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RESULTS OF ECOPRINT MOTIFS BASED ON DIFFERENCES IN TYPES OF FABRIC, LENGTH OF TIME, TYPES OF MORDANTS, AND TYPES OF NATURAL DYES

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Abstract

Biodiversity of flora in Indonesia greatly supports the development of textile products, ecoprint is one of the textile products that involves the utilization of this diversity. Various types of plants found in the surrounding environment can be used as dyes for making ecoprints. Ecoprint is a color transfer technique on fabric which in the manufacturing process requires a mordant to bind plant colors to the fabric. This study aims to determine the effect of variations in fabric type, length of time, type of mordant, and type of natural dye on ecoprint color expression. This experiment used the steaming technique in ecoprint to transfer motifs and colors to fabric. In this study, three types of fabric were used, namely: toyobo cotton, mori, and blanco. Variants of steaming time were tested at intervals of 60 minutes, 90 minutes and 120 minutes. Variations in the types of mordant used are vinegar and alum. Meanwhile, the types of natural dyes used are jolawe, soga, and secang. The results of the research show that there are differences in color expression produced by vinegar and alum mordant substances. Alum mordant produces intense color expression and clear form. Leaf motifs can be printed well on toyobo cotton fabric. Variations in steaming time in this study did not produce significant differences in color expression. Meanwhile, each natural dye produces a different color expression.

Keywords*: Ecoprint; Natural Dyes; Modant*

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INTRODUCTION

The advancement of technology is often accompanied by waste-related challenges, one of which is environmental pollution caused by the use of synthetic dyes in the textile industry (Enrico, 2019). In response, the textile industry is increasingly seeking environmentally friendly and sustainable dyeing methods. Eco-fashion principles, which prioritize the use of environmentally friendly materials, are now at the forefront of this shift (Jalil & Shaharuddin, 2020). Among the various solutions, natural dyeing has gained popularity due to its minimal environmental impact and reduced health risks. Within the realm of natural dyeing, ecoprinting stands out as an innovative approach that merges artistic expression with a deep understanding of nature.

Ecoprinting involves transferring patterns or shapes from plants such as leaves, stems, and flowers onto media like fabric, paper, or leather (Kusumaningtyas & Wahyuningsih, 2021). Generally, three techniques are commonly employed in ecoprinting: steaming, pounding, and leaf or flower fermentation. The steaming technique, in particular, involves arranging plant materials (leaves, flowers, or stems) on mordanted fabric, rolling it up, and then steaming it for a specific duration (Bashiroh *et al*., 2022).

Ecoprinting is best suited for fabrics made from natural fibers, which include textile fibers derived from animals, plants, and minerals. Commonly used fabrics for ecoprinting include prime cotton, primisima, paris, rayon, T56 silk, and T54 silk. The ecoprint technique, which relies heavily on natural elements, yields optimal results when paired with media made from natural fibers. Consequently, fabrics derived from natural sources are preferred for ecoprinting, as they absorb color pigments from plants more effectively (Kusumaningtyas & Wahyuningsih, 2021). This finding aligns with research by Bashiroh *et al*., (2022), which highlights that fabrics of natural origin readily absorb plant-based pigments.

Ecoprint color expression results can be categorized as good if the plants used as motifs produce clear and sharp shapes on the fabric (Kusumaningtyas & Wahyuningsih, 2021). In order to get a good motif, this must be done*treatment*on fabric for ecoprint. The fabric treatment process includes scouring and mordanting, then the fabric can be used for ecoprinting. Scouring is the process of washing fabric to clean factory residue. Meanwhile, mordanting is a treatment of fabric that will be dyed so that starch, oil and dirt left behind during the weaving process can be

removed and the fabric can absorb the dye well. The mordanting stage requires substancesthe mordant toofunctions to strengthen the bond between fabric fibers and dyes so as to produce good sharpness and evenness of color (Bashiroh *et al*., 2022). Materials used for the fabric mordanting process include tunjung ($(Fe(SO_4).7H_2O)$, alum ($Al_2(SO_4)3.K_2SO_4.24H_2O$), or chalk ($CaO$). The three mordant substances each contain Fe, Al and Ca metals (Lestari *et al*., 2018). The mordanting process is also a fixation which functions to strengthen the color of natural dyes and change the natural dyes according to the type of metal that binds them. During the dyeing process, a series of quite complex chemical processes occur from the dye to the fabric fibers. The presence of a mordant will help the color bonding process with the fabric fibers through a chemical bridge from the color to the fabric (Lestari *et al*., 2018; Hernani *et al*., 2017).

Research conducted by (Bashiroh *et al*., 2022) regarding expression teak (*Tectona grandis*) leaf color using tunjung mordant, lime and alum on cotton fabric primisima indicates the result that is the expression of Teak leaf color varies. The use of alum mordant produces a dull yellow color expression, while quicklime mordant produces brown in color, while mordant Tunjung produces a blackish ash color. Apart from that, this study was also carried out variation of boiling time at the mordanting stage is 20 minutes, 40 minutes and 60 minutes. The results of varying boiling times did not show significant differences in color expression. Study conducted by (Masyitoh, 2019) also concerns the color expression of teak (*Tectona grandis*) leaves, but uses vinegar and alum mordant on cotton fabric.

The results of this study indicate that the color of teak leaves on cotton fabric treated with vinegar mordant produces a bright muddy brown hue with a fairly distinct leaf pattern, while the use of alum mordant results in a pompadour purple color that is less bright but with a very clear leaf pattern. These findings suggest that the type of mordant significantly influences the outcomes of ecoprint coloring. According to Masyitoh (2019), further research is needed to explore the effects of various other mordants on ecoprint color results.

Apart from the type of mordant, the results of ecoprint color expression are also influenced by the type of fabric and natural dyes. Research conducted by (Ristiani *et al*., 2020) regarding the results of the ecoprint dyed blanket technique with high natural dyes (*Ceriops tagal*) withvariations of pre-mordan symplocos, tannin-symplocos, alum and variations of 5 types of fabric, namely silk rayon, T54 silk,

primisima cotton, Japanese cotton and Paris rayon.

The results of this research demonstrate that rayon silk fabric and T54 silk fabric produce a brown color on the base fabric, with leaf shapes clearly printed. In contrast, Primisima cotton, Japanese cotton, and rayon-Paris fabrics also produce a brown color on the base fabric, but the leaf shapes are printed with moderate clarity. Additionally, leaf motifs appear more distinct and sharper on rayon silk fabric and T54 silk fabric when using alum as a mordant compared to symplocos mordant.

A related study by Khasanah & Widowati (2022) explored the use of natural dyes, utilizing mangosteen peel, secang, tegeran, tingi, and merr to achieve colors and motifs on Primisima Mori cloth with alum mordant. Their findings indicated that secang dye produced a peach-punch color, tegeran produced a blonde-lemon color, tingi produced a tangerine-ginger color, merr produced a daffodil-mustard color, and mangosteen peel produced an eggnog-sand color. These results demonstrate that natural dyes significantly influence the color outcome in ecoprinting.

Further research is required to explore ecoprint color expressions using different variables to support the sustainability of the environmentally friendly textile industry. This study aims to contribute to the development of eco-friendly dyeing methods by investigating the results of ecoprint motifs with variations in fabric type (Toyobo cotton, white cotton, Mori), steaming duration (60 minutes, 90 minutes, 120 minutes), and type of mordant (alum, vinegar). Additionally, the study compares the effects of various natural dyes on the final outcomes of the ecoprinting process.

RESEARCH METHOD

The research was conducted from July to September 2023 in the laboratory of the Department of Science Education at Universitas Negeri Malang. This study is an experimental research that focuses on creating ecoprints using the steaming technique with variations in fabric type, boiling duration, and mordant type. Additionally, the steam-blanket technique is employed with different types of natural dyes. The tools used in this research include measuring cups, a steamer set, ropes, digital scales, and plastic. The materials required comprise mori cloth, Toyobo cotton, blanco cloth, teak leaves, betel leaves, fern leaves, African leaves, alum, tunjung, calcium carbonate, vinegar, sodium bicarbonate, TRO, and water.

The work procedure in this study consisted of 3 stages for each treatment

observed. These three stages are: (1) scouring stage; (2) mordanting stage; and (3) ecoprint process. The work procedures in this research are presented in the following chart:

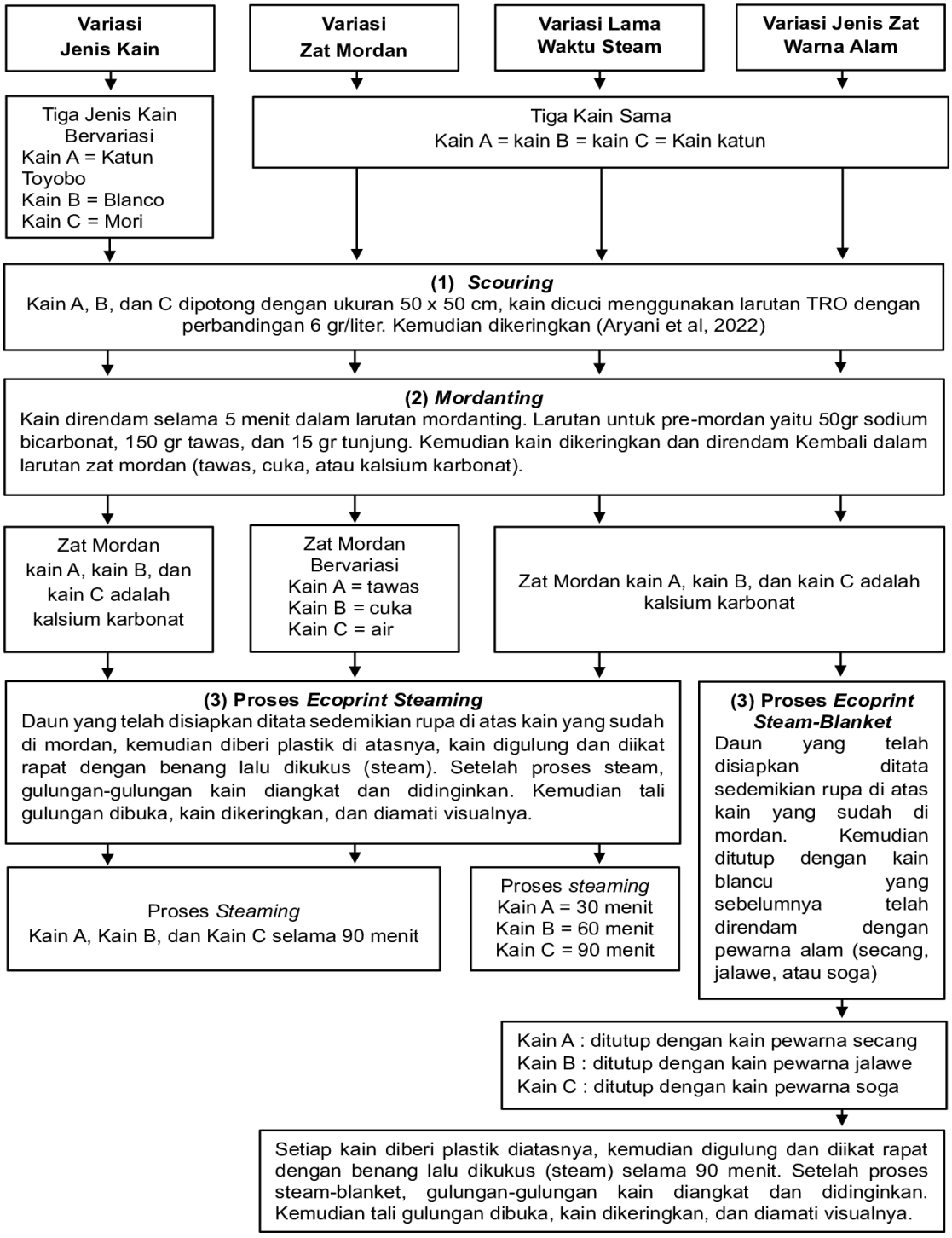


Figure 1. Research Work Procedure Chart

Experiments involving different types of fabric were conducted using three specific fabrics: cotton, blanco, and mori. The amount of mordant and the steaming time were kept constant as control variables.

Experiments involving different types of mordant were conducted using three substances: alum, vinegar, and water. The fabric type and steaming time were controlled.

Experiments to evaluate the effects of varying steaming times were conducted by steaming the fabric for 30, 60, and 90 minutes. The same fabric type and mordant were used as controls.

Experiments involving variations in natural dyes were conducted using a steam-blanket method with three natural dyes: secang, jalawe, and soga. In these experiments, the fabric type, mordant, and steaming time were controlled.

The data were analyzed qualitatively by comparing the color expression of ecoprint products resulting from variations in fabric type, steaming time, mordant type (alum and vinegar), and natural dye type. The ecoprint results were documented with photographs for further analysis. The color direction of various natural dyes was assessed by matching the ecoprint color expression with the color catalog in the Pantone Colors application.

RESULTS AND DISCUSSION

Influence of Fabric Type on Ecoprint Motif Results

When making ecoprints, we generally use a type of fabric made from natural fibers. In this research, the ecoprint coloring technique used is the steaming method by applying it to several types, namely toyobo cotton cloth, blanco cloth, and mori cloth. The results of the expression of ecoprint motifs on Toyobo, Blanco and Mori cotton fabrics can be seen in Table 1.

Table 1Comparison of Ecoprint Color Expressions on Toyobo, Blanco and Mori Cotton Fabrics

Fabric Type	**Results**
Toyobo Cotton	
Blanco	

Mori	

The results of the expression of ecoprint motifs on various types of fabric show that the type of fabric influences the intensity and clarity of the printed motif. The differences in the results of ecoprint motifs on each type of fabric are influenced by the ability of the fabric to absorb different dyes. On Toyobo cotton fabric, teak leaves give off a reddish purple color and the leaf bones are clearly printed. African leaves have a blackish green color, the leaf shape is clearly visible, but the leaf bone motif is vague. Meanwhile, fern and betel leaves emit faint colors in the form of light shadows or silhouettes.

On blanco fabric, teak leaves produce a clearly visible color, namely purple to red and the leaf veins are clear. African leaves give off a blackish green color, the leaf shape and leaf bone motif are quite clearly visible. Meanwhile, fern and betel leaves emit a faint color, in the form of shadows or silhouettes of dark leaves.

On mori cloth, teak leaves give off a faint red color and are not printed clearly. African leaves produce a blackish green color but do not depict the perfect shape of the leaves and veins. Fern and betel leaves are printed faintly or less clearly.

The three types of fabric used are capable of printing motifs according to the shape of the leaves used as dye. This is in accordance with theory (Simanungkalit, 2020) which states that the ecoprint technique is a process of transferring shape and color from plants to media such as fabric through direct contact. Toyobo cotton cloth, mori cloth, and blanco cloth are all made from natural fibers, namely cotton fiber so they can absorb dyes well (Aryani *et al*., 2022).

The Effect of Steaming Time on the Results of Ecoprint Motifs

The steaming method takes an average of 1-2 hours for leaf or flower motifs as dyes to be printed on the fabric. In this study, three were usedvariation Steaming times are 60 minutes, 90 minutes and 120 minutes. Comparison of the color expression of the ecoprint with boiling for 60 minutes, 90 minutes and 120 minutes did not show any significant color differences in the results of the ecoprint motif formed on the fabric. The results of the ecoprint color expression

over time variations can be seen in Table 2.

Table 2. Comparison of Ecoprint Color Expression in Varying Steaming Times on Cotton Fabric Types for 60 minutes, 90 minutes and 120 minutes.

Duration	**Results**
60 minute	
90 minutes	
120 minutes	

Even though time variations were carried out in the steaming process, the results of the ecoprint motif did not show any significant difference. It indicates that within a certain time limit, the pigment can transfer color well to the fabric consistently without any color change. The absence of differences in color expression with variations in boiling time is in line with research conducted by (Bashiroh *et al*., 2022) with a boiling process of 20 minutes, 40 minutes, and 60 minutes did not show a significant difference in color expression in the ecoprint results.

Influence of Mordant Alum Type and Vinegar for Ecoprint Motif Results

Mordanting is one of the important stages in making ecoprint batik. Mordanting is the stage of adding chemicals to the fabric so that the fabric can bind the colors well. The chemicals used for mordanting can vary depending on the desired end result. Use of appropriate chemicals for mordantingso. The resulting color will be sharp, binding, and will not fade easily on the fabric. In this research, we used mordant alum, vinegar, and water or cloth without added mordant. The results of the ecoprint

expression onmordantalum, vinegar and water can be seen in Table 3.

Table 3 Comparison of Ecoprint Color Expression in Alum Mordant, Vinegar, and Water

Mordant Type	Results
Alum	
Vinegar	
Water	

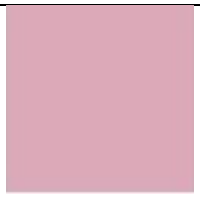
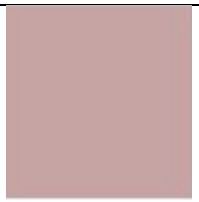
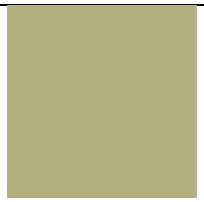
Based on the results of research conducted on mordant, the color expression of teak leaves, African leaves and fern leaves in alum mordant looks more concentrated and has a clear shape compared to vinegar mordant and water immersion. This is consistent with the research conducted by Saraswati and Sulandjari (2018), which demonstrates that using vinegar and alum mordants at masses of 75 grams and 150 grams affects the outcomes of ecoprinting, particularly in terms of shape clarity and color sharpness. The best staining results were obtained with 150 grams of alum mordant. Alum contains aluminum ions, which have a strong affinity for cellulose fibers and enhance the bonding between fabric fibers and dye molecules in leaves and flowers. As a result, ecoprinting with alum mordant produces darker colors (Subiyati et al., 2021). The higher the amount of alum used, the sharper the resulting color. This is in accordance with the properties of alum, which is not easily soluble in water, can intensify the color on the fabric, and can more firmly bind the dye to the fabric (Saraswati & Sulandjari, 2018).

The Influence of Types of Natural Dyes on the Results of Ecoprint Motifs

Natural dyes are textile coloring materials obtained from extracts from various parts of plants such as seeds, flowers, leaves, wood and roots. Most parts of the plant can be extracted and the extract can produce natural dyes, but the quality of the color produced depends on

the content of bioactive compounds in the plant (Bashiroh *et al*., 2022). In this research, the natural dyes used were jolawe fruit peel (*Terminalia bellirica*), secang tree trunks (*Biancaea sappan*), and soga. The color direction test results show that the ecoprint results from each natural dye produce different color directions. The color direction test results can be seen in Table 4.

Table 4. Comparison of Ecoprint Color Expression with Natural Dyes Secang, Jolawe, and Soga

Fabric Type	Results	Color Direction
Secang	 Secang Dye on Main Fabric	 *Pale mauve*
	 Secang Dye on Blanket Fabric	 *Pink cameos*
Jolawe	 Jolawe Dye on Main Fabric	 *Kale*
	 Jolawe Dye on Blanket Fabric	 *Wepping willow*
Soga	 Soga Dye on Main Fabric	 *Woodsmoke*

Soga Dye on Blanket Fabric

Copper tan

Secang natural dye produces a pale mauve color on the main fabric and a cameo pink color on the blanket fabric. Secang wood (*Biancaea sappan*) contains the compound brazilin which can produce a red pigment $C_{16}H_{14}O_5$) (Azmi & R, 2017). Based on study of (Rosyada & Tamamudin, 2020) Secang dye produces the impression of a pseudo-pink red color. It is also supported by research (Khasanah & Widowati, 2022) that the secang dye can produce a peach color on the main fabric and produce a punch color on the blanket fabric.Meanwhile study (Padmaningrum *et al*., 2012) shows that under acidic conditions the secang dye will produce a yellowish color.

Jolawe natural dye produces kale color on the main fabric and wepping willow color on the blanket fabric. According to research (Arifah & Damayanti, 2022) Jolawe fruit skin (*Terminalia bellirica*) is a source of natural dye that produces a brown color. Differences in color expression results on fabric can occur due to differences in the use of mordant substances at the mordanting stage.

Soga is a mixed dye, namely a mixture of jambal wood (*Pelthophorum ferruginum*), tingi wood (*Ceriops candolleana*), and tegeran wood (*Cudraina javanensis*) in a ratio of 3:2:1. According to (Hairotunisa, 2018)Jambal wood (*Pelthophorum ferruginum*) is a plant that produces red and brown colors. According to (Handayani & Maulana, 2013). Tingi bark (*Ceriops tagal*) contains procyanidin type tannins which produce a reddish brown color, while tegeran wood (*Cudraina javanensis*) bsed on (Sholikhah *et al*., 2022) contains tannins which produce a yellow color. In this study, the three dyes were mixed to produce color, the resulting color direction was woodsmoke brown on the main fabric and copper tan brown on the blanket fabric.

CONCLUSION

Based on the experimental results, it can be concluded that there are differences in color expression in various types of fabric, types of mordant, and natural dyes, while variations in length of time do not show significant color differences. Toyobo cotton fabric and blanco fabric can absorb color well,

especially the color absorption of teak leaves. Alum mordant produces a more intense color and clear shape compared to vinegar mordant and water mordant. Each natural dye produces a different color expression. Secang wood produces a pale mauve red color expression, jolawe produces a kale green color expression, and soga produces a woodsmoke brown color expression.

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