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EXTRACTION OF NATURAL DYES FROM CLITORIA TERNATEA FLOWER

Basitah Taif
Faculty of Art & Design, Universiti Teknologi MARA, Shah Alam, 40450, Selangor, Malaysia
taifbasitah@hotmail.com

Siti Hernida Mohd Som
Faculty of Art & Design, Universiti Teknologi MARA, Shah Alam, 40450, Selangor, Malaysia
nydalicious@yahoo.com

Ummi Zinnirah Mohd Yusof
Faculty of Art & Design, Universiti Teknologi MARA, Shah Alam, 40450, Selangor, Malaysia
z1nn1rah2.3@gmail.com

Abstract

This study was to extract the dye from the dried flower of Clitoria Ternatea or Blue Pea. The traditional boiling method was applied to extract its natural colour. The established natural colour has been studied its dyeing ability on silk fabric samples by using pre-mordanting, simultaneous mordanting, post-mordanting and dyeing procedures. The effect on fabric samples were analysed their colour characteristics through CIE L a* b* coordinates and colour fastness to washing. The test results showed that all fabrics samples produced a different range of colours where the most brilliant colours were registered with pre-mordanting method.*

However, all the fabric samples were poor fastness to washing. Thus, having different method of fixing and dyeing procedures with similar extract and concentration allowed variations of hues and shades of the silk samples.

Keywords

Natural Dyeing, ClitoriaTernatea, Boiling, Mordanting

1. Introduction

Tropical climate in South-east Asian countries is suitable for various type of plants to grow whilst offer substantial vegetables and fruits for the food industry (Chin, 1999). Colour extracts obtained from those sources are regularly used as natural colourant in numerous food preparations such as jellies, jams, traditional cakes and fruit juices. Pandanus, roselle and mangosteen are among the plant origin materials utilized in the production of natural colourant for food and drinks in Malaysia. Nevertheless, when consumers are aware of the harmful effects of artificial colourants, colour compounds extracted from natural resources become a substitution to enhance not only their cooking, but also part of dyeing resources for textile's fibre. Zubaidah Shawal (1985), described a famous weaver in Malaysia traditional *songket* textile, Che Ngah Taib applied the green extract from *Cekur manis* or Sauropus androgynus leaves in her textile material. The concentrated green solution was obtained through stages of processes. Besides, many other natural colourants are frequently used in textile industry in various countries and these resources contain valuable natural properties (Deo & Desai, 1999). According to Zarkogianni, Mikropoulou, Varella and Tsatsaroni (2010), dyes obtained from natural resources exhibit higher non-toxic properties and more compatible to be applied in dyeing as compare to the synthetic colourants/dyes. Subsequently, colours achieved in dyeing solid materials such as textiles are varied depend on the type of mordant and the origin of dye material (Mussak & Bechtold, 2009).

In Malaysia, many types of plant are able to grow and produce fruits the whole year through due to its suitable climate. A consistent annual rainfall and moderate temperature have allowed a formation of quality soil and rich with organic matter. As a result, plants such as *mengkud*u (morinda citrifolia), *kundang* (bouea macrophylla), mangosteen (garcinia mangostana), *bunga telang* (clitoria ternatea) and others able to grow perfectly (Mohd. Khalid

Mohd. Zin, Rukayah Aman & Chong, 1993). Parts of these resources such as leaves, roots, flowers, barks and fruits have excellent potential to be extracted as natural dyes.

Clitoria ternatea is a plant which its edible flower is frequently used by the locals to dye rice and other food delicacies. Lee, Rosmawati and Hung (2011) explained that the flower releases blue colour that able to absorb right into the rice after it had been soaking for hours. Other than that, the plant had also been implicated to have antioxidant properties. Patil and Patil (2011), described that the flower is traditionally used as remedy for diuretic, anthelmintic, rheumatism, bronchitis, purgative, urinogenital disorder, demulcent and anticancer.

The purpose of this study was to extract colour from the dried flower of Clitoria ternatea for the production of natural dyes. The traditional boiling method was applied to extract its natural colourant. The established extracts were studied their dyeing ability by experimenting through three different types of mordanting and dyeing method on sample of silk fabric.

2. Material and Method

2.1 Material

Clitoria ternatea is also known as 'bunga telang' (in Bahasa), 'blue pea flower, butterfly pea flower, pigeon wings, tropical alfalfa, mussel-shell climber (English) and Aparajita in Bangladesh and Sankupushpam in Kerala. The plant is a perennial climbing herb that can be found growing abundantly in tropical equatorial Asia, and includes countries such as Africa, Australia and America includes Angola, Benin, Burundi, Cabinda, Cameroon, Cape Verde Is, Chas, Ethiopia, Malawi, India, Sudan and area of Indian Ocean (Mukherjee, Kumar, Kumar, & Heinrich, 2008).

Clitoria ternatea belongs to Fabaceae family which is also placed in Papilionaceae family (Patil & Patil, 2011). It has two varieties of colours, white and blue petals with the average length of about 4 cm (1.6 in) long by 3 cm (1.2 in) wide (Andrews, 1952). In this experiment, the freshly collected flowers petals which exhibits concentrated cobalt blue colour in average size of 1 cm were dried and used for the experiments.

The physical characteristics, the quality and condition of the flower (see Fig. 1), were the main aspect to be considered when collecting the source in a large amount. The parameters were set to ensure that only consistent amounts of flowers to be applied in each procedure. The

collected flowers were thoroughly washed to ensure dirt and other small particles would not affect the final result. Finally, the clean flowers were dried by exposing to sunlight.

Figure 1: *Selected Flowers of Clitoria ternatea*

2.2 Extract Preparation

The dried flowers (see Fig. 2), were weighed and put in gauze fabric as to ensure that only clean extract would be collected. Then, the samples were gradually dissolved in distilled water at a ratio 1:25 at room temperature. The mixture was heated up at 100℃ for an hour to allow the release of dye into aqueous solution.

Figure 2: *The Dried Samples*

2.3 Mordant

Lemon extract (citric) at 5% concentration was used as mordant and mordanting procedures were carried out through Pre-mordanting, Simultaneous mordanting and Post-mordanting methodology.

2.4 Dyeing Procedure

Table 1: *Formula for mordanting and dyeing the silk samples*

Material Preparation	Condition
Material to liquor	1:25
Citric extract (Aqueous Mordant)	5% concentration
Temperature	Room temperature
Weight of the fabric's sample	0.25 gm (25 cm^2)

The pre-mordanting and dyeing, simultaneous mordanting and dyeing and post-mordanting and dyeing methodology were applied to ensure that all samples were treated, thus producing variation of shades for further analysis. Pruthi, Chawla and Yadav (2008), in their research stated that the effects of colour depths achieved from natural dyes do not only depend on the type of mordants applied but also on the application of the various mordanting techniques. Table 1.1 describes the preparation of mordanting and dyeing.

2.5 Colour Measurement and Characterization

The analysis of shades and colours appeared on the samples were undertaken via instrumentation procedure to determine the existence of colour changed. This process is crucial as to confirm the effect of the three mordanting and dyeing applied during the experimental procedure. Colour Spectrophotometer Test (MS ISO 105-J03:2009) analysis was performed to specify colour difference in coordinates presented as ΔL*, Δa* and Δb*. The different in CIE L*a*b* coordinates on the other hand, is to indicate the different between two colours (magnitude and direction) on the samples (Chipot, 2010). The ISO 105-C03:1989 or the Malaysian Standard for wash fastness was applied to assess colour changed that had occurred due to fastness.

3. Results and Findings

The extraction process from the Clitoria ternatea's flowers had established blue aqueous solution contained anthocyanins. The result proves that the flowers contain variation of dark blue colourant that able to act as natural dyes for fabrics.

The aqueous solution shades obtained from all experimental procedures were in bluish shades. The addition of lemon extract as mordant had made the appearance of colours for the fabric samples varies from one another.

Variables such as the mordanting and dyeing procedures, extract's samples and mordant concentration had confirmed on the establishment of various range of colours on fabric. This result was obtained via visual observation which significantly showed the colour changes that had occurred. Excellent depth and shade of colour appears on the silk sample experimented with pre-mordanting and dyeing procedure (see Fig. 3). Silk samples dyed through the pre-mordanting and dyeing method exhibits the darkest grey in shade**.**

Figure 3: *Colour Achieved from Pre-Mordanting and Dyeing Procedure*

Figure 4: *Colour Achieved from Simultaneous Mordanting and Dyeing Procedures*

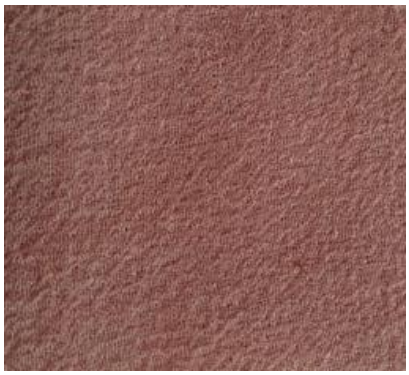

Figure 5: *Colour Achieved from Post-Mordanting and Dyeing Procedures*

A lighter shade of grey colour was obtained through simultaneous mordanting and dyeing experiment (see Fig. 4). Even though only one mordant and dye bath present throughout the procedure which enables the stabilization of the solution, the shade was not as deep as compare to the control sample.

The dried fabric sample experimented with post-mordanting and dyeing showed the lightest colour among all samples (see Fig. 5). This outcome can be suggested due to the instability of the colour attachment on the fabric sample when two separate dye-bath solutions were required to conduct the procedures.

Table 1.2 shows the CIE *L*a*b** measurement of values obtained from the fabric samples dyed with the extracts of Clitoria ternatea and these values were recorded at normal condition. The *L** values showed that samples D1 appeared in deeper shades and the D2 and D3 appeared in the coordinate of grey to white. The result confirms that there was a maximum absorption of dye under the pre-mordanting and dyeing procedure for sample D1.

Table 2: *The CIE L*a*b* Value of Fabric Samples (Silk) Dyed in the Clitoria Ternatea Extracted Solution (Normal Condition)*

Silk Samples	**Procedures**	**CIE**		
		*L**	*a**	*b**
Control	No Mordant	55.89	4.23	4.58
D1	Pre-mordanting and Dyeing	57.26	3.92	5.49
D2	Simultaneous mordanting	66.70	4.91	7.06

	and Dyeing			
D3	Post-mordanting and Dyeing	61.48	11.62	10.42

The wash fastness test showed that all samples were unable to maintain the shades after being washed at 60℃. The procedures were carried out according to ISO 105-C03:1989 standard and confirmed the colour change (staining method) in the scale value of 1 to 5.

4. Conclusion and Discussion

The efforts to rediscover natural colourant extracts from the Clitoria ternatea's flower which is growing wild in Malaysia had already been conducted in this experiment. A comprehensive study on the selected material (*Clitoria Ternatea*) and its variables allow the most suitable flowers to be experimented, thus producing consistency in colour concentrations and shades of dyes. Whether the extraction process requires the utmost utilization of the resources or only parts of it, this would depend on its unique qualities to generate the natural colours and shades. The research outcome confirmed that the extract is not only suitable for food colouration but also possesses unique characteristic in dyeing textile material.

Nevertheless, the result also suggested that the addition of mordant into aqueous solution during the experimental procedures had altered the fixing properties of dyes onto the silk fibre. The consistency in the quality of the extracts obtained from the dried flower provides an interesting platform in discussing the mordanting and dyeing procedures. Citric extract (lemon) as an agent to fix the colour to the fabrics through the Pre-mordanting and dyeing, Simultaneous mordanting and dyeing and Post-mordanting and dyeing had allowed the particles to hold together successfully, thus establishing various shades (Cardon, 2007). Excellent results established through visual observation confirmed the potential of lemon extract to fix the dye onto the fibre, mainly through Pre-mordanting and dyeing. Analysis of colour using Colour Spectrophotometer Test showed that Sample D1 exhibited the lowest value in L* where it was found to be in the darkest shade as compared to others. Similarly, all samples have lost the brightness of their colours during the washfastness test. This fastness test confirms that the dyes could not withstand washing which is the cause of colour fading during the washing procedure. In conclusion, the application of Clitoria ternatea flower as a source for natural colourants, enhanced with a modern technological approach to measure the shade of colour seems to be a

promising departure from this research to establish what is considered as "natural", "eco" or "bio" dye. This research also led to an extended and enriching the use of the palette for the textile craftsman, artists, researchers and many others who are interested in finding uncommon and unique shades of colours (Samantha & Agarwal, 2009).

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