



E-ISSN: 2278-4136

P-ISSN: 2349-8234

[www.phytojournal.com](http://www.phytojournal.com)

JPP 2020; 9(3): 1318-1318

Received: 08-03-2020

Accepted: 12-04-2020

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**Natural dye from *Eugenia jambolana* L. Leaf galls****Dr. R Anitha and Akshaya Vijayatha VK**DOI: <https://doi.org/10.22271/phyto.2020.v9.i3v.11492>**Abstract****Context:** Plants are excellent source of natural dyes. Leaf galls are rich in tannin thereby act as intense dyes.**Objective:** To evaluate the efficiency of leaf galls of *Eugenia jambolana* as natural dye.**Materials and method:** Natural mordants such as *Punica granatum*, *Citrus reticulata* (fruit rind) and *Camelia sinensis* dried leaves were used. Cotton, wool and silk were exposed to gall dye for 5 minutes with prior exposure to mordants for 5, 15 and 30 minutes. Fastness of the dye was also evaluated.**Results:** Cotton stained brown with *Camelia sinensis*, silk stained yellow with *Punica granatum* extract and both stained pale cream in *Citrus reticulata* 15 minutes incubation. *Camelia sinensis* was best mordant.**Discussion and conclusion:** Duration of exposure to the natural mordants did not influence the pattern of dyeing. Gall dye can be used for dyeing cotton, silk and not wool.**Keywords:** *Eugenia jambolana*, gall extract, dye, tannin, natural mordants**Introduction**

*Eugenia jambolana* L. (Myrtaceae) native to tropical America and Australia. The genus comprises about 1100 species. It is commonly known as jambolan, black plum, jamun, java plum, Indian blackberry, Malabar plum, purple plum etc., It is a large evergreen, densely foliaceous tree with greyish-brown thick bark. It is a medicinal plants used for treating various diseases. The medicinal properties are reduction in cholesterol, Blood Sugar, Stomach Acid, Liver Protection, Anti-cancer, Polyuria, Piles, Diarrhoea, Dysentery, Sore Throat, Insecticide, Antibacterial etc.,

The plant is rich in phytochemicals such as anthocyanins, glucoside, ellagic acid, isoquercetin, and myrecetin. The tree is infested with leaf galls through the year. Galls are abnormal plant growth caused by various organisms such as insects, mites, nematodes, fungi, bacteria and viruses. Galls are formed by insect/mite feeding or egg – laying activity. Either mechanical damage or salivary secretions that initiate increased production of normal plant growth hormones which results in the formation of galls. These leaf galls do not hinder the growth and development of the plant. However the photosynthetic efficiency may be affected.

The textile industry has been condemned as being one of the world's worst offenders in terms of pollution. About 17-20% of industrial pollution is due to textile pollution [5, 12, 23]. The textile effluents are highly hazardous with 95% of the waste water generated by colouring process and 1% through rinsing processes [19]. About 2000 different chemicals are used in the textile industry from dyes to transfer agents. Important pollutant in textile effluents are mainly dyes, recalcitrant organics, toxicants, chlorinated compounds and salts. Presently around 10,000,000 tons per annum of synthetic dyes are used which causes serious health hazard, disturbs the ecosystem and toxic to aquatic biodiversity [13, 2, 8, 3].

Recently, interest in natural dyes have grown rapidly, due to its ecofriendly nature and less harmful to Humans. However supply of natural dyes is only 1% of world demand [16]. This shows that there is immense scope to venture into search for other sources of natural dyes. Natural dyes are known for their use in colouring of food substrate, leather, wood as well as natural fibres like wool, silk, cotton and flax. It has a wide range of shades and obtained from various parts of plants including roots, bark, leaves, flowers and fruits [15]. Plant galls are rich source of polyphenols such as tannins [20] and hence they can act as excellent source of dye.

**Materials and Methods**

**Collection of leaf gall:** Leaves of *Eugenia jambolana* containing the galls were collected, shade dried pounded into a powder with mortar and pestle and stored in an airtight container. The gall when collected were devoid of any insects.

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### Preparation of gall extract

Aqueous extraction of the gall powder was carried out. About 5 grams of powder was extracted with 50 ml of sterile distilled water for 5-7 days. The concentrated extract was filtered and stored.

### Estimation of tannin

The gall extract was diluted 10 times with of distilled water. To 1ml of the extracts, 0.3ml of sodium carbonate solution and 0.15ml of Folin phenol reagent was added and the absorbance was read at 660nm. Gallic acid was used as reference.

### UV- visible spectrophotometer analysis

The extract of the gall was subjected to UV-VIS spectrophotometric analysis. The extracts was scanned at 300-600nm to determine the absorption maxima of the extracts.

### Preparation of natural mordant

*Punica granatum* rind, *Citrus reticulata* rind and *Camelia sinensis* each 5 grams were boiled in 50ml of sterile distilled water for 10 minutes, filtered and used as mordant.

### Dyeing

Three different types of fabric such as cotton, wool and silk were taken, cut in to 1x1cm squares. Cotton fabric alone was dipped in 100 ml of 10% NaOH and boiled for 15 minutes to remove the starch and later rinsed in cold water. Prior to dyeing, the fabrics was fixed with the natural mordants separately for 5, 10, 15 and 30 mins. The fabric was removed from the mordant and air dried at room temperature. Later they were dipped in to the gall extract for 5mins. After air drying the fabric was observed for its colour.

### Fastness of the dye

The fastness of the dye was studied by washing in a mild detergent and air dried. The retention of colour was observed and rated as +, ++, +++.

### Results and Discussion

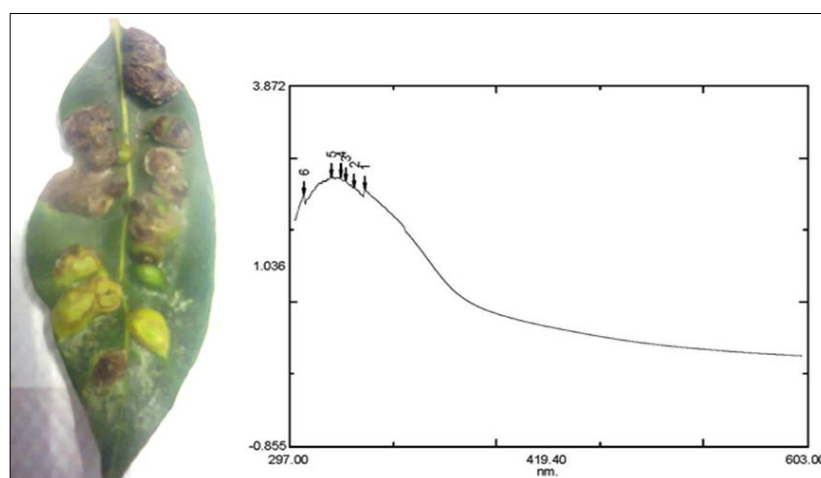
The leaf galls contained an appreciable amount of total tannins (11300 µg/ml). The tannin content varies depending

on various factors such as age of the tree, stage of gall formation, season, geographic area etc. Tannin and other phenolic substance act as excellent mordant and hence these gall dyes in general have been used in past for dyeing fabrics. The Aleppo oak gall of Asia Minor, produced by a cynipid wasp, contained about 65% tannic acid. UV –Visible spectroscopy was used to study the maximum absorbance of gall extract and it was evident hat maximum absorbance was at 341 (Fig-1). Phenolic compound such as flavones had maximum absorption range between 300-380nm.

Mordant are important for successful dyeing techniques. The use of mordants affects the color outcome. The intensity and shades of colour varied from mordant and fabric irrespective of the duration of exposure. Mordants are generally metallic salts such as sulfates, chlorides, hydroxides and oxides [17, 18]. Metal mordants used for natural dyes are alum and iron. These cause soil and water contamination. Large scale usage of these causes environmental problems [7].

The natural mordant *Punica granatum* rind, *Citrus reticulata* rind and *Camelia sinensis* were allowed to imbibe into the fabric prior to the treatment with the gall dye. It was observed that intensity of dyeing in cotton and silk was more in 15min of exposure to *Punica granatum* and *Camelia sinensis*. *Punica granatum* peel and *Camelia sinensis* has it own characteristic colour and the abundant tannin and other polyphenols and hence can act as dye [6]. Prolonged exposure to the gall dye did not influence the staining pattern. Cotton fabric exposed to natural mordant showed intense brown in *Camelia sinensis*. Silk stained yellow with *Punica granatum* mordant and both the fabrics stained pale cream in *Citrus reticulata* extract (Fig- 2). Gall extract had no impact on wool and dyeing of colour was very poor. This is probably that dye obtained from natural material do not stain nylon, wool and polyester as reported by Ratna padhi [11].

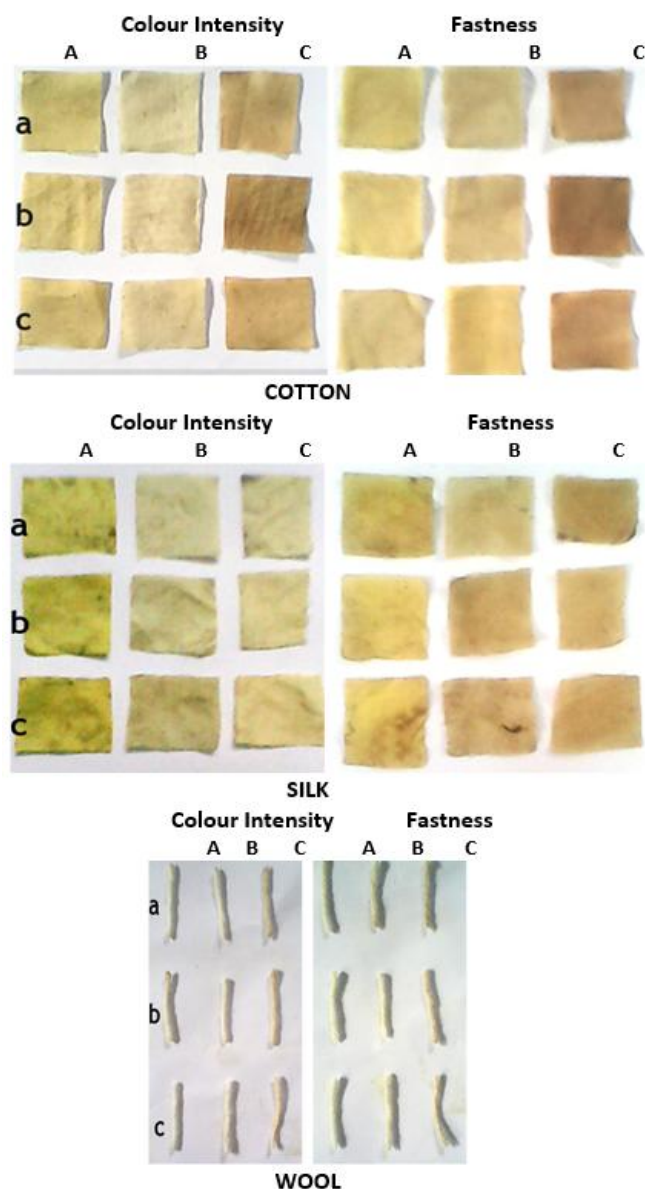
Biomordant are obtained from plant sources rich in tannin [9]. Earlier Ismail [5] showed that Pomegranate extract has been used as biomordant. Wangatia and Tadesse [22] investigated the use of mango bark extract as a mordant for cotton fabric. Similarly Prabhu and teli [9] studied the usage of tamarind skin as mordant since they were rich in tannins. Leaf gall extract of *Q. leucotrichophora* yielded large amount of pigments [10].



**Fig 1:** Galls on the upper surface of *Eugenia jambolana* leaf and UV-Visible spectrum for the presence of Tannin in the gall extract of *Eugenia jambolana*

The fastness of the dye is influenced by the rate of diffusion of the dye and state of the dye inside the fiber. In natural mordants, cotton and silk showed 3+ in *Camelia sinensis*, but

less in other two extract such as 2+ in *Punica granatum* and *Citrus reticulata*. Although cotton and silk stained less in citrus mordant, the fastness of the dye was retained in them.



**Fig 2:** Colour intensity and fastness of gall dye for 5 minutes exposure. a- 5 min b – 15 min c-30 min exposure to mordants. A- *Punica granatum* extract B- *Citrus reticulata* extract C-*Camelia sinensis* extract as natural mordant.

Earlier, Sangeetha *et al.*,<sup>[14]</sup> used lemon leaf extracts for dyeing silk fabric. *Cassia singueana* extract along with *Aloe vera* juice as mordant was used to dye silk fabric successfully<sup>[21]</sup>. Fastness of a dye is also influenced by the texture of the cloth. Complexing the fiber with mordant, has the effect of insolubilizing the dye, making it color fast. It is reported that fabrics dyed with pomegranate rind exhibited good fastness properties<sup>[1]</sup>. Similarly fastness of the gall dye from *Quercus spp.* was not altered by solar light or with detergents *Zizyphus* gall dyes and oak galls showed excellent fastness<sup>[4]</sup>. It is probably because, oak galls contain large amounts of gallic and tannic acid. The gall dye from *Eugenia* was retained best on cotton with *Camelia sinensis* mordant and good staining in *Punica granatum* and citrus mordant. These studies clearly indicate that *Eugenia* gall extract can be utilized as a dye for cotton and silk.

#### Acknowledgement

The authors wish to thank the Principal and The Head of the Department for giving the laboratory facility and constant encouragement.

**Conflict of Interest:** The authors have no conflict of interest.

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