

Studies on Environment Friendly Dyes Obtained from Waste Flowers

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Received on 22-7-2017
Accepted on 17-10-2017

Abstract

In the present study, flowers were used for the extraction of dye and the efficiency of dye was evaluated on silk and cotton. Cost efficient, environment friendly aqueous method was employed to extract dye. Various shades were obtained with pre-mordanting and post-mordanting methods. Very good to excellent colour fastness (mild washing, rubbing) have been shown with all mordants including without mordant whereas colour fastness (daylight) results have been recorded fair to good. Results of study revealed that floral dye has been found a new addition in dyeing and can be served as a good source of fashion colours at economical rates.

Introduction

Herbal dyes were used to colour clothing or other textiles but by mid 1800, chemists began producing synthetic substitutes for them. By early 20th century only a small percentage of textile dyes were extracted from plants. Lately, there has been increasing interest in herbal dyes, as consumers have become aware of ecological and environmental problems related to the use of synthetic dyes. The most common herbal parts used for extracting dyes are seeds, flowers, leaves, berries, stems, barks and roots. Some parts may have more than one colour depending upon which part of plant is used. The shade of colour, a plant produces will vary according to season at which the plant is picked, how it was grown, soil conditions etc. For the present study, flowers of *Caesalpinia pulcherrima* (L.) and *Rosa chinensis* Jacq. were used.

By considering the present scenario of environmental pollution and human health risks (Khattak et al., 2014) generated by synthetic dyes (Arunkumar and Yogamoorthi, 2014) the demand of eco-friendly natural dyes is increasing day by day (Haji, 2010). Furthermore, in order to achieve sustainable development goal, the eco-solution to extract dye from plant waste (GhorVankar et al., 2009) which helps to elevate the income of florists, flower exporters and also replenish the demand of eco-friendly, non-carcinogenic, non-toxic, non-hazardous and non-poisonous green dyes (Pervaiz et al., 2016). So, keeping the above points in view, the present research was carried out in Palakkad to utilize floral waste for dye extraction as they are abundantly available at low price in the province.

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Moreover, the study was designed with the objectives to extract natural dye from floral waste of rose and caesalpinia to assess its dye-ability on cotton and silk fibres.

Materials and Methods

Selection of Fibre

Cotton and silk was selected for the present day. Silk is a natural protein fibre excreted by moth larva, *Bombyx mori*, better known as common silkworm. Silk is a fine continuous monofilament fibre of high luster and strength and is highly valued as a prestige fibre. Cotton plant (*Gossypium hirsutum*, L.) belongs to Family Malvaceae. The cotton blossom, which appears about hundred days after plants are a beautiful creamy white or light yellow flower. For the present study silk was obtained from Silk mark organisation of India and cotton from Precot Mill, Kanjikode.

Selection of Mordants

Copper sulphate, iron sulphate and Potassium dichromate was used as mordants for the dye. To help dyes bind better to fibres, dyes typically use different mordants, most of which are salts of metals like aluminium, iron, tin or chrome. The word mordant actually comes from the Latin word *mordre*, meaning "to bite"; because early dyers thought these substances enabled the dye to get a better bite on fibres. (Sundari, 2015; Pervaiz et al., 2016).

Selection of Dyes

Flowers of rose and caesalpinia were collected and dried. Then it was powdered.

Dyeing in Raw Silk

The degumming of raw silk is generally carried out using four to five grams per litre soap and one gram per

litre soda ash to boil for 45 -60 minutes, maintaining the liquid ratio at 30:1. The treated material is given a hot wash for 10-15 minutes and finally it is washed in cold water. The degumming loss in this process is 20-25%. Effectiveness of a degumming treatment can be assessed by the extent of removal of sericin. Since residual sericin on the material cannot be estimated by a direct method of analysis, mostly the process of degumming is assessed in terms of weight loss by using the following formula:

$$\frac{W_1 - W_2}{W_1} \times 100$$

Expressed as percentage.

W_1 = weight of fabric before degumming.

W_2 = weight of fabric after degumming.

Bleaching of Silk

The silk being spun by silkworm contains natural colouring matter linked with yellow, yellow green and brown pigments. During degumming the removal of sericin from the silk results in dull white to lightly tinted material. Since some of the sericin is closely held by fibroin, complete elimination of the colour by degumming is not possible. Thus during bleaching, natural colouring are decolourized to produce pure white material. Efforts are made to combine degumming and peroxide bleaching in a single stage so as to achieve the bleaching results, equivalent to or better than those obtained in both in bleaching and degumming in two stage process. These silk goods are immersed in the following bath at 90-95°C for 1 hour and finally goods are washed and dried.

Silk	= X
Hydrogen peroxide	= 20 g/l
Soap	= 5 g/l
Soda ash	= 0.5 g/l
Sodium silicate	= 1.5 g/l
Material: water	= 1:30

The dye stuff powder is pasted with cold water and a small amount of soda ash and boiling water should be added to the paste with constant stirring to dissolve it completely. The silk material is then introduced in the dye bath containing dissolved dye solution and required amount of glauber salt (sodium silicate) at room temperature of the dye bath is then gradually raise to 85-90°C and dyeing is continued for 30-45 minutes.

Post Treatment of Silk Dyeing

Increasing the size of the dye molecule can be achieved by using formaldehyde which will link the dye molecules through air bi functional aldehyde group. After treatment of this nature improves the washing fastness of the dyed material.

Dyeing in Cotton

Dye powder is weighed. Cotton fibre was soaked in distilled water and ionic detergent solution containing two gram per litre each of soap in soda ash at 80°C for 1 hour to remove starch. The material to liquor (M: L) ratio was maintained at 1:30, after which fabric was washed with distilled water, dried and iron .Prior to dyeing or

mordant the fibre sample were soaked in water for half an hour. Mordant used as copper sulphate, iron sulphate and potassium dichromate. In case of cold water extract, the powder was soaked in water and kept for 48 hours. The resultant liquid was then filtered. The extracted dye solutions were then concentrated and then dried in hot air circulatory oven at 60-70°C dry material is obtained. The dry material is then removed from trays. The solid mass so obtained was then subjected to extraction with 70:30, alcohol: water mixture and then filtered. Then filtrate was evaporated under reduced pressure to get concentrated mass of colour component. For dyeing experiment cotton fibres were pre treated with acetic acid at M: L (1:10) at 95°C for 30 minutes. The fibre was then dyed bath containing each of dye extracted from flower. The dyeing was carried out at 97-98°C for 45 minutes in which 2% sodium chloride solution basis of material was added to bath and the system was further heated for 15 minutes. Then the fibres were washed thoroughly and with ionized water and dried at room temperature. Mordating was carried out for 30 minutes at 97-98°C.

Results and Discussion

Different shades of color dye were obtained from rose and caesalpine flowers. Mordants play very important role in imparting color to the fabric. With the use of ferrous sulphate the black colored shade was obtained for cotton cloth and silk . Strong co-ordination tendency of Fe enhances the interaction between the fiber and the dye, resulting in high dye uptake . The mordanted cotton and silk cloth was immediately used for dyeing because some mordants are light sensitive. The chromatophore in the dye makes the resistant to photochemical attack, but the auxochrome from dye may alter the fastness (Jothi, 2008). Cotton fibre and cotton cloth showed excellent dyeing.

All the dyed fabrics were evaluated for their surface color reported in Table 1 & Table 2 and the results of assessment of colour fastness behavior to light, washing and resistance are given in table 3. The treated samples subjected to light showed appreciable results with all different types of mordants of optimum concentration. The fastness test of silk and cotton samples to rubbing under dry condition showed that the sample have fair to good fastness as compared to wet rubbing. Fastness towards perspiration has fair to good fastness to silk when compared to cotton. Washing Fastness test showed fair to excellent fastness to Silk when compared to cotton. However silk shows good color fastness and bright color ranges while compared to cotton. Dyeing absorbency of cotton with mordants is good while in silk dyeing absorbency is less when compared .A detail study on the rose and caesalpine flowers was carried out for the dye material concentration for silk and cotton. Both the flowers, which are abundantly available in the season, can be exploited as a good source of natural dye for the cotton and silk dyeing range from olive green to black depending upon the choice of mordant. The efficiency of various mordants is correlated with possible chemical interactions on the dyeing of silk and cotton. We were able to get good ranges of colors.

COLOUR OBTAINED AFTER DYEING

DYES FROM	COLOUR IN SILK	COLOUR IN COTTON
Rose	Pink	Olive green
Casalpinea pulcherrima	Black	Black

TABLE -II

DYE ABSORPTION IN SILK AND COTTON

TYPE OF FABRIC	WAVE LENGT H (nm)	DYE USED	OPTICAL DENSITY BEFORE DYEING	OPTICAL DENSITY AFTER DYEING	DYE ABSORPTION (%)
SILK	570	Rose dye	1.48	1.05	29
		Casalpinea dye	1.66	1.10	34
COTTON	420	Rose dye	1.52	1.14	25
		Casalpinea dye	1.70	0.98	42

**TABLE-III
FASTNESS CHART**

FABRICS	WASHING FASTNESS	SUNLIGHT FASTNESS	PERSPIRATION FASTNESS	RUBBING FASTNESS	
				WET	DRY
Control (Without mordants)	+	+	+	+	+
Silk	+++	++	+	+++	+++
Cotton	+++	+	+	++	++

+ indicates the intensity



Figure 1: Preparation of the Extract



Figure 2: Cotton fibre with Ferrous Sulphate



Figure 3: Cotton fibre with potassium dichromate

Conclusion

In this century, a global awareness is already in place favoring the use of natural resources for protecting the environment and earth from pollution and ecological imbalances. The present scenario is focused more towards the utilization of the vast diversity of natural resources of color pigments for their use in food materials, pharmaceuticals and textiles, in place of their synthetic counterparts. This trend is aimed at safeguarding human health as well as protecting and prolonging life on earth. Detailed scientific studies with natural dyes have established that in most cases their properties are comparable to those of synthetic dyes. Therefore, if natural dyes have to be commercialized, they need to conform to the same stringent standards of performance that are applied to synthetic dyes. It thus follows that much more research and developmental effort needs to go in this area. The traditional practices may have to be substituted by modern, more scientific practices in order to overcome some of the so-called disadvantages of this dye. The above findings strongly suggest and reveal that Indian natural resources could be successfully used for textile coloration. The above test results strongly indicate that natural resources could have a great value in textile coloration and in the export market.

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