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EFFECT OF SOLVENTS AND FIXATION AGENTS ON COLOURING BATIK BY GUAVA LEAVES EXTRACT

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Abstract

This study investigated the effects of solvents and fixation agents on colouring batik using guava leaves extract. In the experimental procedures, fabrics colouring using guava leaves extract was divided into three stages: pre-mordanting, colouring, and post-mordanting processes. In this study, three types of fixation agents were used, namely ferrous sulphate, chalk, and alum. The dissolved guava leaves extracts in water and ethanol were tested using a UV Visible spectrophotometry. The colouring fabrics were characterized by a scanning electron microscope and a Fourier transform infra-red. The results of this study indicated that fixation agents produced different colours of fabrics caused by different complexes of tannin-metal ions. In addition, the differences in solvent in extraction of guava leaves gave different sharpness effect. The use of water as a solvent allowed the production of sharper colouring than that of ethanol. This study showed that variation of solvents and fixation agents has potential to manipulate the desired fabric color that will be useful for batik industry.

Keywords: Batik, Fixation agent, Guava leaves extract, Natural dye, Solvent.

1. Introduction

Generally, the batik craftsmen prefer to use synthetic dyes because it has more economical than natural dyes. Synthetic dyes can give large amounts production, short time processing, and low processing costs [1]. However, synthetic dyes have an adverse effect on the environment because they contain heavy metals such as lead (Sn), chromium (Cr), zinc (Zn), and copper (Cu). These materials are carcinogenic to the human body. The use of natural dyes extracted from plants have many advantages such as not being carcinogenic and environmentally friendly [2].

Many plants can be used as natural dyes, one of which is guava leaves extract. Guava (Psidium guajava L) leaves extract contain active chemical compound, such as flavonoids, saponins, tannins, triterpenoids, and eugenol [3]. The tannin contents in guava leaves extract which causes this extract can give color to the fabric. Tannins can produce yellow, brown, grey and black on the fibre of fabric [4].

In the previous study, it was shown that different types of solvents affect the chemical content in plant extracts [5]. In addition, the diversity of colours produced by natural dyes from plant extracts was usually influenced by the presence of mordant [6] or commonly called fixation agent [7] used. There are three types of mordanting processes, namely pre-mordanting, simultaneously mordanting, and post-mordanting [8]. The use of different fixation agents also can produce different colours [9]. Some fixation agents commonly used are alum, copper sulfate, ferrous sulfate, stannous chloride, potassium dichromate, chalk, copper (I, II) sulfate, cobalt chloride, and nickel chloride [7, 9-11].

The purpose of this study was to investigate solvents and fixation agents various on the application of guava leaves extract as natural dye of batik. In this study, two types of solvents were used, namely water and ethanol and 3 types of fixation agents, namely alum, ferrous sulfate, and chalk. The research method was divided into three stages, namely the pre-mordanting, colouring, and post-mordanting processes. The results showed that the use of different fixation agents and solvents produced different colours and color sharpness. It showed that the types of solvents and fixation agents have a significant impact on the color of fabrics so that it was potentially used in the batik industry to manipulate the colours needed.

2. Method

Guava leaves (obtained from Bandung, Indonesia) were cut into small size and then dried. The dried guava leaves mashed to a powder using grinding apparatuses. To obtain guava leaves extract, maceration method was used by soaking 2 grams of guava leaves powder in 150 mL of solvent for 24 hours. The maceration process was carried out using 2 different solvents, namely water and ethanol (95%, Bratachem, Indonesia). Then, it was filtered using a vacuum filtering.

As a model, this study used three different types of cotton fabrics, namely prima, primisima A, and primisima B. All cotton fabrics were purchased from Rumah Publikasi Indonesia, Indonesia. The fabric colouring process began by pre-mordanting process using three types of fixation agents, namely alum, ferrous sulfate, and chalk dissolved in water or ethanol (3.8 wt%). The fabric was soaked in a solution of fixation agent for 10 minutes and then was dried. The second stage was the colouring process which was done by soaking fabric in guava leaves extract in water or ethanol. This shocking process was carried out for 3 hours. Then, coloured fabrics

were dried. The last stage was the post-mordanting stage. This stage was carried out in the same manner as pre-mordanting stage but the soaked fabric was the dyed fabric.

The dissolved guava leaves extracts in water and ethanol were tested using a UV Visible spectrophotometry (Vis mini 1240, Shimadzu Corp, Japan). To investigate the effect of solvents and fixation agents various on the structural properties of the chemical compounds in the fabrics, an FTIR (FTIR-4600, Jasco Corp., Japan) was used. To determine the effect of solvents and fixation agents various on morphological structure of dye particles in fabric fibers, a SEM (JSM-6360LA, JEOL Ltd., Japan) was used.

3. Data Analysis and Discussion

Figure 1 shows the results of UV Vis analysis of guava leaves extract using water as a solvent. There was a peak at a wavelength of 308 nm. According to Katwa et al. peaks around 310 nm indicate the existence of tannic acid [12]. There was a shift in the peak from 310 nm to 299 nm in extracts that had been mixed with alum, lime and iron sulfate, this was due to the formation of tannin complexes with metal ions.

The results of UV Vis analysis of guava leave extract using ethanol as a solvent showed in Fig. 2. These results show the peak at the same wavelength of 299 nm.

The results of FTIR analysis of prime fabrics were showed in Figs. 3-5. Overall, there were absorptions seen at a wavelength of 1000 cm-1. It was due to the overlap of cellulose function groups, namely stretching vibrations from C - C, C - O and C - O - C [13]. In addition, there were adsorptions at 1410–1310 cm-1 which indicates phenolic compound [14]. Based on the results of UV Visible analysis, its phenolic compound is a type of tannin.

The conditions of these 3 fabrics (prima, primisima A, and primisima B) before and after dyeing were carried out in Figs. 6-8. Figure 6 shows the difference in colours produced on prima fabric. The color of fabric that coloured with water based extract was sharper than fabric that coloured with ethanol based extract.

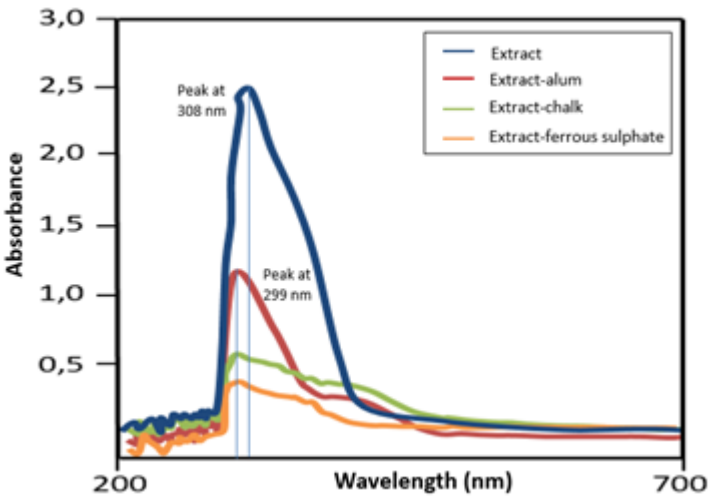

Fig. 1. UV Vis analysis results of guava leaves extract in water before and after mixed with fixation agents.

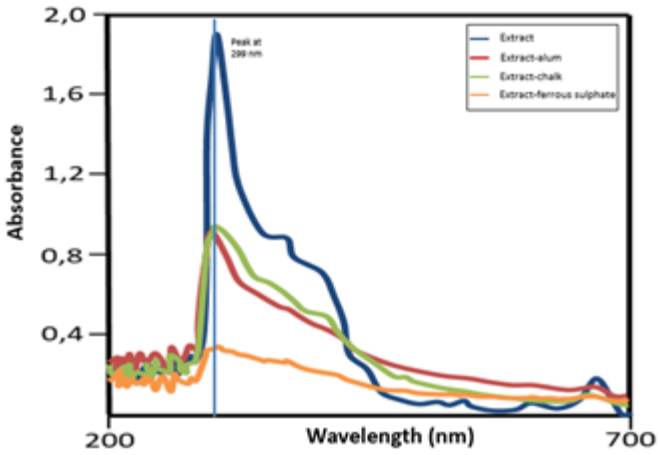

Fig. 2. UV Vis analysis results of guava leaves extract in water before and after mixed with fixation agents.

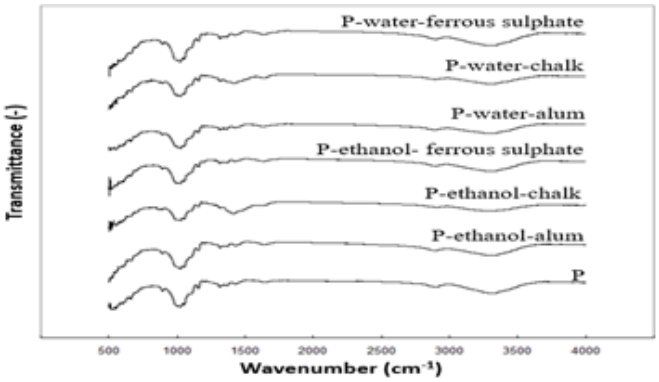

Fig. 3. The results of the FTIR analysis of the prima fabric that has been coloured.

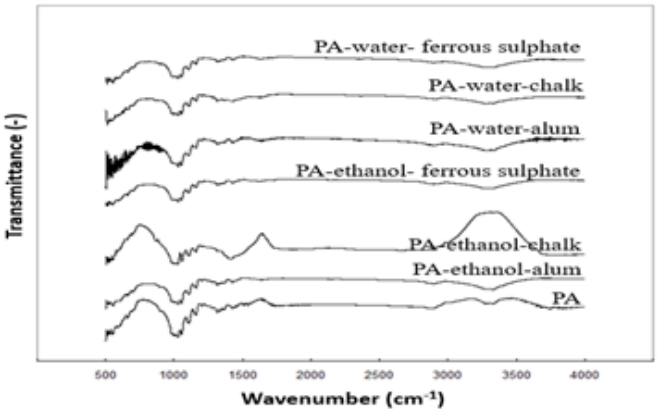

Fig. 4. The results of the FTIR analysis of the primisima A fabric that has been coloured.

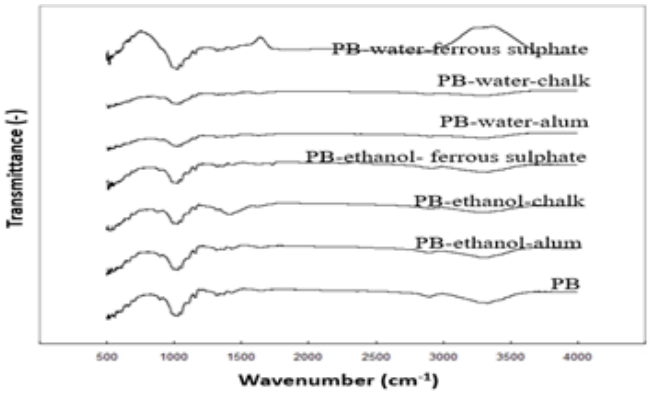

Fig. 5. The results of the FTIR analysis of the primisima B fabric that has been coloured.

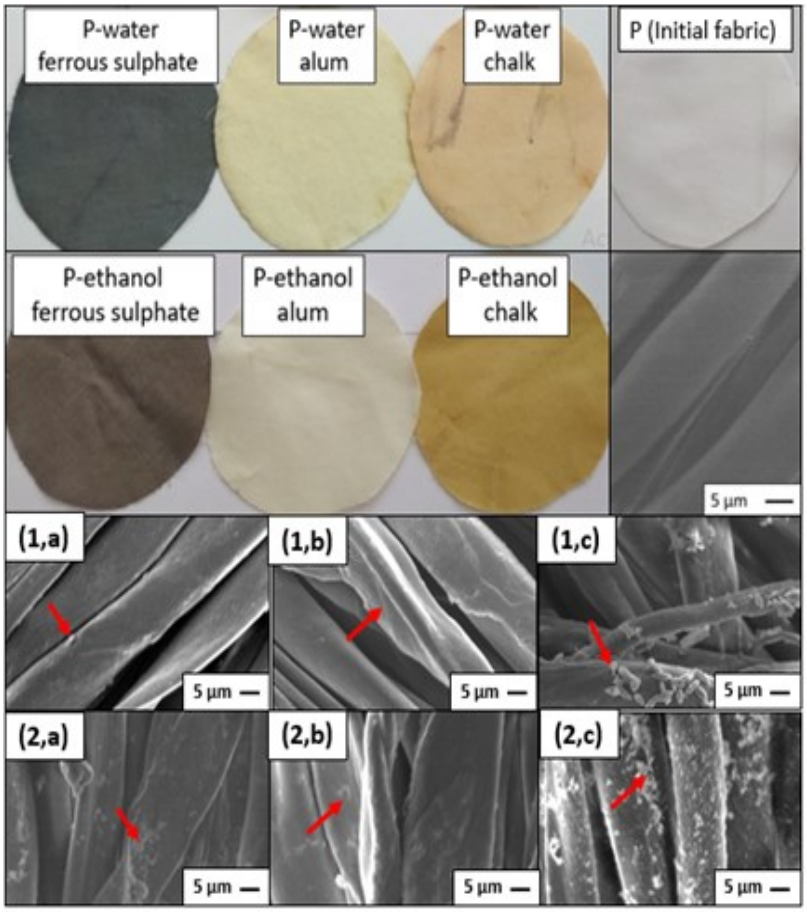

Fig. 6. The photograph images and SEM analysis results of initial fabric of prima and final fabrics of prima coloured by guava leaves extract using (1) water and (2) ethanol as solvents and (a) ferrous sulphate, (b) alum, and (b) chalk as fixation agents.

Figure 7 shows the difference in color produced on the Primisima A. The color sharpness shows similarities to the results in Fig. 6 while extracts that use water as a solvent produce sharper color than extracts using ethanol.

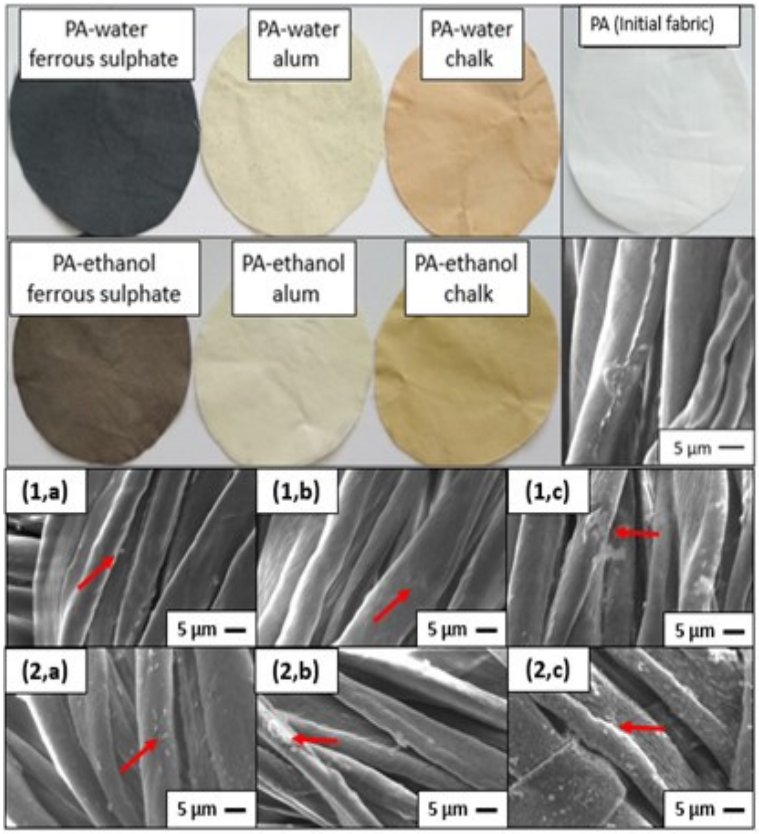

Fig. 7. The photograph images and SEM analysis results of initial fabric of primisima A and final fabrics of primisima A coloured by guava leaves extract using (1) water and (2) ethanol as solvents and (a) ferrous sulphate, (b) alum, and (b) chalk as fixation agents.

The difference in color produced on Primisima B fabric was showed in Fig. 8. Same with Figs. 6 and 7, Primisima B fabric also shows the same results as Prime and Primisima A fabrics related to color and color sharpness. The use of different fixation agents caused different colours in the fabrics. The successive use of iron sulfate, alum, and chalk produced dark blue, ivory, and brown. It was caused by the differences of formation of the tannin-metal ion complexes.

There were seemed particles attached to the fabric fibers. These are particles on prima, primisima A, and primisima B fabrics from compounds derived from fixation agents [7]. The presence of particles in chalk fixated fabric was caused by the formation of $CaCO3$ solids due to $Ca2+$ ion composition with $CO2$ from the air and $OH-$ ions from the solution [15]. Although this study has comprehensively investigated the effect of the above parameters on the colouring process, further

analysis must be done, especially relating to the chemical compound analysis such as Fourier transform infra-red.

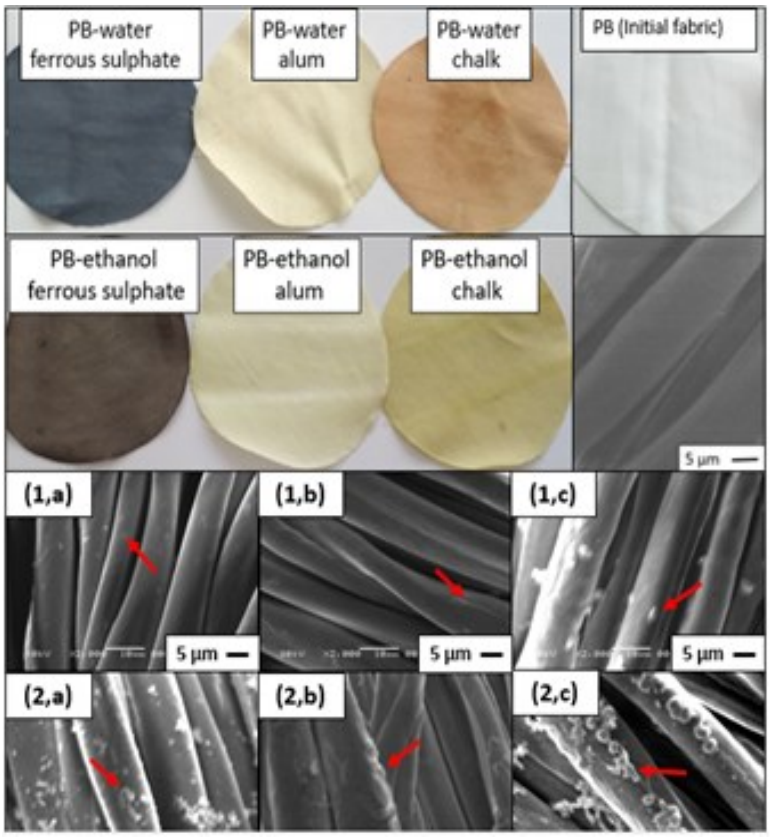

Fig. 8. The photograph images and SEM analysis results of initial fabric of primisima B and final fabrics of primisima B coloured by guava leaves extract using (1) water and (2) ethanol as solvents and (a) ferrous sulphate, (b) alum, and (b) chalk as fixation agents.

4. Conclusion

Based on the results study, proven that fixation agents various can produce different colours. In addition, the difference solvents in extraction of guava leaves extract gives a different sharpness effect while water produces a sharper color than ethanol. The use of different fabrics did not have a significant effect on the type and sharpness of the color produced. It was potentially in the batik industry, color and sharpness can be produced by using various fixation agents and different solvent extracts.

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