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The Effect of Mordant Alum, Tunjung and Betel Lime on the Ecoprint Results of Kersen Leaves (Muntingia Carabura L) on Semi-Wool Materials Using Pounding-Steam Technique

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A B S T R A C T

This study aims to analyze the effect of the use of mordan, alum, tunjung, and betel lime on the yield of *kersen* leaf ecoprint (*Muntingia carabura L*) on semi-wool material using *the pounding-steam* technique. The aspects studied include the direction of the colors produced and the clarity of the shape of the motif. This experimental study uses a quantitative approach with data analysis using sample tests related to Friedman K. The results show that different mordans produce different color characteristics: alum mordans produce *Canary Yellow* (83.33%), tunjung mordans produce darker Olive colors (77.77%), and betel lime mordanus produce Golden *Sundance* colors(94,44%). Regarding the clarity of motives, alum mordan achieved the highest clarity rating (55.55% with the category of "very clear"), while tunjung mordan and betel lime received a "clear" rating (77.77%). Statistical analysis confirmed a significant difference between the mordan treatment ($p < 0.000$), showing that the use of mordanus significantly affected the color yield and motive clarity in the ecoprint process. This research contributes to the development of environmentally friendly textile dyeing techniques using natural materials.

A B S T R A K

Penelitian ini bertujuan untuk menganalisis pengaruh penggunaan mordan, tawas, tunjung, dan kapur sirih terhadap hasil *ecoprint* daun kersen (*Muntingia Carabura L*) pada bahan semi wol dengan menggunakan teknik *pounding-steam*. Aspek-

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aspek yang dipelajari meliputi arah warna yang dihasilkan dan kejelasan bentuk motif. Penelitian eksperimental ini menggunakan pendekatan kuantitatif dengan analisis data menggunakan uji sampel terkait Friedman K. Hasil penelitian menunjukkan bahwa mordan yang berbeda menghasilkan karakteristik warna yang berbeda: mordan tawas menghasilkan warna *Canary Yellow* (83,33%), mordan tunjung menghasilkan warna *Olive* yang lebih gelap (77,77%), dan mordan kapur sirih menghasilkan warna *Golden Sundance* (94,44%). Mengenai kejelasan motif, mordan tawas mencapai peringkat kejelasan tertinggi (55,55% dengan kategori "sangat jelas"), sedangkan mordan tunjung dan kapur sirih mendapatkan peringkat "jelas" (77,77%). Analisis statistik mengkonfirmasi perbedaan yang signifikan antara perlakuan mordan ($p < 0,000$), menunjukkan bahwa penggunaan mordan secara signifikan mempengaruhi hasil warna dan kejelasan motif dalam proses ecoprint. Penelitian ini berkontribusi pada pengembangan teknik pewarnaan tekstil ramah lingkungan menggunakan bahan alami.

1. INTRODUCTION

Ecoprint is an innovation in the world of textiles that combines aspects of art and environmental sustainability (Wahyuningsih et al., 2024). This technique utilizes natural dyes from plants to produce unique motifs on various textile media (Ebrahim et al., 2022). According to Nurmasitah et al. (2022), *Ecoprint* relying on the principle of direct contact between plants and textile materials, where the process of color and shape transfer occurs through the natural dyeing method. Pandiselvam et al. (2023) He further explained that the success of this technique is highly dependent on the sensitivity of the plant to heat, which is a key factor in extracting the color pigment. In its development, *EcoPrint* It has been widely applied to various types of fabrics such as primisima cotton, foal cotton, linen, and silk. However, its use in semi-wool fabrics is still relatively rare. Semi-wool fabric, as described by Kazakov et al. (2021), is a blended textile material that combines wool fibers with synthetic fibers to improve durability and ease of care. The unique characteristics of semi-wool require further research regarding its interaction with natural dyes.

Kersen leaf (*Muntingia Carabura L*) was chosen as a source of natural dyes in this study based on its potential chemical content. According to Jesus et al. (2022), kersen leaves contain a variety of bioactive compounds including alkaloids, flavonoids, tannins, saponins, and essential oils. These contents, especially tannins and flavonoids, play an important role in producing color pigments. Previous research by Hasanah et al. (2024) Ecoprint using teak leaves shows that choosing the right mordan has a great influence on the final coloring result. In the natural dyeing process, mordanus plays an important role as a binder and color enhancer.

Periyasamy (2024) emphasized that fixation is an important process for strengthening dyes, while Pancapalaga et al. (2022) Adding that mordant serves as an enhancer that significantly affects the color yield. Research by Mukkun et al. (2024) It shows that the use of different mordans such as alum, lime, and tunjung results in different color

variations in natural fibers. The use of mordan alum, tunjung, and betel lime in this study is based on chemical characteristics and their influence on the coloring results.

Holakooei et al. (2023) found that alum mordanus can produce a more even color due to its alkaline nature. While Saefudin et al. (2023) Notice that Tunjung tends to give a darker color effect. Betel lime was chosen because of its environmentally friendly nature as a natural ingredient made from calcium hydroxide. The study also used the steam technique, which combines a pounding method to transfer color pigments and vapor to improve color. According to Yıldırım et al. (2020), the steam technique is the most effective way to transfer plant color to fabric because the hot steam releases the dye pigment. The combination of these two techniques is expected to optimize the coloring results and produce a clear motif.

The results of the pre-experiment showed that the results of ecoprints on semi-wool materials using kersen leaves with the use of mordan alum, tunjung and betel lime produced different shapes in terms of the direction of the name of the color and the clarity of the shape of the motif. This study aims to describe the direction of the color name (*hue*), the clarity of the motif shape and the influence produced in the making *of ecoprints* using Mordan Tawas, Tunjung and Betel Lime on semi-wool materials using kersen leaves (*Muntingia Calabura L).*

2. METHOD

This study uses an experimental approach applied at the Department of Family Welfare Sciences (IKK), Faculty of Tourism and Hospitality, Padang State University. The selection of the experimental method was based on the research objective to analyze the causal relationship between the use of different mordans on *the results of ecoprinting* on semi-wool materials.

The object of the study was a semi-wool material measuring 30x30 cm that was treated with a pre-mordanting technique using three different types of mordan: alum, tunjung, and betel lime. The experiment was carried out by controlling variables that could affect the results, including the type and size of kersen leaves, steaming temperature, soaking time, and drying conditions. The main materials used in this study include semi-wool fabric, kersen leaves (Muntingia Carabura L), and three types of mordan with predetermined concentrations.

Alum mordan has a pH of 4 (acidic), a pH 8 (weak base), and a betel lime pH 12 (strong base). In the pre-treatment process, TRO (Turkish Red Oil) is used as much as 2 grams/liter to remove impurities and increase the absorbency of the fabric. The equipment used includes a steamer, stove, thermometer, pH meter, digital scale, mash tool, and documentation device, all of which are calibrated and sterilized before use to ensure the accuracy of the test results. The research procedure begins with a preparatory stage that includes the characterization of semi-wool materials through microscopic tests and combustion tests, as well as pH testing of each mordan.

Preparation of mordan solution according to Pancapalaga et al. (2022) recipe with a ratio of 1:10, followed by pre-treatment of the fabric using TRO. The mordanting stage is carried out by soaking the fabric in a mordan solution for 30 minutes at room temperature, then drying it by aerating it without exposure to direct sunlight. After the mordanting process, the pH of the fabric is tested to ensure the effectiveness of the process. On the process *EcoPrint*technique *pounding* applied to transfer the color pigment from the kersen leaves to the fabric, followed by a steam process for 2 hours at a controlled temperature.

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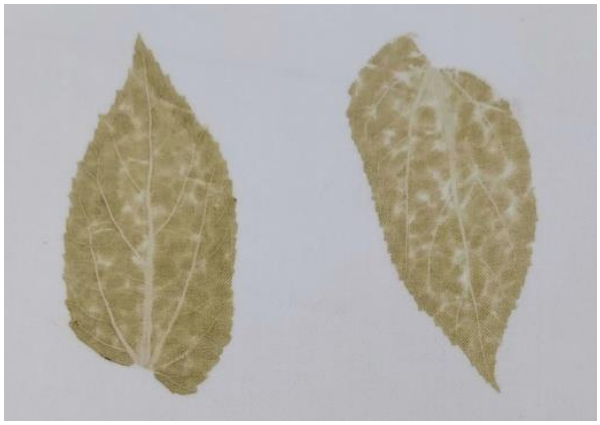
After natural cooling and opening of the results, color fixation is carried out according to the type of mordan used. The research data was collected through visual observation and assessment by 18 panelists consisting of 3 expert panelists (lecturers teaching textile courses) and 15 trained panelists (students who have graduated from textile courses with a minimum grade of B). To ensure the validity of the color assessment, all panelists underwent a color blindness test using the Ishihara method before conducting the assessment. The research instruments used include observation sheets to record process parameters, assessment questionnaires with assessment scales to assess the direction of color (*hue*) using *the ColorBlind Assistant* application and the clarity of motif shapes on a scale of 1-4, as well as visual documentation of each stage of the process. Recording of pH and temperature characterization is also carried out systematically to ensure process consistency.

Data analysis was carried out by combining quantitative and qualitative methods. The color direction is analyzed using a colorblind assistant application to determine the RGB value and color code precisely. Friedman K-related sample test was used to analyze the significance of the difference in results between the mordan treatments, with a significance level of 0.05. Descriptive analysis was carried out to explain the visual characteristics of *the ecoprint* results comprehensively. The validity of the data is guaranteed through triangulation of data collection methods and verification by expert panelists, while the reliability of the instrument is tested through the test-retest method to ensure the consistency of the measurement results.

3. RESULTS AND DISCUSSION

Based on the research conducted on the influence of mordan alum, tunjung, and betel lime on the yield of *ecoprint* of kersen leaves (*Muntingia Calabura L*) on semi-wool materials, data were obtained on the direction of the color produced and the clarity of the motif shape. The research data was obtained through assessments by 18 panelists consisting of 3 expert panelists (lecturers teaching textile courses) and 15 trained panelists (students who have completed textile courses with a minimum grade of B). The color direction was analyzed using *the ColorBlind Assistant application* to determine the RGB value and color code precisely, while the clarity of the motif was assessed using a rating scale of 1-4. The results of the research and discussion are presented as follows.

The results of the research are presented through visual documentation and data analysis from the panelists' assessments. Figure 1 shows the ecoprint results of various mordan treatments on semi-wool materials using kersen leaves (*Muntingia Calabura L*). The samples show the variation in color and clarity of the motif achieved through different mordanting processes.



Picture 1. Ecoprint Scan Results

Each sample in the scan represented a different mordan treatment: without mordan, with alum mordan, with mordan tunjung, and with mordan betel lime. Visual differences in color and motive clarity between samples were noticeable, providing a basis for detailed analysis through panelist assessment using *the Colorblind Assistant* app and clarity rating scales. The following table presents the quantitative data collected from this assessment.

The results of the assessment of 18 panelists regarding the color names (*Hue*) produced by different mordan treatments on the *kersen leaf ecoprint* are presented in Table 1, showing the variation in color results and RGB values and corresponding color codes.

Table 1. Questionnaire data description to assess color names (*Hue*) leaves produced on the influence of mordan alum, tunjung and betel on the ecoprint results of kersen leaves (*Muntingia Calabura L*) on semi-wool materials.

Not	Ecoprint	Color	Color Name (Hue)	Color Code	RGB	F	F%
1	No Mordan		Golden Sundance	#D6B75B	R 214 G 183 B 091	2	11,11%
			Muddy Waters Brown	#A8974B	IDR 168 G 151 B 075	16	88,88%
			Olive	#978A6B	R 151 G 138 B 107	0	0%
2	Alum Mordan		Sulu Light Green	#E7E860	R 231 G 232 B 096	2	11,11%
			Dark Golden Rod	#BEB301	IDR 190 G 179 B 001	1	5,55%

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			Canary Yellow	#BEBF4F	IDR 190 G 191 B 079	15	83,33%
			Muddy Waters Brown	#A9844F	IDR 169 G 132 B 79	2	11,11%
3	Mordan Tunjung		Olive	#737253	R 115 G 114 B 083	14	77,77%
			Dark Brown	#5A5D32	R 090 G 093 B 050	2	11,11%
			Dark Golden Rod	#BEB301	IDR 190 G 179 B 001	0	0%
4	Mordan Lime betel nut		Canary Yellow	#BEBF4F	IDR 190 G 191 B 079	1	5,55%
			Golden Sundance	#B8A552	IDR 184 G 165 B 082	17	94,44%

Based on table 1, it can be concluded that the color names produced by the use of mordan, alum, tunjung and betel lime in the ecoprint *process* of kersen leaves (*Muntingia Carabura L*) use semi-wool material by dyeing semi-wool fabric without using mordan, of the 18 panelists in this study 16 panelists (88.88%) chose *the color Muddy Waters Brown (*#A8974B) and 2 panelists chose the color *Golden Sundance* (#D6B75B). Under the influence of the alum mordan, 15 panelists (83.33%) chose *Canary Yellow (*#BEBF4F), 2 panelists (11.11%) chose *Sulu Light Green (*#E7E860) and 1 panelist 5.55% chose *Dark Golden Rod (*#BEB301). Under the influence of the mordan, 14 panelists (77.77%) chose *Olive* (#737253), 2 panelists (11.11%) chose *Muddy Waters Brown (*#A9844F) and 2 panelists (11.11%) chose *Dark Brown (*#5A5D32). Under the influence of betel lime mordan, 17 panelists (94.44%) chose the color *Golden Sundance (*#B8A552) and 1 panelist (5.55%) chose *Canary Yellow* (#BEBF4F).

Based on the questionnaire answers from the panelists, the distribution of the frequency of color names (*hue) on the influence of alum, tunjung and betel lime on the results of ecoprints of semi-wool fabrics with* kersen leaves (*Muntingia Carabura L*) can be explained in the following table:

Table 2. The frequency distribution of color name assessment (*Hue*) leaves produced by the influence of alum, tunjung and betel lime on the yield *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool materials.

Ecoprint Results	Color	Color name (Hue)	RGB	Color Code	F%	
					F	%

No Mordan		Muddy Waters Brown	#A8974B	IDR 168 G 151 B 075	16	88,88%
Alum Mordan		Canary Yellow	#BEBF4F	IDR 190 G 191 B 079	15	83,33%
Mordan Tunjung		Olive	#737253	R 115 G 114 B 083	14	77,77%
Mordan Lime betel nut		Golden Sundance	#B8A552	IDR 184 G 165 B 082	17	94,44%

Based on table 2 above, it is explained that the color name (*hue*) of the leaves along with the RGB color code (Red, Green and Blue) can be concluded that the color produced from the influence of mordanus, tunjung and betel lime on the ecoprint results of kersen leaves *(Muntingia calabura L*) on semi-wool material obtained without the use of mordans is *Muddy Waters Brown* with the color code R168 G151 B075 #A8974B with a percentage of 88.88% of the total number of panelists 16, with the color alum mordan obtained is *Canary Yellow* with the color code R190 G191 B079 #BEBF4F with a percentage of 83.33% of the number of 15 panelists. For tunjung mordan, the color obtained was *Olive* with the color code R0115 G114 B083 #737253 with a percentage of 77.77% of the number of panelists 14 and in the betel lime mordan obtained was *Golden Sundace* with the color code R184 G165 B082 #B8A552 with a percentage of 94.44% of the number of panelists 17.

Table 3. Questionnaire data description to assess color names (*Hue*) of the mother bone produced on the influence of alum, tunjung and betel lime on the yield *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool materials.

Not	Ecoprint	Color	Color Name (Hue)	Color Code	RGB	F	F%
1	No Mordan		Pale Golden	#EADFAC	R 234 G 223 B 172	11	61,11%
			Antique White	#EEE7D0	R 238 G 231 B 208	5	27,77
			Off White	#FAF9E9	IDR 250 G 249 B 233	2	11,11%
2	Alum mordan		Light Yellow	#FAFDE7	IDR 250 G 253 B 231	3	16,66%

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			Off White Beige	#F7F6DC	IDR 247 G 246 B 220	2	11,11%
			Light Golden Yellow	#EFF7D1	IDR 239 G 247 B 209	13	72,22%
3	Mordan tunjung		Soft Blue	#848791	IDR 132 G 135 B 145	15	83,33%
			Teal	#767982	R 118 G 121 B 130	3	16,66%
			Dark Teal	#555861	R 085 G 088 B 097	0	0%
			Reef Green	#F7F8E6	IDR 247 G 248 B 230	1	5,55%
4	Mordan Lime betel nut		Off White Beige	#F7F6DC	IDR 247 G 246 B 220	4	22,22%
			Antique White	#EEE7D0	R 238 G 231 B 208	13	72,22%

Based on table 3, it can be concluded that the name of the mother bone color is produced from the influence of mordan, alum, tunjung and betel lime on the semi-wool fabric of kersen leaves (*Muntingia Carabura L*) using semi-wool material. By dyeing semi-wool fabric without using mordan, of the 18 panelists in this study, 11 panelists (61.11%) chose the color *Pale Golden (*EADFAC), 5 panelists (27.77%) chose the color *Antique White (*#EEE7D0) and 2 panelists (11.11%) chose *Off-White* (#FAF9E9). In dyeing semi-wool materials using Mordan Alum, 13 panelists (72.22%) chose *Light Golden Yellow* (#EFF7D1), 3 panelists (16.66) chose *Light Yellow* (#FAFDE7) and 2 panelists (11.11%) chose *Off White Beige* (#F7F6DC). Under the influence of the tunjung mordan, 15 panelists (83.33) chose *Soft Blue* (#848791) and 3 panelists (16.66%) chose *Teal* color (#767982). Under the influence of betel lime mordan, 13 panelists (72.22%) chose *Antique White* (#EEE7D0), 4 panelists (22.22%) chose *Off White Beige* (#F7F6DC) and 1 panelist (5.55%) chose *Reef Green* (F7F8E6).

Based on the questionnaire answers from the panelists, the distribution of the frequency of color names (*hue) on the influence of alum, tunjung and betel lime on the results of ecoprint of semi-wool fabric with kersen leaves (Muntingia Carabura L)* can be explained in the following table:

Table 4. Distribution of the frequency of assessment of the color name (hue) of the mother bone produced by the influence of alum, tunjung and betel lime on the results *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool materials

Ecoprint Results	Color	Name Color (hue)	RGB	Color Code	F%	
					F	%
No Mordan		Pale Golden	#EADFAC	R 234 G 223 B 172	11	61,11%
Alum Mordan		Light Golden Yellow	#EFF7D1	IDR 239 G 247 B 209	13	72,22%
Mordan Tunjung		Soft Blue	#848791	IDR 132 G 135 B 145	15	83,33%
Mordan Lime betel nut		Antique White	#EEE7D0	R 238 G 231 B 208	13	72,22%

Based on table 4 above, it is explained that the color name (*hue*) along with the RGB color code (Red, Green and Blue) can be concluded that the color produced from the influence of alum, tunjung and betel lime on the ecoprint results of kersen leaves *(Muntingia Calabura L*) on semi-wool material without using the color mordan obtained is *Pale Golden* with the color code R234 G223 B172 #EADFAC with a percentage of 61.11% of the total number of panelists as many as 11 people, with the alum mordan, the color obtained is *Light Golden Yellow* with the color code R239 G247 B209 #EFF7D1 with a percentage of 72.22% of the total 13 panelists. For the tunjung mordan, the colors obtained were *Soft Blue* with R132, G135, B145, color code #848791 with a percentage of 83.33% of the number of panelists, 15 and in the betel lime mordan, the color obtained was *Antique White* with R238, G231, B208, color code, #EEE7D0 with a percentage of 72.22% of the number of panelists 13.

Table 5. Questionnaire data description to assess color names (*Hue*) bone branches produced on the influence of mordan alum, tunjung and betel lime on the yield *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool materials.

Not	Ecoprint	Color	Color Name (Hue)	Color Code	RGB	F	F%
1	No Mordan		Off White	#FAF9E9	IDR 250 G 249 B 233	2	11,11%
			Light Yellow	#FAFDE7	IDR 250 G 253 B 231	0	0%

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			Off White Beige	#F7F6DC	IDR 247 G 246 B 220	16	88,88%
			Light Golden Yellow	#FAFDE7	IDR 250 G 253 B 231	2	11,11%
2	Alum mordan		Off White Beige	#F7F6DC	IDR 247 G 246 B 220	15	83,33%
			Light Yellow	#FFFFD5	IDR 255 G 255 B 213	1	5,55%
			Pale green	#A7A99B	IDR 167 G 169 B 155	17	94,44%
3	Mordan tunjung		Medium Cyan	#A0A8B0	R 160 G 168 B 176	1	5,55%
			Midnight Blue	#A0A4B0	R 160 G 164 B 176	0	0%
			Off White	#FAF9E9	IDR 250 G 249 B 233	0	0%
4	Mordan Lime betel nut		Antique White	#EEE7D0	R 238 G 231 B 208	15	83,33%
			Off white lavender	#F7F8E6	IDR 247 G 248 B 230	3	16,66%

Based on table 5, it can be concluded that the name of the color of the bone branch is produced from the influence of mordan, alum, tunjung and betel lime on the semi-wool fabric of Kersen leaves (*Muntingia Carabura L*) using semi-wool material by dyeing semi-wool fabric without using mordan, of the 18 panelists in this study 16 panelists (88.88%) chose *Off-White Beige color (*##F7F6DC), and 2 panelists (11.11%) chose *Off-White* color(#FAF9E9). Under the influence of the alum mordan, 15 panelists (83.33%) stated that the color was *Off White Beige* (#F7F6DC), 2 panelists (11.11%) chose *Light Golden Yellow* (#FAFDE7), and 1 panelist (5.55%) chose *Light Yellow* (#FFFFD5). Under the influence of mordan tunjung, 17 panelists (94.44%) chose *Pale Green* (#A7A99B) and 1 panelist (5.55%) chose *Medium Cyan* (#A0A8B0). Under the influence of betel lime mordan, 15 panelists (83.33%) chose *Antique White* (#EEE7D0) and 3 panelists (16.66%) chose *Off White Lavender* (#F7F8E6).

Based on the questionnaire answers from the panelists, the distribution of the frequency of color names (*hue)* on the influence of alum, tunjung and betel lime on the results of ecoprints of semi-wool fabrics with kersen leaves (*Muntingia Calabura L*) can be explained in the following table:

Table 6. The frequency distribution of color name assessment (*Hue*) bone branches produced by the influence of alum, tunjung and betel lime on the yield *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool materials.

Ecoprint Results	Color	Name Color (Hue)	RGB	Color Code	F%	
					F	%
No Mordan		Off White Beige	#F7F6DC	IDR 247 G 246 B 220	16	88,88%
Alum Mordan		Off White Beige	#F7F6DC	IDR 247 G 246 B 220	15	83,33%
Mordan Tunjung		Pale green	#A7A99B	IDR 167 G 169 B 155	17	94,44%
Mordan Lime betel nut		Antique White	#EEE7D0	R 238 G 231 B 208	15	83,33%

Based on table 6 above, it is explained that the color name (*hue*) of the bone branch along with the RGB color code (Red, Green and Blue) resulting from the influence of alum, tunjung and betel lime on the kersen leaf semi-wool fabric (*Muntingia Carabura L*) using semi-wool material, with the dyeing of the semi-wool fabric without using the color mordan obtained is *Off White Beige* with the color code R247 G246 B240 #F7F6DC with a percentage of 88.8% of the total number of 16 panelists, with mordan alum the color obtained is *Off White Beige* with the color code R247 G246 B240 #F7F6DC with a percentage of 83.33% of the total of 15 panelists. For mordan, the color obtained is *Pale Green* with R167, G169, B155, #A7A99B color code with a percentage of 94.44% of the number of panelists, and in mordan, betel lime, the color obtained is *Antique White* with R238, G231, B208, color code, #EEE7D0 with a percentage of 83.3% of the number of panelists, 15.

The description of the clarity of the shape of the leaf motif was obtained from the panelists' research on the clarity of the shape of the leaf motif produced on *the ecoprint* of kersen leaves (*Muntingia Calabura L)* on semi-wool material with mordanus alkalus, tunjung and silt lime as follows.

Table 7. Description of the frequency of clarity of leaf motif shapes produced in the ecoprint of kersen leaves (*Muntingia Calabura L*) on semi-wool material without mordan.

No Mordan			
Not	Clarity of shape	Frequency	%
1	Very clear	5	27,77%

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2	Clear	13	72,22%
3	Pretty clear	0	0%
4	Unclear	0	0%
	Total	18	100%

In the table above, it can be seen that the percentage of the frequency of clarity of the leaf motif shape in *the kersen leaf* ecoprint (*Muntungia Calabura L*) on semi-wool material without mordan is 27.77% of the panelists stated that it is very clear that the shape of the leaf motif has not changed at all and 72.22% of the panelists stated that it is clear or the shape of the leaf motif looks changed or somewhat faint, (0%) no panelists stated that the shape of the leaf motif was clear enough or the shape of the leaf motif looked very changed or very faint, and there was no (0%) panelist who stated that the shape of the leaf motif was not clear or the shape of the leaf motif resulting from the ecoprint of kersen leaves (*Muntungia Calabura L*) on semi-wool material. So in the results of *the ecoprint* without mordan, namely with 72.22% of the panelists clearly or the shape of the leaf motif looks changed or somewhat faint.

Table 8. Description of the frequency of clarity of the shape of the leaf motif produced on *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool materials using mordan alum.

Alum Mordan			
Not	Clarity of shape	Frequency	%
1	Very clear	10	55,55%
2	Clear	8	44,44%
3	Pretty clear	0	0%
4	Unclear	0	0%
	Total	18	100%

In the table above, it can be seen that the percentage of the frequency of clarity of the shape of *the kersen leaf ecoprint* motif (*Muntungia Calabura L*) on semi-wool materials using alum mordanus is 55.55% of the panelists stated that it was very clear which is the shape of the leaf motif there is no change at all, 44.44% of the panelists stated that it is clear or the shape of the leaf motif looks changed or somewhat vague, there are no (0%) panelists who stated that it is quite clear or the shape of the motif The leaves looked very varied or very faint, and none (0%) of the panelists stated that the shape of the leaf motif was unclear or the shape of the leaf motif resulting from *the ecoprint* of Kersen leaves (*Muntungia Calabura L*) on semi-wool material. So that the results of *the ecoprint* used the alum mordan, with 55.55% of the panelists stating that it was very clear that the shape of the leaf motif did not change at all.

Table 9. Description of the frequency of clarity of the shape of the leaf motif produced on *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool material using mordan tunjung.

Mordan Tunjung			
Not	Clarity of shape	Frequency	%
1	Very clear	2	11,11%
2	Clear	14	77,77%
3	Pretty clear	2	11,11%
4	Unclear	0	0%

Entire	15	100%

In table 9 above, it can be seen that the percentage of the frequency of clarity of the shape of *the kersen leaf ecoprint* motif (*Muntungia Calabura L*) on semi-wool material using mordan tunjung is 11.11% of the panelists stated that it is very clear that the shape of the leaf motif has not changed at all, 77.77% of the panelists stated that it is clear or the shape of the leaf motif looks changed or somewhat faint, 11.11% of the panelists stated that it was quite clear or the shape of the leaf motif looked very changed or very faint, and none (0%) of the panelists stated that the shape of the leaf motif was not clear or the shape of the leaf motif was the result *of the ecoprint* of kersen leaves (*Muntungia Calabura L)* on semi-wool material. So that the results of *the ecoprint* using tunjung were with 77.77% of the panelists clearly or the shape of the leaf motif looked changed or somewhat faint.

Table 10. Description of the frequency of clarity of the shape of the leaf motif produced on *EcoPrint* Kersen leaves (*Muntingia Calabura L*) in semi-wool material using mordan betel lime.

Mordan Lime betel nut			
Not	Clarity of shape	Frequency	%
1	Very clear	2	11,11%
2	Clear	14	77,77%
3	Pretty clear	2	11,11%
4	Unclear	0	0%
	Entire	15	100%

In table 10 above, it can be seen that the percentage frequency of clarity of the shape of *the kersen leaf ecoprint* motif (*Muntungia Calabura L*) on semi-wool material using mordan betel lime is 11.11% of the panelists stated that it was very clear that the shape of the leaf motif did not change at all, 77.77% of the panelists stated that it was clear or the shape of the leaf motif looked changed or somewhat faint, 11.11% of the panelists stated that it was quite clear or the shape of the leaf motif looked very changed or very faint, and none (0%) of the panelists stated that the shape of the leaf motif was not clear or the shape of the leaf motif was the result of *the ecoprint* of kersen leaves (*Muntungia Calabura L*) on semi-wool material. So that the results *of the ecoprint* used betel lime mordan, namely with 77.77% of the panelists clearly or the shape of the leaf motif looks changed or somewhat faint.

The data in this study consisted of 18 panelists, therefore the authors used non-parametric statistics and used Friedman K-related sample tests in data analysis. This test was carried out using the SPSS (*Statistic Product and Servie Solution*) version 26 application.

Table 11. Descriptive statistics of the clarity of the form of the motive produced in *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool material with mordan alum, tunjung and betel lime.

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
No Mordan	18	3,56	,511	3	4
Alum Mordan	18	3,61	,502	3	4
Mordan Tunjung	18	3,00	,485	2	4

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Mordan Lime betel nut	18	3,00	,485	2	4

Based on table 11 above, it can be explained that the research data had 18 panelists, obtaining the average value of the clarity of the shape of the motif of semi-wool fabric as follows: without mordan got an average of 3.56, mordan alum got an average of 3.61, mordan tunjung got an average of 3.00 and mordan lime got an average of 3.00.

Table 12. The results of the Friedman K-Ralated sample test on the clarity of the motif form in *EcoPrint* Kersen leaves (*Muntingia Calabura L*) on semi-wool material with mordan alum, tunjung and betel lime.

Test Statisticsa	
N	18
Chi-Square	19,686
Df	3
Asymp. Sig.	,000

a. Friedman Test

In table 12 above, it can be explained that the *Friedman K-Ralated sample* test on the clarity of the motif shape produced on the *ecoprint of* kersen leaves (*Muntingia Calabura L*) on semi-wool materials with mordan, tunjung and betel lime obtained a significance value of 0.000 which is smaller than the significance level of 0.05 or 0.000 < 0.05, meaning that there is a significant difference due to the use of mordanus alum, Tunjung and betel lime for clarity of the shape of *the ecoprint* motif use kersen leaves on semi-wool material.

Based on the results of the research, the discussion was carried out using related theories. The discussion in this chapter is related to the results *of ecoprints* from the difference in mordanus, tunjung and betel lime using kersen leaves (*Muntingia Calabura L)* to the results *of ecoprints* on semi-wool materials seen from the direction of color and the clarity of the shape of the leaf motif.

The color direction (*Hue*) produced from the difference in mordan alum, tunjung and betel lime in the ecoprint results using kersen leaves (*Muntingia Calabura L*) in semi-wool material.

Based on the results of the experiment conducted using *the Colorblind Assistant application* and assessed by the panelists, it can be seen that the result of the color name (*hue) of* kersen leaves (*Muntingia Calabura L*) on semi-wool material without using the mordan color obtained is *Muddy Waters Brown* with the color code R168 G151 B075 #A8974B with a percentage of 88.88% of the total number of 16 panelists, with the color of alum obtained is *Canary Yellow* with the color code R190 G191 B079 #BEBF4F with a percentage of 83.33% of the total number of 15 panelists. For the color mordan, the color obtained was *Olive* with the color code R0115 G114 B083 #737253 with a percentage of 77.77% of the number of panelists 14 and in the betel lime mordan obtained was *Golden Sundace* with the color code R184 G165 B082 #B8A552 with a percentage of 94.44% of the number of panelists 17.

Furthermore, the color name direction (hue) produced from the mother bone of the kersen leaf (*Muntingia Calabura L*) on the semi-wool material without using the color mordanus obtained is *Pale Golden* with the color code R234 G223 B172 #EADFAC with a percentage of 61.11% of the number of panelists 11, with the alum mordan obtained is

Light Golden Yellow with the color code R239 G247 B209 #EFF7D1 with a percentage of 72.22% of the total number of panelists 13. For the tjung mordan, the colors obtained were *Soft Blue* with R132, G135, B145, color code #848791 with a percentage of 83.33% of the number of panelists, 15 and in the betel lime mordan, the color obtained was *Antique White* with R238, G231, B208, color code, #EEE7D0 with a percentage of 72.22% of the number of panelists 13.

And furthermore, the direction of the color name (*hue*) produced from the bones of the kersen leaf branch (*Muntingia Calabura L*) on the semi-wool material without using the color mordan obtained is *Off White Beige* with the color code R247 G246 B240 #F7F6DC with a percentage of 88.8% of the number of 16 panelists, with the color alum mordan obtained is the color *Off White Beige* with color codes R247 G246 B240 #F7F6DC with a percentage of 83.33% of the total number of 15 panelists. For tunjung mordan, the color obtained was *Pale Green* with R167, G169, B155, color code, #A7A99B with a percentage of 94.44% of the number of panelists, and in the betel lime mordan obtained was *Antique White* with R238, G231, B208, color code, #EEE7D0 with a percentage of 83.3% of the number of panelists, 15.

Color name (*Hue*) produced from the ecoprint of Kersen leaves (*Muntingia Calabura L*) is derived from the color-emitting pigments contained in kersen leaves and the use of mordans that are able to bind dyes to fibers. The use of different mordanes and the pH contained in the mordanus will produce different colors. This is in line with the opinion Wahyuningsih et al. (2024) Which states that the color name in the Ecoprint results is influenced by the coloring content in kersen leaves, namely flavonoids, polyphenols, tannins, saponins, terpenoids, and essential oils, and is influenced by the pH (degree of acidity or alkalinity) of the type of mordan used.

Based on the results of the study, with the influence of mordan alum leading to *Golden Yellow* or tend to be bright. The results of this study show that the color *Canary Yellow* on kersen leaves, color *Light Golden Yellow* on the mother bone, and color *Off White Beige* on the bony branch of the leaf leading to *Golden Yellow* or tends to be bright and the color produced is in accordance with the color of the leaves used, because mordan alum contains pH 4 which belongs to the acid category. The greater the pH of the acid, the more it shifts the direction of the lighter color. This is in line with research Utama et al. (2024) The coloring of avocado leaf extract using an alum motif resulted in the color name Golden Sundance and the color code R225 G188 B081 #E1BC51 leading to light.

Based on the results of the study, with the influence of mordan tunjung produces color names *from Olive* on kersen leaves, the color *of Light Blue* on the bone mother, and the Pale Green color on the bone branches where the color leads to dark gray. According to Basri (2023), the resulting dark or dark color is influenced by the alkaline tunjung so that it is able to absorb the color pigment. The results of this study show that the color produced leads to dark gray because tunjung mordan is a greenish crystalline ferro sulfate, which contains pH 8 belonging to the category of weak bases. The greater the pH of the base, the more it shifts the direction of the darker color. This is in line with research Bhuiyan et al. (2017) cotton dyeing material with henna leaf extract (Lawsonia Inermis L) uses a tunjung mordan to produce color *Dark Olive* #32441E that have a value of R (Red) 050 = 88%, G (Green) 068 = 56%, and B (Blue) 030 = 27% which leads to dark.

Based on the results of the study, with the influence of mordan, betel lime produces color names *Golden Sundace* leaf *Antique White* color on the bone mother and *Antique White* The color on the bony branches of the kersen leaves that leads to golden brown or slightly light. According to Saefudin (2023), betel lime it will produce a medium or brownish color in natural coloring. The results of this study show that the color of Golden

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Sundace leads to golden brown or slightly light because betel lime mordanus contains Ph 12 including the strong alkaline category. The greater the pH of the base, the shift towards darker colors. This is in line with the results of the study Pham & Bechtold (2023) · Dyeing cotton materials with henna leaf extract using betel lime resulted in Golden Sundance #BDB76B with a value of R (Red) 189 = 56%, G (Green) 183 = 43% and B (Blue) 107 = 74%.

Based on the description above, it can be concluded that the color name results are influenced by the content of color-inducing pigments in kersen leaves such as tannins and flavonoids and also influenced by the degree of acidity or alkalinity (pH) of the type of mordanus used.

The clarity of the shape of the leaf motif is produced from the difference in alum, lime, and tunjung mordan in the ecoprint results using kersen leaves (*Muntingia Calabura L*) in semi-wool material.

Based on the results of the research conducted, the clarity of the shape of the motif produced from the manufacture of semi-wool ecoprint and kersen fabric (*Muntingia Calabura L)* without the use of mordan, the clarity of the shape of the motif obtained was clear with a percentage of 72.22% of the number of panelists. Regarding the influence of the alum mordan, the clarity of the form of the motive obtained was very clear with a percentage of 55.55% of the total number of panelists. Regarding the influence of the tunjung mordan, the clarity of the form of the motif obtained was clear with a percentage of 77.77% of the number of panelists. And on the influence of betel lime mordan, the clarity of the shape of the motif obtained was clear with a percentage of 77.77% of the number of panelists.

The clarity of the shape of the leaf motif is influenced by the surface of the leaf or the texture of the leaf surface. This is in line with research Andini et al. (2024) stating that the results *from ecoprint* will be clearly printed according to the shape and texture of the original leaf, but the resulting color is sometimes not the same as the original color of the leaf. This is due to the texture of the leaf surface which has leaf bones that appear. Thus, it can be concluded that the results of *Ecoprint* Kersen leaves in semi-wool materials using mordanus alum and betel lime have a clear leaf motif shape. However, the color produced by *Ecoprint* Kersen leaves are not the same as the original color of the kersen leaves used.

The effect of the clarity of the shape of the motif produced from the difference in alum, lime, and tunjung mordan on the results of the ecoprint using kersen leaves (Muntingia Calabura L) on semi-wool material.

Based on the analysis obtained from the *Friedman k-ralated sample test* for the clarity of leaf motif shape, the data obtained from *the ecoprint* of semi-wool material using kersen leaves (*Muntingia Calabura L*) with alum, tunjung and betel lime mordan is 0.000 which is smaller than the significant level of 0.05 or 0.008 < 0.05 which means that H0 is rejected. From this explanation, it can be concluded that there is a significant difference due to the use of mordanus alum and betel lime in the clarity of the leaf motif shape in *the ecoprint* using kersen leaves (*Muntingia Calabura L*) in semi-wool materials.

This is in line with the journal Saefudin (2023) It was stated that there was a significant influence due to the use of mordanus alum, lime or tunjung on the clarity of the shape of the kenikir leaf motif. Thus, it can be concluded that There is a significant difference due

to the use of mordanus alum and betel lime in the clarity of the shape of the motif in *Ecoprint* Using kersen leaves (*Muntingia Calabura L*) in semi-wool material.

4. CONCLUSION

Based on the results of the study on the effect of mordan alum, tunjung, and betel lime on the results of the ecoprint of kersen leaves (Muntingia Calabura L) on semi-wool materials, several conclusions can be drawn. The use of different mordanes results in significantly different color results, with each mordan creating different characteristics: alum mordans produce *a Light Golden Yellow* color, tunjung mordans produce a darker *Olive* color , and betel lime mordanus creates a *Golden Brown color*. This color variation is influenced by the natural pigments present in cherry leaves and the different pH levels of mordan.

The clarity of leaf motifs also varied with different mordanes, with alum mordanus producing the clearest impression (55.55% rated as "very clear"), while tunjung mordanus and betel lime achieved a "clear" rating (77.77%). Statistical analysis through Friedman's test confirmed a significant difference between the mordan treatments ($p < 0.000$), showing that the choice of mordanus substantially affected the color results and the clarity of the motif. These findings show that mordan selection is very important in *the ecoprint* process, as it affects the aesthetic quality and technical results of the final product. This research contributes to the understanding of natural dyeing techniques and provides practical insights for textile artists and manufacturers working with eco-friendly dyeing methods.

5. AUTHOR'S STATEMENT

The author states that there is no conflict of interest regarding the publication of this article. The author emphasized that the article manuscript is free from plagiarism.

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