

The Effect of Mordan Alum, Tunjung, and Betel Lime on the Ecoprint Outcomes of Star Fruit on Semi-Wool Materials

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ABSTRACT

This research is based on the use of star fruit leaves as an ecoprint motif using hammering techniques assisted by mordan and fixation. The purpose of this study is to describe the direction of the color name, determine the clarity of the shape of the motif, the color resistance to washing, and describe the influence of the use of alum, tunjung, and betel lime. The type of data is in the form of primary data with data collection techniques using research instruments in the form of questionnaires consisting of three teaching staff and 15 students. The data analysis technique with the Friedman K-Related Sample Test uses the SPSS program version 31.0. The direction of the color name is generated using the Colorblind Assistant application. The direction of the ecoprint color name uses star fruit leaves on semi-wool material. Mordan alum produces Golden Sundance color, Dark Brown tunjung mordan, and olive color betel lime mordan. The result of the clarity of the shape of the leaf motif on the alum and tunjung mordans produces a clear motif shape while the betel lime mordan produces a very clear motif shape on semi-wool materials. The color fade resistance to the washing of star fruit leaf ecoprint wuluh mordan alum at 1 wash 50% stated unchanged and 50% stated slightly changed, mordan tunjung 1 time wash 94.44% stated unchanged and betel lime mordan 1 wash 100% stated unchanged. The results of the best color fade resistance to washing are shown by betel lime mordan.

KEYWORDS

Ecoprint
Star Warbler
Mordan
SemiWool

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INTRODUCTION

Ecoprint was chosen as an eco-friendly technique in the fashion industry because it produces unique products with aesthetic value. According to Saputyningsih in [Asmara and Meilani \(2020\)](#) Ecoprint can produce fabric sheet products and fashion products that have added value in local culture that is environmentally friendly. Many types of plants can be used to make ecoprints, such as teak leaves, walnuts, cocoa, guava leaves, eucalyptus leaves and others ([Sedjati & Sari, 2019](#)). This study utilizes star fruit leaves as a natural source of pigment. According to [Hasanuzzaman et al., \(2013\)](#) explained that: methanol extract of star fruit leaves (*Averrhoa Bilimbi L*) contains alkaloids, saponins, tannins, flavonoids, phenols, and triterpenoids. These compounds can function to remove color pigments in plants. From the above opinion, it can be seen that star fruit leaves have chemical compounds of flavonoids and tannins which means that they have a function as natural dyes and color pigment binders.

The technique used is the hammering technique to strengthen the motif. According to [Arfahdini and Adriani \(2025\)](#) said that "The hammering technique is carried out by combining punching and steaming techniques, this technique can strengthen the color so that the shape and color

of the leaves can be seen clearly". The fabric medium used is semi-wool. **Watianingsih (2022)** said that "Ecoprint is most ideal to use materials derived from natural fibers. It can be concluded that the manufacture of ecoprints uses a lot of natural fibers, but it is possible that the use of fabrics other than natural fibers can also be used as a medium. After conducting a combustion test on semi-wool fabrics, it was proven that the feed yarn is made of synthetic materials which is proven that when burned it emits an odor like burnt plastic and warp yarn is made of wool material that emits a smell like burnt hair (**Putri & Adriani, 2023**). This mixed properties affect the dyes produced in the ecoprint so that the results vary. To optimize color sharpness, several types of mordants are used (alum, tunjung and betel lime). Mordant can help absorb natural color pigments from plants, as well as make it easier for color to enter the surface of the fabric. According to the opinion of **Simanungkalit & Syamwil, (2020)** Mordant is a "colour-binding substance on fabric". It can be interpreted that the mordant will affect the clarity of different colors depending on the type of mordant substance used. The main problem in this study is how the influence of star fruit leaves, hammering techniques, semi-wool fabrics and mordant variations can affect the quality of the ecoprints produced.

Mordant alum is a crystalline alum salt (Al) that is highly soluble in hot water, and is safe for users and the environment (**Kusumaningtyas & Wahyuningsih, 2021**). Furthermore, tunjung is a type of ferrous sulfate salt that absorbs water vapor from the air, and is soluble in water. According to **Adriani & Atmajayanti, (2023)** Tunjung is a type of mordant that is in the form of blackish-green crystals that are alkaline, which functions to produce a dark color in the process ecoprint. According to **Stefany & Syamwil (2020)** said that tunjung mordant has been proven to be able to transfer shapes and colors very well. This can be seen from the sharpness of the fabric motif using a tunjung mordant which has good contrast. In addition to alum and tunjung, the type of mordant used by the researcher is betel lime. Betel lime mordant is a good mordant to use. **Nilamsari, (2018)** explained that the water from the deposition of betel lime can be used as a food mixture and also as a binding agent for natural dyes in fabrics.

In producing durable colors, fixation is necessary. Fixation is the locking of natural colors so that they can be absorbed into fabrics that have good fastness (**Official & Nelmira, 2024**). It can be interpreted that to make natural colors more absorbent on the fabric, it is necessary to lock the dye so that it does not fade easily. Based on the results of a study conducted by **Silvia Rasmi (2024)** with the title "The Effect of Differences in Fixators of Tunjung Alum and Betel Lime on the Results Ecoprint Technique Error zone on Cotton materials using Fern Leaves (pterydophyta)". The results of this study focus on fixators (alum, tunjung and betel lime) techniques error zone In cotton materials using fern leaves, the limitations are using different plants, media and techniques. Then the results of the research of Kusumaningtyas and **Wahyuningsih (2021)** State University of Surabaya entitled "Analysis of research results on engineering ecoprint using alum, lime, and tunjung mordant on natural fibers". Explain that the use of a mordant makes a variation in the color of the mordant used. And the results of **Arfahdini and Sukardi's (2025)** research with the title "The Influence of Mordant Alum, Tunjung and Betel Lime on Results Ecoprint Watermelon Leaves (Citrullus Lanatus) On Cloth American Drill With Techniques Hammering". The results of this study are the results of the clarity of the motif of the alum mordant leaves 80% of the panelists stated very clear, the tunjung mordant 73% stated clearly, the betel lime mordant stated 67% stated clear.

Based on the description above, the purpose of this study is to explore the effect of the use of mordant (alum, tunjung and betel lime) on semi-wool fabrics using star fruit leaves to produce ecoprint quality that has color sharpness, clarity of motif and fading resistance to washing.

METHOD

This type of research is experimental, according to **Putri et al., (2023)** states that experimental research is "Research that looks at the impact or change that occurs after a subject is given an intervention or action". Meanwhile, according to **Arifin (2020)** "The experimental research method is a research method used to find the influence of certain treatments". Therefore, it can be concluded that experimental research is research that is used to look for changes in a subject and produce the right treatment according to his condition.

The object of the research is a semi-wool fabric that is patterned with a hammering technique

using star fruit leaves (*Averrhoa Bilimbi* L) with alum mordan, tunjung and betel lime. Tools, techniques, recipes, time, and fabric materials with the same treatment. The type of data used is primary data with data collection techniques with research instruments in the form of questionnaires. The questionnaire was distributed to 18 panelists, namely 15 students majoring in IKK UNP with criteria for passing the textile analysis course and not being color blind, as well as three IKK UNP lecturers who are/have taught textile knowledge courses and are not color blind.

The data on the percentage frequency of description of ecoprint results with alum, tunjung, and betel lime mordan was reviewed from the color name, clarity of the shape of the motif, and color fade resistance to washing. Data analysis using the SPSS (Statistical Product And Service Solution) program version 31.0.

RESULT AND DISCUSSION

1. Direction of color names (*hue*)

Table 1. Description of the Direction of the Name of the Color (*Hue*) of Mordan Alum

No.	Mordan Tawas	Color	Color Name	Color Coding	F	F%
1	Name of the Color of the Flesh of the Feathered Star Leaf		Golden Sundance #B29F53	R 178 G 159 B 083	0	0%
			Golden Sundance #BEAC5A	R 190 G 172 B 090	8	44,44%
			Golden Sundance #C3AF5D	R 195 G 175 B 093	10	55,56%
2	Name Color Mother Bone Leaf Star Fruit Feather		Light Brown #D4C46F	R 212 G 196 B 111	8	44,44%
			Golden #E6D29D	R 230 G 210 B 157	10	55,56%
			Golden Sundance #C2B36E	R 194 G 179 B 110	0	0%
3	Name Color of Branch Bone Leaves Star Blossom		Golden Shield #EBDF8D	R 235 G 223 B 141	3	16,67%
			Wheat Light Brown #FAEBB4	R 250 G 235 B 180	13	72,22%

			Off-White #FAF2C0	R 250 G 242 B 192	2	11,11%
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Figure 1. Results *Ecoprint* with Mordan Tawas
 Source : Sari, 2025

The flesh of the leaves produces color (bottle) Golden Sundance with color code #C3AF5D with R(red)195 G(green)175 B(blue)093 and a percentage of 55.56%. In the mother bone of the leaves produce a color (bottle) Golden Shield with the code #E6D29D with R(red)230 G(green)210 B(blue)157 and a percentage of 55.56%. Leaf branches produce color (bottle) Wheat Light Brown with the code #FAEBB4 with R(red)250 G(green)235 B(blue)180 and a percentage of 72.22%.

Table 2. Description of the direction of the color name (*hue*) of Mordan Tunjung

No.	Mordan Tunjung	Color	Color Name	Color Coding	F	F%
1	Name of the Color of the Flesh of the Feathered Star Leaf		Soft Brown #6C6445	R 108 G 100 B 069	1	5,56%
			Dark Brown #534D39	R 083 G 077 B 057	8	44,44%
			Dark Brown #554E32	R 085 G 078 B 050	9	50%
2	Name Color Mother Bone Leaf Star Fruit Feather		Golden Sundance #B8A774	R 184 G 167 B 116	3	16,67%
			Muddy Waters Brown #9A8E52	R 154 G 142 B 082	15	83,33%

			Muddy Waters Brown #9F9162	R 159 G 145 B 098	0	0%
3	Name Color of Branch Bone Leaves Star Blossom		Canary Yellow #C6BA91	R 198 G 186 B 145	17	94,44%
			Golden Sundance #B8A774	R 184 G 167 B 116	1	5,56%
			Clam Shell Pink #CFBF90	R 207 G 191 B 144	0	0%



Figure 2. Results *Ecoprint* with Mordan Tunjung
 Source : Sari, 2025

The flesh of the leaves produces a color (hue) of Dark Brown with a color code of #554E32 with R(red)085 G(green)078 B(blue)050 and a percentage of 50%. In the mother bone, the leaves produce a color (hue) of Muddy Waters Brown with a code of #9A8E52 with R(red)154 G(green)142 B(blue)082 and a percentage of 83.33%. The leaf branches produce a color (hue) of Canary Yellow with a code #C6BA91 with R(red)198 G(green)186 B(blue)145 and a percentage of 94.44%.

Table 3. Description of the Direction of the Name of the Color (Hue) of the Betel Lime

No.	Betel Lime Mordan	Color	Color Name	Color Coding	F	F%
1	Name of the Color of the Flesh of the Feathered Star Leaf		Muddy Waters Brown #AAA254	R 170 G 162 B 084	3	16,67%
			Olive #A09842	R 160 G 152 B 066	7	38,89%
			Olive #A19944	R 161 G 153 B 068	8	44,44%

2	Name Color Mother Bone Leaf Star Fruit Feather		Golden Sundance #C2B36E	R 194 G 179 B 110	10	55,56%
			Golden Sundance #BFA963	R 191 G 169 B 099	8	44,44%
			Golden Shield #EBDE97	R 235 G 222 B 151	0	0%
3	Name Color of Branch Bone Leaves Star Blossom		Golden Sundance #C4AC65	R 196 G 172 B 101	13	72,22%
			Wheat Light Brown #F4DDA2	R 244 G 221 B 162	5	27,78%
			Golden Shield #EBDAA0	R 235 G 218 B 160	0	0%



Figure 3. Betel Lime Ecoprint Results
 Source : Sari, 2025

The flesh of the leaves produces an olive color (hue) with a color code of #A19944 with R(red)161 G(green)153 B(blue)068 and a percentage of 44.44%. In the mother bone, the leaves produce a Golden Sundance color (hue) with a code of #C2B36E with R(red)194 G(green)179 B(blue)110 and a percentage of 55.56%. The leaf branches produce the color (hue) of Golden Sundance with the code #C4AC65 with R(red)196 G(green)172 B(blue)101 and a percentage of 72.22%.

Based on the results of the motive ecoprint, visualization ecoprint Techniques Hammering star fruit leaves on semi-wool material using alum mordan to produce color Golden Sundance. This is in line with the results of the research of **Saqinah & Novrita (2025)** which showed the results of dyeing primisima cotton cloth using jamblang leaf extract using alum mordan to produce the Golden Sundance color.

Color direction of the result ecoprint Using star fruit leaves mordan tunjung on semi-wool materials produces a Dark Brown or dark brown color. In line with the research of **Adriani & Atmajayanti (2023)**, the direction of color ecoprint The leaves of the iler use the tunjung mordan

produce a dark brown color leading to black. Color direction ecoprint Using star fruit leaves, mordan mordan, betel lime, on semi-wool materials, produces an olive color. Based on research conducted by **Saqinah & Novrita (2025)** which states that "betel lime mordan produces a soft brown color". In line with research conducted by **Gustiani & Novrita (2024)** "betel lime mordan produces Muddy Waters Brown color". However, in the results of the experiment that the author has carried out ecoprint Star fruit leaves with olive colored betel lime mordan due to flavonoids and tannins that affect the color result.

2. Clarity of Leaf Motif Shape

The explanation of the shape of the leaves in the results of giving *the ecoprint* motif can be seen as follows.

Table 4. Description of Leaf Motif Shape Clarity Data

Descriptive Statistics			
Red Mordan	Std. Deviation	Minimum	Maximum
Tofu 2,94	,41618	2,00	4,00
Tunjung 2,50	,70711	1,00	4,00
Betel lime 3,72	,57451	2,00	4,00

The results of *the star* fruit leaf ecoprint showed the clarity of the motive assessed by 18 panelists with the following mean value: Mordan alum got an average of 2.94. Mordan Tunjung gets an average of 2.50. Betel lime mordan gets an average of 2.89.

Table 5. Friedman K-Related Test Results of Mordan Sample of Alum, Tunjung and Betel Lime

Test Statistics	
N	18
Chi-Square	33,463
df	3
Asymp. Sig.	<,001
a. Friedman Test	

Based on the table above, it can be explained that the Friedman k-related sample of leaf shape clarity test produced by the application of the star fruit leaf ecoprint motif (*Averrhoa Bilimbi L*) hammering technique on semi-wool materials using alum, tunjung and betel lime mordans obtained a significant value of 0.05 or 0.001 < 0.05. This means that there is an influence due to the use of alum mordan, tunjung and betel lime. The clarity of the shape of the betel lime mordan leaf motif obtained a better and very clear percentage, which is 77.78%. In line with research conducted by **Adriani & Atmajayanti (2023)** said that the clarity of the shape of the leaf motif produced by the iler leaf ecoprint using betel lime mordan was 53.3% of the panelists who chose the assessment category was very clear". In a study conducted by **Manurung (2012)** it was said that betel lime mordan can strengthen the bond of dyes in fabrics. The ecoprint results used 83.33% alum mordan and 50% tunjung mordan with clear categories. It can be concluded that betel lime mordans produce a clearer leaf motif because betel lime is able to strengthen the color bonds on the fabric.

3. Color fade resistance to washing

Color fade resistance to washing dau belimbing wuluh (*Averrhoa Bilimbi L*) hammering technique on semi-wool materials using alum mordan, tunjung and betel lime.

Table 6. Friedman K-Related Sample Test Results Color fade resistance to washing

Test Statistics	
N	18
Chi-Square	35,410

df	3
Asymp. Sig.	<.001
a. Friedman Test	

The data obtained from the results of the application of the star fruit leaf ecoprint motif (*Averrhoa Bilimbi L*) hammering technique on semi-wool materials using alum, tunjung and betel lime, namely for 1 wash, a significant value of 0.05 or $0.001 < 0.05$ was obtained. In 2 washes, a significant value of 0.05 or $0.001 < 0.05$ was obtained and in 3 washes a significant value of 0.05 or $0.001 < 0.05$. This means that there is an effect due to the use of alum, tunjung and betel lime mordans on the washing of the wuluh star fruit leaf ecoprint (*Averrhoa Bilimbi L*) hammering technique on semi-wool materials.

In this study, the results of the best color fade resistance to washing were the result of *an ecoprint* with betel lime mordan because in 1 washing, 100% of the panelists stated that the shape and color of the leaf flesh, the mother of the leaf bones, the leaf branches, did not change at all. In line with the research conducted by [Gustiani et al., \(2024\)](#) said that on "the effect of betel lime mordan on the results of dyeing Mori prima cotton cloth with cinnamon leaf extract (*Cinnamomum Burmanni*) at 1x washing, 15 panelists (83.3%) chose not to change at all".

The fading resistance to washing in this study was influenced by the type of mordan used. In line with research conducted by [Saputri & Novrita, \(2021\)](#), said that "The weight of different alum mordans, tunjung mordans, and betel lime mordans during the dyeing process is suspected to affect the results of the dyeing to be studied". It can be interpreted that the use of different mortars can produce different fading resistance.

CONCLUSION

Based on the results of research and data analysis, it was obtained that the use of alum, tunjung, and betel lime mordans on the results of the star fruit leaf ecoprint was influenced by the direction of the name color, the clarity of the shape of the motif, the fastness of the color to washing, and the effect of the mordan. This can be seen from the direction of the name of the star fruit leaf color on semi-wool material with Golden Sundance mordan, Dark Brown tunjung mordan, and betel lime mordan to produce olive color. The result of the clarity of the shape of the leaf motif on the alum and tunjung mordan produces a clear motif shape, while the betel lime mordan produces a very clear clarity of the motif on the semi-wool material. In 1, 2, and 3 washes, a significance value of 0.05 or $0.001 < 0.05$ was obtained. From the description above, it can be concluded that there is a significant influence of washing results, dyes, the use of mordans with different pH, and the media used can have various effects or influences on the fastness resistance in washing. For the community, it is hoped that the star fruit plant will be preserved so that it can still be used as a material ecoprint. This study can be a reference to find out the difference in results ecoprint star fruit leaves on semi-wool fabric with variations of mordan through hammering techniques. Researchers are then advised to try different mordans and treatments to obtain more diverse colors and motifs, and the results of this study can be used as a reference for students in developing studies on ecoprint based on natural ingredients.

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