



Mahogany Wood as Natural Dyes for Textile Colouring: Experiment at Home Industry Batik Wonorejo Village Singosari Malang Regency

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Abstract. Batik is one of the Indonesian cultures that has been recognized worldwide. UNESCO has recognized that batik is a non-material culture native to Indonesia. Since this recognition, the love for batik has spread among the people of Indonesia. Many people use batik as their daily clothing textile. Batik is not only used as formal wear, but also casual wear. With this opportunity, many regions have begun to develop batik into a regional business and even make the tourism sector in the era of the creative economy. One area that has developed a batik business is Wonorejo Village, Singosari, Malang Regency. Singosari Village wants to develop Batik Village as one of its tourism potentials. This will enable Wonorejo Village to become a tourist destination to learn about natural coloring. Based on initial observations, the process of making batik in Wonorejo Village uses chemical dyes. This study aims to develop innovations in batik coloring with natural dyes. The method used in this research is the experimental method. In the research process, the research team will conduct trials of several natural dyes derived from plants. Furthermore, the test results will be documented and the dosage composition of each dyestuff. This study resulted in a natural batik coloring technique using mahogany wood. Staining trials were also carried out using different fixations using *tunjung* and *tawas*.

Keywords: Batik · textile · natural dyes · home industry · mahogany wood

1 Introduction

The development of the batik industry in Indonesia has risen over time. The central and local governments have promoted many assistance programs for local industry to increase their creativity in producing batik. Each region has begun to develop batik production according to the character of each region. The batik center in East Java, which was previously only centered in a few areas such as Tulungagung, Trenggalek, Sidoarjo, and Madura, is now expanding. Almost all districts in East Java are currently starting to pioneer the development of the batik industry. One area in East Java that is currently starting to develop the batik industry is Wonorejo Village, District, Singosari, Malang Regency.

The development of the batik industry started with members of the PKK in Wonorejo Village who scheduled regular meetings to work on batik together at the village office. This activity is supported by the Wonorejo Village government so that it becomes a routine activity that is carried out every month. The batik-making techniques that are currently being used are hand-written batik and splashed-batik techniques. The dye used is naphthol chemical dye. This type of dye was chosen because it is considered easy in the process of making batik. In the short term, the use of chemical dyes for the batik-making process is indeed quite efficient, but if you think about the production process in large quantities and in the long term, the use of dyes will be harmful to the environment. This is because the production process is carried out in areas close to residential areas. The process of dyeing batik using chemical dyes will produce waste that must be considered for its flow, because if it seeps into the ground around residential areas, it will affect the health of the skin and affect the PH of the water. Therefore, in the long term the development of the batik industry in Wonorejo village needs to innovate coloring with natural materials that are environmentally friendly. The batik industry in Wonorejo village has the potential to develop natural dye-based batik products. This is because the geographical location of Wonorejo village which is located in a mountainous area has many types of plants. Various kinds of plants can be used as a source of natural dyes starting from the leaves, stems and roots.

Based on the background, this article describes the experimental results of natural batik coloring that will be applied in Wonorejo village. The natural dye used is Mahogany. Experiments were carried out with two different fixation materials, namely *tunjung* and alum.

2 Literature Review

2.1 The Urgency of Natural Batik Dyes

Indonesia is a country rich in natural resources. This condition requires us to be able to exploit and explore natural resources properly. One of the resources that can be used in the batik industry is natural dyes. The process of using natural colors in batik techniques has been carried out by our ancestors from generation to generation until synthetic colors are found which are considered practical and economical. Natural dyes used as dyes are in the form of color-carrying pigments that can be obtained from plants and animals [1]. The most common types of pigments are chlorophyll, carotenoids, tannins and anthocyanins. This color carrier pigment is usually obtained through extraction or fermentation processes. Plant parts that can be used as a source of natural dyes include leaves, bark, stems, flowers, fruit and plant roots [2]. Each plant has a different color character.

Beside the extraction of plant parts, the appearance of the resulting color is also influenced by the fixator or color binder selected. In making natural dyes, you can choose a fixator in the form of *tunjung* or *alum*. The resulting colors include basic colors (red, blue, yellow) and color combinations such as brown, orange and indigo. In carrying out the process of dyeing natural batik, the fabric must first be mordant. Mordanting is the process of giving metal elements into fibers or fabrics, so that these metal elements can

react with the coloring material [1]. There are two types of mordant materials, namely synthetic mordant using alum and natural mordant using *loba* or *jirak* plants.

In an article written [3] about batik's understanding of chemical waste, it is stated that, in addition to having an impact on the environment, the uncontrolled use of chemical substances will endanger batik craftsmen. This is because the batik production process is closely related to the use of chemicals caustic soda (NaOH), sodium nitrite (NaNO_2), caustic soda (NaOH), sodium silicate (Na_2SiO_3). These chemicals will have an impact on irritation, itching of the skin and even skin cancer.

In addition to the direct impact on the health of batik, the use of synthetic textile dyes containing heavy metals will cause environmental impacts, including soil, water and air pollution [4]. Another study [5] discusses that there are negative impacts from waste disposal that do not undergo proper processing, especially liquid waste, including 1) causing pollution and contamination of surface water and every drop of water used by humans, 2) disturbing even can kill the life of aquatic ecosystems, 3) Generate odors (the result of the decomposition of anaerobic and inorganic substances), 4) produce mud which has an impact on blockages that can cause flooding. The results of research conducted by Musripah [6] also mentions that the use of natural dyes in the batik process is dangerous if used continuously because chemically, liquid waste from the rest of batik production can change the value of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) in water.

3 Materials and Methods

3.1 Materials and Equipment

In this experimental process several equipment and materials were used. The equipment used in this study included a pot for boiling, a stove, a filter, and a tub for soaking natural dyes. The natural dye used is mahogany. To produce maximum color before the process of dyeing the fabric into the dye solution, it is started by mordanting on the fabric. The mordanting process uses a water mixed with Turkey Red Oil (TRO) and soda ash. at the final stage to do color locking, so that the natural colors produced do not fade, fixation is necessary. The fabric used in this experimental process is cotton fabric with a primissima type. The materials used in the fixation process are *tunjung* and *alum*.

3.2 Experiment Stage

In the process of producing natural dyes there are five main stages carried out in this study, namely:

1. Mordanting
2. Natural Dye Extraction
3. Batik Fabric Dyeing
4. Fixation
5. Release of wax on fabric

4 Findings and Discussion

4.1 Mahogany (*Swietenia Mahogani*)

Mahogany is an annual plant that can produce natural dyes for the textile industry such as batik. The average height of this plant ranges from 5–25 m with rounded stems, many branches, and gummy wood. The leaves are compound leaves of light brown color. Mahogany fruit is a box fruit with an oval shape with five grooves and brown in color. Inside the fruit there are flat seeds with a rather thick tip and dark brown in color. The bark of this plant is used as a producer of brownish red dye in the fabric.

Utilization of waste in the form of sawdust Mahogany can be used as an alternative because until now the utilization is still limited. The selection of mahogany wood powder as a dye for batik is also based on the presence of chemical content in mahogany in the form of *flavoida* which is a color-producing pigment. This mahogany plant is a tropical plant and is found growing wild in the forest. This plant likes a place with sufficient direct sunlight. This plant is a type of plant that can survive in all kinds of conditions, including hard soil [7].

4.2 Mordanting Fabric

The mordanting process is intended to provide a metal salt charge on the fabric, as well as to remove grease, oil, starch, and dirt on the fabric. If some of these particles are not removed, the staining will be less sharp and uneven. Batik cloth that uses natural dyes will fade more easily if it does not undergo a mordanting process first. This mordanting usually uses metal salts which are also used as binders in the fixation process such as alum or tunjung. The following are the stages of the mordanting process on cotton fabric weighing 500 g:

- The cloth is soaked in a solution of Turkey Red Oil (TRO) or detergent as much as 2 g in 1 L overnight
- The cloth is washed clean and squeezed out the water
- A solution is made by mixing 100 g of alum and 30 g of soda ash into 17 L of water, stirred until dissolved, and heated to boiling.
- After boiling, the cotton cloth is inserted and the heating is continued for 1 h.
- The fire is turned off and the cloth is left in the solution overnight.
- The cotton fabric is removed and rinsed and then dried.
- After drying, the cotton fabric is ready to be dyed and dyed (Fig. 1).

4.3 Natural Dyes Extraction

Extraction of natural dyes used in this experiment using mahogany wood and its skin (Fig. 2).

Natural dyes are obtained by extraction, both at high and low temperatures, from the plant parts that are the source and using water as a solvent. In this way the natural dye extracted varies, depending on the type of source. For example, natural dyes in the form



Fig. 1. Mordanting Process



Fig. 2. Mahogany Wood as Natural Coloring Material

of wood can be taken about 6.5% of dyes. In general, sorting is done as the first step in the extraction process by selecting materials that have been cleaned, and then dried so that the remaining plant parts containing dye are left (Fig. 3).

As previously explained, natural dyes come from parts of plants such as skin, roots, seeds, fruit skins, flowers, leaves and so on, cut into small pieces. In this study, the plant part extracted was the mahogany bark. The extraction process is as follows:

1. The material in the form of bark that has been cut into pieces is confirmed to have been dried or dried in the sun to reduce the water contained in it.
2. 1 kg of bark is then put into a pot that already contains 10 liters of water.



Fig. 3. Extraction Process

3. The pan that already contains the mixture of ingredients is boiled at a temperature of 100 degrees Celsius until it boils or for 2-4 hours until the water volume is 4-5 liters.
4. After cooling the solution is filtered or separated from the dregs.
5. The solution is ready to be used as a dye

4.4 Dyeing Fabric

Dyeing with the dyeing process in principle is the process of combining the dye with the fiber/fabric. Merging occurs because of a chemical reaction so that a bond occurs between the two. The process of batik coloring using natural dye extracts at room temperature always takes place at room temperature as well. After being used for one dyeing, the remaining extracts of natural dyes can still be reused for the next dyeing and if necessary, the addition of a new solution.

The requirements for the chemical reaction between the dye and the fiber to run well so that the coloring results are as desired, the following points need to be considered:

1. There is compatibility between the fiber and the dye, which means the dye has an affinity for the fiber/fabric.
2. Fiber/fabric in a pure state means that the cloth fiber has good absorption of dyes without being hindered by dirt or other substances, such as the presence of starch.
3. Required arrangement of appropriate dye solution (acidic, basic, or neutral)
4. Color generation, so that the desired color is produced (the color appears/rises) efforts are needed to trigger the formation of color.

Based on the chemical composition of the dyestuffs, natural dyes are suitable for dyeing natural fibers, both from plants (cellulose fiber) and animals (protein fiber). In this case, it is very suitable for dyeing batik because it can color the fiber/fabric at



Fig. 4. Dyeing Process

room temperature. Basically, the technique of dyeing cloth in a solution of natural dyes produced by various types of plants has the same method except for indigo plants. The following is the process of coloring with natural dyes in general: Kain dibasahi dengan larutan TRO.

1. The batik cloth is soaked in natural dye extract for 15 minutes (at least) then drained.
2. In a semi-dry state, the re-dyeing process is carried out for at least 5 times so that it reaches the desired color level (light color-dark color).
3. Dry cloth, fixed by soaking in a solution (alum or tunjung) for 2–5 minutes then drained to dry
4. The cloth that has undergone a fixation process and is dry, then cleaned from the rest of the night by boiling hot water (Fig. 4).

4.5 Fixation

At the end of the dyeing process, the natural dyes still need to be strengthened again between the bound natural dyes, through the fixation process. Fixation can be done with metal salts such as alum or tunjung. Besides strengthening bonds, metal salts also function to change the direction of natural dyes, according to the type of metal salt that binds them. Metal salts based on the fixation process were Alum with a concentration of 70 g/liter and Tunjung with a concentration of 20 g/liter.

How to make fixation solution:

1. Metal salt is weighed according to the type of metal salt used.
2. Salt is dissolved in water (for alum assisted by heating so that it dissolves quickly)

Table 1. Dyeing Comparison

Coloring Results	Information
	Result of fabric coloring after dyeing 5 times in mahogany wood extraction solution (before fixation process).
	The result of staining that has been fixed with <i>tunjung</i> .
	The results of the fabric fixed using alum.

3. The solution is left overnight. The clear liquid at the top of the solution is used.

Table 1 shows the results of fabric staining using two different types of fixation:

From the experimental results of the coloring of natural mahogany wood, it can be seen that the extraction of this material produces a brownish color. In the dyeing process, it can be seen that the color obtained is still faint. After the fission process occurs, color generation occurs. Fixation using *tunjung* produces a dark brown final color on the fabric, while fixation using alum produces a lighter or light brown color.

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