P-ISSN 1859-3585 | E-ISSN 2615-9619

DYEING ABILITY OF COLORANT WHICH EXTRACT FROM TURMERIC ROOT

KHẢ NĂNG NHUỘM CỦA CHẤT MÀU CHIẾT XUẤT TỪ CỦ NGHỆ

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DOI: https://doi.org/10.57001/huih5804.2023.229

ABSTRACT

This paper presents study on dyeing ability of Turmeric root with silk and cotton woven fabric. The result shows that the colorant which extracted from Turmeric root can dye for both silk and cotton woven fabric, with the color fastness in grey-scale level 3-4 and 1, respectively. By using HPLC method to check the solvent which extract from dyed cotton and silk fabric, the appearance of curcumin peak on HPLC spectra show that curcumin have been absorb on Silk and Cotton fabric.

TÓM TẮT

Bài báo trình bày nghiên cứu khả năng nhuộm màu của củ nghệ trên vải dệt thoi tơ tằm và cotton. Kết quả cho thấy chất màu chiết xuất từ củ Nghệ có thể nhuộm cho cả vải dệt thoi từ tơ tằm và cotton với độ phai màu tương ứng ở cấp độ 3-4 và 1 theo thang thước xám. Sử dụng phương pháp HPLC để kiểm tra dung dịch chiết xuất từ vải cotton và vải lụa đã nhuộm, sự xuất hiện của pic curcumin trên phổ HPLC chứng tỏ curcumin đã được hấp thụ trên vải tơ tằm và cotton.

Từ khóa: *Thuốc nhuộm tự nhiên, nghệ, curcumin, lụa tơ tằm.*

Keywords: *Natural dye, turmeric, curcumin, silk.*

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Received: 06/3/2023
Revised: 30/6/2023
Accepted: 25/11/2023

1. INTRODUCTION

Curcuma longa L. known as, turmeric, which belongs to the Zingiberaceae family, originates from the Indian subcontinent and possibly neighboring areas of Southeast Asia, but it is nowadays widely grown throughout the tropics [2]. Turmeric was use as a colorant for dyeing fabric quite long time ago in Europa as well as in India [1]. The color of Turmeric is brilliant yellow, that special in the natural. Not much colorant in natural has that brilliant color.

Several classes of secondary metabolites have been characterized from *C. Longa*. The rhizomes were found to contain curcuminoids, such as curcumin and derivatives, such as, demethoxycurcumin, bis-demthoxycurcumin, 5′-methoxycurcumin, dihydrocurcumin, and cyclocurcumin [3].

Recently, dyeing with natural colorant is coming back. With many advantage of natural dyeing fabric such as environmental friendly, nontoxic and having medical properties [3], Turmeric can be used for dyeing fabric.

2. EXPERIMENT

2.1. Experiment Materials

Turmeric which are grown in Vietnam was collected. The dyeing solutions have been prepared by boiling turmeric root in water with the liquor ratio of 1:50. Before the boiling process, the root has been cleaned by water. After boiling in 45 minutes, the color solution is filtered then use for dyeing. The pre-treatment silk (plain woven) and cotton (plain woven, Ne 32 yarn count) fabric was used for dyeing.

All the used chemicals are provided by Xilong Co. Ltd, China.

2.2. Technique

The dyeing solution was calculated that the ratio between fabric and turmeric are 1:2; 1:3; 1:5 o.w.f (on the weight of fabric). The dyeing process happens at 100°C, in 45 minutes. After dyeing, the dyed fabric has been washed in hot and cold water. After that, the dye samples were kept dry at room temperature. The dyeing was repeated three times for each sample.

Color measurement was done by using ISO 105 - J01: 1997 the illumination viewing angle is 10°, and sample diameter is 8 mm. Values were calculated for D65 illuminant. Colors given in CIE Lab coordinates are L* corresponding to brightness (100=white, 0=black), a* corresponding to red/green (positive sign=red, negative sign=green) and b* corresponding to yellow/blue (positive sign=yellow, negative sign=blue). Color strength of the dyed samples, in terms of K/S values, was obtained by Kubelka Munk equation.

$$\frac{K}{S} = \frac{(1-R)^2}{2R} \quad (1)$$

ISO 105 - CO_2 was used for testing color fastness to washing. Samples are washed at 40°C for 30 min. Wash fastness ratings (gray-scale) have nine-steps: 5, 4-5, 4, 3-4, 3,

2-3, 2, 1-2, 1 (marks 1-5: 1=poor, 5=excellent) which illustrate delta E difference between unwashed and washed samples. A rating of 5 is given when there is no difference between unwashed and washed samples.

HPLC (High-performance liquid chromatography) with Electrospray ionization (ESI) methood have been used to determine the present of curcumin on the fabric.

3. RESULTS AND DISCUSSION

3.1. Dyeing ability of turmeric root

The dye sample was checked by color spectra photometry measurement. Each sample has been measured three times and the mean values are calculated. The results are showed in Table 1.

The results in Table 1 shows the dyeing ability of turmeric dyeing fabric. The higher K/S ratio, the higher amount of light - absorbing to fabric. The higher light absorbing on materials, the darker color it has. The color strength of silk dyeing fabric is higher in comparison with cotton dyeing fabric. That means the higher dyeing ability of turmeric on silk than that of cotton.

Table 1. K/S value of turmeric dyeing fabric

Fabric	Turmeric ratio (o.w.f)	K/S vaule (at 450nm)
Silk	1 : 2	1.49 ± 0.29
	1 : 3	1.49 ± 0.11
	1 : 5	1.49 ± 0.21
Cotton	1 : 2	1.41 ± 0.29
	1 : 3	1.45 ± 0.24
	1 : 5	1.47 ± 0.32

3.2. Color fastness of fabric that dye with turmeric root

The turmeric dyed silk and cotton fabric have been checked for the color fastness to washing. The difference of color strength between unwashed sample and washed sample (ΔE) have been calculated.

The results which showed in Table 2 indicate the color fastness to washing of silk and cotton fabric that dyed with turmeric. The fastness ratings of silk show higher than that of cotton. The better color fastness indicates that the colorant remains on silk fabric better than in cotton fabric.

Table 2. K/S value of turmeric dyeing fabric

Fabric	Turmeric ratio (o.w.f)	ΔE	Grey-scale value
Silk	1 : 2	3.52	3
	1 : 3	3.58	3
	1 : 5	2.77	3-4
Cotton	1 : 2	12.47	1
	1 : 3	11.84	1
	1 : 5	11.84	1

3.3. Determine the curcumin that extracted from dyeing fabric by indicator

The color extraction was done by using Soxhlet extraction method with methanol solvent at boiling temperature. The dyed fabric was hanged in the thimble chamber of the Soxhlet apparatus. Methanol solvents is heated in the bottom flask, vaporizes into the sample thimble, condenses in the condenser and drip back, continuously. The extraction are finished when the fabric becomes white.

The solvent after extraction was divided into two glass bottles and adding sodium hydroxide 40%; sunfuric acid 70%. The result showed in Figure 1.

a) b) c)

Figure 1. Color of turmeric solvent after adding

a) NaOH; b) solvent only; c) H_2SO_4

The changing of color of solvent showed that solvent have curcumin. Following the literature, curcumin will change to violet color in base environment and red color in acid environment. That means curcumin have been absorbed on to fabric and extracted into solvent.

3.4. Determine the curcumin on fabric by HPLC method

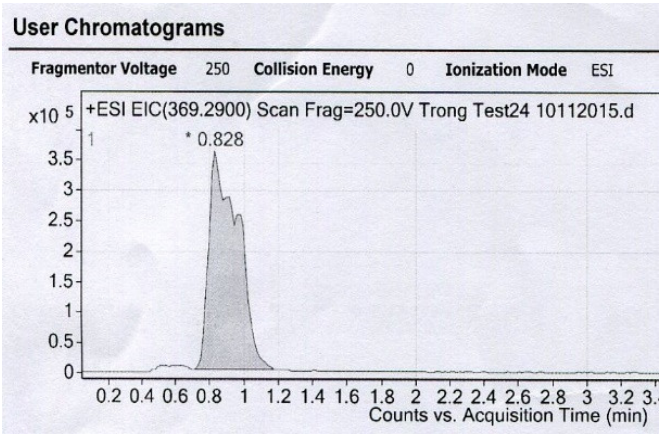

Figure 2. HPLC spectra of solvent extract from dyed silk fabric

The solvent that extracted from dyeing fabric (cotton and silk) was checked by HPLC method using Electrospray ionization (ESI) technic. The result showed in Figures 2 and 3. Figure 2 shows the peak of curcumin in the solvent that

P-ISSN 1859-3585 | E-ISSN 2615-9619

extracted from silk fabric. Figure 3 shows the peak of curcumin in the solvent which extracted from cotton fabric. The appearance of this peak can prove that the colorant which have been extracted from silk and cotton fabric containing curcumin.

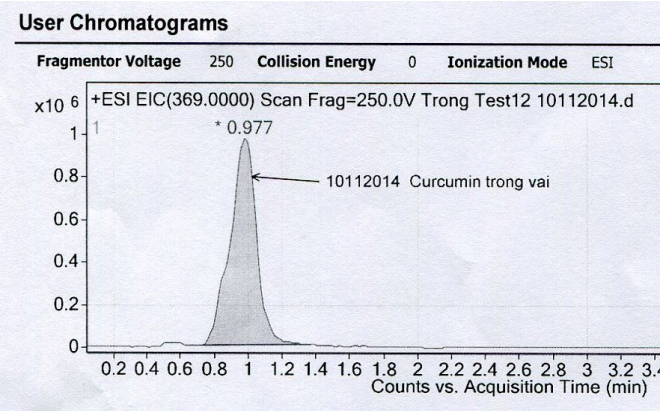

Figure 3. HPLC spectra of solvent extract from dyed cotton fabric

4. CONCLUSIONS

The colorant that extracts from turmeric root can be used for dyeing silk and cotton fabrics. The color fastness of dyed silk fabric is acceptable.

The colorant that make color for silk and cotton fabric is curcumin.

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