SHORT COMMUNICATION

Natural Dye-Yielding Plants from the Rubiaceae Family

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Abstract

Natural dyes were used in the remote past in various fields of life. Even though the earliest dyes were discovered accidentally, constant experimentation and development have refined the art of dyeing. Even from Mohenjodaro, clothes dyed with plant extracts were discovered, which points to the use of herbal dyeing during the Indus Valley civilization. The existence of natural dyes was annulled by the invention of synthetic dyes at the beginning of the 19th century, but still, natural dyes keep supremacy due to their unique eco-friendly and biodegradable prospects. It is to be foreseen that the natural dyes produce less intense colours and are more prone to poor light, wash, and rub fastnesses. The fastness property can be improved by using different mordants and mordanting methods during the dyeing process. Manufacturers abstained from the usage of organic dyes because these were obtained at extremely small quantities from their sources as well at the expense of extraction. In this paper, the most commonly used natural dyeing plants from the Rubiaceae family, their extraction, and application were discussed.

Keywords: Dyes; Dyeing; Plants; Rubiaceae; Colour; Extraction.

Highlights

Rubiaceae is the fourth largest family in angiosperms

Most of them are useful dye-yielding plants producing various shades of yellow to red

Phenolics and flavonoids are responsible for colour production

Natural dyes are an eco-friendly and sustainable source of colourants

The dye-yielding property of a plant depends on its age, habitat, parts used, time of collection, season of collection etc.

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Introduction

With the advent of technological improvement and related living standards, the world is now looking forward to sustainability. For this, he is trying his best to be back in nature. The same is true of the dyeing industry. With the invention of coal tar-based dyes and their flamboyant colours, the glory of natural dye diminished. Once human is conscious of environmental protection and their health concerns, natural colours have once again gained the attention of the world. These dyes are considered eco-friendly because of their better biodegradability as well as their compatibility with the environment.

The tintorial properties of dyes are well defined in available historical scripts. The 15,000-year-old paint made from plant extracts strongly indicates the usage and processing of wild plants for pigment extraction, before domesticating them for food. Now, these dyes were gathered from plants, insects, minerals, microbes, etc. The natural dyes can be processed after standardizing their extraction and purification. There are different types of extraction processes currently available for these natural dyes, which have their limitations based on the parameters that need to be maintained during the extraction process.

Rubiaceae (Madder family) is a pantropically distributed plant family with more than 600 genera. The plant is characterized by the presence of stipules. The leaves are opposite. Most of them can accumulate various phyto-compounds, which are used to treat various ailments. Various parts of plants were used as dye sources, and the colour produced may range from red to blue. The main constituents behind the dyes produced by plants in the Rubiaceae family are anthraquinones, particularly alizarin and purpurin. These compounds are responsible for the characteristic red or reddish-orange hues that come from plants like madder and others. Anthraquinone itself is a non-phenolic, non-glycoside compound. However, anthraquinone glycosides do exist, where it is linked to a sugar. Flavonoids are a diverse group of plant compounds known for their role in producing colours, particularly in flowers, fruits, and leaves. These compounds are responsible for a wide range of pigments, especially in the yellow, red, blue, and purple spectra. Flavonoids produce colour by absorbing light at specific wavelengths and reflecting others. The specific colour observed depends on the chemical structure and environmental factors like pH and metal ion interactions. The extraction and purification of natural dyes made it expensive during the past centuries. These plants' dyes are largely natural, eco-friendly, and have been replaced in many commercial uses by synthetic dyes, but they are still used in traditional crafts and textiles due to its eco-friendly and biodegradable features. In this paper, the most commonly

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Table 1: List of dye-yielding plants from Rubiaceae

Botanical Name	*Main Constituents*	*Uses as a dye*
Adina cordifolia (Roxb.) Brandis	Adinin, tannins, adifoline, cordifoline, benzoic acid, umbelliferon, hydroxyflavanone, b-sitosterol, Theoleoresin, Adicardin [Negi *et al*., 2022]	The chips of heartwood boiled in water to dye silk and cotton [Kar and Borthakur. 2008]
Coffea arabica L.	Melanoidins, Acrylamide, Chloregenic acid, Catechin, Polyphenol, Phenolic acid [Gallardo-Ignacio *et al*., 2022]	Coffee bean powder was used for dyeing cotton [Adeel *et al*., 2023]
Gardenia jasminoides Ellis.	Linalool, a-farnesene, Triterpenoids, Trans-b-ocimene, Crocin, Crocetin, Geniposide, Genipin, Iridoid glucosides, Gardenoside [Yang *et al*., 2009].	The dye is a carotenoid pigment used as a food additive [Yang *et al*., 2011].
Hamelia patens Jacq.	Isopteropodine, Rumberine, Palmirine, Mitrajavine, Kaempferol, Narirutin, Rosmarinic Acid [Surana and Wagh, 2015]	Leaf extracts are the dye source used in textile industries to impart colour to cotton and silk yarns [Paul *et al*., 2003]
Ixora coccinia L.	Ixorene, Oleanolic acid, Quercetin 3-O-a-Rhamnoside, Kaemferitrin, Rubiothiagepine [Sunitha *et al*., 2015]	Pigments isolated from fresh flowers are used to dye textiles [Ghurde *et al*., 2016]
Mussaenda frondosa L	Caryophyllene, 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-, Quinic acid, linoleic acid ester, [Gopalakrishnan and Vadivel, 2011]	Leaves boiled in water [Kar and Borthakur, 2008] to produce yellow dye to colour silk and cotton
Morinda citrifolia L	Morindone, Anthraquinone Soranjidiol, Rubiadin, Alizarin, Xanthopurpurin, Damnacanthol, Morindanigrin [Krishnaiah *et al*., 2011, Rao 2012]	The root bark produces red, maroon, and chocolate shades on mordanted cotton. [Dhingra, 2016].
Morinda tinctoria Roxb.	Morindaaquinone, Scopoletin, (b)-mellein. Rubiadin, Alizarin, Damnacanthal, Nordamnacanthal, Ibercin, 6-primeveroside of morindone [Hasham *et al*., 2022]	Used to impart crimson, chocolate, dull purple to black based on the mordant used [Sahoo *et al*., 2009]
Morinda umbellata L.	Morindone, Soranjidiol, Rubiadin, Alizarin, Xanthopurpurin, Damnacanthol, Morindanigrin. 1-Undecene, Guanosine, Linolenate, Docosanioic acid, Phytol. Guanosine [Sankar *et al*., 2022]	The root bark contains yellow dye for dyeing cotton, silk, and wool in shades of red, chocolate or purple.
Oldenlandia umbellate L	Hydroxyanthraquinone, Quercetin, g-sitosterol, rutin, iridoid glycosides, biflorine, asperuloside, geniposide [Waghdhare, 2021]	The root bark is a source of anthraquinone-based dye for dyeing calico, wool, and silk [Begum, 2023]
Rubia cordifolia L	Purpurin, Alizarin, Manjistin. Pseudopurpurin, Ibericin, Lucidin, Xanthopurpurin, Rubiadin, Anthragallol, Nordamnacanthal [Natarajan *et al*., 2019]	It is used for textile dyeing and food colouring [Priya and Siril, 2022]

used plants belong to Rubiaceae, and their morphology, characteristics, and application were discussed (Table 1).

Adina cordifolia (Roxb.) Brandis

Syn: *Haldina cordifolia* (Roxb.) Ridsdale, *Nauclea cordifolia* Roxb. *Nauclea sterculiifolia* A. Rich. ex-DC.

Common Name

Yellow teak, saffron teak, turmeric wood, etc. The plant is native to China, Bangladesh, India, Nepal, Sri Lanka and Indo-China. The tree is known as yellow teak because of its yellow-barked tree. Flowers are yellow in round heads. Leaves and bark are applied in various forms to cure jaundice, cold, cough, skin problems, wounds, and stomach-related diseases (Jain *et al*., 2006; Narayan and Singh, 2017). According to Indonesian traditional practitioners, the stem sap can be used to treat eye inflammation. In earlier days, the bark of the tree was used as the dye source for colouring wool and linen. According to Kar and Borthakur (2008), the heartwood chips were boiled in water to get the yellow color dye (Fig 1A).

Coffea arabica L.

Common Name: Coffee, Mountain Coffee, Arabian Coffee

The plant is a native of Ethiopia, Kenya, and Sudan. *C. arabica* is an evergreen shrub or small tree. Flowers are in dense clusters, white, star-shaped, and sweet-scented (Melese and Kolech, 2021). Adeel *et al*., (2023) isolated a natural colorant from coffee powder by boiling it in distilled water. Similarly, Rajakaruna *et al*., (2023) experimented that the leaves of Coffea can be used as a potent colourant for cotton fabrics (Fig 1B).

Gardenia jasminoides Ellis.

Syn *Gardenia augusta* Merr., *Gardenia florida* L. *Genipa florida* (L.) Ball.

Common Name: Common Gardenia, Cape Jasmine

The native range of this species is Indo-China to southern Japan. It is a herbaceous plant reaching up to 1-2 meters in height. Flowers are short-stemmed and sweet-scented and white in colour. The plant is reported to have immense therapeutic

activity (Phatak, 2015). It has been found that the fruit pulp extract surrounding the seed is an excellent source of yellow-scarlet dye 'gardenia yellow' used in textiles and confectionaries (Jarvis *et al*., 2014). For the extraction of dye, the powdered fruit was used. The homogenate extraction technology was found to be an efficient technology to achieve maximum colour value (Zhu *et al*., 2014) (Fig 1C).

Hamelia patens Jacq.

Syn. *Hamelia erecta* Jacq., *Hamelia coccinea*, *Hamelia pedicellate* Wernh. *Hamelia latifolia* Reichb. Ex DC.

Common Name: Firebush, Hummingbird bush, Mexican Firecracker, Redhead, Scarlet Bush.

The plant is native to subtropical and tropical America. It is a shrub or small tree with flowers throughout the year. The inflorescence is a dichasial cyme with tubular flowers (Ahmad *et al*., 2012). The plant contains various phytochemicals that are used to treat various ailments. The plant is reported to have anti-depressant, hepatoprotective, anti-urolithiatic, and diuretic potential (Chauhan and Singh, 2019). Leaves are the source of colourant. A known quantity of leaves (6%) was soaked in water (M: L =1:50) and boiled in water for 90 minutes in an acidic medium. The filtrate can directly be used for dyeing (Paul *et al*., 2003) (Fig 1D)

Ixora coccinia L.

Syn. *Pavetta coccinea* (L.) Blume

Common Name: Jungle Geranium or Flame of the Woods

It is native to Bangladesh, Cambodia, India, Sri Lanka, Thailand, Vietnam.

The plant is a dense evergreen shrub. Leaves are opposite or whorled on the stem. Flowers are small, sessile, and are arranged in dense, rounded clusters. The flowers of Ixora are broadly used in traditional Indian systems of medicine for dysentery, healing of ulcers, and, more recently, for anti-tumor activity. They have also been reported to have anti-inflammatory activity comparable to indomethacin. Leaves contain camptothecin, an alkaloid with potent anticancer activity (Saravanan and Boopalan, 2011). The dye is extracted from petals, which were crushed and boiled in water and methanol at 80 $^{\circ}$C for 2 hours (Ghurde *et al*., 2016) to extract the dye (Fig 1E).

Mussaenda frondosa L

Syn. *Gardenia frondose* (L.) Lam.

Common Name: Dobi tree, Flag bush, White flag, Wild mussaenda, White Lady.

The native range of this species is the Indian subcontinent to the Caroline Islands.

The plant is a straggling shrub; branchlets are pubescent. Leaves broadly ovate, sparsely hairy on both surfaces; Flowers as terminal cymes. Traditionally, the leaves are used in the treatment of various ailments like bronchitis, ulcers, leukoderma, etc. (Shanthi, 2021). The leaves extracted in hot water are used to impart a yellow colour to cotton and silk fabrics (Fig 1F).

Morinda citrifolia L

Syn. *Samama citrifolia* (L.) Kuntze

Common Name: Great Morinda, Indian Mulberry, Noni, Beach Mulberry, Vomit Fruit, and Cheese Fruit

The plant is native to tropical and subtropical Asia to N. Australia. M. citrifolia is a tree with white flowers and broad, elliptical leaves. The root bark, when reached 3-4 years old, roots with not less than 1.3 centimeters are used for dyeing. The root chips were placed in warm water, and the preliminary steeping should be done to eliminate the free acids, and then once again boiled to get the neutral dye-bath to get the best results (Dhingra, 2016) (Fig 1G).

Morinda tinctoria Roxb.

Syn. *Morinda coreia* Buch. -Ham., Morinda pubescens J.E. Smith

Common Name: Aal, Indian Mulberry

It is a native of Sri Lanka, Indiato Indo-china, Jawa.

The tree is evergreen with flowers in spherical heads. The flowers are tubular, white, and scented. The plant is used in traditional medicine to treat menstrual disorders and blood stasis. Morindone is the dyeing compound isolated from the root bark (Gokhale *et al*., 2004), named as 'suranji'. The dye can be used to colour red, chocolate, or purple colour to silk, cotton, and wool (Patel, 2011). As the age increases, the dye content also increases (Sahoo *et al*., 2009) (Fig 1H).

Morinda umbellata L.

Syn. *Gynochthodes umbellate* (L.) Razafim and Bremer

Common Name: Akar Ketang, Akar Perut Ayam, Buha Butang

The plant is native to tropical and subtropical Asia to Marianas.

The plant is a semi-woody to woody climber. The leaves are opposite, flowers in white clusters in traditional medicines, leaf powder is used in diarrhoea and dysentery. It also possesses excellent anti-leukemic and antioxidant potential (Ismail and Sulthana, 2008). The bark and stem extracts are the richest source of molindone, which can impart colour to cotton cloth yellow, red or brown (Fig 1I).

Oldenlandia umbellate L

Syn. Gerontogea umbellate (L.) Cham and Schltdl., Hedyotis brevicalyx Sivar., Biju and P. Mathew, Hedyotis umbellate, *Gerontogea umbellata* (L.) Cham. & Schltdl., *Hedyotis brevicalyx* Sivar., Biju and P. Mathew, Hedyotis umbellate (L.) Lam.

Common Name: Chay Root, Indian madder, Choy root

The native range of this plant is from India and parts of India (Coromandel coast), Burma, Sri Lanka, Cambodia, and Indonesia. It is a small prostrate herb with woody root-stock. Flowers are white in terminal clusters. Fruit is a capsule with many angular and reticulate seeds. The plant can be administered for bronchial asthma. The use of febrifuge and expectorant was well explained. It can also be used in consumptive, and asthmatic affections. From the 17th century, the dye was used in various parts of India to colour traditional clothes (Fig 1J).

Rubia cordifolia L.

Syn. *Gallium cordifolium* (L.) Kuntze

Figure 1: List of dye-yielding plants from Rubiaceae A: *Adina cordifolia*, B: *Coffea arabica*, C: *Gardenia jasminoides,* D: *Hamelia patens,* E: *Ixora coccinia*, F: *Mussaenda frondosa*, G: *Morinda citrifolia*, H: *Morinda tinctoria*, I: *Morinda umbellata*, J: *Oldenlandia umbellata*, K: *Rubia cordifolia*.

Common Name: Indian Madder, Common Madder

The plant is a native of Greece, Sudan, to South Africa, and Asia

R. cordifolia is a climbing herb valuable for its perennial roots. The stem is quadrangular with opposite leaves. Two stipules were modified as leaflets. The roots are used in the cure of leucoderma, urinary discharges, jaundice, and piles (Sivarajan and Balachandran, 1994). The plant is famed for its action on diversified cancer cell lines (Sanz *et al*., 1998).

R. cordifolia is well documented for its anthraquinone from its roots. According to Priya and Siril (2022) the powdered root is boiled in water and fermented for one week to get the dyestuff. It is ascribed as "the queen of natural dyes" to colour various shades of red to fibers and fabrics. is used for imparting red, scarlet, brown, and mauve colours to wool, fibers, and fabrics (Fig 1K).

Conclusion

The widespread use of synthetic dyes has revolutionized various industries due to their vibrant hues and industrial versatility, and cost-effectiveness. However, their environmental and health impacts are increasingly concerning. These dyes are persistent pollutants that can contaminate aquatic environments, disrupting marine life and degrading water quality. Improper disposal and lack of efficient wastewater treatment lead to toxic buildup, affecting both wildlife and human populations leading to long-term ecological damage. Moreover, these synthetic dyes are derived from petroleum sources, contributing to fossil fuel dependency and carbon emission.

The significance of natural dyes extends far beyond their aesthetic appeal. They offer a biodegradable and eco-friendly alternative. Though natural dyes have limitations, ongoing research is improving their application potential. The shift toward natural dyes aligns with sustainable development goals represent a step towards a more sustainable future. Promoting eco-friendly dyeing methods and adopting green technologies can mitigate the harmful consequences of synthetic dyes while supporting a healthier planet.

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Author contribution

The work of *Rubia cordifolia* was done by the author.

Conflict of Interest

None

References

Adeel, S., Rehman, F. U., Amin, A., Amin, N., Batool, F., Hassan, A.; Ozomay, M. (2023). Sustainable exploration of coffee extracts (Coffea arabica l.) for dyeing of microwave-treated bio-mordanted cotton fabric. Pigment & Resin Technology, 52(3), 331-340. https://doi.org/10.1108/PRT-02-2022-0024

Ahmad, A., Pandurangan, A., Singh, N.; Ananad, P. (2012). A mini-review on the chemistry and biology of Hamelia patens (Rubiaceae). Pharmacognosy Journal, 4(29), 1-4. https://doi.org/10.5530/pj.2012.29.1

Begum, N. (2023). A study of Natural Dyes and Dye Yielding Plants and its application on Textile in Ancient India. International Journal of Home Science, 9(1), 102-114.

Chauhan, P.; Singh, M. (2019). A Review on Medicinal Property of Hamelia patens Jacq. Scholars Academic Journal of Pharmacy, 8 (5), 200–207. DOI: 10.21276/sajp.2019.8.5.6

Dhingra, S. (2016). Dyeing with *Morinda citrifolia*: In Pursuit of Sustainable future. Textile Society of America Symposium Proceedings. 957. http://digitalcommons.unl.edu/tsaconf/957

Gallardo-Ignacio, J., Nicasio-Torres, M. P., Santibanez, A., Cabrera-Hilerio, S. L., Cruz-Sosa, F. (2022). Ethnopharmacological study of the genus Coffea and compounds of biological importance. *Revista Mexicana de Ingeniería Química* 21(3): Bio2856-Bio2856.

Ghurde, M. U., Padwad, M. M., Deshmukh, V. R.; Malode, S. N. (2016). Extraction of natural dye from Ixora coccinea (Linn.) flowers for cotton fabric colouration. International Journal of Scientific Research, 5(1), 1272-1276. https://api.semanticscholar.org/CorpusID:4186826

Gokhale, S.B., Tatiya, A.U., Bakliwal, S.R.; Fursule. (2004). Natural dye yielding plant in India. Natural Product Radiance,3(4), 228-34.

Gopalakrishnan, S.; Vadivel, E. (2011). GC-MS analysis of some bioactive constituents of Mussaenda frondosa Linn. International Journal of Pharma and Bio Sciences, 2(1), 313-320.

Hasham, K.M., Visagaperumaal, D.; Chandy, V. (2022). Morinda coriea: An overview for its pharmacological activities and docking studies of rubiadin. International Journal of Research Publication and Reviews, 3(4), 241-262.

Ismail, T. S.; Sulthana, A. P. (2008). Standardization of Morinda umbellata Linn. -an effective crude drug for diarrhoea. E-Journal of Chemistry, 5(3), 652-658. https://doi.org/10.1155/2008/376568

Jain, A. P., Pawar, R. S.; Singhai, A. (2006). Anti-inflammatory and anti-nociptive activity of Adina cordifolia bark. Nigerian Journal of Natural Products and Medicine, 10, 90-93. http://www.ajol.info/index.php/

njnpm/article/view/11860

Jarvis, C. E., DuVal, A.; Crane, P. R. (2014). Gardenia jasminoides: a traditional Chinese dye plant becomes a garden ornamental in Europe. Curtis's botanical magazine, 31(1), 80-98. http://www.jstor.org/stable/45066272

Kar, A.; Borthakur, S. K. (2008). Dye-yielding plants of Assam for dyeing handloom textile products. Indian Journal of Traditional Knowledge, 7 (1), 166-171.

Krishnaiah, D., Sarbatly, R.; Nithyanandam, R.R. (2011). A review of the antioxidant potential of medicinal plant species. Food and Bioproducts Processing, 89, 217-233.

Melese, Y. Y.; Kolech, S. A. (2021). Coffee (Coffea arabica L.): Methods, objectives, and future strategies of breeding in Ethiopia. Sustainability, 13(19), 10814. https://doi.org/10.3390/su131910814

Narayan, D.; Singh, P. K. (2017). Ethnobotanical importance and herbal medicine in Vindhya region of Eastern Uttar Pradesh, India. Journal of Medicinal Plants Research, 11(25), 403-413.

Natarajan, S., Mishra, P., Vadivel, M., Basha, M. G., Kumar, A.; Velusamy, S. (2019). ISSR characterization and quantification of purpurin and alizarin in Rubia cordifolia L. populations from India. Biochemical genetics**,** 57, 56-72. https://doi.org/10.1007/s10528-018-9875-4

Negi, S., Negi, A.; Mishra, M.K. (2022). A Review on Pharmacological and Phytochemical Spectrum of "Traditional Medicinal plant *Adina cordifolia*" Family- Rubiaceae International Journal of Scientific Development and Research, 7(4), 216-222.

Patel, A.R. (2011). Different shades developed on cotton yarn from *Morinda tinctoria* Roxb. Life Sciences Leaflets,19, 788-792.

Paul, S., Sharma, A.; Sharma, E. (2003). Fastness properties of natural dye hamelia (Hamelia patans) on cotton. Textile Trends, 46, 31-35.

Phatak, R.S. (2015). Phytochmistry, Pharmacoloigcal Activities and Intellectual Property Landscape of Gardenia jasminoides Ellis: a Review. Pharmacognosy Journal, 7(5), 254-265. DOI:10.5530/pj.2015.5.1

Priya, M.D.; Siril, E.A. (2022). Effect of mordants and mordanting methods on the dyeing property of anthraquinone based dye from Rubia cordifolia. Discovery, 58(319), 742-749.

Rajakaruna, R.M.M.S., Rathnayaka, R.M.J.C.B.; Udayakumara, S.V. (2023). Extraction of Natural Dyes from leaves of Coffea arabica and its application in cotton fabrics. Material Engineering Symposium on Innovations for Industry. http://dl.lib.uom.lk/handle/123/21239

Rao. V. (2012). Phytochemical constituents and activities of Morinda citrifolia L. Phytochemicals A Global Perspective of Their Role in Nutrition and Health, CBS Publishers & Distributors Pvt. Ltd., New Delhi. pp.127. ISBN978-953-51-0296-0, DOI: 10.5772/26094

Sahoo, A.K., Narayanan, N., Kumar, N.S., Rajan, S., & Mukherjee, P.K. 2009. Phytochemical and therapeutic potentials of *Morinda tinctoria* Roxb. (Indian mulberry). Oriental Pharmacy and Experimental Medicine, 9(2), 101-105. DOI 10.3742/OPEM.2009.9.2.101

Sankar, A., Periyasamy, S.; Chandrabalan, S. (2022). In vitro Evaluation of Antioxidant Property, Chemo-profiling, Elemental Analysis of Morinda umbellata L. International Journal of Pharmaceutical Investigation, 12(4), 423-429. DOI: 10.5530/ijpi.2022.4.73

Sanz, M.A., de la Rubia J., Bonanad, S., Barragan, E., Sempere, A., Martin, G., Martinez, J.A., Jimenez, C., Cervera, J., Bolufer, P.; Sanz, G.F. (1998). Prolonged molecular remission after PML/RAR alpha-positive autologous peripheral blood stem cell transplantation in acute promyelocytic leukemia is relevant pre-transplant minimal residual disease in the graft? Leukemia, 12(6), 992–995.

Saravanan, P.; Boopalan, E. (2011). Occurrence of camptothecin an anticancer drug from Ixora coccinea Linn. International Journal of Applied Biology**,** 2(2), 30-34.

Shanthi, S. (2021). Pharmacognostical studies on leaves of Mussaenda frondosa Linn. International Journal of Research in Pharmaceutical Sciences, 12(3): 2139–2146. https://ijrps.com/home/article/view/229

Sivarajan, V. V.; Balachandran, I. (1994). Ayurvedic drugs and their plant sources. Oxford and IBH publishing, New Delhi, pp. 570

Sunitha, D., Hemalatha, K., Manthripragada, B.R.; Chary, N. (2015). Extraction and Isolation of active constituents from Ixora chinensis Lam leaves. Der Pharma Chemica, 7(10), 434-441.http://derpharmachemica.com/archive.html

Surana, A.R.; Wagh, R.D. (2015). Phytopharmacological Review of Hamelia Patens. International Journal for Pharmaceutical Research Scholars, 4(2), 290-295.

Waghdhare, S. (2021). Phytochemical and pharmacological profile of Oldenlandia corymbose plant.: A review. International Research Journal of Science and Technology, 3(12), 995-1004

Yang, B., Liu, X.; Gao, Y. (2009). Extraction optimization of bioactive compounds (crocin, geniposide and total phenolic compounds) from Gardenia (Gardenia jasminoides Ellis) fruits with response surface methodology. Innovative Food Science and Emerging Technologies, 10(4), 610-615. https://doi.org/10.1016/j.ifset.2009.03.003

Yang, W., Wang, J., Li, X.; Du, Z. (2011). New method research for determination of natural pigment crocin yellow in foods by solid-phase extraction ultrahigh pressure liquid chromatography. Journal of Chromatography, 1218, 1423–1428. https://doi.org/10.1016/j.chroma.2010.12.121

Zhu, X., Mang, Y., Shen, F., Xie, J.; Su, W. (2014). Homogenate extraction of gardenia yellow pigment from Gardenia Jasminoides Ellis fruit using response surface methodology. Journal of Food Science and Technology, 51(8), 1575–1581. https://doi.org/10.1007/s13197-012-0683-2