

The Use of Meniran Leaf Tea and Chinese Okra Biofilter as an Effort to Anticipate Pollution Impacts of Batik Synthetic Dye Waste Disposed Into Rivers

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Abstract: Batik is a cultural heritage that must be preserved because of its selling value and tourist attraction. The characteristics and attractiveness of Batik can be seen in its motifs and color combinations. Batik coloring commonly uses synthetic dyes since it is considered more practical and economical with satisfactory quality. However, synthetic dyes containing heavy metals can harm the health of craftsmen and the surrounding community, especially if the coloring waste is not disposed of according to standardized WWTP (IPAL). It is often found in small and medium-scale batik home industries. Community service is given through counseling methods, health checks related to heavy metals, making Meniran leaf tea as an antioxidant, and using simple biofilters for small-scale industries. The results of the pretest to posttest showed an increase in community knowledge, and the results of the partner satisfaction questionnaire showed partner satisfaction.

Keywords: dyes, heavy metals, Meniran tea, biofilter

Abstract: batik merupakan warisan budaya yang harus dilestarikan karena memiliki nilai jual dan daya tarik wisata. Ciri khas dan daya tarik batik dilihat terutama dari motif dan perpaduan warna. Pewarnaan pada batik lebih banyak menggunakan pewarna sintetis. Hal ini dikarenakan lebih praktis dan ekonomis dengan kualitas hasil yang memadai. Namun demikian pewarna sintetis mengandung logam berat yang berbahaya bagi kesehatan pengrajin maupun komunitas masyarakat di sekitar terlebih bila limbah pewarnaan belum dibuang dengan IPAL yang terstandarisasi. Hal ini banyak dijumpai pada home industry batik skala kecil dan menengah. Pengabdian masyarakat diberikan melalui metode penyuluhan, pemeriksaan kesehatan yang berkaitan dengan logam berat, pembuatan teh daun meniran sebagai antioksidan serta pembuatan biofilter sederhana untuk skala kecil. Hasil pre test ke post tes menunjukkan adanya peningkatan pengetahuan masyarakat dan hasil pengolahan kuisioner kepuasan mitra menunjukkan kepuasan mitra

Keywords: pewarna, logam berat, teh meniran, biofilter

Introduction

The coloring process in the batik industry is a very important stage and cannot be skipped. This process uses textile dyes, which will generate waste and can pollute the environment. The batik industry in Indonesia consists of large, medium, small, and even household scale (home industry) categories. Pollution caused by the batik industry does not only occur in industrial areas but also densely populated settlements (Apriyani, 2018).

Batik coloring can use natural and synthetic materials. The use of synthetic dyes for Batik is now widely used since the price is considered affordable, and more color choices are available to enrich batik motifs and patterns. However, the use of synthetic dyes can increase batik workers' exposure to heavy metals such as lead (Pb) and chromium (Cr) contained in batik dyes (Hastuti, et al., 2018).

Pollution mainly comes from dye liquid waste produced by the dye residue and the washing and rinsing process of batik cloth. Synthetic dyes are commonly used since they are easy to obtain and produce bright colors. Examples of dyes are indigosol, naphthol, and indanthrene (Casta and Taruna, 2007). The batik production process requires large amounts of water and produces waste containing dyes, reactive dye residues, and chemicals, so proper management is required before being disposed of into the environment (Ramesh et al., 2007).

The entire batik production process is indicated to use chemicals containing heavy metals, and thus, the waste produced still contains heavy metals (Sasongko, 2006).

Batik wastewater generally has a high organic content which is alkaline. Dyes in batik wastewater are difficult to degrade due to their ability to withstand oxidative damage from sunlight (Manurung, 2004).

Lead exposure has an impact on health. This exposure can cause changes in behavior, hyperactivity, impaired concentration, and decreased IQ in children, while adults can experience hypertension, headaches, anemia, and other minor health problems (Needelman, 2004).

Lead (Pb) toxicology is very dangerous since it can lead to irreversible health effects. It can interfere with several body functions, especially central-laden, hematopoietic, liver, and kidney (Kalia & Flora, 2005). Acute toxicology is related to occupational exposure but is rare, while chronic toxicology occurs at blood lead levels of around 40 – 50 µg/dL. This can be more severe if the symptoms are not treated appropriately. For example, patients experience frequent vomiting, encephalopathy, lethargy, delirium, seizures, and coma (Flora et al., 2006; Pearce, 2007).

Lead exposure is a source of free radicals, which are one of the factors causing DNA damage, in addition to other causes like viruses. Free radicals are molecules, atoms, or groups with one or more unpaired electrons in their outermost

shell, making them highly reactive. Free radicals have many types, but those most abundant in the body's biological systems are oxygen-derived free radicals or reactive oxygen species (ROS) and reactive nitrogen species (RNS). Free radicals result from the homolytic breakdown of the covalent bonds of a molecule or lone electron pairs of an atom. Most of the Reactive Oxygen Species are produced by normal cell metabolism in the body (Endogenous ROS), and are obtained from exposure to other substances or radicals from outside the body (exogenous ROS), which can cause inflammation. Endogenous ROS is a physiological response from the metabolism of normal body cells, such as carbohydrate and protein metabolism. Exposure from outside the body is reactive oxygen from environmental pollutants, radiation, bacterial, fungal, and viral infections, including exposure to lead (Kunwar & Priyadarsini, 2011).

Oxidative stress is an imbalance between the systemic manifestations of free radicals in the form of ROS and the ability of the body's systems to neutralize and repair the damage caused by free radicals. In humans, increased oxidative stress can disrupt normal metabolism and trigger various diseases. Meanwhile, in moderate amounts, free radicals function as the body's defense system by attacking and killing pathogens (Suryadinata, 2018).

Free radicals in the body are a by-product of the oxidation and burning of cells during breathing, cell metabolism, excessive exercise, inflammation, and exposure to pollution (vehicle fumes, cigarette smoke, food, heavy metals, and solar radiation). Free radicals will react with surrounding cell molecules to obtain electron pairs to become more stable, but body cell molecules whose electrons are taken will turn into free radicals. This reaction will occur continuously in the body and will cause oxidative stress if not stopped, causing inflammation, damage to DNA or cells, and various diseases.

Brain damage due to lead exposure causes various neurological disorders, such as brain damage, mental retardation, behavioral problems (antisocial), and nerve damage, and possibly leads to diseases like schizophrenia, Alzheimer's, and Parkinson's (Sanders et al., 2009; Wang & Du, 2013). Lead exposure to the brain can damage the pre-frontal cerebral cortex, hippocampus, and cerebellum (Liu et al., 2013).

Based on the explanation above, lead toxicology due to synthetic batik dyes must be handled thoroughly, and it is necessary to take a personal approach to batik home industry entrepreneurs, batik craftsmen (especially those working in the dyeing division), and the people who live around the batik village environment. Community service activities carried out include education related to the dangers of exposure to heavy metals found in synthetic dyes, health checks for batik craftsmen, demonstrations of making Meniran leaf tea as an antioxidant to fight free radicals due to lead exposure, and demonstrations of making simple biofilters for home

industries that have not yet applied WWTP (IPAL) to minimize river pollution. These activities involved the local government, in this case, the village administration and the head of the Batik village development forum.

Method

The initial method used in community service activities was to cooperate with the village administration and village Batik development forums and then collect aspirations related to health problems to preserve Batik village as a tourist destination.

Based on the results of the aspiration collection, the problems that still need to be addressed are river pollution due to batik-making waste and low awareness of the community living around the environment regarding the dangers of this waste. In this batik village, there is actually a standardized WWTP. However, based on the topography, several household-scale home industries cannot apply WWTP, so another solution is needed to overcome this problem. The following is an action plan for community service activities.

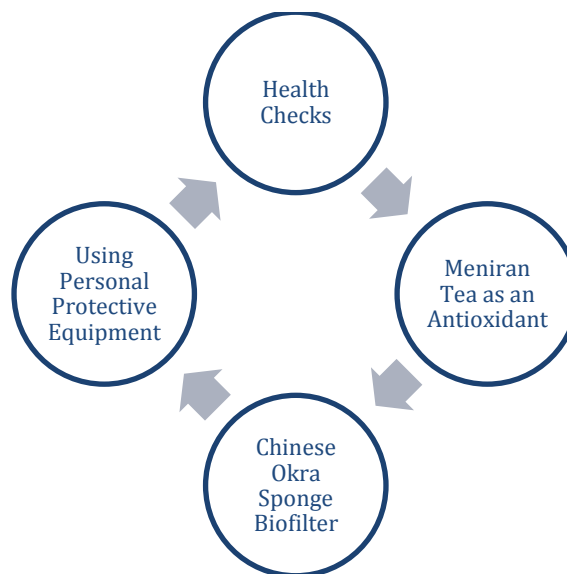


Figure 1. Community Service Activities.

To achieve common perceptions to overcome these problems, health counseling regarding the dangers of lead exposure to the community was carried out. After health counseling, a demonstration of manufacturing Meniran leaf tea as an exogenous antioxidant was carried out. The Meniran plant was chosen since it is a wild plant that is easy to find and has not been utilized optimally. The innovation of consuming Meniran leaf tea is adapted to the culture and age of the people, which is usually consumed in the morning. By drinking Meniran tea, it is hoped that it can be a

habit of a healthy culture in society, especially among people who live around Batik villages. This tea is made by adding 1 teaspoon of Meniran tea and brewing it with 240 ml of warm water, and then it can be added with sugar or honey.



Figure 2. Meniran leaf tea; (a) Ready-to-drink Meniran tea; (b) Meniran plant

Furthermore, health checks were carried out on batik craftsmen, including measuring height and weight to examine the nutritional status, measuring blood pressure, checking uric acid levels, and measuring hand strength. For craftsmen who work directly in the coloring division, further checks were carried out regarding exposure to lead in the blood. Furthermore, early detection was carried out regarding the possibility of Alzheimer's and Parkinson's disease due to nerve damage caused by accumulated exposure to lead from synthetic dye waste.

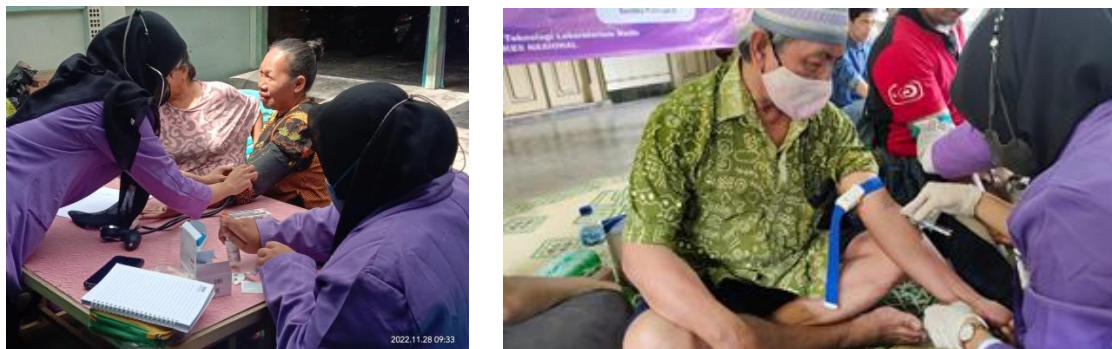


Figure 3 (a) Batik Craftsmen Health Checks; (b) Lead Exposure Detection for Craftsmen in Coloring Division

The following important activity is education or counseling related to the importance of wearing personal protective equipment, especially for employees in the coloring division. After providing education, workers were given personal protective equipment. Personal protective equipment for batik craftsmen, especially in the coloring division, includes masks, gloves, aprons, and boots. In addition to using personal protective equipment, they were encouraged to wash their hands frequently to reduce the possibility of exposure to their mouths through their hands.



Figure 4. Health education

Coordinating with the chairman of the batik village development forum, the next activity was to invite representatives of small and medium industrial batik entrepreneurs, consisting of 20 Small & Medium Industries who do not yet join the WWTP, to provide knowledge regarding simple biofilters.

This biofilter is an appropriate technology for which the method of manufacture is demonstrated as a prototype. A simple biofilter uses natural materials using a Chinese okra sponge, making it more environmentally friendly. The following is a simple biofilter prototype.



Figure 5a. Front view; 2b. Back view

Results

Health check results of blood pressure, uric acid, BMI (Body Mass Index), and hand strength are shown in the table below.

Table. Characteristics of the examination results of participants in community service activities

Characteristics	Description
Blood pressure (Systolic: 130-139mmHg; Diastolic: 85-89 mmHg)	
1. Normal	21.43%
2. Non-normal	78.57%
Uric acid (Male = 7.2 mg/dL; Female = 6.7 mg/dL)	92.86%
1. Normal	7.14%
2. Above normal	
Body Mass Index (BMI) (18.25 – 24.9 Kg/m2)	
1. Underweight	14.29%
2. Normal	42.86%
3. Overweight	42.86%
Hand strength (male = 56.5; female = 24.5)	
1. Normal	
2. Below normal	35.71%
	64.29%

The results of the health checks of blood pressure and hand strength with presentations outside the normal standard were higher than normal presentations. According to the International Cancer Research Institute, lead can damage the nervous system, cardiovascular system, blood circulation system, urinary system, reproductive system, and other organ systems. This is due to contamination of these heavy metal compounds involved in reactions such as Fenton to produce more reactive oxygen species (ROS), better known as free radicals, capable of inducing oxidative stress. In addition, epidemiological studies also reveal the toxic effect of lead on the cardiovascular system, as the level of biomarkers of lead exposure in vivo (such as blood or bone lead levels) increases, which can increase the risk of

cardiovascular diseases such as hypertension, coronary heart disease, and atherosclerosis (Qu et al., 2019).

This hand strength shows that 64.29% of the respondents were in the below-standard category. Lead exposure has an impact on neuromotor disorders. Reading results Hand grip strength is frequently used in assessing neurotoxicity in humans. The impact of lead exposure on the peripheral nervous system has also been observed in the form of peripheral neuropathy, involving reduced motor activity due to loss of the myelin sheath that insulates nerves, thereby severely interfering with the transduction of nerve impulses, causing muscle weakness, especially of the outer muscles, fatigue, and lack of muscle coordination. (Sanders et al., 2009). It also disrupts calcium regulation which leads to a lack of muscle coordination and muscle fatigue. For batik workers, especially those working on making motifs and *canting*, this muscle flexibility is very much needed. Thus, giving antioxidants is expected to reduce the toxicity of lead.

Body mass index plays an essential role in controlling lead toxicology. The better the nutritional status, the better the immune system prevents Pb pollution from entering the body. The healthy and good physical conditions will increase work activity and productivity (Rustanti & Mahawati, 2011).

Based on the results of the educational activities, there was an increase in the knowledge of batik workers, as seen in the average pretest and posttest scores. The pre- and posttest results were analyzed using the t-test using SPSS software. The result obtained a significance value of 0.000, which means there is a significant change in knowledge. The results of partner satisfaction questionnaire processing showed a value of 4.0 with a validity test using the Pearson product-moment technique resulting in a value of 0.549-0.905 and a reliability test using Cronbach's alpha resulting in a value of 0.925. Based on the results of writing suggestions and input at the bottom of the questionnaire, participants felt satisfied after being taught how to make tea from Meniran leaves and consume it directly. In addition, the participants also received the products made or packaged in tea bags so that they could be brewed directly for consumption as exogenous antioxidants against free radicals from lead exposure.

In addition to gaining new knowledge about how to make tea from Meniran leaves, participants also gained new knowledge regarding the benefits of Chinese okra (*oyong* or *gambas*). This vegetable turns out to be not only edible but also serves as a natural ingredient for making a simple biofilter. The biofilter prototype was made using easily available and economical materials such as charcoal, zeolite, sand, and Chinese okra. It is hoped that this method will be a solution in the form of appropriate technology for small-scale home industries that have not yet joined the large WWTP due to the topography of the location of the production house.

Regarding the use of personal protective equipment while working, workers still have to adapt and get used to it since the workers, especially those in the coloring division, have not received information regarding work risks. In this activity, the minimum personal protective equipment that should be used by craftsmen was distributed, especially for those in the coloring division. This cannot completely prevent workers from the risk of lead exposure, but at least using personal protective equipment for workers, especially for dyeing workers, can reduce the risk of accumulated lead exposure.

Discussion

The Batik village of Laweyan is one of the largest places for batik artisans in the city of Surakarta. Based on surveys, coordination, and direct data collection through village administration and batik village development forums, many home industries still do not understand WWTP's importance in disposing of batik dye waste. Based on this condition, it is necessary to conduct further discussions with various parties to create an alternative tool as a simple WWTP, in disposing of batik dyeing waste. One example is making a biofilter in a larger size with the composition according to the prototype that has been conveyed in the counseling of some Small-Medium Industries, which topographically cannot apply the WWTP.

This requires further coordination for future development regarding environmentally friendly and energy-efficient materials while still considering budget to minimize production costs. This method can be a solution to preserve the Batik and protect its resources (the Batik craftsmen).

Workers need to familiarize themselves with personal protective equipment to minimize work risks, including accumulated lead exposure. This requires entrepreneurs to provide personal protective equipment for their craftsmen, especially those working in the coloring division.

It is essential to explore the environment in considering natural and quality dyes as an alternative to synthetic dyes containing heavy metal lead.

Emphasis is needed on clean and healthy living behavior by diligently washing hands, having a healthy lifestyle, consuming foods high in antioxidants to ward off free radicals, and keeping the environment clean by not polluting the river with trash or sewage.

Routine medical check-ups for batik craftsmen are necessary to monitor their physical and psychological health. Exposure to heavy metals not only causes physical ailments such as anemia, hypertension, and gout but can also affect the nerves and cause Alzheimer's and Parkinson's disease, which will greatly affect the quality of craftsmen in producing precise batik motifs and patterns.

Conclusion

Batik is a cultural icon that must be preserved, both by the art and the craftsmen of Batik. This is supported by the role of the batik artisans with the ability to make Batik and coloring, which have artistic value. This is supported by the role of batik craftsmen who have the ability to make Batik and color with high artistic value. However, synthetic batik dyes contain heavy metals, so long-term use will have health impacts on the craftsmen and the people who live around them, especially if the coloring waste is not treated with a standardized WWTP. Anticipatory efforts can be made by consuming food and beverages that are high in antioxidants to ward off free radicals from the heavy metal lead and using simple biofilters from natural materials to reduce the impact of pollution.

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