Potential plant as a natural dyes in Toba Lake, North Sumatra

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Abstract. Ulos is a woven fabric widely used by Batak tribe in North Sumatra., which is a source of warmth both and physically. In ancient times to complete the work of ulos woven fabrics, craftsmen use yarn with natural dye whose source comes from plant, shrubs and other ingredients. Natural dyes are very important in the textile industry, especially the more pro-environment and prevent skin allergies for the consumer. Natural dyes are non-toxic, easy decompose, environmentally friendly, renewable. The rise of ulos fabric manufacturers with chemical dyes in some areas around Lake Toba, North Sumatra, has increasingly marginalized the original ulos craftsmen, who still maintain natural dyes. The research was conducted by inventory at selected locations, interview and detection of natural plant dyes. The purpose of this research is to obtain new information, data related to natural dyes, and the addition of information other ingredients which potential as a natural dye especially of ulos in Toba lake area, North Sumatra. Based on the observation results in several locations in Toba lake area, has been found 18 plants species and four other ingredients that have the potential as natural dyes of ulos.

1. Introduction
North Sumatra is famous for Batak tribe and ulos. According to the ancestors of Batak, there are three sources of warmth, i.e., the sun, fire and ulos. Ulos is a typical woven fabric widely used by Batak people, which is a source of warmth both physically and psychically [1]. In ancient times to complete the work of ulos woven fabrics, craftsmen used yarn with natural dye that come from plant, shrubs and other ingredients. Formerly, these plants to be found on land owned by communities along the Lake Toba. However, now the plant cannot be obtained anymore, so the craftsmen switch to using with chemical dyes. Besides being able to reduce the quality of ulos, coloring with chemicals can pollute the environment. The remaining coloring with chemicals is one of the contributors to pollution in Lake Toba. A number of ulos handicraft centers in Samosir, Toba Samosir and North Tapanuli districts show that have begun to switch to chemical dyes since about 10 years ago. Natural dyes are very important in the textile industry, especially the more pro-environment and prevent skin allergies for the consumer. Natural dyes are non-toxic, easy decompose, environmentally friendly, renewable [2]. Natural dyes in the textile industry have high market potential as superior commodities of Indonesian products with an appeal to unique, ethnic and exclusive characteristics that make their selling value higher [3]. Plants commonly used for natural dyes such as areca nut (Areca catechu), cashew nuts (Anacardium occidentale), Thea chinensis (fruit tea and tea leaves), Ananas comosus (stem and fruit), Alternanthera amoena leaves, roots and stems of three soga: jambal (Peltophorum pterocarpum),

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tingi (Ceriops tagal), and tegeran (Maclura cochinchinensis), Curcuma longa (turmeric), Psidium guajava leaf, the sugar extracted from palms as (Arenga pinnata, Borassus sundaica and Cocos nucifera), Mangifera indica leaves, Indigofera tinctoria (leaves), Swietenia mahagoni wood, fruit palms (fruit), the root of Morinda citrifolia (mengkudu), Terminalia bellirica (jelawe-fruit), Persea americana leaf, Garcinia mangostana peel (4).

The trial using by leaves and other parts of plant that are around us must be continuously carried out. Information about the knowledge of natural dyes and their development is still very lacking in the community. The diversity of flora which has the potential as a natural dye, the use of the technique and the developing technique of products dried extracts of these plant species are still very little known by community. The purpose of this study was to improve knowledge relating to the use of techniques and developing technique of products dried extracts of these plant species that have the potential as natural dyes, especially for ulos in the lake area of Toba, North Sumatra.

2. Materials and Methods
2.1. Site locations of study
This research was conducted in several regions, namely: Lumban Suh-suh Village, Pangururan District, Samosir Regency. Villages in Tobasa Regency i.e.: Gasaribu, Laguboti District; Marsanggap, Sigumpar District; East Sigaol, Uluan District; Meat, Tampahan District; and Jangga Dolok, Lumbangulu District. Nagodang Village, Muara District, North Tapanuli Regency. Kabanjahe City, Karo Regency. Silalahi Village, Silalahi Sabungan District, Dairi Regency. Mt. Singgalang Saribu Dolok Forest, Silima Huta District, Simalungun Regency.

2.2. Methods
The study was conducted by collecting information about natural dye plants. Inventory of plant diversity as a natural dye is done by exploration in the lake area of Toba, North Sumatra following Balgooy [5] and Rugayah et al. [6] methods. During the exploration will be collected plants for collection. Specimens were collected directly pressed and labeled. Recording all information of the plants including morphological characters, local names, local usability, habitat, ecology and distribution, habitus, color of plant parts (flowers, fruits, etc.), altitude, date of collection, location, and documentation.

Data were collected through interviews and field observations. Interviews were conducted on local residents who work as ulos weavers (generally 30 - 87 years old) and migrants as well as some people who know the use of plants used as natural dyes or other purposes. The material asked in this interviews is: plants or materials used in ulos coloring, how to obtain these ingredients, manufacturing process, the part used and how to use it.

Specimen identification was done at “Herbarium Bogoriense”, Cibinong Science Center after drying in oven with temperature 60 °C to dry. Identification was done by comparing specimen with the voucher specimens in “Herbarium Bogoriense”, Cibinong Science Center. This nomenclature refers to the Java Flora naming system [7, 8, 9] and books or magazine of revised family in the Malesia region.

3. Result and Discussion
Although in the Lake Toba region very rare to use natural dyes for ulos weavers, but they still remember that plants or the ingredients their use, how to obtain these ingredients, and the process of making and how to use it. Some of these villages have different techniques in the process of using them, although some are the same.

The following are the results of our observations and interviews in several villages in around Lake Toba. Among the villages, they still found 18 plants and 4 ingredients (Table 1), they had used namely:
1. *Alternanthera brasiliana* (bunga tinta-tinta) 12. *Melia azedarah* (hauresse)
2. *Areca catechu* (pinang)* 13. *Oryza sativa* (beras putih)
3. *Artocarpus communis* (nangka)* 14. *Oryza* sp. (beras merah)
4. *Cajanus cajan* (hisik-hisik) 15. *Persea americana* (alpukat)
5. *Cordyline fruticosa* (lenjuang) 16. *Pterocarpus indicus* (kayu sona)
6. *Curcuma longa* (kunyit)* 17. *Strobilanthes cf. cernua* (indigo)
7. *Euphorbia cotinifolia* 18. *Uncaria gambir* (gambir)* and
8. *Ficus microcarpa* (kayu jabi-jabi) 19. Red stone (batu merah)
9. *Impatiens balsamina* (hatirangga) 20. White soil (tanah putih)
10. *Indigofera tinctoria* (salaon)* 21. Soot (jelaga)
11. *Melastoma malabathricum* (sendudu)* 22. Oker for ceramics (oker untuk keramik)

Hasairin [10] mentions that there are 24 species and 17 families of natural dyes in Southern Tapanuli Regency. Commonly, they used leaves organ for making natural dyes. There are six similar species (*) found with this study. So, there are 30 total species of plants that have the potential as natural dyes in North Sumatra, especially in North and South Tapanuli Regency.

**Table 1.** Results of observations and interviews about total species, ingredients used as natural dyes in around Lake Toba.

| No. | Regency | District | Village     | Total species, ingredients | Species names                                                                 |
|-----|---------|----------|-------------|-----------------------------|-------------------------------------------------------------------------------|
| 1   | Samosir | Paruruan | Lumban Suhi-suhi | 5                           | *Cajanus cajan, Melia azedarah, Ficus microcarpa, Pterocarpus indicus, Indigofera tinctoria |
| 2   | Tobasa  | Laguboti | Gasaribu     | 4                           | *Alternanthera brasiliana, Persea americana, Artocarpus communis, Pterocarpus indicus |
|     |         |          | Marsanggap   | 1                           | *Melastoma malabathricum*                                                     |
|     |         |          | East Sigaol  | 3                           | *Ficus microcarpa, Pterocarpus indicus, Indigofera tinctoria                  |
|     |         |          | Meat         | 1                           | *Indigofera tinctoria*                                                        |
|     |         |          | Jangga Dolok | 1                           | *Indigofera tinctoria*                                                        |

hausted, “buro”
soil, “hula”
stone
Table 1 (Continue)

| No. | Regency      | District | Village | Total species, ingredients | Species names                                                        |
|-----|--------------|----------|---------|----------------------------|---------------------------------------------------------------------|
| 3   | North Tapanuli | Muara    | Nagodang | 7                          | *Strobilanthes* cf. *cernua*, *Impatiens balsamina*, *Cordyline fruticosa*, *Euphorbia cotinifolia*, *Uncaria gambir*, *Curcuma longa*, *Indigofera tinctoria* |
| 4   | Karo City    | Kabanjahe |         | 1                          | *Indigofera tinctoria*                                                |
| 5   | Dairi Silalahi Sabungan | Silalahi |         | 2                          | *Indigofera tinctoria*, *Curcuma longa*                               |

In Lumban Suhi-suhi Village, Paruruan District, Samosir Regency, 5 species were found (*Cajanus cajan*, *Melia azedarah*, *Ficus microcarpa*, *Pterocarpus indicus*, and *Indigofera tinctoria*) which have the potential as natural dyes and have been used by ulos weavers. In this village, there is only 1 weaver who still uses natural dyes. Most of them have switched to synthetic dyes, with the reason that it is difficult to find these materials and the process takes a long time. Dinny [11], is conducted research on the leaves of *Pterocarpus indicus* (kayu sona, angsana) as a natural dye on fabrics of satin, cotton, and mori. They are produces blue number 100 (Fig 1), violet-blue number 98 (Fig. 2), and blue-green number116 (Fig. 3 colors. Identification of its color obtained by using R.H.S Color Chart (12). While, according to Lestari and Satria [13], bark of *Pterocarpus indicus* is to be used as a source of natural dyes for silk batik and produces brown color.

![Figure 1. Blue number 100.](image1.png) ![Figure 2. violet-blue number 98.](image2.png) ![Figure 3. Blue-green number 116.](image3.png)

In several villages of Tobasa Regency, founded several plants that have the potential as natural dyes i.e.: Gasaribu Village, Laguboti District, 4 species were found (*Alternanthera brasiliana/Figure 4, Persea americana, Artocarpus communis, Pterocarpus indicus*), and have been used by weavers. Unfortunately, there are no weavers using these materials at this time. Based on observation in Marsanggap Village, Sigumpar District, is found 1 species (*Melastoma malabathricum*) which used the seeds for batik natural dyes. Another research has been conducted on the use of its fruit extract can be used as coloring in tablet preparations [14]. While, according to Azizah and Hartana [3] the leavesis produced colors that can be used to dye cotton fabric. The colors produced are varies, depend on the use of mordan, namely banana (#E3CF57) without the addition of mordan, khaki 1 (#FFF68F) with alum (“tawas”) mordan, lightgoldenrod 1 (#FFEC8B) with CaO (“kapur”) mordan, and FeSo4 (“tunjung”) mordan is produced sgi gray 36 (#5B5B5B).
In East Sigaol Village, Uluan District, were found 3 species (*Ficus microcarpa*, *Pterocarpus indicus*, and *Indigofera tinctoria*). *Indigofera tinctoria* is most common found in this village, even up to 5 kg, but weavers don't use it anymore. Formerly, in Meat Village, Tampahan District, weavers used *Indigofera tinctoria* for their ulos. Now, weavers use synthetic dyes, but the weaving process is still manual (Figure 5). To start the weaving, the yarn to spread with rice is called “bubur” until about 6 times drying, so that yarn becomes a bit hard (Figure 6). In Jangga Dolok Village, Lumbangjulu District, ulos used “taem” (*Indigofera tinctoria*) staining for blue and black; black color can also used by soot; white color using “buro” soil (soil on the edge of the river), and red color using “hula” stone which produce red powder. “The taem” immersion and “buro” soil process take ± 7 days. Examples of ulos using natural dyes in this village can be seen in Figure 7.
In Nagodang Village, Muara District, North Tapanuli Regency, there were 7 species (*Strobilanthes* cf. *cernua*, *Impatiens balsamina*, *Cordyline fruticosa*, *Euphorbia cotinifolia*, *Uncaria gambir*, *Curcuma longa*, and *Indigofera tinctoria*) which have been used by weavers as natural dyes. Even, though in this village *Indigofera tinctoria* has been cultivated in a large garden area (Figure 8), weavers still do not use these dyes in their ulos production, unless there are special orders that want ulos with natural coloring. The reason is, because the selling value is very expensive, it can reach 5 million rupiahs, so it is very rare to buy it.

**Figure 8.** *Indigofera tinctoria* has been cultivated in a large garden area.

In Kabanjahe City, Karo Regency, the process of making natural dyes from salaon plants by boiling, and then filtered. Results of filter + scrub ash + calcium oxide, then saved for 1 month, will produce black color. Whereas, in Silalahi Village, Silalahi Sabungan District, Dairi Regency, the process is slightly different. Tayoem leaves (*Indigofera tinctoria*) + calcium oxide, soaked for 2 nights, then boiled, will produce blue color. Turmeric is pounded, then squeezed and filtered + acid, and then boiling will produce yellow color. The boiling time depends on the need, if you want a strong yellow color, it must be boiling for a long time, and the fire is reduced. The yarn to be woven is soaked first with water for 1 night, then dried and then put into this boiling turmeric which has yellow color. For red color, used by powdered paint (oker for ceramics) which is heated. Ulos that uses natural dyes, especially from *Indigofera tinctoria* dyes (Figure 9) in "Sumatra Loom Gallery" owned by Torang MT Sitorus. Some examples of ulos that use salaon coloring and red coloring are almost 50 years old, that are not for sale but are prepared for museums (Figure 10).

Djarwaningsih et al [15] mentions that there are 74 species have long been used as a natural dye, and 87 species that never been used for it. In Toba villages, founded six species that no mentioned in those study, namely: *Alternanthera brasiliiana* (bunga tinta-tinta), *Cordyline fruticosa* (lenjuang), *Euphorbia cotinifolia*, *Ficus microcarpa* (kayu jabi-jabi), *Melia azedarah* (hauresse), and *Strobilanthes* cf. *cernua* (indigo). Those species are currently available and have potential for natural dye in Toba villages. Based on this reason, the six species are new information obtained from this study.

The next step after the findings about the plant species potentially used as natural dyes, especially for weavers are continued dissemination of natural coloring sources, procedures for use and technology for product development in order to obtain maximum results. The trial of the use of leaves, roots, stems, bark and other plant parts of six species that are new information and also various plants that are around us must be constantly carried out.
4. Conclusion

Based on the results of this study, plant species have been found that have the potential as ulos natural dyes and have been used in North Tapanuli Regency. There are 18 species of plants, but only 2 species are commonly used, namely: Indigofera tinctoria, and Melastoma malabathricum. Other species still need further study. Six species are founded in Toba villages as new information, namely: Alternanthera brasiliana (bunga tinta-tinta), Cordyline fruticosa (lenjuang), Euphorbia cotinifolia, Ficus microcarpa (kayu jabi-jabi), Melia azedarah (hauresse), and Strobilanthes cf. cernua (indigo). Usually, the techniques used for producing natural dyes from plant still very simple. The plants boiling until the water is evaporated for 1/3 part, and then filtered. Knowledge relating to the use of techniques and developing technique of products dried extracts of those plant that have the potential as natural dyes for ulos, not yet obtained, because this techniques still expensive, especially for weavers...

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