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# Use Of Natural Dyes From Plants In Coloring Woven Yarns

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***Abstract***

*The use of natural dyes as an environmentally friendly alternative to reduce the use of synthetic dyes which have a negative impact on the environment. Natural dyes can be obtained from various natural sources such as plants, animal waste, and minerals, with plants being the most common source. Plant pigments such as anthocyanins, tannins, flavonoids, and chlorophyll provide a variety of colors that can be used for coloring. The natural dyeing process involves four stages: making the dye solution, fabric preparation, dyeing, and fixation. Testing the quality of natural dyes includes color visualization tests, color aging, color differences and fastness to washing. The methodology for writing this article is a literature study, reviewing various related research from 2013 to 2023. The results show that several plants such as Tarum, Coconut, Secang, Noni, Turmeric, and Shallots can produce colors such as dark blue, brownish cream, red , yellow, and brownish orange on fabric. In conclusion, natural dyes not only support environmental sustainability but also offer a safe and low-cost coloring alternative, although there are challenges in the manufacturing and application process of these natural dyes.*

***Keywords:*** *natural dyes; environmentally; manufacturing*

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## 1. Background

The use of natural dyes has been carried out by our ancestors for generations until synthetic dyes were discovered which were considered practical and economical. Some of the reasons for abandoning natural dyes include the manufacturing process being long and resulting in high production costs, not being stored for long before the dyeing process, their durability tends to fade easily compared to synthetic ones, and the dyeing process has to be done repeatedly and takes a long time [1]. The use of natural dyes is an alternative solution to reduce the use of synthetic dyes. Massive use of synthetic dyes must follow standard waste management regulations to maintain sustainability and environmental sustainability. However, what often happens is that awareness is low and does not pay attention to applicable waste management standards, which results in environmental pollution and endangering the health of the surrounding community. The rise of environmental sustainability issues and the high level of support for *green products* , and awareness of returning to nature ( *back to nature* ), increasing interest in environmentally friendly products. Apart from being environmentally friendly, natural

dyes are easy to obtain in the environment, non-toxic, and don't cost a lot. Natural dyes can also last a long time, especially if a binding or locking agent is used [2].

Natural dyes can be obtained from plants, animal waste, and even minerals. Natural dyes that are often used come from plants. Plants contain pigment-producing compounds such as anthocyanins which produce red and purple, tannins which produce brown, and flavonoids which produce yellow, and chlorophyll which produces green [3]. Almost all parts of plants can be processed as natural dyes, such as leaves, stems, roots, flowers and even fruit. Usually when using natural dyes on fabric, after being dyed with natural dye, the fabric will be dipped in a mordant solution (locking solution) as a color retainer so that it does not fade. The mordant functions as a bridge between the dye and the fabric fiber to form a covalent bond so that it can maintain the color fastness of the textile [4]. Some of the conditions for plants that can be used as natural dyes are: (1) they have substances that contain dyes or coloring matter, (2) the dyes can be extracted, (3) they are soluble in water because water is a commonly used coloring medium, (4) can be absorbed by the absorption medium, namely textile or other materials, and (5) there is a bond between the fiber and the dye so that it lasts a long time on the medium and does not fade easily [5].

## 2. Methodology

The literature study method was used in writing this review article to examine various research related to the research topic. Reference searches were carried out on national and international articles and journals published between 2013 and 2023. Only references that were relevant to the problem under study were selected. Once collected, the references are read and analyzed in depth and then categorized based on relevant themes or topics. The results of the analysis are then compiled in the form of a systematic and comprehensive review article, focusing on the aspects emphasized in the review article.

## 3. Results And Discussion

Quoted from Setyorini, several plants that are often used and the colors they produce can be seen in the following table:

**Table 1** . Plants and the colors they produce [6]

| Plant | Processed part | The color produced |
|---|---|---|
| Tarum ( *Indigofera tinctoria* ) | Leaves and twigs | Dark blue |
| Coconut ( *Cocos nucifera* ) | Coir (outer skin) | Brownish cream |
| Secang ( *Caesalpinia sappan* ) | Wood | Red |
| *Noni* ( *Morinda citrifolia* ) | Root bark | Red |
| Turmeric ( *Curcuma domestica* ) | Rhizome | Yellow |
| Shallots ( *Allium fast* ) | Bulbs | Brownish Orange |

## 1. Manufacturing and Coloring Stages

In general, there are 4 stages of coloring, namely making the dye solution, preparing the fabric to be dyed, dyeing or dyeing, and *finishing* or fixation. Making natural dye solutions is done by taking the dye pigments, which is called extraction. Extraction can be done by boiling the material with water. The ratio of ingredients to water is usually 1:10. The ingredients are boiled until the volume of water is reduced to half or thicker [7]. The part of the plant used is the part that is thought to have the strongest or most pigment. A sign that the plant pigment has come out is that the boiled water has become colored. If the solution remains clear, this indicates that the plant almost certainly does not contain colored pigment. The amount of dye solution required and must be provided to dye textiles is adjusted to the weight of the textile material to be used. The ratio commonly used between dye solutions and textile materials is 1:30 [8]. Textile materials used for natural dyeing are those that come from natural fibers, such as silk, wool, and cotton or cotton, the best is silk. Meanwhile, materials made from synthetic fibers such as polyester and nylon do not have good absorbency and natural dyes cannot penetrate the fabric. The dyeing stage, as the name suggests, is carried out by dipping or placing the cloth in a dye solution then draining it and letting it air in direct sunlight while turning it back and forth. The fixation or *finishing stage* is carried out by briefly placing it in a locking solution such as alum and continuing with rinsing using clean water [9].

## 2. Testing Natural Dyes and Their Influence Factors

The quality of color resulting from dyeing from plant extracts can be done by color direction visualization tests using *Pantone Color* and *Encycolorpedia* , color aging tests, color difference tests, and color fastness tests to washing. The color aging test is carried out by measuring the reflectance value (%R) at a wavelength of 380-780 nm [10]. The %R value is converted into a K/S value (Dye density) which describes the amount of dye absorbed by the fabric. The R value is inversely proportional to the K/S value. The greater the %R value, the smaller the K/S value, indicating that the absorption of the dye by the material is smaller or the resulting color is lighter. The aging value of the dye can be influenced by viscosity, temperature and extraction time. Usually, the greater the ratio of the material to the extraction solvent used, the less it will produce optimal viscosity and color aging values [11]. Extraction temperature also affects the color maturity value. Temperature stability that is not too high can influence the color pigment to be extracted more optimally and can protect the dye molecular chain from damage due to too high a temperature. The longer the extraction time will produce more optimal color pigment extract and better color intensity [12]. The formula that can be used to calculate K/S is as follows:

$$\mathbf{K/S = (1-R)/2R} \quad \text{..... (1) K/S formula}$$

$$\mathbf{K/S = (K/S)_0 - (K/S)_1} \quad \text{..... (2) Total K/S Formula}$$

Information:

K = Light absorption coefficient
S = Light scattering coefficient
R = Reflectance

K/S = Density of dye
$(K/S)_0$ = Darkness of colored fabric
$(K/S)_1$ = Oldness of the white cloth

The L*a*b* color difference test can use the CIELAB method, which is a color space that includes all colors that can be seen by the eye. This color space is a 3D space which is divided into 3 axes, namely L* (brightness), a* (green-red), and b* (blue-yellow). The reading of the L* value is from 0 (black) and 100 (white), the a* value is + (red) and - (yellow), and the b* value is + (yellow) and - (blue). The lower the value in the L* notation, the darker the resulting color, and the greater the value, the lighter or closer to white the resulting color blank [13]. The color fastness test was carried out at 40°C soap washing using standard methods. The reading of the color fastness test values can be seen in the following table:

**Table 2**. Reading of color fastness test values [12]

| Color Fastness Value | Color Fastness Evaluation |
|---|---|
| 5 | Very well |
| 4-5 | Good |
| 4 | Good |
| 3-4 | Pretty good |
| 3 | Enough |
| 2-3 | Not enough |
| 2 | Not enough |
| 1-2 | Bad |
| 1 | Bad |

## 4. Conclusion

Natural dyes not only support environmental sustainability but also offer a safe and low-cost coloring alternative, although there are challenges in the manufacturing and application process of these natural dyes.

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