Exploration of natural dyes as alternative substitutes of synthetic dyes on batik making fabrics

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Abstract. Business batik developing after recognition UNESCO 2009 batik as cultural heritage. World batik summit 2011 in jakarta declare batik industry indonesia should be based on natural protection, environment, and research provision of traditional dye natural. The data from the ministry industry 2015 there is 47.755 unit hpi batik, labor 199.444 people. Suppliers batik 25 % origin Jogja, other Solo and Pekalongan, most wearing dye synthesis, causes pollution of the environment and dangerous. Research objectives the knowledge of the and direction color / different color inflict a natural dye indigofera, jalawe and higher in with the fixation alum, lime and tunjung. Uses experimental methods making dyes natural material herbs leaves indigofera, bark jalawe and wood higher in. Making the color of indigofera by fermentation, jalawe material and higher in with the process of extracting. The staining with dipped in solution dye, dried and repeating 3 times. Then the process fixation 15 minutes in fiksator alum (70g / l), lime (50g / l) and tunjung (50g / l), and dried in place has direct sunlight. The observation visually and testing different colors wearing spectrophotometer uv-vis 2401.The results showed type and the color berbeda-beda, jalawe produces a light brown fixation to after dark brown, high produces a reddish brown discoloration towards dark brown. While indigo produce blue if fixation alum, lime and with tunjung the dark blue. Strong weak color produced depending on the type of nature, the fixation, the number and long immersion cloth.

1. Introduction
Batik is cultural heritage has commercial value high, various regions in Indonesia have typical batik in each region. Is the legacy of batik Indonesian culture based on the intangible heritage that acquired international recognition through the organization of the world Unesco of the date of the 2 October of 2009. Besides the city Yogyakarta will also obtain recognized international as batik city the world by World Craft Council (WCC) should be based on historical value, orisinalitas, revitalization efforts and regeneration, economic value, environmentally friendly and having a reputation of international. The recognition of batik was granted because the government and the Indonesia is have done a lot of concrete measures to protect and conserve batik from generation to generation. Batik considered together with the society of his supporters significantly by the philosophical about living in wisdom [1].

Indonesia National Standard (SNI) No 08-0239 1989 define batik as a result the textile according to batik typical Indonesia, using a candle batik as a barrier [2]. One of natural resources in Indonesia that can be used in of batik is dyes nature. It has since built a, the use of a nature to staining batik products in line with the concept of the utilization of greening with the idea of a natural dye utilization sources. In some states such as Germany and the Netherlands, has been done the prohibition on the use of dyes
chemical made since 1996. Hence starting to show up textile products that uses a natural dye, especially batik. The use of a natural dye made batik diversity is the utilization of the biodiversity that would have an impact on the preservation of biodiversity and people’s income. In obtaining dyes derived from nature generally do with the process extract of plants on the stem/wood, roots, flowers, leaves, seeds or fruits. There are many plants that can be used as a natural dye for the craftsman batik process extract of which leaves guava (psidium guajava), the bark soga jambal (Pelthophorum ferruginum), kesumba (Bixa orellana), fruit jalawe, bast soga tingi (Ceriops candolleanaan), secang (Caesalpinia sappan L), wood tegeran (Cudraina javanensis), saffron (Curcuma), tea (The), roots mengkudu (Morinda citrifelia), and with fermentation process to leaf indigofera (indigofera sp.) [3]. The dye experienced to batik fabrics uses some kind of plant that is natural dyestuff very interested in various parties fans batik, this will spur grow and growing batik industry to attempt by make its use the natural batik. Excess dyestuff other nature is the substance and smell antibacterial bursting [4].

There were several problems found a lot in the batik industry that uses the color of natural, one of the problems which there is technical problems in the process of dyeing who take a long time and undertaken in over and over again. Until now there has never been any the batik industry which gives you the repetition of dyeing which is being undertaken to another kind of natural colors. Tingi in natural dye, jalawe and indigofera is some kind of natural colors much used for staining in the batik industry, because it could give directions to the brown color of, yellow and dark blue by repetition dyeing. Repetition immersion in every batik industry not the same, according to the survey results obtained data that there is an industry who performs immersion more than 15 times. For the natural staining based on the research done by steady that treatment in dyeing using a natural dye indigofera on cloth cotton batik times as much as 8 immersions, can give color indigofera toward blue better on cloth cotton batik [5].

Staining batik natural dyestuff produce products batik attractiveness on natural characteristics, unique, ethnic, and exclusive, so has the potential market high, as a product of Indonesia main in entering the global market. In the process of separation of a natural dye to get fluid dyes until now method of separation most often used is the method extraction with solvent because effectiveness and efficiency method of separation than another [6]. Extraction using solvent ethanol 96 % produce levels of tannin most great 24,343 ppm [7]. Some material a natural dye including soga tingi/tengar the names of a group of plants of marga Ceriops having scientific names Ceriops tegal, the plant is also known as some other names like tengar, tengal, tengah, tingi, palun, parun, bido-bido, and others [8]. Pigment in natural colors indigofera belong to the dye fat is blue inflicted back on fiber through a reduction process [9]. Natural colors indigofera obtained by fermentation leaves of herbaceous plants Indigofera Sp. by immersion into water for 36-48 hours till obtained pasta Indigofera. An ingredient colors can be mixed with any other color to acquire color certain places such as of a green color of a combination of yellow and blue, violet of a combination of blue and red as on the theory Brewster [10]. In framework to lift and preserve batik one example is the exploration a natural dye for making batik is dye environmentally friendly, therefore done research of the natural color of the nature of the leaves indigofera, rind jalawe, and bark tingi for staining on cloth batik with a fastener/fixsator alum, lime and tunjung.

2. Research methods
Methods used in this research is experiments in laboratory, with using nature materials of the natural colors of the leaves of a plant tom or indigofera (Indigofera Sp.), the rind of the fruit jalawe (Terminale bellirica) and bark tingi (Ceriops tagal). The process of making solution dyestuff nature is the process to take color pigments in plants there are both on the leaves, stems and fruit. Natural colors of leaves indigofera obtained by the process of fermentation/decay leaves indigofera in water and settled for 24 hours later filtered and will get dye in the form of a paste. While natural colors from the fruit of jalawe and bark tingi performed with extraction process. The process of exploration of the receipt of the pigment substance called the process of extracting natural colors. The process of extraction was conducted by boiling material with a solvent of water until the temperature 100 degrees after that cooled. Part of a plant are in extract is a passage that indicated most having the pigments color as the leaves, the stem or its fruit. In the process of extracting supporting material used in the process of covering
(Na2CO3), TRO (Turkish Red Oil), brown sugar, and wax batik, kostik (NaOH) and hydrogen peroxide (H2O2). In dying process cloth that color not easily wear off used of materials lock the color of aluminum sulphate/alum [Al2(SO4)3 K2SO4 24H2O], lime Ca(OH)2 and fero sulphate/tunjung (FeSO4). For a piece of equipment instruments consist of instrument extraction with thermostat, a drum plastic, soaking tub, a tub dyeing, a pan dissolying, of copper, a sieve, a stirrer, weighing-machine, a stove, scissors, a measuring glass, test tube, stop-watch, and instrument for testing different color cloth used Spectrophotometer UV-2401PC.

2.1. Staining nature of the batik cloth
The batik of cotton cloth before process of coloring natural through immersion in solution dyestuff process that is done mordanting process the fabric with submersion batik into a solution 2 gr soap sunlight bullion or TRO (Turkey red oil) for every 1 liters for 2 hours to 12 hours after was washed with clean water and dry in the shady and much wind. When batik cloth is dried up next material to be included in a solution of alum and water with comparison 8 gr alum and 1 liter of water, solution has been heated to temperature 600 C and cloth be inserted in a solution of continued to heated at a temperature constant for 1 hour. After that is the warm up abandoned and cloth still allowed in the in solution for 24 hours. After soaking for 24 hours and cain is raised and am flushed with clean water next dried and the process of mordanting finished, having a dry cloth prepared to be carried staining. When the process mordanting finished then done process of preparing the color of material jalawe and tingi, material processed by means of extraction namely raw materials natural colors dried and cut into pieces and is weighed according to his by concentration of the comparison 1: 10, in which every 50 gr of jalawe or tingi heated in water with comparison 5 litres of using a pot of copper. In the process of warming or boiling was conducted until the water half or get a third. According to Bogorriani, in the process boiling water has changed when of colors it is showing an indication that pigment color of the worlds was out, the solution the extraction or boiling filtered separated between the solution and natural materials which it is an ingredient extract or residue results [11]. Solution of liquid extract the results of the dyes then cooled then after chilled prepared for use as dyes natural. For materials leaves indigofera the process of extracting has not been carried out, except with the process of fermentation that is soaking pieces of leaves or twigs indigofera in water for 1 the last day leaves and twigs be taken and a solution of boiled for two hours while inserted lime dried up. After that a solution of ignored for 24 hours then strained to get paste. To coloring, paste that is produced taken 1 kilogram for is dissolved by brown sugar which has been mixed with water 2 liters. After it had been added as many as 6 liters of water then was kept in silence Tuesday 24 hours while be closed from happening oxidation and a solution of ready for use. To get tingi in natural colors substance, and a combination of indigofera jalawe and combination of indigo tingi in his official has already spent in material remaining attached to required materials for locks in the color of that color attached to the good, done fixation by immersion for 15 minutes with the ratio of concentrations 1: 10, fixation alum (70g/l), lime (50g/l) and tunjung (50g/l). Material batik fabric have fixation the results of dyeing sun-dried, next were analysed the color of the results of staining of any species of the natural dye visually test and the quality of being necessary one of them is testing different color using spectrophotometer UV-Vis 2401PC to know the colours of ingredients. On process of coloring carried on batik using the wax/candle when staining done with high temperature immersion can melt wax (wax batik) causing color will enter absorbed into barrier color led damage to a batik [12].

3. Result and discussion
Research on explorasii natural dye was an activity that has been done to get the natural color of indigofera material, jalawe and tingi in, used for staining batik making cloth. In coloring batik cloth performed with the process of dyeing the fabric on a natural dye three times, batik fabric have given color then will be the process of fixation that is the process of binding color so that not quick to wear off. The process of fixation is dyeing cloth that had been colored into a solution of fixator are mixed with water, a solution of alum fixator was, lime and tunjung. After natural process of coloring then will be testing different color cloth and testing in visualization.
3.1. Different color test
Testing different colors on cotton fabric already tinged with a natural dye of material indigofera, jalawe, and tingi in after processed fixation intended to see how differences in the hues of each coloring matter to the color of elementary substance cotton fabric namely color cloth white, and differences in the hues with each type of do in staining of material color the natural. For example, how different of a color between staining indigofera with the results of staining tingi as well as with the results of staining jalawe material. Likewise, for knowing how different color the combination of staining indigofera and tingi or the combination of indigofera with jalawe obtained the data in the laboratory. Testing different color using spectrophotometer whose outcome is shown as on a table 1.

Based on the results of the testing it turns out the brightness (lightness) letter L* put a value positive for all of the products of staining either by indigofera, jalawe and tingi, and staining combination of indigo and jalawe as well as the combination of indigofera and tingi, only its value declines which means the level of lightness reduced. In combination staining indigo and jalawe use these three types of produce values as fixator namely -5.98, and -0.64 -2.86, in value by the price of negative all show sample color to the position of greenish. A kind of fixator used is giving the response that not equal in lock/bind natural colors so it influences brightness and the direction of color. Fixation with a solution of alum all produce values L* (brightness) the highest fixation with a solution of tunjung put a value L* the lowest to the direction of color older/dark. For staining tingi and jalawe use these three types of fixator produce values a+ and value b+ which means sample tasteless in position redness and yellowish.

Table 1. Different color cloth testing shows the use of a dye Indigofera, Jalawe and Tingi [13].

| Sample Code             | The value of different color |
|-------------------------|------------------------------|
|                         | L*  | a*  | b*  |
| STD white cloth         | 99.31 | 0.06 | 0.09 |
| Indigo, fixation alum   | 57.85 | -3.24 | -13.63 |
| Indigo, fixation lime   | 56.87 | -2.58 | -11.76 |
| Indigo, fixation tunjung | 53.37 | -2.49 | -9.87 |
| Jalawe, fixation alum   | 60.78 | 11.78 | 36.59 |
| Jalawe, fixation lime   | 51.82 | 10.51 | 24.58 |
| Jalawe, fixation tunjung | 37.47 | 0.73  | 3.82  |
| Tingi, fixation alum    | 55.55 | 25.68 | 26.91 |
| Tingi, fixation lime    | 43.92 | 19.15 | 12.59 |
| Tingi, fixation tunjung | 35.45 | 1.70  | 1.79  |
| Indigo +Jalawe, fixation alum | 39.94 | -598 | 3.24 |
| Indigo +Jalawe, fixation lime | 37.16 | -2.86 | 6.13 |
| Indigo +Jalawe, fixation tunjung | 40.09 | -0.64 | -0.08 |
| Indigo +Tingi, fixation alum | 39.83 | -1.77 | 0.16 |
| Indigo +Tingi, fixation lime | 39.12 | 4.21  | 4.97  |
| Indigo +Tingi, fixation tunjung | 40.75 | -0.84 | 0.93 |

3.2. Change color cloth
With the results of the extraction of natural coloring indigo leaves, the rind of the fruit jalawe and bark soga tingi in dissolved in water and cain cotton dipped in such colors after that dried by aerated. Having a dry the fabric to be included in solution a fastener each alum, lime and tunjung to be further dried in the most unlikely places affected by the rays of the sun directly. Staining is also done by combining namely staining between indigofera and jalawe, and also the combination of indigofera and tingi in. After process of coloring on the material cotton cloth is complete and is dried and all the fixation with a solution of alum, lime and tunjung the colors are produced so different. Fixation is a process of locking color so that colors become not easily look in vain for relief. There is a kind of 3 fixation often used the alum, lime tohor, and tunjung, the material to strengthen ties dyestuff the fabric and give direction different colors [8].
Color results on dyeing process is shown in table 2. In process of coloring with the indigofera by the process fixation (locking) using these three types of material fiksator produces color blue by the difference virtually invisible, so that it can be said not differences color significant. To the staining with jalawe if fixation with alum produce a light brown color/bright, then fixation with lime changed the brown color of darker, while when performed fixation with tunjung it turns out that change a light brown color becomes of the color dark brown/dark. The results of staining tingi in with the process of fixation alum produce young brown to reddish color, but if aimed fixation with lime so a reddish brown color will becomes of the color is more red leading to reddish brown. But if fixation with fixator tunjung so a reddish brown color changing to a black color dark. The results of fixation with tunjung upon the coloring matter of jalawe and tingi in the results showed almost under the same of a black color somewhat pellucid. In the combinations of indigo and jalawe by fixation alum but the results the light blue, if fixation lime and color turned into of a dark brown color, whereas fixation with tunjung and colors changeable dark brown leading darker. Later in the between indigofera and tingi when fixation with alum produce the dark blue, but if fixation with lime color will be turned into tanned old, then fixation tunjung of a dark brown turned into a little dark blue.

Based on table 2 in approval of the result of the staining with 3 types of fiksator turn out to staining jalawe and the staining with tingi if fixation with tunjung produces color that is almost the dark brown under the same, meanwhile for staining combination indigofera jalawe and a combination of indigofera tingi in produce a dark shade of blue. In coloring natural usually dyeing is done with repeated to get the desired color. It means after it is dyed then drained (aërated some time with it), dyed again repeatedly until obtained the desired color and then will fixatation and dried. There are also performed with dyed then difixation, dipped again difixation repeatedly to obtained the desired color then dried. The process of fixation with tunjung so ions Fe²⁺ will give direction the color of the darkness, while fiksator alum with an ion Al³⁺ will give direction color brightest and fiksator lime with an ion Ca²⁺ will give direction staining the older of fiksator alum. Even fiksator lime can change a shade of blue old become tanned old on staining the combination of indigofera and tingi. Staining natural resulting from the indigodera, jalawe, tingi and indigofera jalawe and indigofera tingi when used in batik fabrics will be obtained color interesting, even color produced could arise color cannot prediction. It is interesting from the natural especially by means of the combination and the process of dyeing that repeated be able to create color on batik fabrics more interesting as table 3 shows following.

Table 2. Color changes data be produced in the fixation process.

| No | Natural Dyes | FIXATOR  | ALUM/TAWAS | L  | a*  | TUNJUNG | b*  |
|----|--------------|----------|------------|----|-----|---------|-----|
| 1  | Indigofera   |          |            |    |     |         |     |
| 2  | Jalawe       |          |            |    |     |         |     |
| 3  | Tingi        |          |            |    |     |         |     |
| 4  | Indigofera+Jalawe |      |          |    |     |         |     |
| 5  | Indigofera+Tingi |      |          |    |     |         |     |
### Table 3. The results of the staining of nature at batik cloth.

| Natural Dyes | Various types of fixation |  |
|--------------|--------------------------|---|
|              | Alum Fixation | Lime Fixation | Tunjung Fixation |
| Indigofera   | ![Image](image1) | ![Image](image2) | ![Image](image3) |
| Jalawe       | ![Image](image4) | ![Image](image5) | ![Image](image6) |
| Tingi        | ![Image](image7) | ![Image](image8) | ![Image](image9) |
| Indigofera + Jalawe | ![Image](image10) | ![Image](image11) | ![Image](image12) |
| Indigofera + Tingi  | ![Image](image13) | ![Image](image14) | ![Image](image15) |

*Figure 1. The application of the results of the manufacture of a natural dye on a community batik in Yogyakarta.*

### 4. Conclusion
The color intensity value will depend on the type of fixators used (alum, lime, tunjung) on the cotton cloth so that the resulting color will different. The fixator touches the material that most shows the direction of the color to a dark color or dark brown, especially for the dye combination of indigofera-jalawe and indigofera-tungi. By making a color combination with some materials it will produce colors that cannot be predicted beforehand, for example a combination of indigofera jalawe and indigofera-tungi colors that are produced into a dark color. A lot of material nature like stems, leave, root, twigs and fruit that can produce a natural dye. In combination staining natural indigofera and jalawe use these three types of fiksator produce a negative value at testing different color, this shows that the sample to the position of a greenish color.

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