Research Article

Eco Safe Textile Coloration Using Natural Dye

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ABSTRACT

In the present study, an attempt has been made to utilize petal parts of chrysanthemum (*Dendranthema grandiflora*) flower and peel of badam fruit (*Prunus dulcis*) to extract dye for application on the fabrics. The natural dye was extracted by aqueous method at boiling conditions. The extracts were then applied on cotton and silk. The natural dye was extracted from the flowers of chrysanthemum with two different colors; dark purple and red, and pink dye from peel of fruit using a simple extraction technique. Here copper sulphate as mordant used for fixing the dye. The dyes were treated with and without mordant to examine their effects on the dyeing efficiency. According to the experimental results, the performance was better with the all the natural dye which can be the better alternative of synthetic dyes.

Keywords: Natural dyes, Aqueous extraction, Fabrics, Dyeing, Mordanting.

INTRODUCTION

The effect of synthetic dyes from textile industry in introducing contaminants is one of the major environmental issues. In order to process a ton of textile, one might have to use as much as 230 to 270 tons of water. The effluent generated by this much water would pollute the environment as it contains a heavy load of chemicals including dyes used during textile processing[1]. Over 7 x 105 tones and approximately 10,000 different types of dyes and pigments are produced world-wide annually. It is estimated that 10-15% of the dye is lost in the effluent during the dyeing process[2]. Research has shown that synthetic dyes are suspected to release harmful chemicals that are allergic, carcinogenic and detrimental to human health[3]. In contrast, natural dyes are environmental friendly, exhibit better biodegradability and generally have a higher compatibility with the environment than synthetic dyes[4].

Recent resurgence in research and development on natural dye production and application is observed due to increasing popularity of more natural lifestyle based on naturally sustainable goods[5]. Natural dyes can be sorted into three categories: natural dyes obtained from plants for example indigo, those obtained from animals for example cochineal, and those obtained from minerals for example ocher[6-9]. Natural dyes/colorants derived from flora and fauna are believed to be safe because of its nontoxic, non-carcinogenic and biodegradable in nature[10]. In many of the world's developing countries, however, natural dyes can offer not only a rich and varied source of dyestuff, but also the possibility of an income through sustainable harvest and sale of these dye plants. Many dyes are available from tree waste or can be easily grown in market gardens[11].

Chrysanthemum (*Dendranthema grandiflora* T.) is one of the most important flowers crop grown commercially in India for cut and loose flowers and is also used for garden display. It belongs to family Asteraceae and is commonly called as the "Queen of the East".

The availability in range of colours and types of flowers adds to its value to be used for different purposes[12]. Almond (*Prunus dulcis* L.) is one of the species of *Prunus* belonging to the subfamily *Prunoideae* of the family Rosaceae.

Nutritionally and medicinally almond is a valuable food commodity[13]. Keeping in view current scenario of environmental consciousness the present study was planned to dye of fabrics with three natural dyes from two different color of chrysanthemum (*Dendranthema grandiflora*) flower petals and peel of badam fruit (*Prunus dulcis*).

MATERIALS AND METHODS

Plant Material

The present study was conducted to extract dye from natural and herbal sources. Three plant materials were used. The flower petals from two different color of chrysanthemum (*Dendranthema grandiflora*) flower and peel of badam fruit (*Prunus dulcis*) were used (Figure 1). A dark purple and red variety chrysanthemum flowers were collected from Chennai flower market and badam fruits were collected from the badam tree in university campus.

Figure 1: Purple (a) and red (b) variety of Chrysanthemum and badam fruit (c)

Extraction of Natural Dyes

The dyes were extracted by aqueous extraction method. In this method, dye from flowers were extracted by preparing an aqueous solution of the dried flowers (20 g in 100 ml distilled water) and the extraction process was carried out at a temperature range of 70-80 °C for 2 h.

Coloring materials from the flowers and fruit peels were extracted for dyeing of the fabric samples.

After the extraction procedure is complete, the flowers, peels were taken out and they were taken for extraction of dye for the second time.

Textile Material and its Pretreatment

Commercially available cotton and silk fabrics were selected for this experiment. Scouring of cotton fabrics as well as the yarns of cotton and wool were done by washing it in a solution containing 0.5 g/l sodium carbonate and 2 g/l non-ionic detergent (Triton-X) at 50 °C for 25 min, keeping the material to liquor ratio of 1:40.

The scoured fabrics were thoroughly washed with tap water and dried at room temperature.

The scoured materials were soaked in clean water for 30 min prior to dyeing or mordanting[14]. All chemicals were used of analytical grade with highest purity and procured from Hi-Media, Mumbai (India).

Dyeing and Mordanting

The extracts obtained through above mentioned methods were used for dyeing.

Both type of fabrics (cotton, silk) used for dyeing were boiled in NaOH solution (10 %) for 15 min to remove starch from the cloth, and then washed with cold distilled water.

For mordanting, copper sulphate ($CuSO_4$, $5H_2O$) (Hi-Media, Mumbai) with concentration of 20-30 g/l was used.

These fabrics were then transferred in mordant for 30 min followed by treatment in the dye bath for one hour. Effects of dye without mordanting the fabrics were also studied. Then the all treated fabrics was washed with tap water, detergents separately, and dried in sunlight.

RESULTS AND DISCUSSION

India is a major exporter of herbal dyes mostly due to ban on production of some of the synthetic dyes and intermediates in the developed countries due to pollution problem[15]. Natural dyes are now a days in demand not only in textile industry but in cosmetics, leather, food and pharmaceuticals. The rich biodiversity of our country has provided us plenty of raw materials, yet sustainable linkage must be developed between cultivation, collection and their use[3].

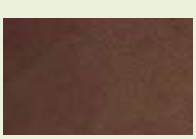
Mordants play very important role in imparting color to the fabric. Better color strength results are dependent on the metal salt used[16]. Strong co-ordination tendency of Cu enhances the interaction between the fiber and the dye, resulting in high dye uptake. Copper sulphate has the ability of forming co-ordination complexes (Coordination number is 4). Functional groups such as amino and carboxylic acid on the fiber can occupy the unoccupied sites on interaction with the fiber. Thus, a ternary complex is formed by the metal salt on which one site is with the fiber and the other site is with the dye[17]. Use of copper sulphate gives high resistance to fading[18]. Complexing the fiber with mordant has the effect of insolubilizing the dye, making it color fast. Mordants give different shades to the fabric[19].

Cotton and silk, both the fabrics showed significant result in dyeing with three dyes with and without mordanting (Table 1, 2, 3). The dyes produced heavy shades on silk, and on cotton, the shades were light in colour with the same concentration, dyeing time and dyeing temperature.

This is due to reason in behind that silk is a protein fibres, its absorption power is high, because it is acidic in nature. On the other hand, cotton is a cellulosic material, its absorption power is very poor than that of silk, because it is basic in character and the fibrous materials of cotton is closely attached.

Mordanting may be carried out on fibres because it acts as a key or bridge between the dye and the fibre. So, on mordanting of silk, its fibre will be loosely bound and the dye can uptake easily but on cotton, its fibre do not easily loosely bound and the dye cannot uptake easily[20].

Table 1: Dyeing of fabrics with dark purple flower petals of chrysanthemum with and without mordant

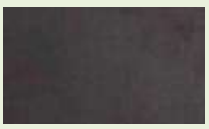
Dark purple flower petals of chrysanthemum		Control	Water wash	Detergent wash
Cotton	Without mordant			
	With mordant			

Silk	Without mordant			
	With mordant			

Table 2: Dyeing of fabrics with red flower petals of chrysanthemum with and without mordant

Red flower petals of chrysanthemum		Control	Water wash	Detergent wash
Cotton	Without mordant			
	With mordant			
Silk	Without mordant			
	With mordant			

Table 3: Dyeing of fabrics with pink peels of badam fruit with and without mordant

Pink peels of badam fruit		Control	Water wash	Detergent wash
Cotton	Without mordant			
	With mordant			
Silk	Without mordant			
	With mordant			

CONCLUSION

Chrysanthemum petals and badam fruit peel can be used as a substitute of synthetic reactive dyes for dyeing of cotton and silk fabrics.

These dyes have strong color properties even after washing with detergents, but also have major advantage of being eco-friendly and can help to minimize the problems of effluents from synthetic dyes.

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