The use of yellow velvetleaf (*Limnocharis flava*) as a natural color for *colet* technique using cold wax

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**Abstract.** Yellow velvetleaf is a fast-growing plant. It cannot be optimally used, particularly the old leaves. Old yellow velvetleaf waste has not been used appropriately, even though it has more benefits and value. The leaves of yellow velvetleaf contain natural color of carotenoids and flavonoids which can be used for natural dyes. The potential color produced can possibly be applied for textile coloring *colet* technique using cold wax. The research method was carried out through experiments and data analysis using descriptive analysis. The results show that yellow velvetleaf can be used for *colet* coloring technique using cold wax, and the resulted colors differs depending on the mordant used. Color aging test shows that during the process of *nglorod* (wax exfoliating) using water, the darkest color was found in *tunjung* mordant with a color different of 81-100, belongs to “very dark” category. The test of fastness to rubbing shows score of 4 (good) for all samples. The highest result for motif sharpness test is found in the process of *nglorod* with water and *tunjung* mordant with color different of 81-100, which is categorized as “very sharp”.

1. **Introduction**

Yellow Velvetleaf is categorized as swamp plants. It is a native American plant that grows in tropical and sub-tropical climates. The plant is found in India, Vietnam, Thailand, Laos, Cambodia, Malaysia and Indonesia [1]. Young Yellow Velvetleaf is an edible vegetable as used by people. The rapid growth of the plant makes it, especially the old leaves, cannot be used optimally thus becomes waste. If the old leaf waste is used properly, it can provide more benefits and value. The leaves of yellow velvetleaf contain natural color of carotenoids and flavonoids which can be used for natural dyes [2]. One of which, can be used as a natural batik dye.

The process of batik drawing requires wax (to cover certain parts so as not to be dyed) substance to resist the color. Before wax was discovered, Bantenese people used black sticky rice porridge as ink to make motifs on cloth, which was called *simbut*. The fifth century of Tarumanagara Kingdom, there was an artifact of *simbut* that used sticky rice porridge material to resist the dye [3]. Along the time, wax was discovered, and people switched to wax which was considered more efficient. Sticky rice porridge or often called cold wax began to be abandoned by people due to the long making process and could only be used for *colet* coloring techniques. This made the cold wax began to be abandoned by people. Seeing this condition, some people then started to use cold wax as an alternative to hot wax and to make it be better known to the broader community.
Dyes can be synthetic and natural. Synthetic dye has been widely used by the public because it is more practical, easily obtained, has diverse colors, and inexpensive. However, it has a negative impact that is endangering health and causes environmental pollution if used excessively [4]. Seeing this, efforts were made to reuse natural dye (back to nature) as an alternative to synthetic dye [5, 6]. Natural dye is sourced from natural materials that are environmentally friendly, renewable, easily degraded and not harmful to health.

The objectives of this study are to know whether yellow velvet leaf (*Limnocharis flava*) can be used as a natural batik dye, and to know the coloring quality in the aspect of color direction, color darkness, fastness to rubbing, and the motif sharpness in batik coloring result.

2. Method
This research is an experimental research. The objects of this study are yellow velvetleaf, mordant (alum, tunjung, and quicklime), cotton (unbleached plain) cloth, cold wax. The approach of this research is a pure experimental method, in which the experiment of colet drawing here used cotton fabric that had been designed and outlined with cold wax. Once the wax was dry, it was dyed using yellow velvetleaf extract solution combined with natrium alginat. It was then continued with mordanting step using post mordanting process in which the mordant used were alum, quicklime, and tunjung. Afterwards, cold wax was then exfoliated (lorod) by using water and steam.

There is a single variable in this study that is the quality of the result of yellow velvetleaf colet coloring technique using cold wax based on the color direction, color darkness, fastness to rubbing, and the motif sharpness.

Data collection technique used was organoleptic test which was to determine the color direction based on a color catalog, and a laboratory test to determine the color darkness, fastness to rubbing. Meanwhile, the motif sharpness is calculated based on the score of the color darkness result.

The data was analyzed by using descriptive statistical method. Descriptive analysis is used to analyze data by describing or defining data that has been collected as is without intending to make conclusions that apply to the public or generalization [7]. The result of the quality analysis of colet coloring using cold wax includes the color direction, color darkness, fastness to rubbing, and the motif sharpness of the color.

3. Result and Discussion
Yellow velvetleaf (*Limnocharis flava*) can be used as a natural coloring substance using dye and colet technique that is done based on consideration of utilizing the natural potential and reducing environmental pollution. Yellow velvetleaf coloring uses two wax removal (exfoliating) processes using water and steam. Based on the research, there is no significant changes between wax removal process using steam and water. There is no significant change for yellow velvetleaf during steaming [8]. Meanwhile, different types of mordant produce different color quality.

3.1. Color direction
On the color direction, it produces a different color in each mordant and wax removal process. Coloring using alum mordant produces yellow color. For quicklime, it produces yellow and mordant tunjung produces a color that tends to be dark, which is greenish brown. Mordant will form a chemical bridge between natural dyes and fibers so that the affinity of the dyes increases, and mordant greatly influences the results of coloration which results in varying colors [9]. The use of different mordant will produce a variety of soft to bright colors [10]. In the motif, the result of colet coloring using alum mordant and wax removal process using water shows the color of daffodil-blonde. Meanwhile, the use of quicklime mordant shows the color direction of macaron shortbread, and the use of tunjung mordant with wax removal process using water indicates the color direction of sage-hazel wood. On the other hand, the wax removal process using steam for alum mordant produces a beige-parmesan color direction. In quicklime mordant, it shows the color direction of the beige-sandcastle, while in tunjung mordant; it shows the color direction of sage-wood.
Yellow velvetleaf is a plant that contains carotenoid and flavonoid pigments. Carotenoid and flavonoid pigments can be taken by heat extraction [11]. The results showed a difference in color in the use of mordant and wax removal processes. The results of the descriptive analysis showed that the extract of yellow velvetleaf produces a yellow to brownish green color as shown in table 1.

### Table 1. Color direction

| Mordant      | Water Color Direction | Steamed Color Direction |
|--------------|-----------------------|-------------------------|
| Alum         | daffodil              | beige                   |
| Quicklime    | macaroon              | sandcastle              |
| Tunjung      | sage                  | beige                   |

#### 3.2. Color Darkness

The results of the color darkness test analysis in figure 1 shows that the use of alum, tunjung, and quicklime mordant resulted in a varying quality color darkness score, while the wax removing process using water and steam did not significantly affect the color darkness score.

![Figure 1. Color Darkness Test Chart](image)

_Tunjung_ mordant produced the highest color darkness score in the wax removal process using water, which was 85.50%, while the lowest color darkness score was shown in the wax removal process using steam, which was 85.46%. For alum mordant, the highest score of color darkness is in
the wax removal process using water, which was 59.52%, while the lowest score of color darkness was in the wax removal process using steam, which was 58.49%. For quicklime mordant, the highest score of color darkness is in the wax removal process using water, which was 52.49%, while the lowest color aging score was in the wax removal process using steam, which was 52.46%.

Mordant tunjung produces the strongest color darkness score compared to alum and quicklime mordant. This happens because mordant tunjung produces the darkest color, while alum and quicklime mordant produce light colors. This statement is supported by a research which states that in a coloring process, there is a reaction between tannin in yellow velvetleaf leaves with Fe$^{2+}$ metal from tunjung mordant which produces complex salts (ferro tamar) [12]. The complex salt is formed due to the coordination covalent bonds between metal and non-metal ions which produce a blackish green color.

Furthermore, the use of quicklime mordant on mori cloth shows the darkest yellow color compared to alum, and the color occurs because of the ionic reaction between tannins and Ca$^{2+}$ ion on the quicklime that produces yellow sediment [13].

The use of alum mordant on cotton shows the lightest color compared to the other two mordants. The cloth with the material of mordant Al$^{3+}$ or alum produces a lighter fabric color and the resulting color is almost the same as the original color [14]. It happens because alum is a complete aluminium sulphate salt which is clear and color-strengthening.

### 3.3. The Fastness to Rubbing

The color fastness to rubbing test was carried out using yellow velvetleaf extraction solution (Limnocharis flava) on primishima cloth using a crock meter tool through three laboratory tests in this study. The test results can be seen from the color staining scale in “different color” unit (CD). Table 2 shows that the average staining scale results of fastness to fabric rubbing which are tested to all samples produced the same category of results in the wax removal process both with water and steam, and different types of mordant which were alum, tunjung and quicklime. The coloring process that belongs to good category with a score of 4 and a color difference of 3.33 is found in tunjung mordant, while alum and quicklime mordant have a score of 4-5 with a color difference of 2.0.

The existence of Al$^{3+}$ from alum solution, Ca$^{2+}$ from chalk quicklime solution, and Fe$^{2+}$ from tunjung solution causes bonds between ions and tannins in the fiber to bind with other fibers, so that the dye molecules remain in the fiber to be strong and do not easily escape [15]. It shows that tunjung mordant is able to enlarge the molecules of yellow velvetleaf natural dye, so that it remains in the fiber and do not easily escape or fade at the lowest concentration. Meanwhile for alum and quicklime mordant, it occurs at the highest concentration.

| Staining Scale | Water | Steam |
|----------------|-------|-------|
|                | Score | CD (Color Difference) | Category | Score | CD (Color Difference) | Category |
| **Alum**       | 4-5   | 2.0               | Good     | 4-5   | 2.0               | Good     |
| **Tunjung**    | 4     | 4.0               | Good     | 4     | 3.33              | Good     |
| **Quicklime**  | 4-5   | 2.0               | Good     | 4-5   | 2.0               | Good     |

### 3.4. Motif Sharpness

The variance of analysis results in figure 2 shows that the wax removal process using water and steam has no significant effect on the score of the motif sharpness, while the type of mordant (alum, tunjung, and quicklime) significantly affects the score.
Figure 2. Motif Sharpness Test Chart

Tunjung Mordant produced the highest score of motif sharpness in the wax removal process using water which was 90.15%, while the lowest score of motif sharpness in wax removal process using steam which was 90.11%. For alum mordant, the highest score of the motif sharpness was found in wax removal process using water which was 64.45%, while the lowest score of the motif sharpness was in the wax removal process using steam which was 64.14%. For quicklime mordant, the highest score of the motif sharpness was found in wax removal process using water which was 57.14%, while the lowest score of the motif sharpness was in the wax removal process using steam which was 57.11%.

The result of the motif sharpness analysis is affected by the score of color darkness. The highest score of motif sharpness is found in tunjung mordant with removal process using water which is 90.15%, and categorized as “very sharp”, while the lowest score of motif sharpness is found in quicklime mordant with removal process using steam which is 57.11%, and categorized as “average”.

4. Conclusion
Based in the research result and discussion, it can be concluded that that yellow velvetleaf (Limnocharis flava) can be used as a batik dye. The quality of coloration of the color direction aspect in alum, quicklime and tunjung respectively are daffodil or blonde color, macaroon or shortbread color, and sage or hazel wood color. On the other hand, the removal process using steam and alum mordant produces beige or parmesan color, in which lime produces beige or sandcastle color, and tunjung produces sage or wood color. For the highest color darkness aspect, "Very Dark" category is found in the wax removal process using water and tunjung mordant. The quality of fastness to rubbing of all mordants shows "Good" criteria. The highest motif sharpness quality or "Very Sharp" category is found in the wax removal process using water and tunjung mordant.

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