madras, Tamil Nadu, pp. 180-186.

Chavan S and Ghosh E (2015). Cotton and silk dyeing with Natural dye extracted from floral parts of African marigolds (*Tagetes erecta*). *International Journal of Research in Advent Technology*, ACGT 2015, pp. 16-19.

Chul CC and Soon KA (2003). A Study on the Dyeing Properties of Silk Fabrics Dyed with *Impatiens balsamina* extract. *Textile Coloration and Finishing*, *15*(1), pp. 1–7.

Conley E and Lewis M (1960). *Vegetable Dyeing*. Paperback, Panland School of Crafts,Penland, N.C, 36.

Datta DB, Das D, Sarkar B, and Majumdar A (2023). *Lantana camara* flowers as a natural dye source for cotton fabrics. *Journal of Natural Fibers*, 20(1), 2159604.

Dayal R and Dobhal PC (2001). Natural dye from some Indian plants, *Colourage*, 48, pp. 33-38.

Duthie JF (1906). Catalogue of the Plants of Kumaon and the Adjacent Portion of Garhwal and Tibet Based on the Collections Made by Strachey and Winterbotton During the Years 1846-1849, London.

Furry MS and Vinmont BM (1935). Home dyeing with natural dyes. U.S. Dept of Agriculture, (reprint. by Thresh Publications), pp. 001-036.

Gaur, R. D., & Barthwal, B. S. (1995). A contribution to the forest flora of Pauri district-Garhwal Himalaya. *Higher plants of Indian subcontinent*, *5*, pp. 1-134.

Ghosh A (2003). Traditional vegetational dyes from Central W. Bengal, *J Econ Taxon Bot*, pp. 7, 825.

Ghosh D (2019). *Science Reporter*.

Ghule YL, Jadhav RS, Vikhe DN and Waghchaure AG (2022). Pharmacognostical study and biological potential of *Nerium Oleander* Linn. *International Journal of Advanced Research in Science, Communication and Technology*, 2(1), pp. 345–352.

Gulrajani ML and Gupta D (1992). Natural Dyes and Application to Textiles, *Department of Textile Technology, IIT*, New Delhi, India, pp. 10-25.

Gulrajini ML (2001). Present Status of Natural Dyes. *Indian Journal of Fibre and Textile Research*, 26, pp. 191-201.

Hosur H and Handral M (2021). A review on *Canna indica* and its pharmacological studies. *World Journal of Pharmaceutical Research*, 10(4), pp. 2003-2012.

Islam MS and Lucky RA (2019). A Study on different plants of Apocynaceae Family and their medicinal uses. *Journal of Pharmaceutical Research*, 4(1), 40-44.

Jaikumar KSJ (2017). Phytochemical analysis of *Caeselpinia pulcherrima* Leaf extract. *IJPSDR*, 9(2), 90-93.

Joshi CS and Pande PC (1999). Kumaon *kala avam sanskriti mein prakritic rang: ek sarvekshan*, In: Ethnobotany of Kumaon Himalaya, by PC Pande, DC Pokhriya and JC

Bhatt (Eds), Scientific Publishers, Jodhpur, 1999, pp. 439-447.

Kala SP and Gaur RD (1982). A contribution to the flora of Gopeshwar, In: Vegetation Wealth of Himalayas, by GS Paliwal (Ed), Puja Publishers, Delhi, pp. 352-419.

Kalita S, Karthik L and Rao VB (2012). A review on medicinal properties of *lantana Camara* Linn. *Research Journal of Pharmacy and Technology*, 5(6), pp. 711–715.

Kierstead SP (1950). Natural dyes. *Bruce Humphries*, Inc., Boston, 104.

Kim HJ, Bin YT, Karthick SN, Hemalatha KV, Raj CJ, Venkatesan S and Vijayakumar G (2013). Natural dye extracted from *Rhododendron* species flowers as a photosensitizer in dye sensitized solar cell. *International Journal of Electrochemical Science*, 8(5), pp. 6734-6743.

Kiumarsi A, Gashti MP, Salehi P and Dayeni M (2016). Extraction of dyes from *Delphinium Zalil* flowers and dyeing silk yarns. *Journal of Textile Institute*, 108(1), pp. 66-70.

Křížová H (2015). Natural dyes: their past, present, future and sustainability. *Recent Developments in Fibrous Material Science. Prague: Kosmas Publishing*, pp. 59-71.

Madhvi SK, Sharma M, Iqbal J and Younis M (2019). Phytochemistry, Traditional uses and Pharmacology of *Rhododendron arboreum*: A Review. *Research Journal of Pharmacy and Technology*, *12*(9), 4565.

Mahanta D and Tiwari SC (2005). Natural dye-yielding plants and indigenous knowledge on dye preparation in Arunachal Pradesh, Northeast India. *Current Science*, 88, pp. 1474-1780.

Malakar M and Biswas S (2021). *Mirabilis*: Medicinal uses and conservation. In *Springer eBooks*, pp. 1–57.

Mousavi SM, Hashemi SA, Behbudi G, Mazraedoost S, Omidifar N, Gholami A, Chiang W, Babapoor A and Rumjit NP (2021). A Review on Health Benefits of Malva sylvestris L. Nutritional Compounds for Metabolites, Antioxidants, and Anti-Inflammatory, Anticancer, and Antimicrobial Applications. *Evidence-based Complementary and Alternative Medicine*, 2021, pp. 1-13.

Muruganandham M, Sivasubramanian K, Velmurugan P, Suresh, Arumugam N, Almansour AI, Suresh KR, Manickam S, Pang CH and Sivakumar S (2023). An eco-friendly ultrasound approach to extracting yellow dye from *Cassia* flower petals: Characterization, dyeing, and antibacterial properties. *Ultrasonics sonochemistry*, 98, 106519.

Naik R, S S, P P, A M and V SS (2019). Extraction of Natural Dyes from floral parts of plants and its application in Fabrics. *JETIR*, *6*(5), pp. 377–380.

Nishida K and Kobayashi K (1992). Dyeing Properties of Natural Dyes under aftertreatment using Metallic Mordants, *American Dyestuff Reporter*, 81, pp. 61-63.

Osmaston AE (1927). A Forest Flora for Kumaon, *Govt. Press*, Allahabad, 526.

Patil BD, Patil KN, Gaikwad PV, Shewale LU and Bamburdekar BS (2016). Extraction of natural dye from Rose Flower for dyeing cotton fabrics. *International Journal for Innovative Research in Multidisciplinary Field*, 2, pp. 135–137.

Qian H, Wang B, Ma J, Li C, Zhang Q and Zhao Y (2023). *Impatiens balsamina*: An updated review on the ethnobotanical uses, phytochemistry, and pharmacological activity. *Journal of Ethnopharmacology*, 303, 115956.

Rahmawati D, Lestari U and Kasmudjiastuti E (2020). Utilization of *Nyctanthes arbor-tristis* L and *Artocarpus heterophyllus* Lam extracts as natural dyes for sheepskins leather with different mordants. *Majalah Kulit, Karet, Dan Plastik*, 36(2), 73.

Raizada MB and Saxena HO (1978). Flora of Mussoorie, Bishen Singh Mahendra Pal Singh, Dehradun, 1.

Rajwar GS and Gupta SK, Subodh K (1988). Flora of Garhwal Siwaliks between Khoh and

Ganga. *Indian Journal of Forestry*, 11(1), pp. 69-73.

Rau MA (1961). Flowering plants and ferns of North Garhwal, U.P., India, Bull Bot Surv India, 2, 61-94.

Rongmei GAK and Yadav PS (2005). Traditional dye yielding plants of Manipur, NE India, *Indian Journal of Traditional Knowledge*, 4, pp. 33-38.

Rushworth F (2015). Dyeing Wool with Rose Mallow Flowers. *Https://Wooltribulations.Blogspot.Com*..

Sachin NG (2021). A review article on: Kachnara, *WJPMR*, 7(6), pp. 143-147.

Sahoo SS, Salunke GS, Kadam V and Pathan HM (2020). *Canna* Lily Red and Yellow Flower Extracts: A New Power Source to Produce Photovoltage through Dye-Sensitized Solar Cells. *Energy & Fuels*, 34(8), pp. 9674–9682.

Sahu J (2012). *Quisqualis indica* Linn: A review of its medicinal properties. *International Journal of Pharmaceutical and Phytopharmacological Research*, 249-6084, pp. 313–321.

Serra MB, W A, Filho FFS, Silva SDN, Borges ACR, Campos MB, Borges MOR (2020b). Pharmacological Evidence from Plants of Genus *Jacaranda*. *Biomedical Journal of Scientific and Technical Research*, 28(4), pp. 21730-21734.

Sharma M, Arya G and Borah A (2022). *Rhododendron arboreum* and its potential health benefits: A Review. The Pharmacy Innov. J, 11(6), pp. 926-933.

Shetty LJ, Sakr FM, Obaidy K, Patel MJ and Shareef H (2015). A brief review on medicinal plant *Tagetes erecta* Linn. J App Pharm Sci, 5 (Suppl 3): pp. 091-095.

Siva R (2007). Status of Natural Dyes and Dye yielding plants in India. *Current Science*, 92(7), pp. 916-925.

Soni H and Sehrawat S (2019). Phytopharmacology Profile of *Bougainvillea glabra*: An Overview. *British Journal of Medical and Health Research*, 6(5), pp. 29–38.

Sudhakar C, Selvankumar T, Selvam K and Govindaraju M (2016). *Bauhinia purpurea* L. flower-mediated dye used as sensitizer for TiO2-based dye-sensitized solar cells. *International Journal on Advanced Science, Engineering*, 2(4), pp. 209-13.

Swami SB, Ghgare SN, Swami SS, Shinde KJ, Kalse SB and Pardeshi IL (2020). Natural pigments from plant sources: A review. *The Pharma Innovation Journal*, 9(10), pp. 566-574.

Thorat BR (2018). Review on *Celosia argentea* L. Plant. *Research Journal of Pharmacognosy and Phytochemistry*, 10(1), pp. 109-119.

Tripathi A, Kumar S and Srivastava KS (2021). Medicinal Properties of Harsingar (*Nyctanthes Arbor-Tristis* Linn.): A review. *IJCRT*, 9(1), pp. 3406–3410.

V.S AVJ and Raj SJ (2020). Therapeutic Properties and Applications of *Tecoma stans* Linn. Int. J. Pharm. Sci. Rev. Res., 63(1), pp. 111-115.

Vankar PS and Shanker R (2008). Ultrasonic dyeing of cotton and silk with *Nerium oleander* flower. *Colourage*, 55, pp. 90-94.

Vargas RA and Petricevich VL (2018). *Bougainvillea* Genus: A review on Phytochemistry, pharmacology, and Toxicology. *Evidence-based Complementary and Alternative Medicine, 2018*, pp. 1–17.

Verenkar NGS and Krishnan S (2017). Some potential natural dye-yielding plants from the State of Goa, India. *Indian Journal of Natural Products and Resources*, *8*(4), pp. 306–315.

Yin T, Cai L and Ding Z (2020). An overview of the chemical constituents from the genus *Delphinium* reported in the last four decades. *RSC advances*, 10(23), pp. 13669-13686.

Zhang W, Wang X, Weng J, Liu X, Qin S, Li X and Gong J (2022). Eco-dyeing and functional finishing of wool fabric based on *Portulaca oleracea* L. as colorant and Musa basjoo as natural mordant. *Arabian Journal of Chemistry*, 15(2), pp. 1-13.

Zhou Y, Xin H, Rahman K, Wang S, Peng C and Zhang H (2015). *Portulaca Oleracea* L. A Review of Phytochemistry and

Pharmacological Effects. *BioMed Research International*,2015, pp. 1–11.

Zumahi SM, Hossain MK, Islam S, Abser MN, Matin R, Bashar MS, Hossain F and Hossain MA (2018). Extraction of different natural Dyes from Flower Plants. *International Conference on Recent Advances in Mathematical and Physical Sciences.* Jahangirnagar University, Savar, Dhaka, Bangladesh.