



## The Effect of Natural Mordants on Color Shades of Indigo Dyed Fabric

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### Abstract

The application of synthetic dyes severely effects health conditions and negatively influences the eco-balance of nature. The natural dyeing process is a complicated and needed workers' experience. The purpose of this research was to investigate natural dyes and mordants such as indigo, *Nypa palm*, mud, and fly ash to dye fabric. The results showed that natural mordants had different styles and colors with the lack of mold inhibition properties. The mordant from *Nypa palm* bark provided darker shades of black compared to indigo dyed fabric, while the use of water as a mordant had little pale-colored fabric. Mud and ash were also used as mordants and caused changes in indigo dyed fabric in terms of brightness and color shades. In conclusion, natural mordants provided various color shades. When used as mordants, *Nypa palm* extract decreased brightness of colors, but mud and fly ash extract did not.

**Keywords:** *Natural dyes, Indigofera tinctoria, Nypa palm, Mordant, Brightness*

### 1. Introduction

Textile dyeing industry used synthetic dyes due to cheaper prices, wider ranges of bright color shades, and considerably improved fastness properties in comparison to natural dyes (El-Nagar et al., 2005; Iqbal et al., 2008). Synthetic dyes were dependent on petrochemical sources which contained carcinogenic amines (Hunger, 2003). The application of those dyes causes a serious health condition and a negative impact on the eco-balance of nature (Bruna & Maria, 2013; Goodarzia & Ekrami, 2010; Jothi, 2008). Furthermore, many countries already imposed strict environment standards over the synthetic dyes. From this situation, a higher demand was put towards the greener alternatives (Ammayappan et al., 2014). Natural dyes were promising options to create a greener textile dyeing process. Plant leaves and other agricultural wastes were potential sources of natural dyes because they were easy to find and abundant in nature. Cotton was the king fabric because most apparel was made from cotton. The cotton fibers have several good advantages because of its comfort, moisture absorption, and wicking properties. It is breathable and moisture absorbent with high-dimensional stability. Classical blue or dark blue denim fabric dyeing with indigo had unique characteristics, such as low washing fastness and rubbing fastness, and moderate light fastness.

### 2. Objectives

The aim of this research was to study the effect of natural dyes and mordants on color shades for dyeing fabric.

### 3. Materials and Methods

Extraction of the dyes: The aqueous extraction method was used to extract dyes from indigo and *Nypa palm* samples. The crude extracted by dye solution was used immediately for dyeing.

Dyeing cotton: The cotton fabric (1.5 g) was used for dyeing with crude dye extract obtained from indigo. The cotton fabric was soaked in aqueous solution of indigo (200 mL) for 30 minutes at a temperature of 30°C in a 1000 mL beaker. Then, the fabric was thoroughly washed with tap water. Five



times of dyeing were applied in this step. Three mordants included *Nypa palm*, ash and mud were used to fix the color of cotton fabric.

Mordanting method: The fabric was soaked in each 200 mL aqueous solution, namely *Nypa palm*, ash, and mud for 30 minutes at the temperature of 30°C in three separate 1000 mL beakers. Then, the fabric was thoroughly cleaned by tap water. The indigo dyed fabrics were dyed 5 times.

Evaluation of color fastness

Color measurement: Color development and dye absorption potential of cotton fabric were evaluated according to CIELab color coordinates (Sule, 1997).

Statistical analysis: Statistical analyses such as mean and standard deviation were performed by using free software of GNU PSPP. The significance was defined by  $P \leq 0.05$ .

#### 4. Results and Discussion

Natural mordants prepared from *Nypa palm* bark, mud, and ash gave colors and styles as shown in Figure 1. After testing the properties of the auxiliary agents to inhibit fungi, the result demonstrated that all of the mordants cannot prohibit the growth of black fungi. Then, the indigo dyed fabric was soaked in different natural mordants.



**Figure 1** Natural mordants extracted by pure water (A), *Nypa palm* bark (B), mud (C) and ash (D)

Color fastness without application of mordants: The blue color shades on the fabric were dyed from indigo extract. The variation in color shades resulted from different uses of mordants, mordanting methods, and dyeing time. The color of the cotton fabric using *Nypa palm* as mordant showed darker black colors compared to indigo-dyed fabric as shown in Figure 2. However, the use of water as a mordant generated little pale color on fabric. In the case of using mud and ash as mordants, the results showed changes in color shades of indigo dyed fabric. Wewa and Khucharoenphaisan (2017) reported that after the cotton fabric were stained with indigo and *Nypa palm*, the color of the cotton fabric will be black.



**Figure 2** The cotton fabric dyeing using Indigo and various mordants ; Indigo and water (A), Indigo and *Nypa palm* (B), Indigo and mud (C), Indigo and fly ash (D)

Evaluation of the color shade after being treated with natural mordants was done on the dyed cotton fabric by using a spectrophotometer. The result showed that the cotton fabric stained by indigo dye using *Nypa palm* as a mordant showed the lowest L value (Lightness shade) with  $13.09 \pm 1.79$  as shown in Table 1. This indicated that using *Nypa palm* as a mordant increased darkness of the colors on the cotton fabric. Mud and ash had higher L values:  $23.37 \pm 1.49$  and  $51.59 \pm 8.96$ , respectively, indicating that both mordants provided cotton fabric with lightness colors. Wewa et al. (2015) also stated that the *Nypa palm* bark could be used as sources for colors. It was suitable and interesting for dyeing because of its high volume and low-cost.



C value is an indicator to cheerfulness. The cotton fabric strained with indigo dye using ash as the mordant showed the highest C value with  $48.75 \pm 3.86$ . However, the cotton fabric strained from indigo dye using *Nypa palm* as the mordant had the lowest C value with  $10.10 \pm 2.29$ .

h value is an indicator to red (h = 0), yellow (h = 90), green (h = 180) and blue (h = 270) color. The cotton fabric strained from indigo dye using *Nypa palm*, mud, and ash as mordants showed the h value was near 270 as shown in table 1, meaning that the cotton fabric is blue.

**Table 1** the color fastness on cotton fabric with the application of dye obtained from Indigo with various mordants

Dyeing cotton with	Color value		
	L	C	h
Indigo	17.74 $\pm$ 2.25	27.15 $\pm$ 1.43	273.25 $\pm$ 1.54
Indigo and <i>Nypa pulm</i>	13.09 $\pm$ 1.79	10.10 $\pm$ 2.29	266.05 $\pm$ 2.72
Indigo and mud	23.37 $\pm$ 1.49	23.66 $\pm$ 1.21	267.23 $\pm$ 1.98
Indigo and fly ash	51.95 $\pm$ 8.96	48.75 $\pm$ 3.86	262.12 $\pm$ 2.16

Note : The value in the table = mean  $\pm$  S.D.

## 5. Conclusion

The cotton fabric strained with indigo dye using natural mordants as *Nypa palm*, mud, and fly ash showed different shades of colors. The differences were explained by lightness shades in colors, cheerfulness, and color tones. Fly ash was the best mordant to get different shades of colors. A variety of shades is an option for consumers when choosing fabrics. Further studies should focus on two factors: (1) improving the stability of color against light; and (2) washing the fabrics.

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