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# EXTRACTION OF NATURAL DYE FROM THE FLOWERS OF *Eichhornia crassipes*

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## ABSTRACT

**Water hyacinth (*Eichhornia crassipes*) infestation is considered as a menace globally. It is a serious problem in many parts of our country, especially water-rich states like Kerala. Various eradication methods were tried, but all attempts failed due to several reasons, especially their faster growth rate and anthropogenic activities. Since all methods of control have failed, the only viable option is eradication through utilization. Water hyacinth is reported to be used for several purposes. In this study, the extracts of water hyacinth flowers were tested as a potential source of natural dyes. Three different methods were followed for the extraction of the dye. Potassium dichromate ($K_2Cr_2O_7$), copper sulphate ($CuSO_4$), oxalic acid ($C_2H_2O_4$), stannous chloride ($SnCl_2$) and ferrous sulphate ($FeSO_4$), each at a concentration of 6 % of the dye were used as mordants. The effectiveness of these mordants and the extracted dye was compared after dyeing cotton cloth. The dyed clothes were washed and checked for the fastness. A range of colours was obtained through our study and they were not altered on drying under the sun. This study proves that the flowers of water hyacinth could be used as a source of natural and eco-friendly dye with potential for a range of applications.**

**KEYWORDS:** Aquatic Weeds, Water Hyacinth, *Eichhornia crassipes*, Natural Dye Extraction

*Eichhornia crassipes,* also known as water hyacinth, is a free floating perennial aquatic plant native to tropical South America. It is regarded as the most troublesome aquatic weed of the world (Holm et al; 1997), which was introduced in India as an ornamental plant in 1896 (Rao; 1988). It has complex root structure and rapid growth rate which result in dense interlocking mats of the weed on water surface(Mitchell; 1985). The weed grows best in warm water rich in macronutrients(Jafari; 2010) and most of our water bodies are in this condition.Thus it affects water transportation, fish production, hydroelectric projects, irrigation, potability of water, etc. Several eradication measures were tried in India, but all failed (Gopal; 1987).

Now extensive research is being carried out to utilize these weeds. It is used phytoremediation - for removing heavy metals from water (Vesk et al.; 1999, Yahya; 1990). The plant has been used as animal feed (Gopal; 1987), fertilizer, handicraft making, paper (Jafari; 2010, Majid; 1986), boards, substrate for mushroom cultivation (Anoop et.al.; 2014) and solid state fermentation (Suresh; 2005). All parts of the weed has applications. The plant also posses beautiful lilac flowers, which could be used for dye extraction.

Interest in natural dyes is growing at a fast rate because of their advantages over synthetic dyes. The by-products produced by synthetic dyes are harmful. Some of them are carcinogenic and therefore they are banned in some European countries (Bains et al.; 2003). Unlike synthetic dyes the sources of natural dyes are renewable and biodegradable (Ashish and Adwaita; 2011). Several works are being done for production and application of natural dyes (Dayal and Dobhal; 2001).

## MATERIALS AND METHODS

In the present study, flowers of *Eichhornia crassipes* were collected from a pond in Alleppey, Kerala.Dye was extracted as aqueous extract from the collected flowers using three different techniques:

1. By preparing an aqueous solution of flowers (10 g in 50 ml distilled water) in the ratio 1:5 and the extraction process was carried out in a heating mantle at a temperature of 85°C for 1hr (SampleA).
2. In the second method, the flowers (10 g) were placed in50 ml distilled water for extraction in the ratio 1:5. This pasty mass was kept for 60 minutes without boiling to extract the dye (SampleB).
3. In the third method of dye extraction, the flowers with peduncle (10g) were crushed using a mortar and to it 100 mL distilled water was added (1:10). It was boiled for 1hour in a glass beaker (SampleC)

The extracts were used to dye cotton cloth (5x5cm). The cloth used for dyeing was boiled in NaOH solution (10%) for 15 minutes to remove starch from the cloth and then washed with cold distilled water (Neha and Vidya; 2011)

Mordants used were potassium dichromate ($K_2Cr_2O_7$), copper sulphate ($CuSO_4$), oxalic acid ($C_2H_2O_4$), stannous chloride ($SnCl_2$) and ferrous sulphate ($FeSO_4$), each at a concentration of 6% (v/v). Dyeing procedure was carried out in a glass beaker containing the dye-mordant mixture. The treated cloth was immersed in

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the mixture and the whole set up was placed in the water bath at a temperature range of 70-75$^{o}$C for one hour (Fig. 1). The above steps were repeated with different mordants in separate beakers. Effect of dye without mordant was also studied.After dyeing, the clothes were washed with tap water and kept under sun for 2 hours to evaluate light fastness.

**Figure 1: Dyeing procedure**

## RESULTS AND DISCUSSION

The dyes extracted from the flowers of *E. crassipes* developed different shades on cotton cloth with the application of different mordants. A wide range of colours were obtained from the aqueous extract. The obtained colours are mentioned in Table 1, figures 2 to 5. The best results were obtained from boiled extract in the ratio 1:5 (Sample A).

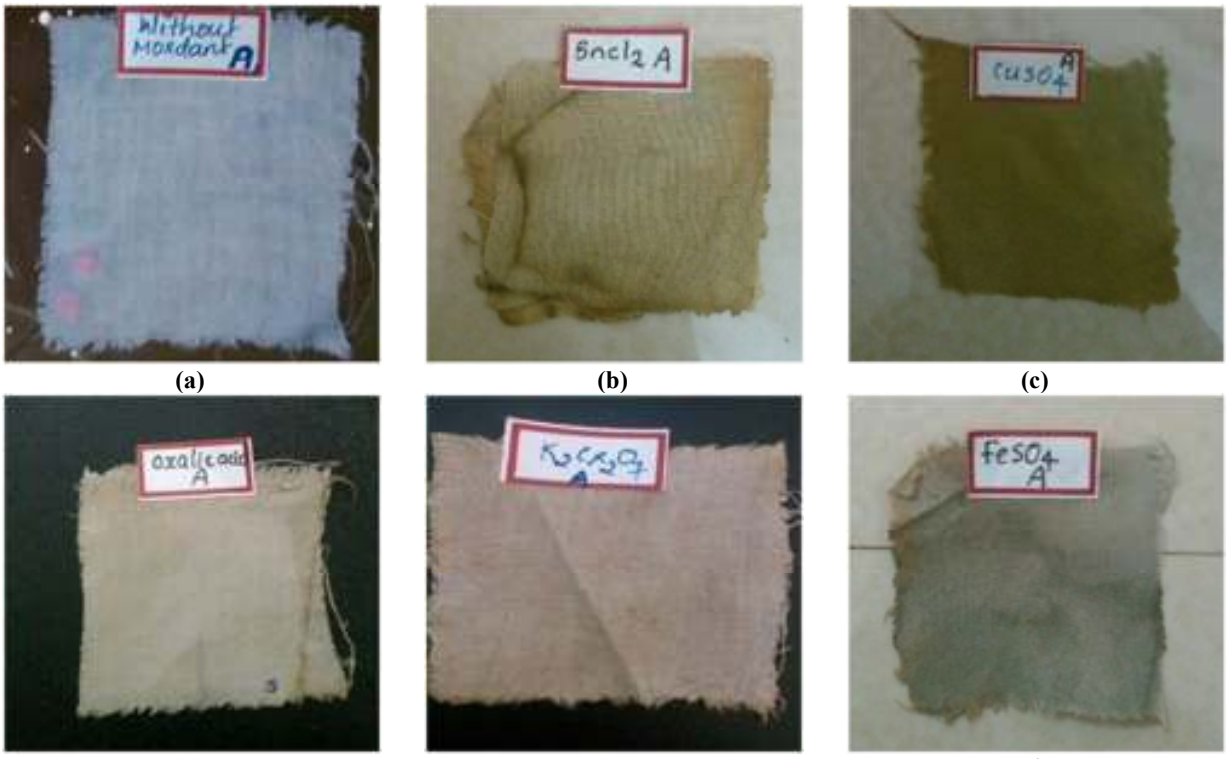
Different extraction techniques resulted in different colours with same mordant and without mordant (Table 1). Lavender colour was obtained from Sample A without mordant. While metallic bronze and peach shades were obtained from samples B and C respectively. But these shades faded after about a week (Figure 2). So it is evident that mordants are essential for dyeing fabric with the dye extracted from *E. crassipes* flowers.

The mordant ferrous sulphate resulted in ash colour with all three samples. The shades developed were not altered on sun drying. Therefore, the dye has good light fastness. But oxalic acid as mordant resulted in colour change after some days of storing. The colour obtained immediately after the treatment was reddish pink. Slowly the colour changed into pinkish lavender (Figures 3 to 5).

**Figure 2: Clothes dyed without mordant (left), after two weeks (right)**

**Table 1: Colors developed from flowers of *E. crassipes***

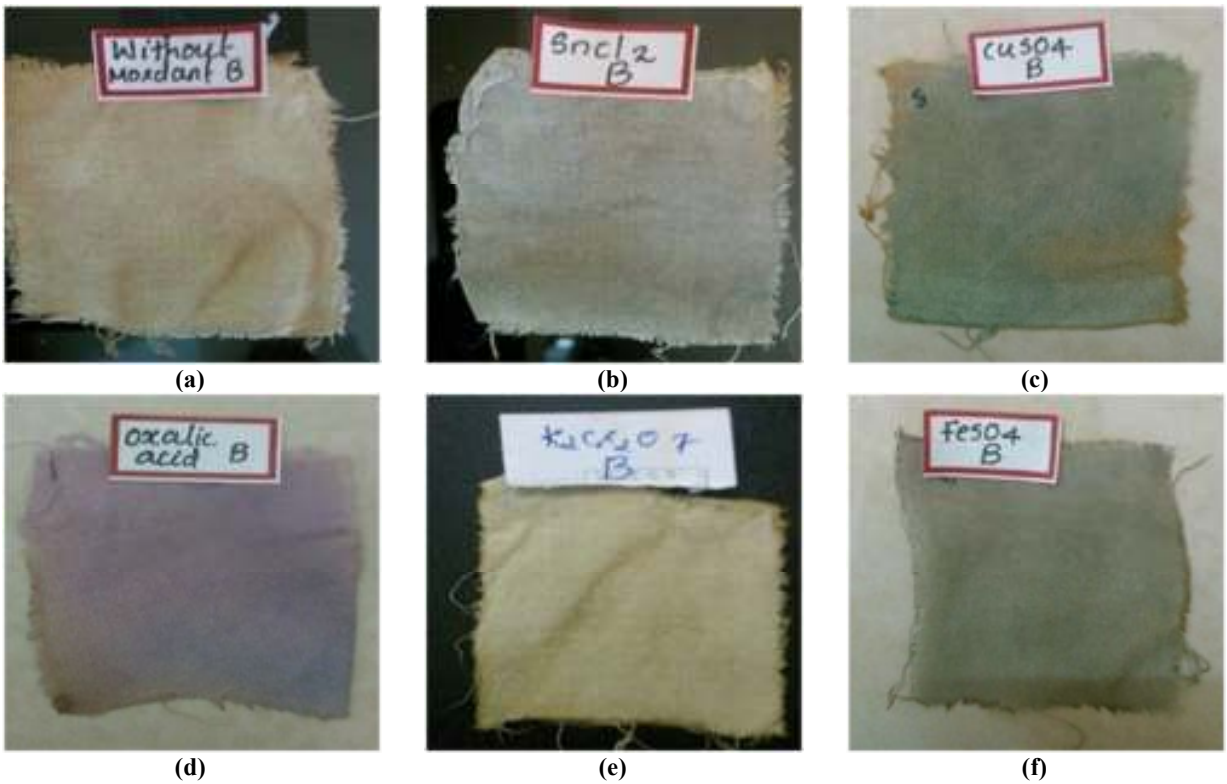
| Sl. No. | Mordants | Shades obtained | | |
|---|---|---|---|---|
| | | Sample A | Sample B | Sample C |
| 1 | Without mordant | Lavender | Metallic bronze | Peach |
| 2 | Potassium Dichromate | Pale celery | Pale taupe | Pale taupe |
| 3 | Copper sulphate | Spruce Green | Spruce green | Ivory |
| 4 | Oxalic acid | Sage | Reddish pink | Peach |
| 5 | Stannous chloride | Taupe | Ash | Off white |
| 6 | Ferrous sulphate | Metallic ash | Metallic ash | Pale ash |




(a) (b) (c)

(d) (e) (f)

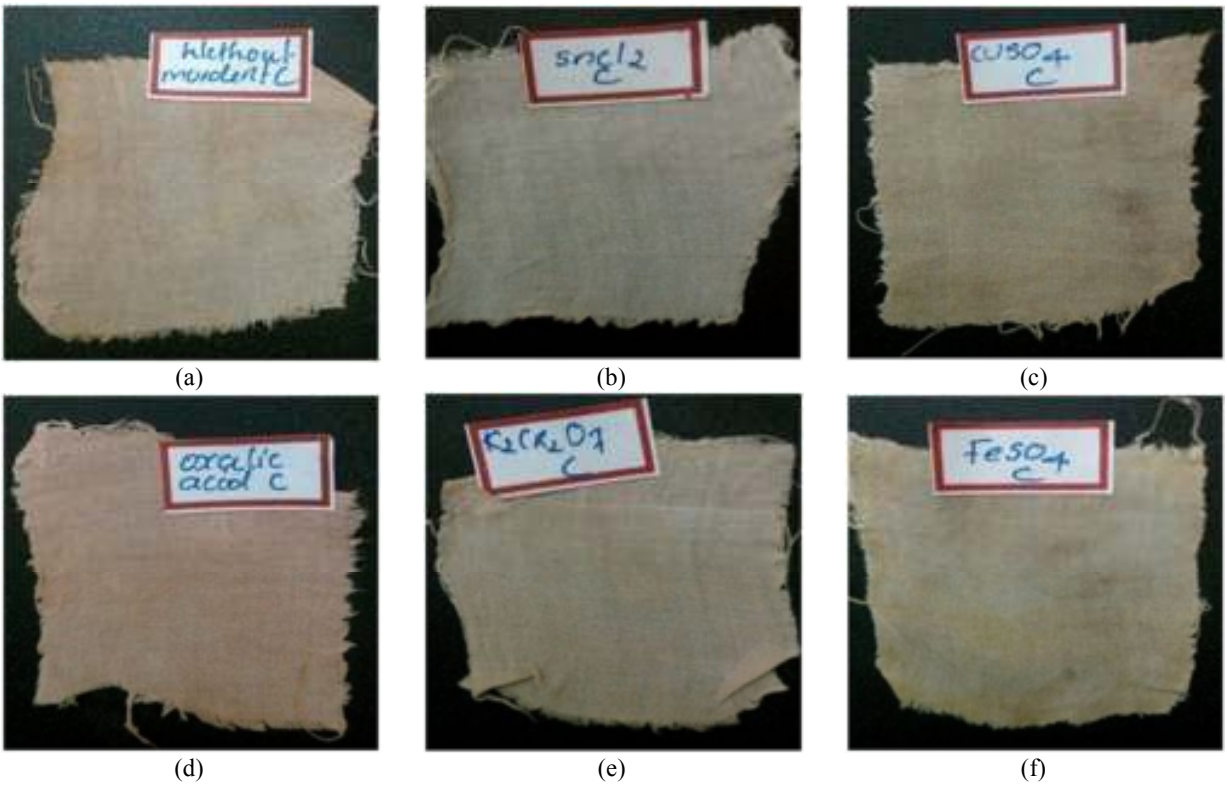
**Figure 3: Clothes dyed using Sample A with (a) No mordant, (b) $SnCl_2$,(c) $CuSO_4$, (d) $C_2H_2O_4$, (e) $SnCl_2$, (f) $FeSO_4$**




(a) (b) (c)

(d) (e) (f)

**Figure 4: Clothes dyed using Sample B with (a) No mordant, (b) $SnCl_2$,(c) $CuSO_4$, (d) $C_2H_2O_4$, (e) $SnCl_2$, (f) $FeSO_4$**




(a) (b) (c)

(d) (e) (f)

**Figure 5: Clothes dyed using Sample C with (a) No mordant, (b) $SnCl_2$,(c) $CuSO_4$, (d) $C_2H_2O_4$, (e) $SnCl_2$, (f) $FeSO_4$**

Usually, natural dyes have poor light fastness compared to synthetic dyes, but they produce lesser or no allergic reactions (Anderson; 1971). So now, utilization of natural colour pigments is promoted for their use in food colouring, pharmaceuticals and textiles. The extraction process is economically viable as the raw materials are available at low cost or free of cost. It is also an eco-friendly process as there are no harmful by-products (Bains et al.; 2003). The results of our study clearly prove that the flowers of *Eichhornia crassipes* are suitable for the extraction of natural dyes which can be used in many industries as an alternative to harmful chemical dyes.

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