Development of Batik Painting Technique Silk Fabric via Natural Dyes

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Abstract

The aim of this research is to paint silk fabric with batik technique using five natural dyes from margosa bark, lac, mango leaves, marigold and otaheite gooseberry bark. The pre-mordant and after-mordant techniques were used in this work. Ten mordants, Aluminum potassium sulphate, Copper (II) sulphate, Sodium dichromate, Tannic acid, Tartaric acid, Tin (II) chloride and Calcium acetate-monohydrate were applied. The batik fabrics were characterized in color strength, rubbing fastness, washing fastness, light fastness and stiffness. The result indicated that silk fabric painted with natural dye from margosa bark could use all 10 mordants to improve color strength and gave various shades of color. The silk fabric painted with natural dye from lac could not use all 10 mordants to improve color strength, but it gave various shade. The silk fabric painted with natural dye from mango leaves, marigold and otaheite gooseberry bark showed that almost 10 mordants gave higher color strength and various shade. The mordanting technique would give good fastness and reduce the stiffness of batik fabric.

Keywords : Batik painting, Natural dye, Mordant

1. Introduction

Batik is a method of dyeing or painting a fabric by which the parts of the fabric not intended to be dyed are covered with hydrophobic material such as wax, paraffin, etc. To make batik is limited in choosing the dyestuff because of dye fixation process was necessary to do in room temperature condition. Generally, reactive dye was selected as a dyestuff for batik fabric production. Because, reactive dye can react chemically with the fiber to form a covalent bond between the dye molecule and fiber polymer in alkaline condition at room temperature. And, in dye fixation process at room temperature takes time 8 -12 hours.

Nowadays, in many dyeing process used natural dye instead of synthetic dye in order to help the producer, the consumer and the environment safe from chemical pollution because in the procedure of natural dyes do not use the hazard chemicals for people and environment. The raw material is applied in dying to bring from the nature and trees. If the producer considers only a lot of the productions and the marketing don't consider the damage of the trees and the forest where is raw material place, the nature dyeing will destroy the nature and the environment. Thus the technical dyeing nature encourage this issue all the time, the natural conservation and the continual environment get the consciousness and the relationship between a person and the forest to go up by the villagers. The worth of the trees has the food and the medicine can applied the residence and the shady sunlight when the hot weather. The tree still can dye the natural dye or garment product. The villagers look after the trees, do not everyone cut the wood because they received the worth of the tree. So the natural conservation will simultaneously encourage, it actually makes the worthy nature dyeing and the friendly environment. The organic dye make the batik fabric because of the individual feature of dyestuff, no poisonous color, on the environment pollution and harmless the user.

From the problem, the researchers have the idea to make the batik on silk fabric by using natural dye and improved fastness properties of batik fabric by using mordant in order to abate the time in fixation process and develops the batik technique for increasing the product.

2. Materials and Methods

The natural dyes from 5 raw materials, i.e. margosa bark, mango leaves, lac, marigold and otaheite gooseberry bark were extracted at the same temperature. The ten mordants, i.e. Aluminum potassium sulphate Copper (II) sulphate, Sodium dichromate, Potassium dichromate, Tin (II) chloride, Iron (II) sulpahte, Tannic acid, Tartaric acid, Iron (III) chloride and Calcium acetate were used in this study. The amount of mordants was 3, 5 and 7 g/l. The process in this study was separated into 3 methods : no mordanting, Pre-mordant (mordanting before painting) and After-mardant (mordanting after painting).

2.1 Natural dye extraction

- *Margosa bark*

Dried margosa bark was soaked in water for overnight, and then boiled at 100 ^{O}C for 60 minutes. After that filtered the extracted solution and then adjusted to pH 5.

- *Lac*

Lac was stirred in warm water until the red color was extracted. The solution was filtered and then boiled at 100 ^{O}C for 60 minutes. After that the extracted solution was adjusted to pH 6.

- *Mango leaves*

Dried mango leaves was boiled at 100 ^{O}C for an hour and then filtered. The extracted solution was adjusted to pH 5.

- *Marigold*

Dried marigold was boiled at 100 ^{O}C for an hour and then filtered. The extracted solution was adjusted to pH 5.

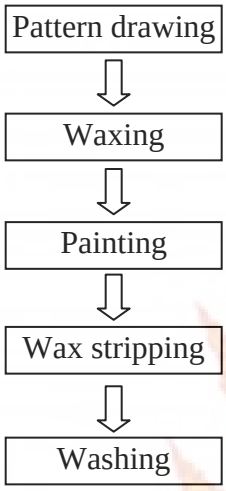
- *Otaheite gooseberry bark*

Dried otaheite gooseberry bark was boiled at 100 ^{O}C for an hour and then filtered. The extracted solution was adjusted to pH 5.

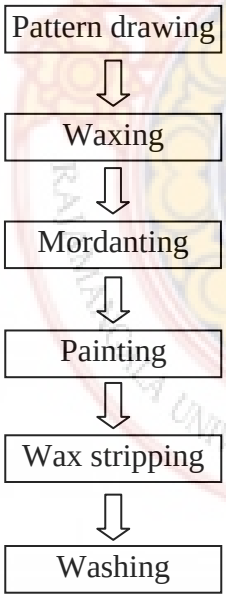
The liquor ratio of natural dye to water was 1.5 : 10 (g:ml).

2.2 Batik process on silk fabric

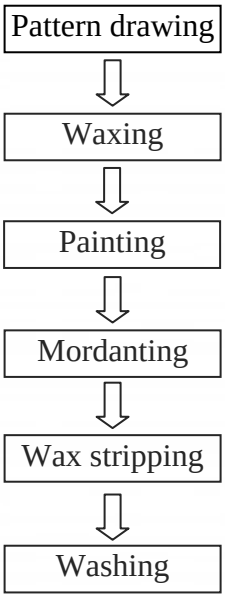
- *No mordant*



- *Pre-mordant*



- *After-mordant*



2.3 Fabric Properties evaluation

The color strength (K/S) and CIELAB value (L*a*b*) were measured by spectrophotometer. The crocking fastness was tested following AATCC 8 - 2004. The washing fastness was tested following ISO-105-C01: 1989 (E) Color Fastness To washing : Test 1. and ASTM D 1388- 96 : Stiffness of Fabric.

3. Results and Discussion

3.1 Color strength and CIELAB value

- *No mordant process*

The results of no mordanting showed that the color strength was not good because the room temperature was not enough to fix the natural dye on the silk fiber. After wax stripping by boiling at 100 ^{O}C, the unfixed dye would be washed off.

- *Pre-mordant Process*

The extracted dye from margosa bark, it was found that mordanting before painting would give high color strength when the silk fabric was mordanted with sodium dichromate and tannic acid. For the other mordants, silk fabric appeared different shade of color depending on the concentration of mordant.

The extracted dye from lac showed that it was not different between no mordanting and mordanting before painting. The color strength on silk fabric was not good.

The extracted dye from mango leaves showed high color strength of silk fabric mordanted with aluminum potassium sulphate, copper (II) sulphate, iron (II) sulphate, iron (III) chloride, calcium acetate. The other mordant showed difference shade of color depending on mordant concentration.

The extracted dye from marigold showed high color strength on the silk fabric mordanting before painting with tartaric acid and calcium acetate. And the others showed difference shade of color depending on mordant concentration.

The extracted dye from otaheite gooseberry bark showed high color strength on the silk fabric mordanting before painting with tannic acid and calcium acetate. The others showed difference shade of color depending on mordant concentration.

The painting on the fabric that used mordanting before painting was difficult to control shading.

- *After mordant process*

The extracted dye from margosa bark showed high color strength on the silk fabric after modanting with aluminum potassium sulphate, copper (II) sulphate, tannic acid, potassium dichromate, tin (II) chloride, iron (II) sulphate, iron (III) chloride and calcium acetate. The different shade of color depended on concentration of mordants and also appeared various shade.

The extracted dye from lac showed more color strength than mordanting before painting process but less than no mordanting.

The extracted dye from mango leaves showed high color strength on the fabric after mordanting with sodium dichromate, tannic acid, tartaric acid; potassium dichromate and tin (II) chloride. They appeared different color shade depending on mordants concentration.

The extracted dye from marigold showed high color strength after mordanting the silk fabric with aluminum potassium sulphate, copper (II) sulphate, sodium dichromate, tannic acid, potassium dichromate, tin (II) chloride, and iron sulphate. The different shade of color depended on concentration of mordants and also appeared various shade.

The extracted dye from otaheite gooseberry bark showed high color strength on the silk fabric after mordanting with aluminum potassium sulphate, copper (II) sulphate, sodium dichromate, tartaric acid, potassium dichromate, tin (II) chloride, iron sulphate and iron chloride. They appeared different color shade depending on mordants concentration. And they gave the various shades.

From the results indicated that the mordanting after painting gave more high color strength that the others.

3.2 Effect of mordant types and mordant concentration

The concentration of mordant that applied on the silk fabric after painting with the natural dyes extracted from margosa bark, mango leaves, lac, marigold and gooseberry bark shown in the Table 1.

The result of the silk fabric painting with natural dyes, i.e. margosa bark, mango leaves, lac, marigold and otaheite goose-berry bark, using no mordanting, mordanting before painting and mordanting after painting processes showed that the silk fabric appeared in different color shade. The mordants affected on the color strength and shades. Some mordant increased the color strength and gave different shade of color.

Table 1 Mordant types and concentration

Natural dye	Mordants concentration (g/l)									
	$AlK(SO_4)_2 .12 H_2O$	$CuSO_4 . 5 H_2O$	$Na_2Cr_2O_7$	$C_{76}H_{52}O_{46}$	$HOOC(CH_2O)_2COOH$	$K_2Cr_2O_7$	$SnCl_2$	$FeSO_4$	$FeCl_3$	$Ca(C_2H_3O_2)_2$
Margosa bark	5	7	7	3	5	5	5	3	7	7
Lac	X	X	3	X	X	X	X	X	X	X
Mango leaves	3	7	7	X	X	7	7	3	X	X
Marigold	7	7	X	X	X	7	3	7	X	X
Gooseberry bark	X	3	7	X	X	7	X	3	5	X

Note : X means the mordant concentration cannot improve color strength.

3.3 Color fastness of batik fabric

The result of color fastness to crocking and color fastness to washing of batik fabric painting with natural dyes are shows displayed table 2 and 3.

From the result found that grey scale value of the changing of batik were valuable between 2 to 4 - 5 color that meant the durability to washing in low level to excellent.

3.4 Stiffness of batik fabric painting with natural dyes

The results showed that the stiffness of silk fabric after mordanting would decrease when compared to no mordanting.

Table 2 Color fastness to crocking of batik fabric painting with natural dyes

Mordants		Natural dyes				
		Margosa bark	Lac	Mango leaves	Marigold	gooseberry bark
$AlK(SO_4)_2.12H_2O$	Dry	4-5	3-4	4	4-5	4
	Wet	4	2	2-3	2-3	3
$CuSO_4. 5H_2O$	Dry	4-5	3	4-5	4-5	3-4
	Wet	3-4	3	4-5	4-5	3-4
$Na_2Cr_2O_7$	Dry	4-5	4-5	4-5	4-5	3-4
	Wet	3-4	2-3	3	3-4	3
$C_{76}H_{52}O_{46}$	Dry	4-5	4	4-5	5	5
	Wet	4	3	3	3	4-5
$HOOC(CH_2O)_2COOH$	Dry	4-5	4-5	5	4-5	5
	Wet	4-5	3	3-5	2-3	4
$K_2Cr_2O_7$	Dry	4-5	4	4-5	4-5	3-4
	Wet	4-5	3	3	3	3
$SnCl_2$	Dry	4-5	3	4	3-4	4
	Wet	4	1-2	2-5	1-2	3
$FeSO_4$	Dry	4	3	4-5	4	3-4
	Wet	4-5	1-2	2-5	2	2
$FeCl_3$	Dry	4	3-4	4-5	4-5	2-3
	Wet	3	2	4-5	4-5	2-3
$Ca(C_2H_3O_2)_2$	Dry	4-5	4-5	4-5	4-5	4-5
	Wet	4-5	2	2	2-3	3-4

Table 3 Color fastness to washing of batik fabric painting with natural dyes

Mordants		Natural dyes				
		Margosa bark	Lac	Mango leaves	Marigold	gooseberry bark
$AlK(SO_4)_2.12H_2O$	C	5	5	5	5	5
	S	4-5	4	4-5	4-5	4-5
$CuSO_4.5H_2O$	C	5	5	4-5	5	5
	S	4-5	4-5	4-5	4-5	4
$Na_2Cr_2O_7$	C	4-5	5	5	5	5
	S	4-5	4-5	4-5	4-5	4-5
$C_{76}H_{52}O_{46}$	C	5	5	5	2-3	4-5
	S	4-5	4	4-5	2-3	3-4
$HOOC(CH_2O)_2COOH$	C	5	5	5	2	5
	S	4-5	3	4-5	2-3	4-5
$K_2Cr_2O_7$	C	4-5	5	5	5	5
	S	4-5	4-5	4-5	4-5	4-5
$SnCl_2$	C	5	5	5	5	5
	S	4-5	4-5	4-5	4-5	4-5
$FeSO_4$	C	5	5	5	5	5
	S	4-5	4-5	4-5	4-5	4-5
$FeCl_3$	C	5	5	5	5	5
	S	4-5	4-5	4-5	4-5	4-5
$Ca(C_2H_3O_2)_2$	C	4-5	5	5	3	5
	S	4-5	4-5	4-5	3	5

Note : C mean color change
S mean color staining

4. Conclusion

The silk fabric after painting with natural dye extracted from margosa bark, marigold and otaheite gooseberry bark showed that 10 mordants could improve the color strength when compared to no mordant fabric. They appeared different shade of color depending on the mordant types and concentration. The mordanting can be used all two processes, i.e. mordanting before painting and mordanting after painting. The painting including mordanting would give higher color fastness and decreased the stiffness of silk fabric.

The silk fabric painting with natural dye extracted from Lac showed that all ten mordants could not improve color strength but gave different color shade. They improved the color fastness and reduced the stiffness of silk fabric.

The silk fabric painting with natural dye extracted from mango leaves showed that almost of 10 mordants could improve the color strength and gave different shade of color. The mordanting before painting and mordanting after painting processes could be used to apply on silk fabric. The color charecteristic depended on the mordants concentration. The mordanting could improve the color fastness and also reduced the stiffness of silk fabric.

5. Acknowledgement

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