Environment and Ecology 41(3) : 1425—1431, July—September 2023
Article DOI: https://doi.org/10.60151/envec/PANQ7879
ISSN 0970-0420

Studies on the Diversity of Tannins and Dyes Yielding Plants of Kathua District of J and K, India

Rupinder Kaur, Rekha Dhanai, Joshna Sharma, Sunil Puri

Received 9 February 2023, Accepted 20 May 2023, Published on 24 July 2023

ABSTRACT

Dyes are the manufactured or natural compounds used to color a variety of things. They are derived from many plant parts, including the leaf, stem, bark, rhizome, flower, buds and berries, among others. The diversity of plants that produce tannin and dyes in J and K's Kathua district is the subject of the current study. The current study provides information on 35 species of tannin and dye-producing plants from 31 genera and 20 families, along with information on their common names, families, components they are used for and their applications. With the aid of locals and the material that was readily available, the trees were recognized. The families such as Fabaceae and Combretaceae were represented by higher number of species. Natural dye-producing plants are extremely important in the socio-economic and socio-cultural lives of ethnic people, and promoting these products in a controlled manner can help to preserve traditional knowledge and local biodiversity. However, it is concerning that indigenous expertise of natural dye extraction, processing, and application has dwindled as a result of the widespread availability of synthetic dyes.

Keywords Tannin, Dye, Traditional knowledge, Kathua district, Ethnic communities.

INTRODUCTION

Plants are employed not just for essential life-sustaining necessities like as food, fuel, and shelter, but also for clothing and natural colors. The interaction and approach of tribal communities with the forests is the vital reason for the discovery of various new herbals. Tannins are phenol glycosides and non-crystallizable compounds which are found in many plants product of secondary metabolism. Their water-soluble nature makes extraction simple and makes them valuable in a variety of chemical and medicinal applications. Complex, organic, non-nitrogenous, polyphenolic compounds with a greater molecular weight are known as tannins. They serve as antiseptics and are employed in the production of ink, leather goods and textile dyes. Tannins are amorphous, pale-yellow to brown-red compounds that are widely present in plants and can be extracted from their barks, stems, leaves and roots.

Tannins are secondary plant compounds found in stems, bark, leaves, flowers, seeds, and cell walls or vacuoles of dicotyledonous plants. These may be found in a variety of plant materials such as leaves,

Rupinder Kaur[1]*, Rekha Dhanai[2],
[1,2]Assistant Professor, Department of Agriculture, Tula's institute, Dehradun, Uttarakhand 248001, India

Joshna Sharma[3]
Uttaranchal College of Science and Technology, Dehradun, Uttarakhand 248001, India

Sunil Puri[4]
Dean-academics cum Registrar, Shoolini University, Solan (HP) 173229, India

Email: roopnarang@gmail.com
*Corresponding author

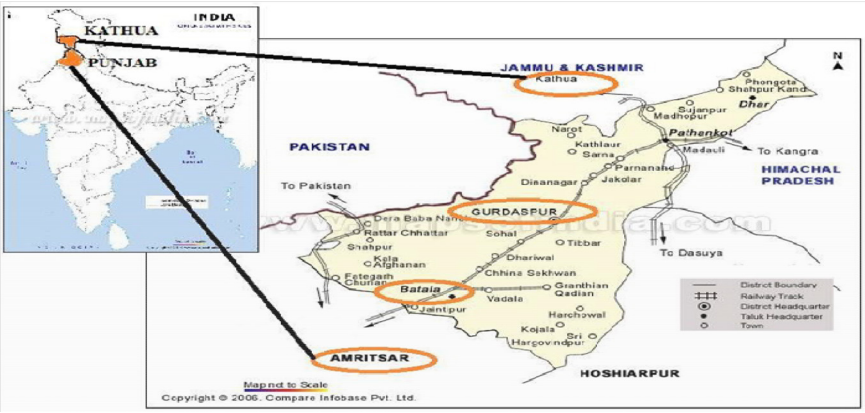

Fig. 1. Showing map of Kathua district.

fruits, wood, bark and many other plant species. Plants, animals, insects, and other naturally existing sources can all be used to make natural dyes. But unlike any other source, plants create natural dyes that exhibit a wide range of colors. These plants have therapeutic qualities in addition to their ability to produce dye. Since the discovery of synthetic dyes, the use of natural dyes has declined (Singh and Singh 2002). Dyes have found use in paints, inks, textiles, polymers and other materials. Seeds, flowers, leaves, berries, stems, barks, and roots are the most essential elements utilized in dye extraction. The shade of color produced by a plant might vary depending on the season, how it was grown, soil conditions, and so on. Natural fibers such as cotton, linen, wood, jute, silk and sisal work well with herbal dyes.

Red color dyes, yellow color dyes, blue color dyes, and black color dyes are the hues-or predominant colors-by which natural dyes are categorized. To ensure that the color is somewhat fast to sunshine and washing, herbal dyes need a mordant, which are metallic salts of aluminium, iron, chromium, copper, and others. To make the fiber susceptible to dye, mordants form a connection between the dye and fiber. According to Chengaiah *et al*. (2010), herbal dyes are important for fibers like cotton, silk, jute, ramie, linen, wool and sisal. It is an older surviving example of textile dyeing derived from a piece of cloth colored with natural madder *Rubia cordifolia* (Yusuf *et al.* 2016).

Most natural dyes have been largely superseded by synthetic dyes in recent years, which are used extensively to color meals and textiles. Pollutants are emitted from the fast food and textile industries as a result. Since the discovery of synthetic dyes, the use of natural dyes has declined. However, numerous studies have shown that synthetic dyes are hazardous to both human health and the environment. This is a significant contributor to both substantial health risks and environmental damage. Because of the excessive use of synthetic colors in the food, textile, drug and other industries, there has been an alarming breakout of several diseases and ailments. Screening natural dyes from plant sources and choosing the most environmentally friendly and biodegradable ones for usage in businesses is therefore urgently needed.

Several publications on traditional health care practices, wild edible plants, ethno veterinary plants and fiber plants have been published (Das and Mondal 2012a, Rashid 2013, Sutradhar *et al.* (2015), Patil *et al.* (2019) and Pathania *et al*. (2021) which claimed that substantial ethno botany study has raised awareness among scientists in India over the previous 15-20 years. The goal of this study was to conduct a comprehensive survey to identify tannins and dyes yielding plants, useful information of these plants, and to learn how tribal peoples use these plants to acquire tannins and colors.

MATERIALS AND METHODS

The Kathua district of Jammu and Kashmir was chosen for this study because it lies between 320-17’ N

Table 1. List of tannins and dye yielding plants along with their uses reported from Kathua district (J and K).

Sl. No.	Name of plants	Common name	Family	Plant part containing tannin	Plant part containing dyes	Applications of tannins and dyes
1	*Acacia nilotica*	Babul	Fabaceae	Deseeded Pods	Fruit and gum yield black color	Used for the textile coloration
2	*Acacia catechu*	Cutch black, Khair	Fabaceae	Bark	Brown	Used for coloring the fabric, Paper, soaps
3	*Cassia fistula*	Golden rain, Kroongal	Fabaceae	Bark, stems, roots	Bark produces golden yellow, peach to brown, brown to black	Used for coloring the nylon fabric, wool and paper
4	*Lawsonia inermis*	Heena, Mehandi	Lythraceae	Leaves	Leaves produce orange dye	Skin is stained by the dye derived from macerated or powdered leaves. The leaves are also used to color skins, leather, silk and wool
5	*Emblica officinalis*	Amla, Indian gooseberry	Phyllanthaceae	Bark	Black dye from bark	Cotton, rope, silk
6	*Mallotus philippensis*	Kamla	Euphorbiaceae	Fruits	Fruits produce red dye	Silk, cotton, wool
7	*Terminalia arjuna*	Arjun tree	Combretaceae	Bark	Bark	Wool and cotton
8	*Terminalia bellirica*	Bahera	Combretaceae	Stems, leaf, fruits	Stems, leaf, fruits	Silk and cotton
9	*Woodfordia fruticosa*	Dhataki	Lythraceae	Leaves, fruits, flower, gums	Flowers produce red dye	Used for coloring cotton fabrics
10	*Impateins balsamina*	Teera	Balsaminaceae	Leaves	Leaves produce yellow dye	Wool
11	*Tegetes erecta*	Genda	Asteraceae	Flower	Flower produce yellow, orange dye	Used in flavoring cacao
12	*Hibiscus rosa sinensis*	Gudhal, china rose	Malvaceae	Flower	Flower produce red dye	Wool and cotton
13	*Adhatoda vasica*	Adulsa or vasa	Acanthaceae	Stem	Flower produce yellow and orange dye	Cotton
14	*Butea monosperma*	Flame of forest	Fabaceae	Bark	Orange dye from flowers	Orange dye, which is used for coloring the clothes and other decorative purposes
15	*Tectoona grandis*	Teak	Lamiaceae	Stem	Leaves and bark produce black and red dye	Silk, cotton, wool
16	*Curcuma longa*	Turmeric, Haldi	Zingiberaceae	Rhizome	Yellow dye from Rhizome	Wool, silk and cotton, as well as a food colorant
17	*Citrus limon*	Nimbu, limon	Rutaceae	Leaves and bark	Fruit peel	Used as good source material for light yellow and orange dyes for hair coloring
18	*Eucalyptus globules*	Safeda, blue green	Myrtaceae	Leaves	Leaves	Application in the leather tanning industry
19	*Albizia adianthifolia*	Flat crown	Moraceae	Leaves	Leaves	Used in tanning industry
20	*Ficus sur*	Cape fig	Moraceae	Leaves, bark	Leaves and bark	Bark yields a brown dye and also used for tanning leather

Table 1. Continued.

Sl. No.	Name of plants	Common name	Family	Plant part containing tannin	Plant part containing dyes	Applications of tannins and dyes
21	*Pinus roxburgii*	Chir pine	Pinaceae	Needle	Pods on drying gives black, Dye, green dye from needle	Used for making inks
22	*Mangifera indica*	Mango	Anarcardiaceae	Bark and leaves	Bark and leaves gives dyes on drying and crushing	Cotton
23	*Tamarindus indica*	Imli	Fabaceae	Seed testa	Seed	Used for dyeing textiles
24	*Terminalia chebula*	Harad	Combretaceae	Fruit	Fruit and flower gives yellow and brown color	Cotton dyeing
25	*Punica granatum*	Anar	Lythraceae	Fruit	Fruit peel yields red dye	Dyeing cotton fabrics
26	*Bombax ceiba*	Silk cotton tree, Kapok tree	Malvaceae	Root and stem	Flower produce red dye	Used for dyeing cotton, wool, silk and nylon
27	*Ficusreligiosa*	Peepal tree	Moraceae	Bark	Bark produce dark red dye	Used for dyeing silk fabric
28	*Bauhinia variegata*	Kachnar, Orchid tree	Fabaceae Fabaceae	Leaves and bark	Flowers and bark produce purple and brown dye	Used for painting and dyeing clothes
29	*Juglans regia*	Walnut, Akhrot	Juglandaceae	Shelled and inshelled walnut	Leaves, shell and husk	Used for various textile fibers (wool, cotton and viscose)
30	*Indigo tinctoria*	True indigo, Neel	Fabaceae	Whole plant	Bark produces yellowish brown dye	Used as food dye
31	*Helianthus annus*	Sunflower	Asteraceae	Seed	Seeds produces purple dye	Used for dyeing cotton, baskets
32	*Nerium indium*	Kaner	Apocyanaceae	Whole plant	Roots and barks and leaves produce black and green dye	A green dye obtained from leaves used for skin disease treatment
33	*Solanum indicum*	Indian Nightshade, African Eggplant	Solanaceae	Leaves	Half ripe Fruit produce black dye and dark chocolate color dye	Used for dyeing turban, dhoti, chadar, dhoti, chadar
34	*Psidium guajava*	Amrood	Myrataceae	Leaves	Leaves produce yellow, red dye	Used for dyeing cotton fabric and for dyeing matting
35	*Litchi chinensis*	Litchi	Sapindaceae	Seed or semen litchi	Fruit peel and seed	Used for dyeing cellulose fabric namely silk, wool and jute

and 320-55' N latitude and 750-7' E to 740-10' E longitude, encompassing an area of 2651 square kilometers. The current research is based on comprehensive surveys conducted in the Basoli and Billawar villages of Kathua district, J and K, India (Fig. 1). While conducting the survey on tannin and dye yielding plants of the above region from September 2017 to May 2018, information including their local names, plant parts used, altitudinal information, habitat, and so on was obtained from local inhabitants, and additional information was obtained from secondary sources such as the government of Jammu and Kashmir's websites. For data interpretation, references from research papers, books and articles were also used.

Personal interviews and group discussions with community chiefs, old people, women and the village local market were conducted according to

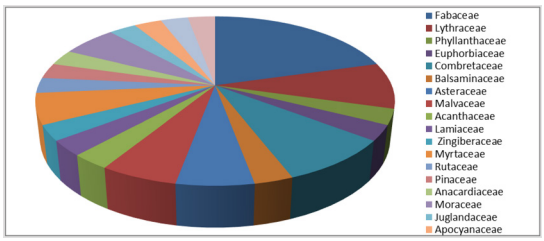

Fig. 2. Plants belonging to different families.

conventional protocol (Jain and Rao 1977, Rao and Hazra 1994). With the assistance of a local informant, the specimens were obtained from the neighboring woodland region. The plant specimens were herbariumed using normal herbarium procedures. Floras of Udhampur (Swami and Gupta 1998) and Flora of Jammu and Plants of the Neighborhood (Sharma and Kachroo 1981) were used to identify herbarium specimens. The data were meticulously documented and analyzed.

RESULTS AND DISCUSSION

The current study includes thorough information on the biological diversity and traditional applications of 35 plants that produce tannin and dyes and belong to 20 different groups in the Kathua district. The following information regarding the plant part utilized to create dyes and tannins, as well as their uses, has been described in Table 1: *Acacia nilotica*, *Acacia catechu*, *Cassis fistula*, *Lawsonia inermis*, *Phyllanthus emblica*, *Mallotus philippensis*, *Terminalia arjuna*, *Terminalia bellerica*, *Woodfordia fruticosa*, *Impateins balsamina*, *Tegetes erecta*, *Hibiscus rosa sinensis*, *Adhatoda vesica*, *Butea monosperma*, *Tectona grandis, Curcuma longa, Citrus limon, Eucalyptus globule*, *Albizia adianthifolia*, *Ficus sur, Pinus roxburgii*, *Mangifera indica, Tamarindus indica, Terminalia cheebula, Punica granatum, Bombax ceiba*, *Ficus religiosa, Bauhinia variegate, Juglans regia, Indigo tinctoria, Nerium indium, Helianthus annus, Solanum indicum, Psidium guajava* and *Litchi chinensis* belonging to 20 families, Fabaceae, Lythraceae, Phyllanthaceae, Euphorbiaceae, Combretaceae, Balsaminaceae, Asteraceae, Malvaceae, Acanthaceae, Lamiaceae, Zingiberaceae, Rutaceae, Myrtaceae, Moraceae, Pinaceae Anarcardiaceae, Juglandaceae, Apocyanaceae, Solanaceae and Sapindaceaeas depicted through Pie-chart (Fig. 2). These tannin and dye-producing plants are commercially and ethno botanically significant. It is derived from diverse plant components such as fruits, stems, seeds, roots, and leaves. These dye-producing plants are used by ethnic communities for a variety of daily activities such as coloring food, clothing, cosmetics and fashion jewellery. For dyeing applications, fresh extracts in paste form are most suitable for the populations.

The current record of 35 species is substantially equivalent to 39 species from Tripura, North-East India (Sutradhar *et al.* 2015), 49 species belonging to 27 families from Ponmudi hills, an eco-tourist region of Trivandrum district of Kerala (Lawarence *et al.* 2015), and 53 sp. of dye yielding plants from Khandesh region of Maharashtra (Patil and Shishode, 2017) is similar to the present survey. As a result, the current study presents the evident resources of tannin and dyes yielding plants, that have a lot of scope and small-scale industrial prospects, as well as indigenous potential of processing the natural dyes from plant parts, that must be evaluated and upgraded, or value added, in order to integrate with modern product generation.

Das and Mondal (2012b) also described 15 traditional dye-producing plants from West Bengal and their therapeutic value. Their research focused on the usage of dye-producing plants by locals in two well-known handicrafts: 'Patchitra' in Pingla and 'Mat craft' in Sabang districts of Paschim Medinipur district. Indigenous knowledge of utilizing these natural colors from plants has been passed down from generation to generation with no changes. Antima *et al.* (2012) also accounted for the dye-producing plants of Garhwal Himalaya, reporting 46 dye-producing plants from 33 families, as well as their habits, portions utilized, dye type, and distribution. Indigenous expertise of natural dye extraction, processing, and application has mostly vanished among new generations of ethnic groups, with only a few remaining practitioners.

Rashid (2013) identified 48 plant species from Rajouri, Jammu and Kashmir, belonging to 40 genera and 27 families. The most regularly utilized families were Asteraceae, Fabaceae, and Rosaceae. Their research found that a significant plant resource base for natural dyes existed in the study region but

is mostly untapped. As the tannins extracted from the vegetables are important in the leather industry, Elgailani and Ishak (2014) analyzed and compared the tannins of three common *Acacia species* in Sudan. The proportion of tannins in the bark, leaves, mature and immature fruits of *Acacia species* was calculated. Sutradhar *et al.* (2015) investigated traditional dye-producing plants in Tripura and identified 39 species from 35 taxa and 26 families, with common name, habit, and plant component utilized to get colored dye. Khan and Sanghi (2016) have identified 15 plant species that produce natural dyes (13 families). Natural colors were continuously explored and over utilized prior to the discovery of synthetic dyes. Plant dyes are regaining popularity due to their non-problematic and environmentally beneficial nature as compared to synthetic colors.

Nikita *et al.* (2017) also identified 62 dye-producing plants from 37 families in Goa, India, and extracted natural colors from diverse plant components such as fruits, seeds, barks, flowers, roots, and so on. Patil *et al.* (2019) also recorded dye-producing plant species, creating the first comprehensive inventory of dye-producing angiosperms in Maharashtra, as well as their resultant color, pigment and range. Based on available research on dye plants and various state and regional floras, a checklist of 195 species dispersed among 153 genera and 58 families is offered. As reported by Kumari *et al.* (2019) clothing and other goods are dyed using these species. There are 17 species of plants that produce dye altogether, spread over 13 families and 17 genera. Different plant components were used, but the majorities were fruits (07 species), followed by bark (04 species), flowers (05 species) and leaves (03 species). 20 plant species, 20 plant genera and 19 plant families as plants that produce dye were recognized by Pathania *et al.* (2021).

Banu *et al.* (2019) reported 50 species of dye-producing angiosperm plants in all, and they come from 27 different families. Bark and flowers were the plant parts which provide most of the dyes, whereas roots and rhizome were employed much less frequently. Natural dyes are therefore preferable to synthetic dyes, and modern technical advancement can boost plant dye production and industrial applications in the future. Mandal and Das (2022) documented the plants utilized by the various tribal and rural populations of West Bengal's Birbhum and Burdwan districts which are used for producing traditional dyes. 32 natural dye-producing plants were reported in total. 2 species, 2 genus and 2 families of monocotyledons and 30 species, 29 genus, 22 families of dicotyledons make up these 32 taxa. Six of the reported plant species are farmed as cultivated crops and garden plants, while 26 are found in the wild. *Bixa orellana*, *Butea monosperma*, *Carthamus tinctorius*, *Lawsonia inermis*, *Calotropis gigantean*, *Nyctanthes arbor-tristis* and *Curcuma* longa were few notable dye-producing plants.

This knowledge may be applied further by workers in the fields of phytochemistry, genetics, the food and textile industries, conservation biology and so on. To evaluate the true potential and availability of natural resources which provide dyes, as well as to propagate species that are in high demand on a commercial scale, more thorough research is required as well as to increase the amount and quality of dye production, biotechnological and other contemporary techniques are needed. For the sake of biodiversity, these significant dye-producing plants ought to be preserved.

CONCLUSION

People are turning to natural goods due to the toxicity of synthetic colors and environmental concerns. Natural dyes are in demand by food businesses because to their non-toxic qualities, absence of side effects, and reduced pollution, yet, due to a lack of recording of this traditional expertise, the extraction and dyeing technology is progressively fading. In Jammu, there is a rich trove of dye-producing plant variety that can entirely replace synthetic dyes to maintain the ecosystem and ecology of our vulnerable areas. Both industrialists and local forest residents may contribute to this initiative by working together. Traditional knowledge about dye and tannin producing plants is limited to the surviving old community members and only a handful of them pass it on to the new generation. No significant efforts have been made in Jammu and Kashmir to chronicle and preserve indigenous people's traditional knowledge and it is past time to save them from extinction. Because natural dyes

are both environmentally friendly and economically viable, they should be explored for long-term use in a variety of applications. The extraction of natural colors from them would benefit the local economy. The current study encourages the use of natural dyes and tannins by different small and large-scale companies for dyeing and leather production, which might benefit the economy.

To summarize, indigenous knowledge of natural dye extraction, processing, and application has declined dramatically among the present generation as a result of the easy availability of low-cost synthetic hues as well as modern attitudes and lifestyles. Traditional indigenous knowledge on dye-producing plants is vital for community development and ecologically beneficial items. It has opened up new avenues for future research on the reported species' many characteristics, such as detailed examination for updating the present list and investigating the conservation aspects of the region's diminishing flora.

REFERENCES

Antima S, Dangwal LR, Mukta D (2012) Dye yielding plants of the Garhwal Himalaya, India: A case study. *Int Res J Biol Sci* 4: 69—72.

Banu M, Rani R, Basha EK (2019) A survey of natural dye yielding plants in Dharampuri district, Tamilnadu, India. *J Emerg Technol Innov Res* 6(1): 201—206.

Chengaiah B, Rao K, Kumar M, Alagusundaram M, Chetty CM (2010) Medicinal importance of natural dyes. *Int J Pharm Technol Res* 1: 144—155.

Das PK, Mondol AK (2012a) The dye yielding plants used in traditional art of Patchitra in Pingla and mat crafts in Sabang with prospecting proper medicinal value in the Paschim Medinipur District, West Bengal. *Int J Life Sci Pharm* 1: 158—171.

Das PK, Mondal AK (2012b) Biodiversity and conservation of some dye yielding plants for justification of its economic status in the local areas of Lateritic Zone of West Bengal, India. *Adv In Bio* 1: 43—53.

Elgailani IEH, Ishak CY (2014) Determination of tannins of three common acacia species of Sudan. *Adv In Chem* 1—5.

Jain SK, Rao RR (1977) A handbook of field and herbarium methods, Today and Tomorrows Printers and Publishers, pp 242.

Khan A, Sanghi SB (2016) Study of natural dye-yielding plants with its medicinal value in district Rajgarh (MP). *Int J Res Granthaalayah* 4(9): 131—135.

Kumari P, Samant SS, Puri S, Singh A, Rathore S (2019) Diversity, indigenous uses and traditional practices of dye yielding plants in Central Himachal Pradesh, Northwestern Himalaya. *Ind J Trad Knowledge* 18(3): 560—564.

Lawarence B, Mahesh S, Aswathy JM, Greeshma M, Muru gan K (2015) Ethnic knowledge of dye yielding plants used by the Kani Tribes of Ponmudi hills: A case study. *Indo Ame J Pharmac Res* 5(7): 2611—2616.

Mandal S, Das U (2022) Studies on diversity of natural dye yielding plants of Birbhum and Burdwan districts of West Bengal, India. *Int J Ecol Pl* 9(1): 022—027.

Nikita GS, Verenkar, Krishnan S (2017) Some potential natural dye yielding plants from the state of Goa, Indian. *Ind J Nat Prod Res* 4: 306—315.

Pathania SM, Bhardwaj P, Pathania SD (2021) Preliminary study on few dye yielding plants of district Solan, Himachal Pradesh. *Int J Prog Res Sci Engg* 2(8): 764—771.

Patil DA, Shisode SB (2017) Natural dye: Yielding vegetable sources in Khandesh region (Maharashtra) India. *Int J Adv Res Dev* 2(5): 18—21.

Patil SH, Kurlapkar DD, Gaikwad DK (2019) Dye yielding plant resources of Maharashtra, India: A checklist. *Biodiversitas* 20(1): 250—266.

Rao RR, Hajra PK (1994) Methods of Research in Ethno botany: A Manual of Ethno botany, Scientific Publishers (India), Jodhpur.

Rashid A (2013) Dye yielding plant diversity of district Rajouri Jammu and Kashmir state-India. *Int J Pharm Bio Sci* 1: 263—266.

Sharma BM, Kachroo P (1981) Flora of Jammu and Plants of Neighbourhood. Editors; Singh Bishen and Pal Mahendra Singh, Dehradun, India, pp 413.

Singh V, Singh RV (2002) Healthy hues. *Down to Earth* 11: 25—31.

Sutradhar B, Dipankar D, Koushik M, Datta BK (2015) Traditional dye yielding plants of Tripura, Northeast India. *Biodiversitas* 2: 121—127.

Swami A, Gupta B (1998) Flora of Udhampur. Publishers: Bishen Singh and Mohinder Pal Singh. Dehradun, India, pp 455.

Yusuf M, Faqeer M, Shabbir M, Khan MA (2016) Eco-dyeing of wool with *Rubia cordifolia* root extract: Assessment of the effect of *Acacia catechu* as bio mordant on color and fastness properties. *J Emerging Techno Innov Res* 2(10): 1—9.