A Study of Producing Natural Red Color on Ikat Weaving Threads

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Abstract. The aims of this study are to find out what materials that used to produce red color on ikat weaving threads; what factors affect the making of red color on ikat weaving threads; the process of plants processing that used as a natural red colorant for the thread; and the kinds of red color produced from natural colorant plants. The samples were taken from the Kupang Regency area consists of three villages that are: Oesao, Sahraen, and Apraen village. The sample that took from three villages is Noni root, teak leaves, betel nut, and cherry fruit as the additional sample that was obtained from Dutalia Supermarket in Kupang city. The method that used in this study is the qualitative method with documenting technique and experiment. This study was done from January to March in the Biology Laboratorium of Universitas Kristen Artha Wacana, Kupang. The result of this study was found 11 red colors that produced from 4 kinds of plant that used for coloring the jark they are Noni root produced 4 colors (deep maroon, strawberry red, cardinal red, and terracotta). Cherry fruit produced 5 colors (coral pink, powder pink, hot pink, baby pink, and watermelon pink). Teak leaves produced the red-violet color and the last is Betel nut produced 2 colors (rust brown).

1. Introduction

The dye is an indispensable substance that gives additional artistic value and is used in varying a product (Jos et al, 2011). The dye is one of the main attractions that are more often used as the main colorant agent of the woven threads. Coloring of the weaving threads is usually done using synthetic dyes and natural dyes. Synthetic dyes are dyes derived from chemicals. While natural dyes are colors that can be produced from various types of plants that produce natural dyes that can be obtained from their parts such as leaves, bark, fruit skins, seeds, roots, and flowers that have gone through several processes, namely boiling, burning, pounding and directly used (Berlin et al., 2017).

Currently, the use of synthetic dyes began to replace the use of natural dyes, because the process was much easier and the resulting colors could be more diversified. The advantages of synthetic dyes when compared to natural dyes include fixed color composition, broader color selection, ease of use, brighter resulting color, available for all types of fibers and generally have better resistant to color fading (Pujilestari, 2015). According to Rymbai et al. (2011) colors derived from mineral derivatives (potassium dichromate and copper sulfate) can cause serious health problems and have a harmful effect on the environment. Considering the effect of synthetic dyes, it is very important to develop natural dyes, because they are more environmentally friendly and do not pollute the environment.

Most flora or plant species produce dyes that can be used in the textiles industry. According to Hariyanto (2017), there are 28 types of plants from 19 families that have been used as natural dyes. This
shows that there are lots of plants that can be utilized as natural dyes in yarn, therefore, reducing the need to use synthetic dyes.

Some color-producing plants can produce various colors, one of which is the natural red color-producing plant for the weaving thread. So far, people have always thought that natural red dye only has limited and less varied colors, one of the colors that have a variety of colors is red. Red is one of the primary colors or base colors. Primary colors are colors that already exist by themselves, these colors can be combined and produce other derivative colors, made in various hues and shades of red by combining pure red with other colors (Meilani, 2013).

One example that shows how red can be combined with other colors is by adding white to red. However, if there is enough white color, it will turn to pink color. This is what proves that the color red can be varied, and there are several types of plants that can produce red. The absorption process of the dye in the fibers increases when mordant is added to the dye solution. Mordants also play an important role in the dyeing process. The mordants used in the coloring process here are Loba, alum, and lime. Mordant is also called a special substance that can increase the adhesion of various dyes to fabrics or threads. The mordant substance functions as a form of a chemical bridge between natural dyes and fibers so that the affinity (attraction) of the dye increases to the fiber, where metal salts will chemically bind the color carriers present in natural dyes and natural colors can be more easily react with the yarn fibers or it can facilitate the absorption of dye into the yarn fibers so that the resulting color can be more strongly absorbed and may produce different hues of colors.

The resulting color difference is influenced by the treatment of acids, alkalis or metal salts (Rosyida and Zulfiya, 2013). The alum mordant is used to produce threads that are light in color according to their original color, lime mordant produces threads with darker or darker colors. Meanwhile, Loba mordant is a mordant that is used as a special color extractor for noni roots. The aims of this study are a) to find out what materials that used to produced red color on ikat weaving threads. b) to find out what factors that effects the making of red color on ikat weaving threads. c) to find out the process of plants processing that used as natural red colorant for thread. d) to find out the kinds of red color that produced from natural colorant plants.

2. Research Method
The method used in this research is the qualitative method. The qualitative method is research on descriptive research and tends to rely on an analysis (Suryana, 2010). This research was conducted for 2 months starting from January 8 to March 5 2019 at the Biology Laboratory of Universitas Kristen Artha Wacana, Kupang. The work procedure in this study was carried out in several stages: 1) Sampling of plants used as the natural red dye was taken in the Kupang Regency which consists of 3 villages, namely Oesao, Sahraen, and Apren Village. 2) Preparation of tools and materials, before carrying out a color test at the laboratory, all equipment used in research must be clean. 3) The process of releasing the wax substance on the cotton yarn, the yarn is boiled for one hour so that the wax contained in the yarn fibers can be released and the yarn can absorb the dye evenly. 4) The dyeing process, which consists of two processes, the first stage of dyeing cotton threads using simultaneous mordant and the second stage of dyeing cotton threads using the preliminary mordant or pre-mordanting.

2.1. Data analysis
The data analysis in this study used a qualitative descriptive analysis technique. There are three data collection techniques in this study, documentation, experiments and literature study.

2.1.1. Documentation. At the documentation stage, the researcher takes a picture of the sample that used in the yarn coloring, the dyeing process stage, to the resulting red color.

2.1.2. Experiment. Experiment is the process of taking the obtained plant specimens to the laboratory to have their color extracted and carry out color tests on the yarn.
2.1.3. Literature study. Methods of collecting data through printed and online media, such as books, color catalogs, magazines, and websites.

3. Results and discussion
First, the wax is removed from the cotton thread that will be used with natural dyes. This process is carried out so that the yarn could easily absorb the color in the dyeing process. The process of wax removal from the fabric / yarn is done by boiling it in water for about 1 hour so that the wax coating on the yarn fibers could come off and therefore enable the yarn fibers to easily absorb the natural dyes.

In the process of dyeing the weaving threads using natural dyes derived from plants, each color produced is obtained from different methods and materials, be it the main ingredient (plant), the measurement of each main ingredient and, additional ingredients (solvent and mordant).

Table 1. Plant types, ingredients (plant) measurements and resulting red color in dyeing weaving thread.

| No | Plant | Ingredien (gram) | Parts | Water (ml) | Mordant | Boiling duration | Soaking duration | Resulting color | pH |
|----|--------|------------------|-------|------------|----------|-----------------|-----------------|----------------|----|
| 1  | Noni   | Thread 7 gram    | Root 110 gram | Distilled water (ac) 250 ml | Loba 5 gram | 8 Minutes | 6 Days | Deep Maroon | 7 |
| 2  | Noni   | Thread 7 gram    | Root 70 gram | Distilled water (ac) 250 ml | Loba 5 gram | 10 Minutes | 4 Days | Strawberry red | 7 |
| 3  | Noni   | Thread 7 gram    | Root 117 gram | Distilled water (ac) 250 ml | Loba 5 gram | 12 Minutes | 6 Days | Deep Maroon | 7 |
| 4  | Noni   | Thread 7 gram    | Root 100 gram | Distilled water (ac) 250 ml | Alum 7 gram | 8 Minutes | 6 Days | Deep Maroon | 7 |
| 5  | Noni   | Thread 7 gram    | Root 120 gram | Distilled water (ac) 250 ml | Alum 7 gram | 10 Minutes | 6 Days | Cardinal Red | 7 |
| 6  | Noni   | Thread 7 gram    | Root 105 gram | Distilled water (ac) 250 ml | Alum 7 gram | 12 Minutes | 4 Days | Terracotta | 7 |
| 7  | Noni   | Thread 7 gram    | Root 100 gram | Distilled water (ac) 250 ml | Lime 2 gram | 8 Minutes | 6 Days | Deep Maroon | 7 |
| 8  | Sweet Cherry | Thread 7 gram  | Fruit 34 gram | Distilled water (ac) 50 ml | - | 5 Minutes | 3 Days | Coral pink (Pink with orange accent) | 3 |
| 9  | Sweet Cherry | Thread 7 gram  | Fruit 34 gram | Distilled water (ac) 50 ml | - | 5 Minutes | 3 Days | Coral pink (Pink with orange accent) | 3 |
| 10 | Sweet Cherry | Thread 7 gram  | Fruit 34 gram | Distilled water (ac) 50 ml | Thread soaked in Alum Mordant | 4 Minutes | 3 Days | Powder pink | 3 |
| 11 | Sweet Cherry | Thread 7 gram  | Fruit 34 gram | Distilled water (ac) 70 ml | Thread soaked in Lime Mordant | 4 Minutes | 3 Days | Hot pink (Bright Pink) | 3 |
| 12 | Sweet Cherry | Thread 7 gram  | Fruit 69 gram | Aquades 10 ml | Alum 7 gram | - | 3 Days | Coral pink (Pink with orange accent) | 3 |
| 13 | Sweet Cherry | Thread 7 gram  | Fruit 34 gram | Aquades 10 ml | Lime 2 gram | - | 3 Days | Baby pink (Bright Pink) | 3 |
| No | Plant                  | Ingredient (gram) | Parts            | Water (ml)          | Mordant                | Boiling duration | Soaking duration | Resulting color          | pH |
|----|------------------------|-------------------|------------------|--------------------|------------------------|------------------|------------------|------------------------|----|
| 14 | Sweet Cherry           | Thread 7 gram     | Fruit 69 gram    | Noni Root Extract  | -                      | 5 Minutes         | 5 Days           | Water melon            | 7  |
|    |                        |                    |                  | 200 ml Distilled water (ac) 1 liter |                       |                  |                  |                        |    |
| 15 | Teak                   | Thread 7 gram     | Leaf 138 gram    | -                  | 15 Minutes             |                  | Soaked for 4 days in teak leaf extract, 1 week soaked in Noni extract | Red violet | 7  |
|    |                        |                    |                  |                    |                        |                  |                  |                        |    |
| 16 | Betel Nut and Betel    | Thread 7 gram     | Betel Nut 30 gram, and Betel 8 gram | Aquades 250 ml | 8 Minutes              |                  | 6 Days           | Rust brown (Brownish Red) | 7  |
|    |                        |                    | Betel Nut 70 gram, and betel 8 gram | Lime 2 gram |                  |                  |                  |                        |    |
| 17 | Betel Nut and Betel    | Thread 7 gram     | Betel Nut 70 gram, and Betel 8 gram | Distilled water (ac) 500 ml | 12 Minutes             |                  | 6 Days           | Rust brown (Brownish Red) | 7  |
|    |                        |                    |                  | Lime 3 gram |                        |                  |                  |                        |    |

*Figure 1. Different types of red colour (Doc. Dala Ngapa, 2019).*

The materials used to produce a red color in the weaving thread or the carded cotton is generally used to make thick textured woven fabrics derived from natural fibers. According to Visalakshi and Jawaharlal (2013), water from taps or from nature contains a lot of minerals, such as iron and other substances that ultimately can affect the color extract. In order to avoid this color shift, distilled water and *Aquades* were used as both have been distilled and have only small amount of mineral content. This proves that distilled water and *Aquades* can be used as solvents in the coloring process. *Aquades* and distilled water were chosen as solvents in order to obtain a solution of color extract and can dye the yarn fibers well, detergent soap (Daia) is used to remove wax substances in the yarn fibers that were to be
dyed, while mordant is used so that the dye can be absorbed more evenly into the yarn and can produce different colors. The resulting color difference is influenced by the treatment of acids, alkalis or metal salts (Rosyida and Zulfiya, 2013). The mordan used, (Loba skin, alum and lime) and the red color-producing plant organs used in the dyeing process, (noni root, teak leaves, betel nut and sweet cherry fruit). These plant organs are used as coloring agents in the dyeing process because the plant organs contain anthocyanin pigments (red pigments).

The factors that influence the coloring process include the length of soaking time of the yarn in the color extract. According to Failisnur and Sofyan (2016), the longer the dyeing time of the fabric in the dye extract the darker (thick) the color density would be. This proves that the longer the soaking process, the darker or thicker the color will be. The yarn soaked for longer in the color extract, resulting in a darker color. pH is also one of the factors that can affect the color of the yarn. This is because anthocyanins are red dyes that are stable at low pH and neutral pH. Their stability will decrease if the pH is increased (Winarti and Firdaus, 2010). Therefore, pH paper is used to measure the acidity level of the color extract used to dye the yarn. Based on this theory, it was found that the pH contained in the color extract used in the coloring process, for the natural red color extract produced by noni roots, betel nut and teak leaves with the addition of Loba mordan, alum and lime have a pH value of 7 (neutral) and color extract from the fruit of cerry with the addition of mordan alum and lime has a pH value of 3, it can be concluded that the higher the pH value, the darker the red color and the lower the pH contained, the resulting color leads to a very light color or light pink.

4. Conclusion
Based on the results in the research, it can be concluded that:
1) Ingredients that were used to give red color to the yarn (carded cotton) are Aquades and distilled water as solvents. Detergent (Daia), Mordants (Loba skin, Alum and Lime) and natural red producing plants parts (noni root, teak leaves and sweet cherry fruit).
2) Factors that influenced the produced color is amount of pH and the soaking length.
3) The method of processing plants used as natural red dye in the weaving thread was done by these methods:
   a) Wax removal from the cotton thread
   b) Cotton thread coloring using the simultaneous mordant
   c) Cotton thread coloring using the preliminary mordant
4) Red color can be produced from naturally-producing red plants such as Noni root which can produce 4 different red color, deep maroon, strawberry red, terracotta, cardinal red. Cherry fruit can produce 5 red color, coral pink, powder pink, hot pink, baby pink, water melon. Whereas, teak leaves and betel nut can produce one red color, Red Violet and Rust Brown, respectively.

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