Identification of biomordant in Hundihopo Village, East Rote District, Rote Ndao Regency

N A Bako¹, A C Sabuna¹, and Y Daud¹

¹Department of Biology Education, Universitas Kristen ArthaWacana, Kupang 85227 Indonesia

E-mail: alan.sabuna@gmail.com

Abstract. Information of plant species, mordants, and the mordan ting process of the yarn of ikat weaving in Hundihopo village are still minimal and not well documented. Therefore, the aim of this study was to identify biomordant in Hundihopo Village. Samples were collected by exploration methods. Parts of plants, mordan ting process, and kinds of color were recorded based on observation, interview with craftsmen and documentation. A total of 12 species were traditionally used as biomordants in Hundihopo village namely Sterculia foetida L., Erythrina varegata, Areca catechu L., Ceriops tagal, Datura metel, Calotropis gigantea, Abrus precatorius L., Symlocos sp., Jatropha curcas L., Citrus aurantifolia, beura and faliti. The plant organs used as a source of mordan ting are leaves, barks, fruits, and seeds. The method of processing was to be burned, crushed, boiled and soaked and the resulted color was red, black and yellow.

1. Introduction

Indonesia is one of the countries that are abundant in natural resources. Colored plants become one of the natural resources which have the potency to be used as the woven dye in Indonesia, especially in the development of a product that has nuances of the naturalist, imitative, cultural, and exclusive. Colored plants could also be the raw material for the weaving industry that has high economic value [1].

In the ancient time, the process of coloring ikat weaving in East Nusa Tenggara used dyes derived from natural ingredients. However, along with the discovery of synthetic dyes, the craftsmen began to shift their choice using synthetic dyes to dye the yarn, because synthetic dyes are considered easier to obtain, affordable prices, have a variety of colors, and the coloring process also does not require a long period time [2].

However, synthetic dyes often cause environmental problems because they contain heavy metals that are harmful to human health. Moreover, if pollutants are discharged into the water can pollute the environment [1]. Considering the impacts, one alternative to overcome them is to return to natural dyes, because the waste from the dyeing weaving is considered safer, environmentally friendly, less pollute, has a more natural color, shows the impression of cold, soft, and comfortable [3]. However, behind these advantages, natural dyes also have a weakness that is the color produced easily faded. Therefore, it is necessary to add mordant to increase the stickiness of various dyes on the fabric.
According to Sabuna et al. [4], the weavers at Hundihopo Village in East Rote Sub-district of Rote Ndao have used the mordant plants but have not been known clearly regarding the types of those plants. Therefore, we research the Identification of Biomordant in Hundihopo Village, Rote Timur District, Rote Ndao Regency.

2. Materials and Methods

2.1 Study area

Our study was conducted in Hundihopo Village. Hundihopo is located in the western part of Rote Island. Administratively, Rote Ndao district is the southernmost district in the Republic of Indonesia. This regency has an area of 1280.10 km² which consists of 96 islands and is geographically located between 10 degrees 25 - 11 degrees South Latitude, and 121 degrees 49 - 123 degrees 26 East Longitude with clear boundaries, to the north bordering the Savu Sea, to the east is bordered by the Pukuafu Strait, to the west is the Savu Sea, and to the south is the Indian Ocean. The Rote Ndao regency is climatologically the same as the climate in other regions in NTT, namely a dry climate influenced by monsoons. The land surface is generally hilly and mountainous (32,625 Ha) and partly consists of lowlands (45,250 Ha) with an average slope of up to 45%. The contours of the island of Rote vary, at the coast, the altitude is 0-10 m above sea level while in the middle it reaches an altitude of 200 - 1500 m with a slope of 40 - 60% [5].

![Figure 1. Map of Rote Ndao](image)

2.2 Materials

The instruments used in this study are: stationeries, camera, knife, plastic bag, mortar, hot plate, analytic scale, measuring cup, glass beaker, and spatula. The materials used are cotton thread, water, and the organ of coloring plants and mordanting plants.

2.3 Selection of participants

The participant selection technique used in this initial observation is the purposive sampling method [6]. The chosen figures to be interviewed are two local authorities and one traditional elder. From our preliminary observation, the data of prospective informants for the next stage are suitable to be interviewed. The selection of participants at this interview stage was carried out by the snowball sampling method. There are four key participants were selected purposively and systematically based on the recommendations of knowledgeable elders. The key participants are traditional experts who
guard the indigenous knowledge of natural dye. Nowadays, most of the waivers at Hundihopo village use synthetic dye to color the yarn, particularly for the new generation.

2.4 Data collection

Our study used four data collection techniques, namely semi-structured interviews, field observations, documentation, and simple experiments. To interview the key informants, we ready a list of questions in Bahasa, such as does the coloring yarn use additional material to strengthen the color? What mordanting plants are used? Which mordanting plant organs are used and other questions? Every answer to the question is recorded. We then carried out field observations with the help of informants to collect data for morphology features and habitats of mordant plants species. Samples of mordanting plant organs were collected in the field, stored in a plastic bag, and delivered to the Biology laboratory, ArthaWacana Christian University, for characterizations. Characterizations were performed by weighing natural dyes and mordanting plant organs and processed in such a way as to produce colors in the ikat yarn. The experiment was designed to visibly compare the effect of mordant on the color of the yarn, that is, yarn soaked using mordant and without mordant. The resulting color was documented using a camera.

2.4 Data analysis

All specimens of mordanting plants were classified and identified using Flora's book [7]. Once identified, the collected data were analyzed descriptively and presented in the form of local names, scientific names, families, the used organ, processing methods, and the resulted color.

3. Results and Discussion

3.1. The types of mordant plants found at Hundihopo village

The mordant plants used by weavers at Hundihopo Village were 12 species and 9 families, namely Malvaceae, Rhizophoraceae, Solanaceae, Asclepiadaceae, Fabaceae, Euphorbiaceae, Rutaceae, Arecales, and Symplocaceae (Table 1).

| No. | General Name       | Local Name | Scientific Name      | Family         |
|-----|--------------------|------------|----------------------|----------------|
| 1   | Kelumpang          | Nitas      | Sterculia foetida L  | Malvaceae      |
| 2   | Dadap              | Deras      | Erythrina variegata  | Fabaceae       |
| 3   | Areca Nut          | Pua        | Areca catechu L      | Aracaceae      |
| 4   | Soga tingi         | Tene       | Ceriops tagal        | Rhizophoraceae |
| 5   | Kecubung           | Loloa      | Datura metel         | Solanaceae     |
| 6   | Biduri             | Koleng susu| Calotropis gigantea | Asclepiadaceae |
| 7   | Saga               | Memea      | Abrus precatorius L  | Fabaceae       |
| 8   | Loba               | Loba       | Symplocos sp         | Symplocaceae   |
| 9   | Castor Oil Plant   | Jarak pagar| Jatropha curcas L    | Euphorbiaceae  |
| 10  | Lime               | Jeruk nipsis| Citrus aurantifolia | Rutaceae       |
| 11  | -                  | Faliti     | Unidentified         | Unidentified   |
| 12  | -                  | Beura      | Unidentified         | Unidentified   |

Source: The 2019 result of study

To compare with the previous study, which conducted in Kaliuda village, East Sumba, 3 types of plants used as mordant such as Loba (Symplocos sp), Candelnut (Aleurites moluccana L.) and Dadap (Erythrina variegata L.) [8]. While Oktiarni [9] found that star fruit used as mordant in natural dyes with Guava leaf (Psidium guava), Dewandaru leaf (Eugenia uniflora), and Rosella leaf (Hibiscus sabdariffa L.) as natural plant dyes. Furthermore, Martalinda [10] used coconut water as a mordant on
the extract of Curcuma tuber (*Curcuma xanthorriza roxb*) to produce the variations of yellow color. Suppose there are lots of mordants have been used a long time ago and every place has their resources for coloring the ikat yarn.

### 3.2. Plant parts used as mordant

Weavers of the study area harvest different plant parts for the preparation of coloring woven yarn such as bark, leaves, fruits, and seeds, which listed in the following table.

| No | Plant name       | Scientific Name           | Organ Used        |
|----|------------------|---------------------------|-------------------|
| 1  | Kalumpang        | *Sterculia foetida* L     | Fruit shell and Seed |
| 2  | Dadap            | *Erythrina variegata*     | Bark              |
| 3  | Loba             | *Symlocos sp*             | Bark              |
| 4  | Soga tingi       | *Ceriaps tagal*           | Bark              |
| 5  | Kecubung         | *Datura metel*            | Leaf              |
| 6  | Biduri           | *Calotrops gigantea*      | Leaf              |
| 7  | Saga             | *Abrus precatorius* L     | Leaf              |
| 8  | Areca Nut        | *Areca catechu* L         | Seed              |
| 9  | Castor oil plant | *Jatropha curcas* L       | Bark              |
| 10 | Lime             | *Citrus aurantifolia*     | Fruit             |
| 11 | Beura            | Unidentified              | Leaf              |
| 12 | Faliti           | Unidentified              | Leaf              |

Source: The 2019 result of study

Based on Table 2, it could be seen that the organ of Kelumpang used as the mordant is fruit shells and dried seeds, which are commonly found in the house yard of weavers, while the fruit shells of Kelumpang plant have thick skin and its edge is tapered shaped. The level of maturity depends on the individual and the factor of the growing place.

Inside the shell of Kelumpang fruit, there is a shiny black seed containing much oil which it can be used to dulcify the thread. There is also another benefit of kepuh seed, which as industrial material in making shampoo, soap, paint, and plastic [11].

The organ of Dadap (*Erythrina variegata*) used is the bark of stem. On the stem bark of Dadap contains saponins, flavonoids, and polyphenols, which roles in fabric coloration [12].

Loba is a shrub plant to the tree. The inside of the stalk (stem) contains some amount of aluminum (reaching 50% of the ash), which is one type of mordant substance that functions as a binding agent in the coloration of thread [12]. Similar to the sogatingi plant, the organs used are dried bark of stem. The bark stem of sogatingi also contains tannins that are good to be used in the process of threads coloration and also as tanners and color substance for the paint [13].

Kecubung includes shrub species. Its root, stem, leaf, and seed contain an alkaloid, steroid, flavonoid, phenol, and tannin [14]. Biduri is a large shrub plant with a height of 4 meters to 10 meters. This plant has an oval-shaped pale green leaf containing tannin, saponin, and calcium oxalate, which can treat itching, trachoma, coughing, constipation, and scabies [15].

Saga is a shrub plant, has compound leaves, oval-shaped, and also small in size. Saga leaf contains the chemical substance of flavonoid, tannin, triterpenoid, and steroid [16], while areca nut contains 15% of tannins [17]. Unripe areca nut mashed and mixed with alkali can produce a wine-carmine color. Therefore in India, they have used areca nuts to dye cloth. Lime also contains citric acid, hesperidin, and aurantiamarin, which could be used as mordant [18].
Based on the review above, the reason for the weavers at Hundihopo Village used these organs as mordant because the ancestors had already used them, and they believed that on those organs containing substances of mordant.

3.3. Processing method of mordant plant
The weavers at Hundihopo Village generally process the mordant plants in various traditional ways, which are burned, pounded, boiled, and then soaked together with coloring plants. The longest treatment process happens in the soaking process because it takes three days. Before proceeding to the yarn coloration, weavers do the initial soaking of the thread with the dried kalumpang fruit and then burnt it, the ash of the combustion of the kalumpang fruit is mixed with sufficient water and soak it for three days after that separate the solution from the result of the soaking of kalumpang ash. Next step, add the kalumpang seeds, saga leaves, amethyst leaves, biduri leaves, and finely crushed dadap skin into the kalumpang fruit bath. Prepare the yarn, put it in the marinade, and kneaded until completely mixed, then soak for two days. After that, yarn is removed and dried. Based on the interview, the purpose of this initial immersion is to strengthen the basic color, so it does not fade easily. We found that the purchased yarn was not used immediately, instead of through initial treatment because the distinctive color of the East Rote woven fabric was grayish-white.

In coloration process, there is known 3 types of colors that will be formed which are black, red, and yellow.

3.3.1. Red color. The needed plant is the root skin of mengkudu, Loba bark, and water. Each organ pounded until smooth, and then adds water sufficiently while stirred until the bubbles appeared on the surface. Insert the thread into the extract, and cook it but avoid boiling. Afterward, the thread soaked in the container for 2 days. Lastly, the thread is removed and dries it until completely dried.

3.3.2. Black color. The initial step is to collect tarum leaves, dried areca nut, Jatropha bark, and sogatingi bark. Pound all ingredients until smooth, except for sogatingi bark. Mix all ingredients with sufficient water while stirring, then put the yarn, cook but avoid boiling, stir, then soak for two days until the black color accumulates. Afterward, removed and dried. Boil the sogatingi bark with sufficient water, and add the yarn. Soak it for five minutes. Lastly, remove and dry it.

3.3.3. Yellow color. The materials used to produce yellow color are turmeric, lime, and water. Turmeric rhizome is pounded until smooth, add lime juice sufficiently, then put in the screw, cook until boiling, and then soak for 2 days. Afterward, the yarn is removed and dried until it is completely dry.

4. The Resulted Color
Based on our research in the village of Hundihopo, several things were found, namely the mordant plant used by the weavers, and the steps in the coloring process, however the craftsmen made the colors do not use exact measurements. The results of this study intend to find a definite measure of each material used by craftsmen so it will provide the understanding and possibly reciprocity of the entire process made. The results of our simple research are as follows:
Based on Figure 2, before the yarn is colored, the yarn is soaked first in the mordant solution. The method of making mordant begins by burning the kelumpang. The formed ashes are taken 3.600 grams, then add a half-liter of water and soak for three days. Furthermore, the amethyst leaves, biduri leaves, saga leaves, dadap bark and kelumpang seeds each pounded, then each ingredient weighed as much as 15 grams of Saga leaves, 45 grams of amethyst leaves, 45 grams of biduri leaves, 38 grams of kelumpang seeds, and 30 grams of dadap bark. After all the ingredients have been weighed, the next step is to separate the solution from the soaking ash. All of the weighed ingredients were placed together with the yarn in the ashes solution, while the thread is kneaded, then soaked for 2 days. Afterward, the thread is removed and dried. This process is called pre-mordanting. Before the yarn is dyeing, the yarn is soaked with mordanting plants to strengthen the basic color, so the thread does not easily fade.

Table 3. The resulted colors through the mordanting process

| No | Type of Plants | Processing Method | The Resulted Color |
|----|----------------|-------------------|--------------------|
| 1  | Loba Bark      | Pounded           | Pounded            |
|    | Mengkudu Root  | Pounded           | Wine Color         |
| 2  | Dry Areca Nut  | Pounded           | Black              |
|    | Soga Tingi Bark | Pounded       |                    |
|    | Skin of Castor Oil Plant | Pounded       |                    |
| No | Type of Plants | Processing Method | Mordant Plant | Color Plant | Mordant Plant | Color Plant | The Resulted Color |
|----|----------------|-------------------|---------------|-------------|---------------|-------------|-------------------|
| 3  | Lime Juice    | Turmeric          | Squeezed and juice taken | Pound | Yellow |

Source: The 2019 result of study

Based on Table 3 for the red color, the needed plants are the root bark of mengkudu (*Morinda citrifolia* L.), Loba skin (*Symplocos sp.*), and water. Previously each material is cleaned and then pounded until smooth, then weighed 6 grams of Loba bark, 46 grams of mengkudu root skin, and 350 ml of water. All materials are cooked but avoid boiling, then put yarn inside, while stirring until evenly distributed, then the thread is soaked for two days. After that, the thread is removed and dries it until completely dry.

For black, the plants needed are 70 grams of tarum, 5 grams of dried areca nut, 20 grams of *Jatropha* bark, sogatingi skin, and 350 ml of water. All ingredients are ground until smooth, except for the sogatingi skin. Mix all crushed ingredients and add water, then the yarn is inserted. Cook the solution but keep it from boiling, then soak the yarn for two days, until the black color accumulates. Afterward, remove and dry it. Next step, boil the sogatingi skin with 350 ml of water, add the yarn, and soak for about 5 minutes. In the last stage, remove the thread and dry it in the sun.

For yellow color, the waivers used turmeric, lime, and water. Turmeric weighed 45.0 grams smoothed, 30 ml of lime juice, and 350 ml of water. Mix and cook the materials until boiling, put into the thread while stirring until the yellow color accumulated. After that, soak the yarn for two days. The last step is the yarn removed and dries it until dry.

**Table 4.** The resulted color with and without the addition of mordant

| No | Coloring Plant | Without mordant | Mordant |
|----|----------------|-----------------|---------|
| 1  | Tarum (*Indigofera tinctoria* L.) | Pale Black | Thick Black |
Based on Table 4, our results showed that the cotton yarn dyeing using tarum leaves extract without mordant produce a pale black color while in the coloring process with the addition of mordant produces a thick black color.

Likewise, the mengkudu root bark extract without adding mordant produces a pale red color and uneven color on the yarn, whereas in the coloring process using mordant, a color change occurs, namely the red heart color (wine). And the last color produced from turmeric extract without mordant produces a brownish yellow color and uneven color on the yarn. While the coloring process using mordant, produces bright yellow, and color evenly distributed.

Based on the description above, it can be concluded that the addition of mordant to the yarn coloring process can affect the color. This is supported by Sulistiami and Fathonah [19] which state that mordant is a color enhancer. The use of mordant can increase the stickiness of various dyes on the fabric. Mordant can affect the final color of a dye; therefore, the use of different mordants will produce a variety of colors. In addition, according to Prabhu and Bhute [20], mordant can improve the fixation of natural colors in fibers by forming complexes with dyes.

5. Conclusion

It was concluded that the type of mordanting plants used in the process of threads coloration by weavers at Hundihopo village are 12 plant species, namely Sterculia foetida L., Erythrina variegata, Symplocos sp, Ceriops tagal, Datura metel, Calotropis gigantea, Abrus precatorius L., Areca catechu L., Jatropha curcas L., Citrus aurantifolia, Beura, and Faliti. Plant organs used are leaf, bark, fruit, and seed. The processing methods are burned, pounded, boiled, soaked, and the resulted colour is black, red and yellow. In this study, there were 2 species of plants that have not been found the scientific names, faliti, and beura. Therefore, it is expected for the next researchers to identify the plants.
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