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# Natural Staining of Silk Fabrics by Leaves of *Acer Ginnala* and Skins of *Pinus densiflora* and Color Changes by Mordants

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**Abstract:** *Acer ginnala* known as amur maple is native to Northeastern Asia. *Pinus densiflora*, also called, Korean red pine has a home range that includes Japan, the Korean Peninsula and Northeastern China. The term, natural dye, covers all the dyes derived from natural resources such as plants, insects and animals. In this study, the leaves of *A. ginnala* and the skins of *P. densiflora* were applied as natural dyes. In addition, the color patterns were compared by the pre-mordanting, that is onchrome to silk fabric. Moreover, it was analyzed to understand how much the color changes by mordants were induced. The staining by the leaves of *A. ginnala* was performed with modants. Its leaves have green color but staining of the silk fabric showed yellow color. Copper acetate and aluminum potassium sulfate did not induce very different color changes as compared with the silk fabric without any mordant. Sodium tartrate plus citric acid and potassium dichromate induced colors close to dark brown. Interestingly, iron (II) sulfate induced very different color change close to black. Silk fabric was shown colors close to grey by the skins of *P. densiflora* without any mordant and with sodium tartrate plus citric acid and copper acetate even if there were darkness and brightness. Potassium dichromate and aluminum potassium sulfate induced yellow mixed with grey color. On the other hand, iron (II) sulfate induced very dark grey. Our study would be useful to comparatively analyze the staining changes by the leaves of *A. ginnala* and the skins of *P. densiflora*. Further study will be processed to evaluate them as a biological usage and other applications of natural staining.

**Key words:** *Acer ginnala, P. densiflora*, natural staining, mordants, silk, copper acetate

## INTRODUCTION

*Acer ginnala* known as amur maple is native to Northeastern Asia. In Republic of Korea, *A. ginnala* has been used as a traditional folk medicine for the treatment of eye disease, wound healing and diarrhea (Choi *et al*., 2010; Park *et al*., 2017). In addition, *A. ginnala* has been reported to demonstrate antioxidative, antibacterial and antitumor activities (Park *et al*., 2017; Han *et al*., 2004; Choi *et al*., 2005).

*Pinus densiflora*, also called, Korean red pine has a home range that includes Japan, the Korean Peninsula and Northeastern China. This pine has become a popular ornamental and has several cultivars but in the Winter it becomes yellowish (https://en.wikipedia.org/wiki/Pinus_densiflora).

The term, natural dye, covers all the dyes derived from natural resources such as plants, insects and animals (Sharma and Grover, 2011). The natural dyes are vegetable dyes from plant sources roots, fruits, coats, leaves and wood. Mordant is used to help natural dyeing (Jung, 2018; Jung and Park, 2014). Mordants include tannic acid, alum, chrome alum and certain salts of aluminium, chromium, copper, iron, potassium, etc. Moreover, the mordants can change and obtain other colors (Jung, 2018; Jung and Park, 2014).

In this study, the leaves of *A. ginnala* and the skins of *P. densiflora* were applied as natural dyes. In addition, the color patterns were compared by the pre-mordanting, that is onchrome to silk fabric. Moreover, it was analyzed to understand how much the color changes by mordants were induced.

## MATERIALS AND METHODS

**Preparation of natural dyes from the leaves of *A. ginnala* and the skins of *P. densiflora*:** The leaves of *A. ginnala* and the skins of *P. densiflora* were purchased from a traditional market and washed three times with Distilled Water (DW). The 100 g of each material was completely dried on air for the next extraction of dye. Extraction of their natural dyes was performed with two steps. In the first step, the dried each material was dissolved into 5 L of DW by boiling with strong flame. The pH 4.0 was continuously maintained and boiling to completely extract the natural dye was performed for 60 min. In the second step, 3 L of distilled water was added into about 2 L of the extract above. Finally, they were filtered to obtain the pure dye for all natural staining by a 0.22 um syringe filter (Sartorius).

**Staining of silk fabric by the leaves of *A. ginnala* and the skins of *P. densiflora*:** Our research targeted the staining of silk fabric, using the leaves of *A. ginnala* and the skins of *P. densiflora* and changes of silk colors using a variety of mordants. Mordants of copper acetate, aluminum potassium sulfate, sodium tartrate plus citric acid, iron (II) sulfate or potassium dichromate were pre-mordanted with the fabric silk as shown in Table 1 and then the dye was added. The dyeing time was about 60 min. After the dyeing was finished, the silk fabric was washed with water and dried without squeezing.

Table 1: Treatment of mordants to silk fabric

| Mordants | Volume of mordants (g) | Volume of distilled water (mL) | Treatment time (min) |
|---|---|---|---|
| Copper acetate | 10 | 600~1000 | 15 |
| Aluminum potassium Sulfate | 10 | 600~1000 | 15 |
| Sodium tartrate plus Citric acid | 30+90 | 600~1000 | 15 |
| Iron (II) sulfate | 20 | 1500 | 5 |
| Potassium dichromate | 10 | 600~1000 | 15 |

## RESULTS AND DISCUSSION

**Staining of silk fabric by the leaves of *A. ginnala*:** The staining by the leaves of *A. ginnala* was performed with modants. Its leaves have green color but staining of the silk fabric showed yellow color (Fig. 1). Copper acetate and aluminum potassium sulfate did not induce very different color changes as compared with the silk fabric without any mordant. Sodium tartrate plus citric acid and potassium dichromate induced colors close to dark brown. Interestingly, iron (II) sulfate induced very different color change close to black (Fig. 1).

**Staining of silk fabric by and the skins of *P. densiflora*:** Here, to understand the use of the skins of *P. densiflora* as a natural dye, silk fabric was applied for the staining with the mordants as mentioned at materials and methods. Silk fabric was shown colors close to grey by the skins of *P. densiflora* without any mordant and with sodium tartrate plus citric acid and copper acetate even if there were darkness and brightness (Fig. 2). Potassium

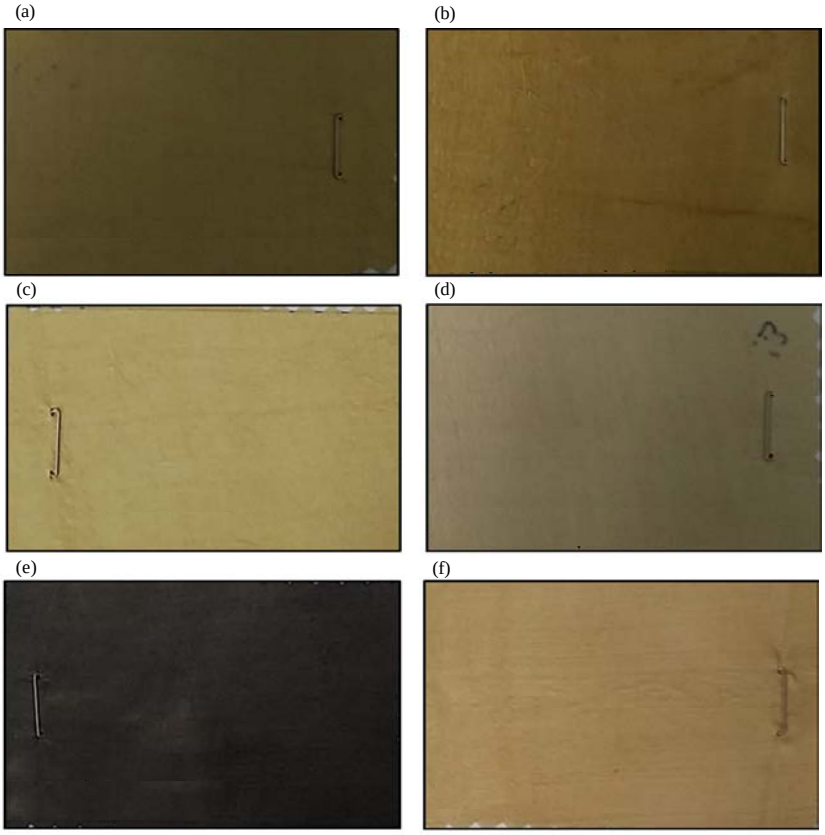


Fig. 1: Natural staining of silk fabric by the treatment of mordants followed by the leaves of *Acer ginnala*: a) Potassium dichromate; b) Copper acetate; c) Aluminum potassium sulfate; d) Sodium tratrate plus citric acid; e) Iron (II) sulfate and f) None

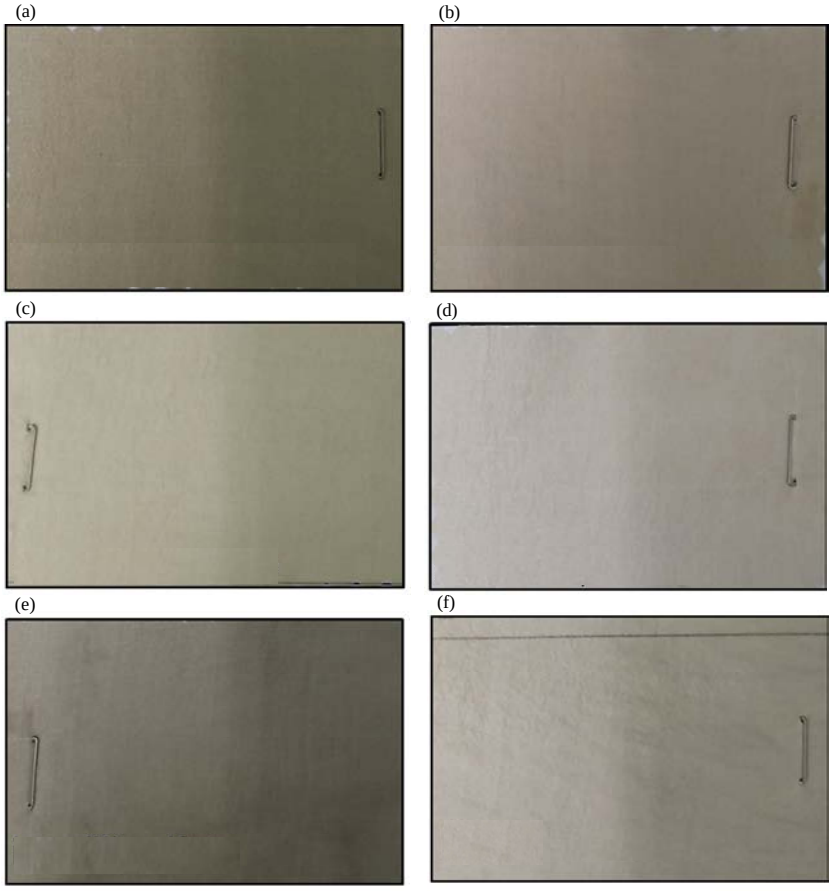


Fig. 2: Natural staining of silk fabric by the treatment of mordants followed by the skins of *Pinus densiflora*: a) Potassium dichromate; b) Copper acetate; c) Aluminum potassium sulfate; d) Sodium tratrate plus citric acid; e) Iron (II) sulfate and f) None

dichromate and aluminum potassium sulfate induced yellow mixed with grey color (Fig. 2). On the other hand, iron (II) sulfate induced very dark grey (Fig. 2).

It is well known that natural dyes are not harmful to the environment and specifically are good to human body. Due to the eco-friendly advantages, the demand for natural dyes is increasing day by day (Ali *et al*., 2009; Guinot *et al*., 2008). Therefore, natural dyes must be good materials alternative to synthetic chemical dyes. This study provided information about the application of the leaves of *A. ginnala* and the skins of *P. densiflora* as natural dyes and also color changes by the pre-mordanting method.

## CONCLUSION

Natural dyes are used in a wide variety of materials such as fibers, etc. and are also applied to cells and used for microscopic analysis. The reports about the leaves of *A. ginnala* and the skins of *P. densiflora* as natural dyes are rare but in one report as the numbers of dyeing and mordanting increased, the ramie fabrics gradually increased to show reddish and bluish signs using *A. ginnala* (Kim, 2014).

The leaves of *A. ginnala* and the skins of *P. densiflora* did not have many common characteristics but in this study how much the staining difference was induced by mordants. Except for other four mordants, iron (II) sulfate could induce very different color changes as compared with no mordant.

As mentioned above, for the biochemical assay, haematoxylin is widely used to stain tissues with a counterpart of eosin as an eco-friendly component (Mirjalili *et al*., 2011). Haematoxylin is also a dye extracted from a natural product for biological usage.

This study would be useful to obtain color changes by the leaves of *A. ginnala* and the skins of

*P. densiflora* for some materials, e.g., cotton. Further study will be processed to evaluate them as a biological usage.

## RECOMMENDATIONS

Our study would be useful to comparatively analyze the staining changes by the leaves of *A. ginnala* and the skins of *P. densiflora*. Further study will be processed to evaluate them as a biological usage and other applications of natural staining.

## ACKNOWLEDGEMENT

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