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Increasing Process Effectiveness and Utilization of Maceration Waste of Cusia Strobilantes Leaves and Twigs, by Enumeration of Materials

Murni Yuniwati[1], Era Mawarni[2], Bambang Kusmartono[3], Dewi Wahyuningtyas[4], Muhammad Yusuf[5]

[1,2,3,4,5]Instititut Saisn dan Teknologi AKPRIND

ABSTRACT: The small industry of UMK Shibiru, Ngadirejo, Temanggung, produces natural dyes from the leaves and twigs of Strobilanthes cusia. The method used to extract dyes from leaves and twigs is a maceration process using water by placing the leaves and twigs from farmers into the maceration bath, adding water and letting it stand for three days. By cutting the twigs and leaves into smaller sizes, there will be decomposition of cell walls and membranes. The waste obtained is small in size, this will facilitate the processing of waste into useful products, for example processing it into fertilizer. Manure is dried and dried in the sun, then it easily forms fertilizer in various ways. Fertilizer will be a by-product of the natural dyes industry. The results showed that the leaves and twigs of Cusia strobilantes contained two types of dyes, namely the wavelength of 409 which shows purple color and the wavelength of 678 nm which shows red color, with purple being more dominant. More dye is contained in the leaves of Cusia Strobilantes than in the twigs. The smaller the material size and the longer the maceration time, the more extracted dyes are indicated by the greater the absorbance value of the maceration solution. Cutting the leaves and twigs of Cusia strobilantes can increase the effectiveness of the maceration process and make it easier to process leaf and twig waste into fertilizer. In this study, the best results were obtained for leaves and branches with a size of 0.5 cm and maceration time of 3 days, resulting in a maceration solution with a wavelength of 409 having an absorbance of 24.295 nm for leaves and 10.975 for twigs. . While the wavelength of 678 has an absorbance of 12.150 nm for leaves and 4.975 for twigs. Until now there has been no attempt to separate the two colors, so the maceration product contains both colors, and the appearance of the color when dyeing the cloth becomes a dark blue color.

KEYWORDS: leaves, strobilantes, twigs

I. INTRODUCTION

The small industry of UMK Shibiru Ngadirejo Temanggung produces natural dyes from the leaves and twigs of Strobilanthes cusia (figure 1). The process used to extract dyes from leaves and twigs is a maceration process using water by placing the leaves and twigs from farmers in a maceration bath, adding water and leaving it for three days (figure 2). The result obtained is in the form of a maceration solution which is further processed, besides that waste is produced in the form of leftover branches and leaves of Strobilanthes cusia which smells increasingly bad due to decomposition.

Figure 1. Cusia Strobilantes Plant

Figure 2. The process of maceration of leaves and twigs

The large size of the branches and leaves causes problems with the maceration process which is less than optimal and waste which is difficult to utilize. By chopping the twigs and leaves into smaller sizes, there will be a breakdown of the cell walls and membranes. This will facilitate the rate of mass transfer and expand the contact surface of the material with the solvent. The dye will dissolve faster, and the amount of dissolved dye will be maximized. The waste obtained is small in size, this will facilitate the processing of waste into useful products, for example processing it into fertilizer. The sewage is drained and sun-dried, then it easily forms fertilizer

in various ways. Fertilizers will be a by-product of the natural dyes industry.

Strobilanthes cusia is a shrub-like shrub, an annual plant with upright, branching stems which can grow to be woody near the base, this plant can grow 50-80 cm tall. The leaf shape is pinnate with a serrated leaf edge and a tapered leaf tip. The flowers are purple with a diameter of 2.5-2.5 cm, the petals are funnel/trumpet shaped. This plant comes from Japan, Taiwan, China, India, and the Indochina peninsula. Habitat in hilly areas. Strobilanthes cusia grows from the warm temperate zone of southern China to the tropics of Indochina, found at altitudes up to 2000 meters. Plants can be harvested 2-3 times a year for young shoots, usually harvested after 3 months of age (Zhang et al., 2021). Strobilanthes cusia is a type of indigo plant that grows and produces indigo dye. Indigo dyes are generally traded in paste form. Indigo dye paste is obtained by fermentation. During fermentation, indican contained in indigo leaves is hydrolyzed into indoxyl and glucose in the presence of the enzyme β-glucosidase. Furthermore, indoxyl is oxidized through contact with air to form indigo (Arta et al., 2019).

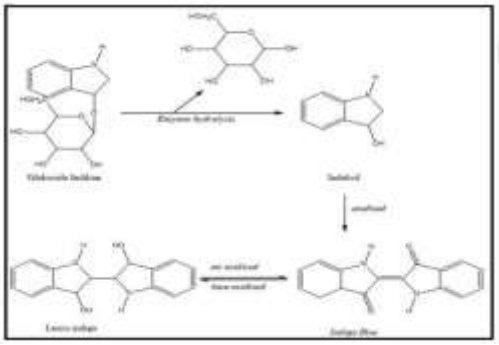

Figure 3. The process of chemically forming indigo compounds (Arta et al., 2019)

In the process of making Strobilanthes cusia indigo paste (picture 3), it begins by soaking the leaves and the pieces of twigs in water. The indigo leaf soak is then cleaned of leaves and pieces of twigs. The indigo solution is added to the quicklime solution for further aeration. The addition of quicklime solution is done to help settling. Quicklime provides calcium molecules which bind indigotine molecules in the leaves to form a paste. Separation of the paste in the indigo solution is carried out by filtering. Indigo dye must be converted to the alkaline leuko form which dissolves in water before use. The formation of alkaline leuko is carried out by adding reducing agents, namely palm sugar, molasses, or sodium hydrosulfite (Hossain et al., 2016).

Extraction is a way to separate a mixture of several substances into separate components (Winarno et al. 1973). Dye extraction is usually carried out using water as a solvent and carried out at room temperature. This method is often referred to as the maceration process. Maceration comes from the Latin "macerare" which means to irrigate, is the simplest way of extraction.

The materials used are generally chopped/cut or powdered to increase the contact surface with the solvent. Shaking or stirring is usually done to increase the mass transfer rate.

The ratio of materials and solvents is adjusted so that more active ingredients are extracted but the results are not too runny, thus facilitating the separation process. The greater the ratio of the material to the extraction liquid, the better the results obtained (Voight, 1994). Extraction with the maceration method has the advantage of guaranteeing that the active substance extracted will not be damaged. During the soaking process the material will break down the cell wall and cell membrane caused by the difference in pressure between the outside of the cell and the inside of the cell so that the secondary metabolites present in the cytoplasm will break down and dissolve in the organic solvent used (Chairunnisa et al, 2019).

Analysis of the maceration solution was carried out using a UV-Vish spectrophotometer (figure 4). The Ultra-violet and Visible Spectrophotometry methods are based on the LAMBERT-BEER law. The law states that the amount of Visible, Ultra-violet and other light radiation absorbed or transmitted by a solution is an exponential function of the concentration of the substance and the thickness of the solution. (Triyati, 1985). UV-Visible spectrophotometry can be used for the determination of samples in the form of solutions, gases or vapors. In general the sample should be converted into a clear solution. For samples in the form of solutions, it is necessary to pay attention to several requirements for the solvent used, among others, must dissolve the sample completely, the solvent used does not contain conjugated double bonds in its molecular structure and is colorless (may not absorb the light used by the sample), no interaction with the molecule of the compound being analyzed, and its purity must be high.

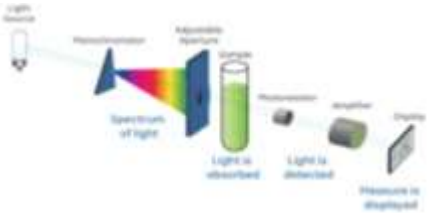

Figure 4. The principle of spectrophotometer measurement

The UV-Vis spectrum is described in two dimensions, with the abscissa being the wavelength and the ordinate being the absorbance. The concentration of the solution being analyzed is proportional to the amount of light absorbed by the substances present in the solution. In this case, Lamber beer's law can state the relationship between light absorption and the concentration of substances in solution.

$A = \varepsilon bc$

A = absorbance (no units)
ε = absorption constant (L/mole.cm)
b = cuvette width (cm)
c = concentration of solution (mol/L)

In the UV-Vis spectrophotometer, the color absorbed by the compound or element is the complementary color of the observed color, it can be seen from the colored solution that has the maximum absorption in the complementary color. In the UV-Vis spectrophotometer, the color absorbed by the compound or element is the complementary color of the observed color, it can be seen from the colored solution that has the maximum absorption of the complementary color (see table 1).

Table 1. The relationship between colors in visible light with a certain wavelength

Wavelength	Color	Complementary colors
400 nm - 435 nm	Purple	Yellowish green
435 nm - 480 nm	Blue	Yellow
480 nm - 490 nm	Greenish blue	Orange
490 nm - 500 nm	Bluish green	Red
500 nm - 560 nm	Green	Reddish purple
560 nm - 580 nm	Yellowish green	Purple
595 nm - 610 nm	Orange	Greenish blue
610 nm - 680 nm	Red	Bluish green
680 nm - 700 nm	Reddish purple	Green

II. METHODOLOGY

Strobilantes cusia twigs/stems were chopped in various sizes (0.5cm, 1cm, 2cm, 3cm, 4cm, 5cm, 8cm). Fifteen grams of twigs of a certain size are put in a container made of plastic, a certain amount of water is added, in this study the ratio of the mass of the material and water is 1: 6). The maceration process was carried out with various processing times of 1 hour, 2 hours, 3 hours, 4 hours, .5 hours, 6 hours, 24 hours, 48 hours and 72 hours. Then each maceration solution was analyzed using a UV-Vish spectrophotometer by measuring the wavelength to determine the type of color contained in the solution and absorbance to determine the color intensity of the solution. The results of this study will be compared with the same process but using the raw material of Cusia strobilante leaves which was previously done by Murni et al, 2021.

III. RESULTS AND DISCUSSION

The results of the analysis using the UV-Vish Spectrophotometer show that the macerated solution of the strobilante twigs has two wavelengths, namely at 409 nm and 678 nm. As shown in Table 1, the wavelength of 409 nm is found in colors that tend to be purple while the wavelength of 678 nm is found in colors that tend to be red. It can be concluded that the maceration solution of strobilantes twigs has two visible light colors, namely purple and red. The observed absorbance values for the leaves and twigs of the cusian strobilante at each wavelength are shown in Table 2.

Table 2. Absorbance values of maceration results at 72 hours

Material type	Absorbance Value	
	Wavelength 678 nm	Wavelength 409 nm
Strobilantes Cusia leaves	12,15	24,925
Cusia Strobilantes Twigs	4,975	10,975

From Table 2. it can be seen that the red color contained is less than the purple color, both in the leaves and in the branches of the cusia strobilante, and the color content in the leaves is more than in the branches. Until now there has been no attempt to separate the two colors, so that the maceration product contains both colors, and the appearance of the color of the cloth from the dyeing process is dark blue, as shown in Figure 5.

Figure 5. The results of dyeing fabrics in Cusia

Strobilantes dyes

To determine the effect of material size and time, the maceration process was carried out on twigs of various sizes, and carried out at various times, then measurements were made of the absorbance of the dye extract with a wavelength

of 678 nm, as well as with a wavelength of 409 nm. The experimental results with a wavelength of 678 nm can be seen in Table 3 and presented in graphical form which can be seen in Figure 6 for a time of 2 to 6 hours, and for a processing time of 6 hours to 72 hours

Table 3. Absorbance of the macerated solution at a wavelength of 678 nm

Branch length (cm)	Absorbance value with maceration time (hours)							
	2	3	4	5	6	24	48	72
0,5	0,143	0,275	0,294	0,515	1,29	3,275	4,05	4,975
1	0,042	0,097	0,126	0,435	0,785	2,4	3,425	3,975
2	0,027	0,076	0,099	0,39	0,485	1,55	3,25	3,725
3	0,026	0,069	0,065	0,32	0,42	1,4	3,03	3,4
4	0,022	0,048	0,061	0,32	0,305	1,25	2,475	3,05
5	0,019	0,041	0,05	0,25	0,295	1,125	1,9	2,475
8	0,018	0,037	0,047	0,18	0,24	0,75	1,325	2,25

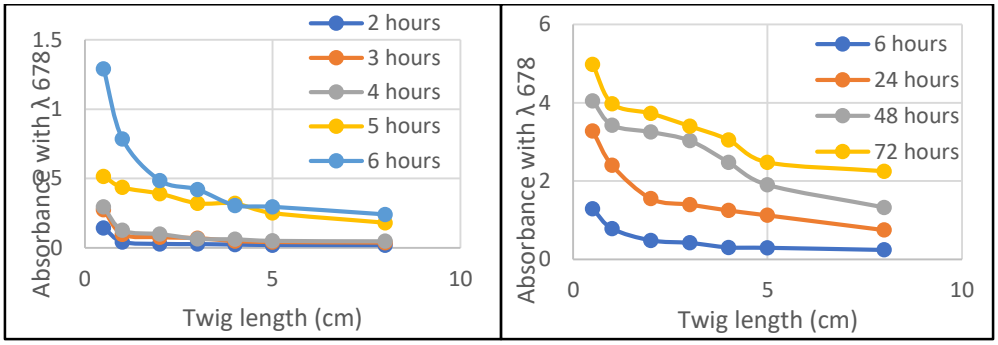

Figure 6. Effect of material size and time on absorbance values

While the experimental results with a wavelength of 409 nm can be seen in Table 4 and presented in graphical form which can be seen in Figure 7. For a time of 2 to 6 hours and a processing time of 6 to 72 hours.

Table 4. Absorbance of the macerated solution at a wavelength of 409 nm

Branch length (cm)	Absorbance value with maceration time (hours)							
	2	3	4	5	6	24	48	72
0,5	0,608	0,866	0,915	0,976	3,075	7,05	9,8	10,975
1	0,235	0,354	0,396	0,795	1,735	3,55	9,325	9,875
2	0,161	0,263	0,303	0,72	0,99	3,15	8,25	9,025
3	0,109	0,236	0,236	0,605	0,78	3,25	7,025	8,7
4	0,106	0,168	0,191	0,605	0,71	2,875	6,275	7,6
5	0,101	0,129	0,151	0,53	0,7	2,8	5,225	7,11
8	0,101	0,118	0,139	0,435	0,67	2,075	2,325	6,651

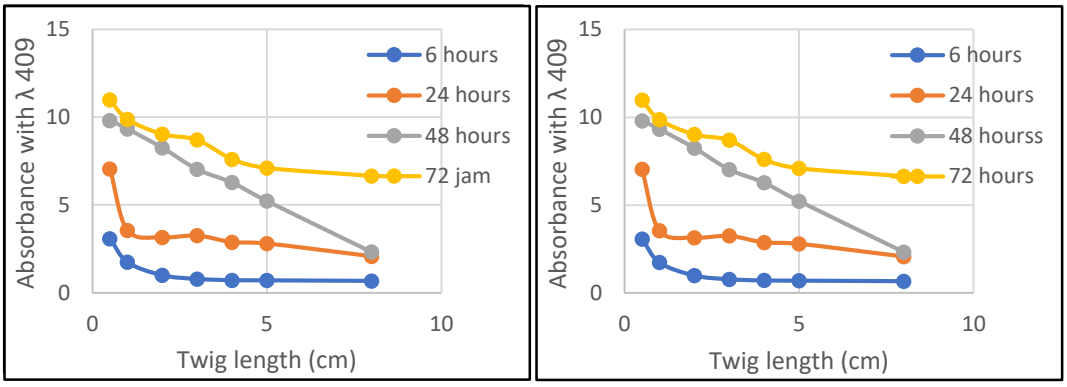

Figure 7. Effect of material size and time on absorbance values

The results showed that the smaller the size of the material and the greater the maceration time, the greater the absorbance value of the solution, this indicated that more dyes were extracted. The smaller the size of the material due to the shredding will cause a larger surface area of the material so that the contact area with the solvent is greater, besides that the shredding also causes the cells of the material to open thereby spurring the diffusion of the dye to the surface and then dissolving in the water. The greater the extraction time, the greater the opportunity for contact between the material and the solvent so that more material is extracted. In this study the smallest material size used was 0.5 cm and the largest time was 72 hours. This is done by considering the chopper which will be more expensive to enumerate materials with even smaller sizes. The time for 72 hours or three days is done by considering the occurrence of decomposition for more than 3 days, which can be observed from the stench that starts to appear.

From the results of research and observations of the maceration process of Cusia strobilante leaves, it was found that the leaves and branches of Cusia strobilantes contain two types of dyes with a wavelength of 409 which shows purple color and a wavelength of 678 nm which shows red color, with purple being more dominant. More dyes are contained in the leaves of Cusia Strobilantes than in the twigs. The smaller the size of the material, the more extracted colors are indicated by the greater the absorbance value of the maceration solution. The longer the time used for the maceration process, the more dye is extracted. In this study, the best results were obtained for the size of the leaves and branches of 0.5 cm and the maceration time for 3 days, resulting in a maceration solution with a wavelength of 409 having an absorbance of 24.295 nm for leaves and 10.975 for twigs. Meanwhile, the wavelength of 678 has an absorbance of 12.150 nm for leaves and 4.975 for twigs. Until now there has been no attempt to separate the two colors, so that the maceration product contains both colors, and the appearance of the color from dyeing the cloth is dark blue.

IV. CONCLUSIONS

From the results of research and observations of the maceration process of Cusia strobilante leaves, it was found that the leaves and branches of Cusia strobilantes contain two types of dyes with a wavelength of 409 which shows purple color and a wavelength of 678 nm which shows red color, with purple being more dominant. More dyes are contained in the leaves of Cusia Strobilantes than in the twigs. The smaller the size of the material, the more extracted colors are indicated by the greater the absorbance value of the maceration solution. The longer the time used for the maceration process, the more dye is extracted. In this study, the best results were obtained for the size of the leaves and branches of 0.5 cm and the maceration time for 3 days, resulting in a maceration solution with a wavelength of 409 having an absorbance of 24.295 nm for leaves and 10.975 for twigs. Meanwhile, the wavelength of 678 has an absorbance of 12.150 nm for leaves and 4.975 for twigs. Until now there has been no attempt to separate the two colors, so that the maceration product contains both colors, and the appearance of the color from dyeing the cloth is dark blue.

REFERENCES

1. Arta, T.K., Vivin A., Agus H., Dwi W.L., Isnaini dan Masiswo. 2019. Pewarnaan Batik Menggunakan Bubuk Pewarna Alam Indigofera tinctoria dan Strobilanthes cusia. Dinamika Kerajinan dan Batik: Majalah Ilmiah 36(2):163-172.
2. Chairunnisa, S., Wartini, N. M., & Suhendra, L. (2019). Pengaruh Suhu dan Waktu Maserasi terhadap Karakteristik Ekstrak Daun Bidara (Ziziphus mauritiana L.) sebagai Sumber Saponin. Jurnal Rekayasa dan Manajemen Agroindustri ISSN, 2503, 488X.
3. Hossain, M. D., Khan, M. M. R., dan Uddin, M. Z. 2016. Fastness Properties and Color Analysis of Natural Indigo Dye and Compatibility Study of Different Natural Reducing Agents. Journal of Polymer and Environmental.

4. Murni, Pratiwi, W., Kusmartono,B., Sunarsih.,S.2022. Pengaruh Waktu Proses dan Ukuran Bahan terhadap Efektivitas Proses Maserasi Daun Strobilantes Cusia, Jurnal Teknologi, ISSN: 2338-6711, Volume 15, Nomor 1, Juni 2022. Fakultas Teknologi Industri IST AKPRIND Yogyakarta.
5. Triyati, E. (1985). Spektrofotometer ultra-violet dan sinar tampak serta aplikasinya dalam oseanologi. Jurnal Oseana, X (1), 39-47.
6. Voigt R. 1994. Buku Pelajaran Teknologi Farmasi. Edisi ke-5. Diterjemahkan oleh: Dr. Soendani Noerono. Yogyakarta: Gajah Mada University Press.
7. Winarno FG, Fardiaz D dan Fardiaz S. 1973. Ekstraksi, Kromatografi Dan Elektrophoresis. Bogor: Departemen Teknologi Hasil Pertanian Fatemeta- Institut Pertanian Bogor.
8. Zhang, Libin., Lu W., Anthony B. C., Yuru S., and Yuhua W. 2021. Blue Footprint: Distribution and Use of Indigo-yielding Plant Species Strobilanthes cusia (Nees) Kuntze. Jurnal of Ethnobiology and Ethnomedicine.