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The Effect of Mordan Alum, Betel Lime and Tunjung on the Ecoprint Results of Bitter Melons On Armani Silk Fabric

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ABSTRACT
This research is motivated by the use of bitter melon leaves as an ecoprint motif using the ecoprint technique assisted by mordants and fixatives. The purpose of this study is to see the name of the color, the clarity of the shape of the motif, and the resistance of color fade to washing with alum mordants, betel lime, and tunjung. This research is an experimental research with the object of research - namely, Armani silk material produced by bitter melon leaf ecoprint using alum mordant, betel lime, and tunjung. The type of data is in the form of primary data with a data collection technique using filling in an instrument in the form of a questionnaire. Data analysis techniques with Friedman K-Related test using SPSS (Statistical Product and Service Solutions) version 29.0 program. The result of the ecoprint color name uses bitter melon leaves on Armani silk material with alum mordant producing olive color, betel lime mordant producing camouflage green color, and tunjung producing dark olive green color. The result of the clarity of the shape of the leaf motif on the mordant of alum, betel lime, and tunjung produces a clear clarity of the shape of the motif, which means that the shape of the leaf (leaf flesh, base of the leaf, and edge of the leaf) is clear on the material of Armani silk. The color fading resistance to washing as a result of applying bitter melon leaf ecoprint motifs on Armani silk materials using alum mordant, betel lime, and tunjung in washing the three colors was slightly reduced.

KEYWORDS

Ecoprint, Mordan, Bitter Melon, Armani Silk.

INTRODUCTION

Synthetic batik dyeing waste is one of the factors that cause environmental pollution, such as water, soil, and air pollution and has an impact on health. One of the efforts that can be applied in fashion development is the provision of textile motifs that are environmentally friendly and do not pollute the environment, such as the technique of giving ecoprint motifs. The ecoprint technique is a process of giving motifs to fabrics using natural materials. According to (Maharani, 2018) the ecoprint technique is a form of the process of anorizing colors and motifs directly on the surface of the fabric by using several natural materials as the main materials in making motifs. Then according to Rasmi & Nelmira (2024:64), he said that the ecoprint technique is made by printing motifs from natural materials that contain natural dyes, the materials used are leaves, flowers, plant stems and others that can bring out beautiful shapes and colors. One of the leaves that can be applied in the application of this ecoprint technique is bitter melon leaves (Momordica Charantia L.). According to (Erlyn et al., 2020), bitter melon leaves (Momordica Charantia L.) contain chemical compounds such as tannins, flavonoids, saponins, triterpenoids, and alkaloids. Based on this opinion, it can be concluded that bitter melon leaves (Momordica Charantia L.) contain flavonoid compounds and

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tannins which are color pigments in plants so that bitter melon leaves (Momordica Charantia L.) can be used as a natural material medium in making ecoprints.

In the process of making ecoprints, the choice of the type of material used will have an effect. According to (Leha & Khayati, (2022), fabrics with mixed materials or fully synthetic materials both have a good chance of being ecoprint fabrics because based on the color fastness test against washing has a good value. Armani silk fabric belongs to the group of satin fabrics which is a type of synthetic fiber that has a shiny and slippery surface and this fabric has the characteristics of being light and falling. Satin fabric is usually made of a type of polyester fiber, polyester satin fabric is available in various types, one of which is armani silk satin fabric. Therefore, this armani silk fabric can be used as a fabric for ecoprint motifs because it has tight fibers and can absorb natural dyes in plants.

In the process of giving ecoprint motifs, ecoprint techniques are needed in the process. According to (Purwosiwi Pandansari dkk, 2022), there are three techniques to produce a good ecoprint, including: (1) Bundles (2) Hammering, and (3) Hapa zome. In this study, the author used the hapazome technique for the process of making ecoprints. According to (Utami et al., 2022) the hapazome technique is a technique for making ecoprints by hitting the surface of plants such as leaves, flowers or fruits on the surface of the fabric. Based on these various ecoprint techniques, the author uses the hapazome technique, because the hapazome technique does not require a lot of tools and time and is the easiest technique to apply, and the ecoprint results produced during the ecoprint making process are also very optimal in terms of the shape of the leaves that are used as the object of the ecoprint.

Before applying the ecoprint motif using bitter melon leaves, the fabric needs to be given a mordan. According to (Novrita & Fatihaturahmi, (2019) which states that mordan substances function to form a chemical bridge between natural dyes and fibers, the affinity of dyes increases to fibers. Therefore, mordan is a substance that functions to increase color and color generation so that the resulting color can absorb well into the fabric and is fastness.

Alum, betel lime and tunjung can be used as mordans in the process of giving ecoprint motifs because they are environmentally friendly, easy to obtain and effective when used. According to (Ainiyah et al., 2018) "Mordan alum can produce a color that tends to be lighter, this is based on the chemical structure of alum that can purify water". Then betel lime used as a mordan is betel lime that is effectively made when used. According to Nilamsari, (2018:841) stated that the water formed from the deposition of betel lime can be used as a mixture for food and as a natural dye binder on fabrics. Next is tunjung, according to Ajmajayanti & Adriani, (2023:231) that tunjung is a mordan that contains sulfur, oxygen in the form of a pale blue crystal with a molecular formula of FeSO4, iron, and is weak alkaline with a pH of 8-10. The alkaline mordan ecoprint will produce dark or dark leaf motifs.

After the process of applying the bitter melon leaf hapazome technique ecoprint motif on armani silk, a fixation process is needed as a post-mordunting stage. The physicators in this study are the same as the mordans used in this study, namely alum, betel lime and tunjung. This fixation process can also provide different color effects according to the fixation substance used. This is in line with the opinion (Naini et al., 2021) that the purpose of fixation is to lock the natural dyes of the mordan group and function to provide different color effects (color direction) according to the fixation substances used.

Based on the results of the research (Umaira & Adriani, n.d.) with the title "The Influence of Mordan of Lime Tohor and Tunjung on the Results of Ecoprint Motifs Using Kenikir Leaves (Cosmos Caudatus) on Satin Bridal Materials" that the use of bridal satin material on the results of the clarity of leaf motifs produces clear motifs and good color absorption. Then the results of the research (Arsa, n.d.) with the title of the study "The Effect of Mordan on the Ecoprint Results of Japanese Papaya Leaves (Cnidoscolus Aconitifolius) on Cotton Materials" that betel lime mordan produces a yellowish directional color and the clarity of the shape of the leaf motif is very clear. Then the results of the research (BENTH Adriani & Atmajayanti, n.d.) with the title "The Influence of Mordan Tunjung and Betel Lime on the Ecoprint Results of Iler Leaves (Coleus Scutellarioides") that Mordan Tunjung produces ecoprints towards browning and the clarity of the shape of the motif is very good. And the results of the research (Arfahdini & Sukardi, 2025) with the title "The Effect

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of Alum, Tunjung, and Betel Lime Mordan on the Ecoprint Results of Watermelon Leaves (Citrullus Lanatus) on American Drill Fabric with Hammering Technique" that alum mordan produces brighter colors and is very good at color fading resistance.

Based on the description above, it can be concluded that in this study, the use of bitter melon leaves as an ecoprint object is to prevent environmental pollution by synthetic coloring, by making ecoprint motifs using alum mordants, betel lime and tunjung. The use of alum mordans tends to produce lighter colors, the use of betel lime mordans tends to produce a yellowish color and the use of tunjung mordan tends to produce colors in a darker direction, therefore, researchers are interested in using these three mordans. And for the material used, armani silk is a category of satin fabric because it has tight fibers so that it can absorb colors better.

METHOD

This type of research is experimental research, according to (Sugiyono, 2019) that "Experimental method is a research method used to find the influence of certain factors on others under controlled conditions so that in this study it can regulate all external variables that affect the course of randomly selected experiments". Then, based on the opinion (Arifin et al., n.d.) that "Experimental research methods are research methods used to find the influence of certain treatments". Therefore, it can be concluded that experimental research is research that is used to find the effect of the *course of treatment* and can regulate certain treatments to produce the most appropriate treatment and according to their conditions.

The object of the research is *armani silk* material which is given a motif with *an ecoprint* technique, namely *the hapazome* technique using bitter melon leaves using alum mordan, betel lime and tunjung. The bitter melon leaves used are of the type *(momordica charantia L.).* Tools, *ecoprint techniques,* mordan recipes, processing time and fabric materials with the same treatment. The type of data used is primary data using data collection techniques with research instruments in the form of questionnaires. The questionnaire was distributed to 18 panelists, namely 15 students of the UNP IKK Department with the criteria of having passed the textile analysis course and were not color blind, and 3 UNP IKK lecturers who were/had taught textile knowledge/textile analysis courses and were not color blind.

The data on the percentage frequency of description of ecoprint results with alum mordan, betel lime and tunjung was reviewed from the name of the color, the clarity of the shape of the motif and the resistance of color fade to washing. Data analysis was conducted using the SPSS *(Statistical Product And Service Solution)* Version 29.0 program.

RESULT AND DISCUSSION

1. Color Name (Hue)

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

No	Alum Mordan	Color	Color Name	Color Code	F
1	Leaf Flesh		Olive #70774D	R 112 G 119 B 77	18
2	Leaf Bone Mother		Green Smoke #969D73	R 150 G 157 B 115	13
3	Base Of Leaf		Canary Yellow #AAB0BA	R 170 G 176 B 138	18
4	Leaf Edge		Olive #70774D	R 112 G 119 B 77	18

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Figure 1. Ecoprint Results With Alum Mordan
Source: Sari, 2024)

The flesh of the leaves produces the color name *(Hue) of Olive* with a color code of #70774D with R *(Red)* 112 G *(Green)* 119 B *(Blue)* 77 and a percentage of 100%. In the mother bone, the leaves produce the color name *(Hue) Green Smoke* with a color code of #969D73 with R *(Red)* 150 *(Green)* 157 B *(Blue)* 115 and a percentage of 72%. At the base of the leaf produces the color name *(Hue) Canary Yellow* with a color code of #AAB0BA with R *(Red)* 170 G *(Green)* 176 B *(Blue)* 138 and a percentage of 100%. And on the edges of the leaves produces the color name *(Hue) Olive* with a color code of #70774D with R *(Red)* 112 G *(Green)* 119 B *(Blue)* 77 and a percentage of 100%.

Table 2. Description Color Name *(Hue)* Betel Lime Mordan

No	Betel Lime Mordant	Color	Color Name	Color Code	F
1	Leaf Flesh		Camouflage green #718055	R 113 G 128 B 85	12
2	Leaf Bone Mother		Canary Yellow #AAB491	R 170 G 180 B 145	15
3	Base Of Leaf		Reef Green #B3B495	R 179 G 186 B 149	14
4	Leaf Edge		Camouflage green #718055	R 113 G 128 B 85	12

Figure 2. Ecoprint Results With Betel Lime Mordan
(Source: Sari, 2024)

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The flesh of the leaves produces the color name *(Hue) Camouflage Green* with the color code #718055 with R *(Red)* 113 G *(Green)* 128 B *(Blue)* 85 and a percentage of 67%. In the mother bone, the leaves produce the color name *(Hue) Canary Yellow* with a color code #AAB491 with R *(Red)* 170 *(Green)* 180 B *(Blue)* 145 and a percentage of 84%. At the base of the leaf produces the color *name (Hue) Reef Green* with a color code of #B3B495 with R *(Red)* 179 G *(Green)* 186 B *(Blue)* 149 and a percentage of 100%. And on the edges of the leaves, it produces the color name *(Hue), Camouflage Green* with a color code #718055 with R *(Red)* 113 G *(Green)* 128 B *(Blue)* 85 and a percentage of 67%.

Table 3. Description Color Name *(Hue)* Tunjung Mordan

No	Tunjung Mordant	Color	Color Name	Color Code	F
1	Leaf Flesh		Dark Olive Green #646845	R 100 G 104 B 69	12
2	Leaf Bone Mother		Olive #9A9C71	R 154 G 156 B 113	11
3	Base Of Leaf		Muddy Waters Brown #A9A580	R 169 G 165 B 128	10
4	Leaf Edge		Dark Olive Green #646845	R 100 G 104 B 69	12

Figure 3. Ecoprint Results With Tunjung Mordan
(Source: Sari, 2024)

The flesh of the leaves produces the color name *(Hue), Dark Olive Green* with a color code #646845 with R *(Red),* 100 G *(Green),* 104 B *(Blue),* 69, and a percentage of 67%. In the mother bone, the leaves produce the color name *(Hue) Olive* with a color code of #9A9C71 with R *(Red)* 154 G *(Green)* 156 B *(Blue)* 113 and a percentage of 61%. At the base of the leaf produces the color name *(Hue) Muddy Waters Brown* with the color code # with A9A580 R *(Red)* 169 G *(Green)* 165 B *(Blue)* 128 and a percentage of 67%. And on the edges of the leaves produces the color name *(Hue), Dark Olive Green* with a color code #646845 with R *(Red)* 100 G *(Green)* 104 B *(Blue)* 69 and a percentage of 67%.

Based on the results of the *ecoprint* motif, the visualization *of the bitter* melon leaf hapazome *technique* ecoprint on *armani silk* material using alum mordan produces a bright green color. This is in line with the results of the research (Hanim & Novrita, n.d.) which states "that the dark and light color of a natural coloring result with a different result with a mordan of alum results in a lighter color". Then the results of the research (Rasmi & Nelmira, 2024) which states that the name of the color (Hue) is also influenced by the acid content (pH) of the fixer used. So the color name (Hue) produced by the alum fixator will be lighter than the tunjung and betel lime fixators.

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Visualization of *the ecoprint* ecoprint of *bitter melon leaf* hapazome technique on *armani silk* material using betel lime mordan produces a green color. Based on research that has been conducted by (Zulikah, n.d.) which states that lime will produce an intermediate or brown color in natural coloring. Further stated by (Sofyan et al., 2015) that the lime mordan will produce a brownish color direction.

Visualization of *ecoprint ecoprint* of *bitter melon leaf* hapazome technique on *armani silk* material using mordan tunjung to produce a dark brown color. This is because tunjung (FeSO4) or commonly called ferrosulfate reacts with tannins from bitter melon leaves (*Momordica charantiaL.*). This is in accordance with research conducted by (Kusumaningtyas et al., 2021) which shows that the use of Mordan Tunjung has the advantage of the most powerful color produced, namely a deep dark green color with a well-printed motif because the leaf bones are visible. Thus, the color expression of *the ecoprint* treated with mordan tunjung in general does produce a darker and more intense color. Thus, the results of this study are in accordance with the theory of several previous studies on the resulting color results, namely the direction of darker colors.

This is because bitter melon leaves contain tannins and flavonoids. According to (Verdia Mutiara et al., 2014), Flavonoids and tannins are water-soluble pigments that give them yellow, blackish green and blue colors. Based on the description above, it can be concluded that bitter melon leaves contain natural color pigments, namely tannins and flavonoids. So with the presence of tannins and flavonoids, bitter melon leaves can produce natural colors that can be used as natural coloring for ecoprints. Then the color produced by tannins and flavonoids can also affect the color produced according to the mordan used.

2. Clarity of Leaf Motif Shape

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

Table 4. Description Clarity Of Leaf Motif Shape

No	Mordant	Frekuensi	Frekuensi (%)	Information
1	Alum	9	50%	Clear
2	Betel Lime	11	61%	Clear
3	Tunjung	8	44%	Clear

The results of *the bitter melon leaf ecoprint* show the clarity of the shape of the leaf motif with clear categories. Mordan alum has a frequency of 9 (50%). Betel lime mordan 11 (61%). And mordan tunjung 8 (44%) . The results of the influence of mordan alum, betel lime and tunjung on the clarity of the shape of the leaf motif are as follows.

Table 5. *Friedman K-Related Sample* Test Result Description Clarity Of Leaf Motif Shape

Test Statistics[a]	
N	18
Chi-Square	9,436
df	3
Asymp. Sig.	,024
a. Friedman Test	

Based on the table above, it can be explained that *the Friedman K-Related sample* of leaf shape clarity was produced on the application of *the ecoprint motif* of bitter melon *leaf (Momordica charantia L.)* The hapazome *technique* on *Armani Silk materials* using alum, betel lime, and tunjung mordans obtained a significance value of 0.05 or 0.024 < 0.05. This means that there is an influence due to the use of alum mordan, betel lime and tunjung.

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Clarity of the shape of the leaf motif resulting from the application of *the bitter* melon leaf *ecoprint motif (Momordica charantiaL.)* The hapazome *technique* in *Armani Silk* uses alum mortar, betel lime and tunjung. The clarity of the shape of the leaf motif, betel lime mordan obtained a better percentage of 61%. This is in line with the results of research conducted by (Tresnarupi & Hendrawan, n.d.) That the final result on the betel lime mordan includes the color, silhouette and leaf bones that are clearly visible and well printed on the fabric. Therefore, the results of the study using bitter melon leaves are the best results for the clarity of the shape of the motif seen on betel lime mordan than the ecoprint results using 50% alum mordan, 44% tunjung mordan and 56% of the number of panelists without mordan.

The clarity of the shape of the leaf motif can be influenced by several things. First, in leaf selection, because each leaf has a different color pigment content and the texture on the leaf surface can also affect the results of the *ecoprint.* This based on the opinion (Diva et al., 2023) which states that the clarity of the leaf shape and motif is influenced by the lower surface of the leaf sheet or the texture of the lower surface of the leaf. Second, the thing that can affect the results of giving *ecoprint* motifs is the use of textile materials, and the third is the influence of the techniques used when giving the *ecoprint* motifs.

3. Color Fade Resistance to Washing

Color fading resistance to washing bitter melon leaves (*Momordica charantia L.*) hapazome technique on *armani silk* materials using alum mordan, betel lime and tunjung.

Table 6. Description Of Color Fade Resistence To Washing

No	Mordant	Jumlah Pencucian	Frekuensi	Frekuensi (%)	Information
1	Alum	1X wash	12	67%	Slightly Changed
		2X wash	12	67%	Changed
		3X wash	13	72%	Changed
2	Betel lime	1X wash	14	78%	Unchanged
		2X wash	15	83%	Slightly changed
		3X wash	14	78%	Slightly changed
3	Tunjung	1X wash	17	95%	Slightly changed
		2X wash	17	95%	Changed
		3X wash	12	67%	Changed

Table 7. Data Description Of Color Fade Resistence To Washing.

	N	Mean	Std. Deviation	Minimum	Maximum
Alum 1xwash	18	4,33	,485	4	5
Alum 2xwash	18	3,50	,786	3	5
Alum 3xwash	18	2,56	,784	2	4
Betel lime1xwash	18	4,78	,428	4	5
Betel lime2xwash	18	3,78	,428	3	4
Betel lime3xwash	18	3,72	,575	2	4
Tunjung 1xwash	18	4,06	,236	4	5
Tunjung 2xwash	18	3,11	,471	3	5
Tunjung 3xwash	18	2,78	,548	2	4

Friedman K-Related Sample *Test Results* of Color Fastness Resistance to Washing on the Results of *Ecoprint* Motif of *Bitter Melon Leaves (Momordica Charantia L.)*Hapazome *Technique* on *Armani Silk* Material with Alum Mordan, Betel Lime Mordan and Tunjung Mordan.

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Table 8. *Friedman K-Related Sample* test Result Of Color Fatness To Washing

Test Statistics[a]	
N	18
Chi-Square	28,122
df	3
Asymp. Sig.	<,001
a. Friedman Test	

Data obtained from the results of applying *bitter* melon leaf *ecoprint motifs (Momordica charantia L.)* The hapazome *technique* on *Armani Silk* materials using alum, lime and tunjung mordants is for 1x washing obtained a significance value of 0.05 or 0.001 < 0.05. In 2x washing, a significance value of 0.05 or 0.001 < 0.05 was obtained. And in 3x washing, a significance value of 0.05 or 0.001 < 0.05 was obtained. This means that there is an effect due to the use of alum mordan, betel lime and tunjung on *bitter melon leaf ecoprints* on color fade resistance to *hapazome* technique *ecoprint* washing using bitter melon *leaves (Momordica charantia L.)* on *Armani Silk material.*

In this study, the results of the best color fade resistance to washing were the result of *ecoprinting* with betel lime mordan. This is in line with research conducted by (Simanungkalit & Syamwil, 2020) that betel lime mordan obtains a good fading resistance value. Then the research carried out (Gustiani et al., 2024) stated that the percentage of frequency of color fastness/fading to 3x washing using lerak soap on the dyeing of Mori primissima cotton fabric with gambier leaf extract (Uncaria Gambir roxb) without using mordan was 88.9% of the panelists stated that the color changed/decreased, the mordan alum 100% of the panelists stated that the color changed slightly/decreased, with mordan tunjung 100% of the panelists stated that the color did not change at all and with the betel lime mordan 100% of the panelists stated that the color changed slightly change/decrease.

Testing the color fastness resistance to washing without mordans, alum mordan, betel lime mordan and tunjung mordan at 1, 2 times and 3 washes resulted in varying fading resistance. This is in line with the results of the research (Saraswati & Sulandjari, 2018), stated that the use of mordans in the natural dyeing process in addition to functioning to change color can also be used to increase color fastness.

This is supported by the results of color fastness resistance to washing through the *Friedman K-Related Sample* test which shows a significant influence. The effect of alum, betel lime and tunjung mordan on the resistance of color fade to washing. According to the results of the study (Silfia et al., 2020), which states that the color fastness of a fabric can be affected by several things, such as the chemical and physical state of the dye, the chemical properties of the fibers, the bonding of the dye substance with the fibers, the molecular structure of the dye, the concentration and others. Therefore, the results of the research on the application of *the bitter melon leaf* hapazome technique ecoprint *motif on armani silk* material with alum, betel lime, and tunjung mordan, the effect can be caused by natural color pigments, materials, and mordans used.

CONCLUSIONS

Based on the results of research and analysis, it was obtained that the use of alum, betel lime and tunjung mordans on the results of bitter melon leaf ecoprint on the color name, the clarity of the shape of the leaf motif and the resistance of color fade to washing had an effect. This can be seen from the results of the ecoprint *color* name using bitter melon leaves on armani silk material with alum mordan producing olive color, betel lime mordan producing camouflage green color and tunjung producing dark olive green color. The result of the clarity of the shape of the leaf motif on the mordan of alum, betel lime and tunjung produces a clear clarity of the shape of the motif which means that the shape of the leaf (leaf flesh, base of the leaf and edge of the leaf) is clear on the material of armani silk. The color fade resistance to washing as a result of applying *bitter melon leaf ecoprint* motifs on armani silk materials using alum mordan, betel lime and tunjung in the washing of the three colors was slightly reduced.

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The color fade resistance to washing of *bitter melon leaf* ecoprint on *armanisilk* material using alum mordan in washing has changed slightly, in betel lime mordan washing has not changed and in tunjung mordan in washing has not changed at all. The analysis obtained from the *Friedman K-Related Sample* test for color fastness was carried out on the basis of a significant value decision greater than the significant level, namely: significant value > significant level. Data obtained from the results of applying *bitter* melon leaf *ecoprint motifs (Momordica charantia L.)* The hapazome *technique* on *Armani Silk* materials using alum, lime and tunjung mordans is for 1x washing obtained a significance value of 0.05 or 0.001 < 0.05. In 2x washing, a significance value of 0.05 or 0.001 < 0.05 was obtained. And in 3x washing, a significance value of 0.05 or 0.001 < 0.05 was obtained. This means that there is an effect due to the use of alum, betel lime and tunjung mordans on *bitter melon leaf ecoprints* on color fade resistance to *the washing of ecoprints* of the hapa zome *technique* using bitter melon *leaves (Momordica charantia L.)* on *Armani Silk material.*

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