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The Effect of Coconut Fiber Soaking Time in Natural Secang Wood Dye (*Caesalpinia sappan* Linn.) on Color Intensity and Color Fastness of Cotton Fabric with Lime Fixator

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ABSTRAK

Penelitian ini bertujuan mengevaluasi pengaruh lama perendaman sabut kelapa dalam ekstrak kayu secang terhadap intensitas dan ketahanan warna pada kain katun setelah pencucian dengan sabun. Metode yang digunakan meliputi ekstraksi kayu, perendaman sabut kelapa, dan pencelupan, diikuti dengan fiksasi menggunakan kapur. Pengujian dilakukan untuk mengukur intensitas warna dengan spektrofotometer UV-2401 PC dan ketahanan warna terhadap pencucian menggunakan standar skala abu-abu. Hasil menunjukkan bahwa perendaman sabut kelapa menghasilkan warna yang lebih cerah dibandingkan tanpa perendaman. Meski pencelupan pada sabut kelapa yang direndam dan tidak direndam menunjukkan ketahanan warna yang serupa, penggunaan kapur sebagai fiksator meningkatkan intensitas warna. Secara keseluruhan, perendaman yang lebih lama dan fiksasi kapur menghasilkan warna yang lebih dalam dan cerah, serta mempertahankan ketahanan warna terhadap pencucian sabun secara efektif.

ABSTRACT

This study aims to evaluate the effect of soaking coconut husk in secang wood extract on the color intensity and color fastness of cotton fabric after washing with soap. The methods used include wood extraction, soaking coconut husk, and dyeing, followed by fixation using lime. Tests were conducted to measure color intensity using a UV-2401 PC spectrophotometer and color fastness against washing using a gray scale standard. The results show that soaking coconut husk produces brighter colors compared to not soaking. Although dyeing with both soaked and unsoaked coconut husk exhibited similar color fastness, the use of lime as a fixer enhances color intensity. Overall, longer soaking periods and lime fixation resulted in deeper and brighter colors while effectively maintaining color fastness against soap washing.

1. INTRODUCTION

Indonesia has rich natural resources, including plants that can be used as natural dyes. Natural dyes come from natural sources in plants, are easily biodegradable, environmentally friendly, non-toxic, do not cause allergies, and are easy to obtain (DS & Alvin, 2019). However, in the textile industry, natural dyes are rarely used because they are less bright, fade easily, and are less uniform. Along with the development of technology, the industry prefers synthetic dyes because they are practical and have a variety of colors. However, the use of synthetic dyes causes environmental pollution and health problems. Therefore, the use of natural dyes is important to reduce these risks (DS & Alvin, 2019).

Secang wood (*Caesalpinia sappan linn*) is a natural dye that has been used in the textile industry. The compound that gives color to secang is brazilin. In coloring, secang wood can provide a bright red color. The red color of secang is caused by the brazilein compound which is the result of oxidation of the brazilin compound (yellow) which is oxidized in water (Nisa, 2020). Traditionally, sappanwood plants are often used by local communities. The parts of the sappanwood plant that are commonly used are wood

chips or wood chips.

Coconut fiber, alongside sappanwood, can be utilized as a natural dye. It yields fibers suitable for various economically valuable products and can also be processed into natural dyes for textiles. The presence of tannins and quinone dyes in coconut fiber enables it to produce these natural dyes effectively. The extract of young coconut fiber produces light brown to dark brown colors, while the extract of old coconut fiber can produce reddish brown colors (Setiawan & Wiratma, 2021).

Natural dyes can be used to dye several types of fabrics, including cotton fabrics. The selection of the type of fabric used for the coloring medium must have good absorption and have a high fiber density so that the color can be bound in the fabric fibers. Cotton fabric was chosen as the coloring medium in this study, because cotton fabric has high absorption and natural dyes produce dense colors when applied to cotton fabrics. The results of the study from (Yuniati et al., 2021). showed that the color fastness of cotton fabrics produced good values, because cotton fabrics have cellulose fibers that can absorb dyes well. The novelty in this study was a combination of two natural dyes between sappanwood and coconut fiber. Natural coconut fiber dyes will be extracted using a solution extraction from sappanwood with a time variation of 24 hours and 48 hours. The selection of this time variation is to determine the optimal conditions that produce the best color with the appropriate level of color fastness. In this coloring process, a fixation process is also needed which aims to bind or lock the dye to the fabric so that it is resistant to fading (Azizah et al., 2018) in (Andriyanti et al., 2020). In this study, the type of fixator used was lime. Lime has an acid content that can bind the dye absorbed into the fabric (Saputri et al., 2018). In a study conducted by (Andriyanti et al., 2020) it was stated that the lime fixator for the color fastness of soap washing with gray scale standards has a value with an average good category. Lime fixator can produce brighter colors, because lime has a pH of 2-3 in an acidic environment, where the acidic pH produces the lightest color and the higher the acidic pH, the brighter the color will be (Ramelawati, 2017). One of the challenges in using natural dyes is the limited color variations, the dyeing process that takes a long time and low color fastness. Color fastness is very important in the quality of clothing or dye materials. The fixation process is needed to achieve good color fastness, where fixation materials such as lime are used to lock the color before dyeing. Lime was chosen because it is affordable and easy to find in the market.

The novelty in this study is the combination of two natural dyes, namely secang wood extract and coconut fiber with a soaking process. The process of soaking coconut fiber and secang wood extract aims to produce a darker or darker red color. Natural coconut fiber dyes are extracted using secang wood solution extraction through a soaking process with variations in soaking time of 24 hours and 48 hours. The soaking time affects the tannin content produced by a material and different soaking times will produce tannin levels with different concentrations. In the coloring process, a fixation process is needed, aiming to bind or lock the dye to the fabric so that it is resistant to fading and color-forming substances. In this study, the type of fixator used was lime. Lime has an acid content that can bind the dye absorbed into the fabric. The selection of the type of fabric used for the coloring medium must have good absorbency and have a high fabric fiber density so that the color can be bound in the fabric fibers. Cotton fabric is chosen as the coloring medium in this study, because cotton fabric has high absorption and natural dyes will produce a dense color when applied to cotton fabric. The color intensity test is carried out to determine the amount of dye absorbed into the fabric and the color fastness test aims to determine the color fastness to repeated washing.

2. METHOD

This research was conducted at the Chemical Engineering Laboratory, Faculty of Engineering, Singaperbangsa University, Karawang and color intensity and color fastness sample testing was conducted at the Laboratory of the Islamic University of Indonesia, Yogyakarta. It was carried out in the time span used in the research process and data collection, namely in November - December 2023.

Research Procedures

1) Preparation of Raw Materials

Prepare the natural dye material of sappan wood (Caesalpinia sappan linn) then weigh the natural dye material 1 kg, and coconut fiber 1kg, then prepare 10 liters of water.

2) Extraction

Extraction of sappanwood solution, the stages of the extraction process, namely 1 kg of sappanwood and 10 liters of water or 1:10 put into a container, then turn on the stove with medium heat for 30 minutes or until the temperature is 100 ◦ C. then the clarification process is carried out between the extraction solution and the undissolved solids. The extraction solution is separated into 3 containers, namely 5 liters for treatment without soaking or 0 hours, 24 hours soaking and 48 hours soaking.

3) Soaking

In the soaking process, namely inserting 1 kg of coconut fiber into a solution of natural dye extract from sappan wood (Caesalpinia sappan linn), then with a soaking time of 24 hours and 48 hours. To obtain the soaking solution, separate the solution from the coconut fiber.

4) Dyeing

Dyeing, cotton fabric is dyed by dipping into a solution without soaking treatment or 0 hours, 24-hour soaking solution and 48-hour soaking solution. Dyeing is done 5 times with a time of 10 minutes each time and dried at room temperature and without exposure to sunlight.

5) Fixation

Make a 30 ml fixation solution, namely by squeezing the lime fixator to 30 ml and 1 liter of distilled water. Then each cloth resulting from the dipping of the dried soaking solution is dipped back into the fixation and dipping solution for 10 minutes, after which is dried in the sun.

6) Durability

The color resistance test to soap is carried out using the Gray scale tool

7) Color intensity

The color intensity test is carried out using the UV-VIS 2401 PC Spectrophotometer. The samples used in this study with several treatments, including:

a. Color intensity test

Table 1. Color intensity test

Immersion	Lime	Non Fixator
0 hours	NF0	NFF0
24 hours	NF24	FF24
48 hours	NF48	FF48

b. Color Consistency Test

Table 2. Color Fastness Test

Immersion	Lime	Non Fixator
0 hours	NF0	NFF0
24 hours	NF24	FF24
48 hours	NF48	FF48

Description:
F : Fixator
NFF : Non Immersion Fixator
NF : Non Fixator
FF : Immersion Fixator

Method of collecting data

In processing research data using Microsoft Excel software to determine the differences in the level of intensity and color resistance of each sample produced after testing with the UV-Vis 2401 PC Spectrophotometer and Gray scale.

3. RESULT AND DISCUSSION

Color Intensity

The color intensity test aims to determine the amount of dye absorbed into the material. Measurements are made using a Spectrophotometer (UV-PC). The reflectance value (R%) is taken from one of the strongest reflectance (R%) values, namely the last sequence range between 1-5 at the bottom. The smaller the reflectance value (R%), the darker the fabric color, while the greater the reflectance value (R%) the lighter the fabric color or towards white.

The results of the color intensity test on the fabric before dyeing using lime fixator have a reflectance value (R%) of 5.16, while the fabric after dyeing using lime fixator has a reflectance value (R%) of 5.35. This is because the safe pH content in lime can produce bright colors and has high intensity. Lime fixator also has a great influence on color sharpness, because it has a fairly high nitric acid content which can reduce the pigment absorbed in the fabric.

Table 3. Results and Color Intensity Test

Sample	Fabric Color Intensity Test Value (R%)
Blank	105.63
Non Fixator 0 Hours	5.16
Lime Fixator 0 Hours	5.35
Non Fixator 24 Hours	10.85
Lime Fixator 24 Hours	19.24
Non Fixator Lime 48 Hours	14.33
Lime Fixator 48 Hours	23.09

Based on Table 3, the results of the color intensity test of the fabric before being dyed in coconut fiber immersion have a reflectance value (R%) of 5.16 and for the fabric that has been dyed in coconut fiber immersion for 24 hours has a reflectance value (R%) of 10.85 while the fabric with coconut fiber immersion treatment for 48 hours has a reflectance value (R%) of 14.33. Variations in the immersion time of the fabric in the dye affect the coloring results and the percentage of color pigments absorbed by the fabric. Soaking coconut fiber for 48 hours can produce darker colors compared to soaking coconut fiber for 24 hours. This is because soaking coconut fiber for 48 hours can absorb color optimally. The pores in the fabric in the extract will open and get bigger over time so that more dyes will be absorbed by the fabric.

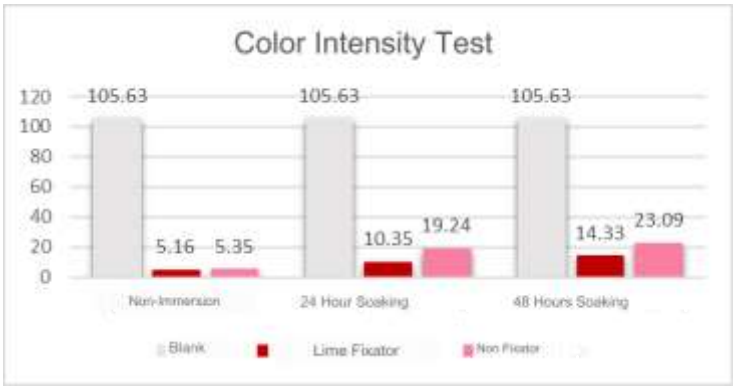

Figure 1. Color intensity test

The color results of the fabric before the coconut fiber soaking are dark red while the color of the fabric after the coconut fiber soaking is peach. This is due to the tannin compound in coconut fiber. Tannin is a mixture of polyphenol compounds and when viewed under a microscope tannin has a yellow, red, or brown color (Fransisca Rosella Lisan, 2015).

Color Fastness Resistance

After conducting research on color resistance using the Gray scale tool, the following results were obtained:

Table 4 . Color Fastness Test Results

Sample	Color Fastness Test
Blank	4 (Good)
Non Fixator 0 Hours	4 (Good)
Lime Fixator 0 Hours	4 (Good)
Non Fixator 24 Hours	4 (Good)
Lime Fixator 24 Hours	4 (Good)
Non Fixator Lime 48 Hours	4 (Good)

Color fastness testing to washing conducted in the Textile Evaluation Laboratory FTI-UII Yogyakarta using standard gray scale tools. Before dyeing the sappanwood extract, the fabric was first morded. Mordanting is an initial treatment on the fabric to be dyed so that fat, oil, starch and dirt left in the weaving process can be removed and the dye can be directly absorbed by the fabric. In addition to aiming to increase the attractiveness of natural dyes to textile materials, Mordanting is also useful for

producing good color evenness and sharpness (Putri et al., 2023). The principle is to condition the dye that has been absorbed for a certain time so that a reaction occurs between the fabric dyed with the dye and the material used for fixation (Eskak, 2020).

The results of the color fastness test on the fabric before dyeing with lime fixator have a value of 4 (Good) while the fabric after dyeing with lime fixator has a value of 4 (Good). This is because the color pigments contained in sappanwood extract are well absorbed into cotton fabrics. The results of the color fastness test on the fabric before and after lime fixator dyeing produced the same value or did not change the color fastness value. This is in accordance with the theory of the function of the fixator in addition to producing color, it can also prevent dehydration of color pigments by strengthening the bonds of fiber and color (Andriyanti et al., 2020).

The color fastness test aims to determine the color fastness to repeated washing. Based on the results of the color fastness test of the fabric before being dyed with coconut fiber soaking, it has a value of 4 (Good), while the fabric after being dyed with coconut fiber soaking for 24 hours and 48 hours has a value of 4 (Good). Lime fixator does not have a significant effect on color fastness to soap washing. Where with lime fixator treatment and without lime fixator treatment on coconut fiber soaking or without coconut fiber soaking produces the same value, namely 4 (Good). However, visually the results of the color fastness test on the fabric after being dyed with lime vixator show a color change. The majority of theories say that the fixation process can prevent the fading of natural dyes on the fabric, but the factors that affect the fastness of a fabric do not rely only on lime which acts as a fixator alone. There are still many other possible factors that have an influence on the colorfastness of a fabric, such as research conducted by (Saputri et al., 2018), stating that the magnitude of the influence of lime fixator on the coloring of guava leaf extract is seen from the color aging and fastness of batik cloth dyeing is 25%, while the remaining 75% is influenced by other factors. However, the results of this study indicate the influence of lime fixator on colorfastness after going through a washing test.

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that the extract of sappanwood with coconut fiber immersion affects the intensity of the color produced on the fabric to become brighter. the highest color intensity (dark) with a reflectance result (R%) of 5.16 While the coloring of the fabric with 24-hour coconut fiber immersion has 10.85 and 48-hour coconut fiber immersion has a reflectance result (R%) of 14.33.

Fabric coloring in sappanwood extract with 24-hour and 48-hour coconut fiber immersion does not have a significant effect on the color fastness value because the value produced is the same, namely 4 (Good). Lime juice fixator can affect the level of fabric color intensity but is able to lock the color of the fabric from the color fastness test with soap washing.

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