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Wavelength of Biodyed Cloths and Its Psychological Impacts on Human

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Abstract

The psychological impacts of an ecofriendly natural alizarin dye extracted from madder roots using the soaking method were studied. Where cotton fabric was dyed with alizarin natural dye using various mordants, such as copper sulfate and ferrous sulfate. The dyeing behavior of dyes was assessed by colorimetric evaluations of fabrics carried out by a spectrophotometer. Good wash fastness, rubbing fastness, light fastness, water fastness, and perspiration fastness were obtained. They received satisfactory grades. The alizarin natural dye showed lovely colors and shades on selected fabrics with satisfactory retention properties, hence it can be utilized commercially for the coloration of cotton cloth fabrics. The wavelength of these colored dyed cotton fabrics was investigated and found to have positive psychological impacts.

Keywords: Natural alizarin, Lovely colour, wavelength, Dyeing, Psychological impact.

Introduction

Nowadays, fortunately, there is increasing awareness among people towards the use of eco-friendly natural dyes owing to their better biodegradability and higher compatibility with the environment. They are non-toxic, non allergic to skin, non carcinogenic, abundant and renewable. R. tinctorum (madder) is one of the oldest. It is a perennial herbaceous plant that belongs to the Rubiaceae family. In Central Asia, it has been widely cultivated since 1500 BC. As a natural source of red, pink, orange, purple, gray, and brown. (1), (2):(7) The increasing awareness and sensitivity to the environment have made the reintroduction of natural dyes in the textile industry even more important. Natural dyes. Consumers nowadays are becoming more and more concerned about environmental issues, and hence the demand for natural products incorporating natural ingredients soars. Thus, natural dyes are gaining increasing importance as they are obtained from renewable resources, are free from health hazards, and some of them sometimes act as health care products too. (8), (9)

Chemical tests of red fabrics found in the tomb of King Tutankhamen in Egypt show the presence of alizarin, a pigment extracted from madder. (10), which demonstrates the alizarin dye's good fastness properties in modern times.

Alizarin is a red dye originally obtained from the root of the common madder plant, Rubia tinctorum. (11) Alizarin natural dyes are mordant dyes that need additional chemicals to make the color permanent. (12)

Red light has no effect on the circadian clock, so it can use a dim red light at night. Although red effects are abundantly found, it will be included for its wavelength characteristic and arousal effect to human senses. The second colour is white as it has less documented effect, and furthermore, subjects' preferred and less preferred colours will be observed as it is said preferred colour will give positive effect. (13) & (14) Numerous studies in academic journals have addressed the effects of light and the influence of colored light-waves on human response. While Human vision is a complicated and poorly understood process, and it has been discovered that the receptor system for detecting light and colored light is distinct from that linked to the circadian cycle. (15)

The human circadian rhythm is influenced by light and colored light, and variations in light-dark exposure can throw off the circadian cycle, making it harder to go to sleep and wake up and having an impact on physiological and metabolic functions. Furthermore, studies on seasonal affective disorder show that interruptions to the circadian rhythm might alter mood and behavior. (16), (17) The neuroendocrine system of humans has also been found to be affected by light and wavelength of light, which may also reduce melatonin and increase cortisol production, both of which are hormones that regulate sleep may have detrimental effects. (18) Additionally, a number of recent studies have suggested that various light wavelengths and color wavelength may have particular effects. Where bright and warm red is an emotional color that stirs up powerful sensations. It is also thought to be an intense, color that stirs up feelings of enthusiasm or passion. (19) Depending on its wavelength, light has different effects on how melatonin and core temperature behave. Long wavelengths of light, such as red light and low color temperature light, have little effect on the biological rhythms of human impacts. (20)

Technical procedures

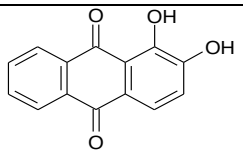
Materials and Fabrics.

Scoured 100% cotton fabrics, 130gm/m^2, (1/1).

They were supplied from Economic and Developing Co., Cairo, EGYPT and used in this study

Dyes.

Alizarin powder extract is a natural dye, which is obtained from root of Alizarin plant.

English name	Alizarin
Principle colour	red
Origin	root
The source	Local market
Chemical structure	

Chemicals.

Cupric sulphate and ferrous sulphate for pre-mordant

(Na_2CO_3) and (CH_3COOH) for controlling the pH level of the dyeing solution

Nonionic detergent

HCL acid

Methods

Pre-mordant process:

Accurately weighed cotton cloth was treated with different metal salts (mordants used-cupric sulphate and ferrous sulphate).The processes of mordanting used were Pre mordanting: It is a technique that involves applying the mordant first and then introducing the dye to the material .It is also called on chrome treatment. (21)

Mordanting was done with 5% (o.w.f.) ferrous sulphate, 5% (o.w.f.) cupric sulphate and their binary combinations with half of their concentrations. Before pre-mordanting, cotton fabric samples were soaked in water to increase surface wettability. The mordants were dissolved in water keeping material to liquor (M: L) ratio of 1:40. Soaked cotton fabric were immersed in the solution at about 30°C, temperature was raised at constant rate up to 90°C and kept for 1 hour with constant stirring. Mordanted yarn samples were rinsed with tap water to remove unused mordants.

Dyeing process:

The colorants were taken from the powdered madder roots in order to perform dyeing. The required amounts of powdered madder root (80% and 100% o.w.f.) were added to an acidic aqueous solution of 2-3 pH using a material-to-liquid (M:L) ratio of 1:20, held for 12 hours, boiled for 1 hour while stirring occasionally, cooled, and then filtered through a clean cotton cloth. The madder dye that is extracted has a reddish-yellow hue. The leftover residue was filtered once more after being percolated with an aqueous solution of acid (HCl) to extract all of the colors. This process was repeated until there was no more colorant. The liquid madder dye is separated from the filter. The filtrate's pH was raised to 8 and applied to cotton fabric samples for dyeing. (22) Manual stirring was done after every 5 minutes to achieve uniform shades. All samples were washed with 5 mL/L nonionic detergent (Safewash Wipro), rinsed with tap water, and dried in the shade. The eco-friendly shades produced (23)

Measurements

Color measurements of dyed cotton samples were carried out by the following standard procedure in terms of color strength (K/S) and CIEL* a* b* values on Gretag Macbeth color-eye 7000 A spectrophotometer connected to a computer with installed software of Mini Scan XE Plus. Color strength (K/S) value was calculated by using Kubelka-Munk equation: $\frac{K}{S} = \frac{1-R}{2R}$ Where K is the adsorption coefficient, R is the dyed sample's reflectance, and S is the scattering coefficient. (24)

Fastness properties

Wash fastness and light of dyed cotton fabric samples were measured by Digi LIGHT-NxTM and Digi WASH-SSTM (Launderometer) as per test methods ISO 105-B02:1994 (Amd.2:2000) and ISO105-C06:1994 (2010) specifications. (25), (26) Dry and wet rubbing fastness of dyed cotton fabric samples were tested using a Digi CROCKTM (Crockmeter) based on ISO 105/X12:2001. (27), (28)

Psychological impacts and wavelength:

The wavelength of highest K/S dyed samples were measured by using spectrophotometer.

Results and discussions

Colour strength (K/S) values

It is evident from figure (I) that the color strength increases with time storage until it reaches high values (36 hrs.), at which point it drops. These behaviors are related to the impact of time storage, which converts alizarin plant cellulose to beta-glucose when the pigment in the extracted dye decreases. As premordant had demonstrated, the highest color strength was achieved. (29), (30) Relatively higher colour strength (K/S) values for mordanted samples underline the fact that mordanting has significantly increased dye exhaustion. Comparatively shade depth analysis of Alizarin dyed cotton samples showed higher colour strength (K/S) values for premordant by cupric sulfate and ferrous sulfate together. (31)

Cupric sulfate and ferrous sulfate together formed strong coordination complexes with the dye, they tend to form quite strong bonds with the dye and with the fiber, so they give high K/S. (32)

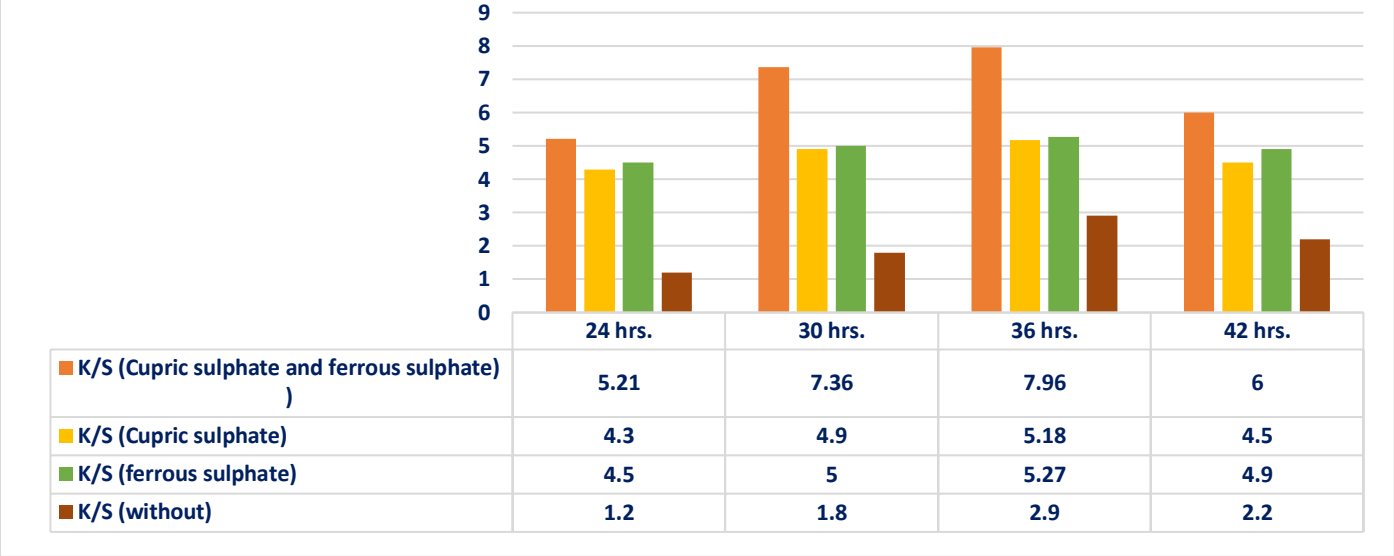


Figure (I) shows the effect of time storage and type of pre-mordant with cupric sulphate or ferrous sulphate or cupric sulphate and ferrous sulphate together on the K/S of dyed samples. Where the highest values of K/S

Colorimetric data and wavelength

From Table I, it was found that the color strength (K/S) values increased and the lightness (L*) values decreased. The phenolic hydroxyl groups of tannins form hydrogen bonds with the reactive groups in cotton fabrics. (32) The highest color strength of dyed cotton samples with natural red alizarin dyes has a short wavelength and a lovely color that affects human biological rhythms. Values of a* and b* recorded positively in dyed fabric, where values of a* recorded higher than the values of b*. The better and more positive values of a* and b* indicate much more reddish-purple shades, which have a positive impact on human psychology. (33)

Table (I) Colorimetric data and its wavelength of dyed cotton samples

The reflectance of the dyed fabrics was measured to visualize the colour coordinated values (CIE L* a* b*). The L* values indicate perceived lightness or darkness. Value of 0 indicates black and 100 indicates white. The values of a* indicate red (+a) and green (-a) while b* indicates yellow (+b) and blue (-b). (33)

K/S	**wavelength**		**LF**	**CIELAB Co-ordinates**		**Helmholtz Co-ordinates**		
			Y %	X	Y	L*	a*	b*
7.96	400		21.57	0.47	0.29	53.57	60.33	9.47
7.36	420		23.55	0.47	0.29	55.63	62.18	11.01
5.21	500		25.53	0.44	0.28	57.59	58.24	4.45

Colour Fastness Properties of Premordanted Cotton Fabric Samples

Table (II) displays outstanding wash fastness (4-5 or 5). Good to exceptional dry- and wet-rubbing

fastness (4–5). Excellent fastness to light. The majority of the mordanted samples showed an improved fastness properties especially premordant by Cupric sulphate and ferrous sulphate together which give excellent all fastness properties.(34)

Table (II)

Fastness properties of Alizarin dyed cotton samples.

C.C.= colour change; C.S. = colour staining on cotton; C.W. = colour staining on wool.

(Wash, light and rubbing fastness on gray scale: 1, poor; 2, fair; 3, moderate; 4, good; 5, excellent).

Premordant with:	**K/S**	**Light fastness**	**Wash fastness**			**Rubbing fastness**	
			C.C.	**C.S.**	**C.W.**	**Dry**	**Wet**
Cupric sulphate and ferrous sulphate	7.96	5	5	5	5	5	5
Cupric sulphate	5.18	5	4-5	4-5	4-5	4-5	4-5
ferrous sulphate	5.27	5	4-5	4-5	4-5	4-5	4-5
Without mordant	2.9	3-4	3-4	3-4	3-4	3-4	3-4

Conclusion:

Alizarin plants can be exploited as a sustainable source of natural dye for textile coloration. It produces lovely, exciting, and distinctive reddish to brownish shades on cotton and silk fabrics with excellent fastness properties even without mordant. The application of CTAB as a surface modifier significantly enhances the dye ability of cotton fabrics, as the L*, a*, b*, and K/S values are obviously improved in comparison with untreated cotton fabrics. This is due to the addition of the hydrophilicity and wettability properties of the fabrics with the premordant application of cupric sulfate and ferrous sulfate. (35) The highest color strength values of dyed cotton fabrics have a reddish purple color and a short wavelength, which have a positive effect on human impact through biological rhythms. (36)

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