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Natural Staining of the Coat of *Allium cepa* L. and Leaf of *Camellia sinensis* Var. Assamica to a Silk Fabric

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Abstract: *Allium cepa* L., from Latin cepa "onion" is a vegetable and is the most cultivated species of the genus Allium. A traditional fermented tea leaf (*Camellia sinensis* var. *assamica*) and fresh tea leaves of C. *sinensis* var. *assamica* are conventionally used as the raw material for Miang fermentation in Thailand. In this study, using various mordants, color changes to fabric silk were compared with the dye of the coat of onion and *C. sinensis* var. *assamica*-fermented leaf. The 300 g of the coat of onion was dissolved into 12 L of distilled water. For a natural dye from dried *C. sinensis* var. *assamica*-fermented leaf, its extraction was also performed with two steps as the coat of onion. 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 for both dyes from the onion and tea. Only onion dye stained the silk traditional brown without any mordant which was similar color with the dried coat of onion. Copper acetate and potassium dichromate showed very similar colors with "none" but darkness or brightness was shown. Very interestingly, iron (II) sulfate induced near black which was completely different from the only staining by onion dye without any mordant. Original color without any mordant of "none" represented brownish in the staining of *C. sinensis* var. *assamica*-fermented leaf. In particular, aluminum potassium sulfate induced very clear shiny yellow and iron (II) sulfate did the mix of brown and gray. This study would be useful to comparatively analyze the staining changes by the coat of onion and *C. sinensis* var. *assamica*-fermented leaf. Further study will be processed to evaluate them as a biological usage.

Key words: Coat of *Allium cepa* L., leaf of *Camellia sinensis* var. *assamica*, mordant, staining, aluminum, dichromate

INTRODUCTION

The genus Allium covers more than 750 species distributed all over the Northern hemisphere (Puizina, *et al*., 1999). Among them, the onion (*Allium cepa* L., from Latin cepa "onion") also known as the bulb onion or common onion is a vegetable and is the most cultivated species of the genus Allium (Block, 2010). Many epidemiological studies confirmed that dietary consumption of onions is associated with a reduced risk of developing many forms of cancer and cardiovascular and neurodegenerative diseases (Fredotoviæ *et al*., 2017; Kendler, 1987; Nicastro *et al*., 2015; Yang *et al*., 2013). Apart from the biological activities, it has been sometimes used as a dye. Wool, silk and cotton fabrics were dyed by the onion with mordants. The dyeability, i.e., color and light fastness ratings were found to depend on the fabric type, dye concentration as well as the mordant used (Tera *et al*., 2012).

A traditional fermented tea leaf (*Camellia sinensis* var. *assamica*) and fresh tea leaves of *C. sinensis* var. *assamica* are conventionally used as the raw material for Miang fermentation in Thailand (Kanpiengjai *et al.,* 2016). It is rare to report usefulness as a natural dye for the tea leaf. On the other hand, chemical analysis has been studied. For example, chemical constituents of *C. sinensis* var. *assamica* were analyzed to have thirteen components e.g., caffeine, theobromine, gallic acid, (+)-catechin, etc., (Zhu *et al*., 2013). The leaf actually was fermented and thus, it's color was changed into dark brown.

To recover original colors and change them, mordants have been used. In our previous reports, copper acetate, aluminum potassium sulfate, sodium tartrate plus citric acid, iron (II) sulfate and potassium dichromate were applied to fabric silk and they induced color changes of the silk (Hwang and Park, 2013). The coat of the onion is tinged with brown and *C. sinensis* var. *assamica*-fermented leaf is also tinged with dark brown. The mordants would be able to change original colors by the coat of onion and *C. sinensis* var. *assamica*-fermented leaf dye.

In this study, using various mordants above, color changes to fabric silk were compared with the dye of the coat of onion and *C. sinensis* var. *assamica*-fermented leaf.

MATERIALS AND METHODS

Preparation of the coat of onion and *C. sinensis* var. *assamica*-fermented leaf: For a natural dye from the dried

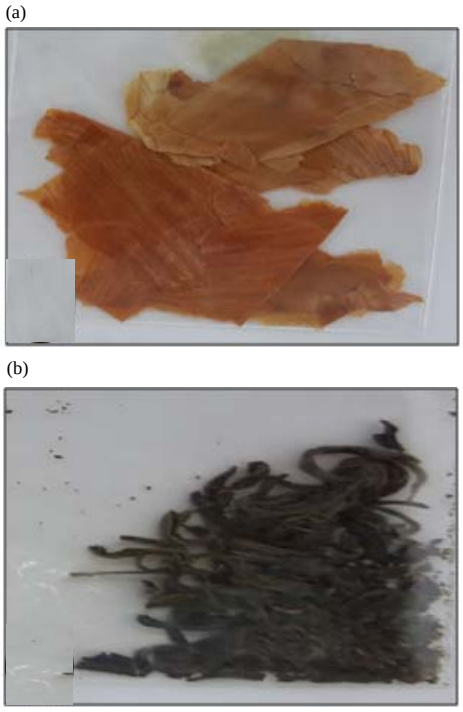

Fig. 1: a) Dried coat of onion and b) Dried *C. sinensis* var. *assamica*-fermented leaf

coat of onion in Fig. 1a, its extraction was performed with the two steps. Briefly, about 300 g of the coat of onion was dissolved into 12 L of distilled water. pH 4 was continuously maintained and boiling to completely extract the natural dye was performed for an hour. For the next step, the mixture of resulting about 8 L from the first step above was also boiled at 100°C again.

For a natural dye from dried *C. sinensis* var. *assamica*-fermented leaf in Fig. 1 B, its extraction was also performed with two steps as the coat of onion. Briefly, about 500 g of the *C. sinensis* var. *assamica*-fermented leaf was dissolved into 6 L of distilled water. pH 5 or pH 5.5 of acidic condition was continuously maintained and boiling to completely extract the natural dye was performed for half an hour. For the next step, the mixture of resulting about 5 L from the first step above was also boiled at 100°C again. Therefore, the natural dyes were subsequently applied to stain fabric silk.

Staining of natural dyes with various mordants: Our research targeted the staining of silk, using the dried coat of onion and dried *C. sinensis* var. *assamica*-fermented leaf and changes of silk colors using a variety of mordants. Two dried products had brown or dark brown color which was compared.

Table 1: Treatment of various mordants to fabric silk

Mordants	Volume of mordants (g)	Volume of distilled water (mL)	Treatment time (min)
Copper acetate	10	600	15
Aluminum potassium sulfate	10	600	15
Sodium tartrate plus citric acid	30+90	600	15
iron (II) sulfate	10	600	15
Potassium dichromate	20	600	5

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 for both dyes from the onion and tea as shown in Table 1.

For staining of fabric silk by onion dye, silk was simply immersed in the staining solution at 50-80°C. The staining was done for 30 min with rubbing down. Finally, residual staining solution was washed away and the silk was well dried.

For dried *C. sinensis* var. *assamica*-fermented leaf, staining time of 1 h was different from the staining of onion dye but other steps are identical.

RESULTS AND DISCUSSION

Staining of fabric silk by the coat of onion: The staining patterns of silk by the onion dye were analyzed and color changes of the silk was also done by the treatment of mordants. Mordants are used to set dyes on fabrics or tissue sections by forming a coordination complex with the dye which then attaches to the fabric or tissue (Kadolph, 2013). It may be used for dyeing fabrics or for intensifying stains in cell or tissue preparations. Here, it was precluded that various mordants, e.g., copper acetate, aluminum potassium sulfate, sodium tartrate plus citric acid, iron (II) sulfate and potassium dichromate would change the color of silk followed by the staining of cochineal dye. Figure 2 represented that only onion dye stained the silk traditional brown without any mordant which was similar color with the dried coat of onion. Copper acetate and potassium dichromate showed very similar colors with “none” but darkness or brightness was shown. However, other mordants showed very different color changes as compared with “none”, copper acetate and potassium dichromate. The color of silk by aluminum potassium sulfate and sodium tartrate plus citric acid was yellowish but sodium tartrate plus citric acid induced more darkness. Very interestingly, iron (II) sulfate induced near black which was completely different from the only staining by onion dye without any mordant.

Fig. 2: Staining patterns of dye from the coat of onion and color changes by mordants

Fig. 3: Staining patterns of dye from the *C. sinensis* var. *assamica*-fermented leaf and color changes by mordants

Staining of fabric silk by the *C. sinensis* var. *assamica*-fermented leaf: Constituents of the *C. sinensis* var. *assamica*-fermented leaf are not similar with the coat of onion. Thus, mordants may be able to change the silk colors stained by the leaf as compared with the coat of onion. As shown in Fig. 3, original color without any mordant of "none" represented brownish. As the coat of the onion, although, there are darkness, copper acetate and potassium dichromate induced brownish as well and sodium tartrate plus citric acid did just like the mix of brown and yellow. Very interestingly, aluminum potassium sulfate induced very clear shiny yellow and iron (II) sulfate did the mix of brown and gray.

CONCLUSION

The term, natural dye, covers all the dyes derived from natural resources such as plants, insects and animals (Sharma and Grover, 2011). Copper acetate, aluminum potassium sulfate, sodium tartrate plus citric acid, iron (II)

sulfate and potassium dichromate were applied to the silk fiber (Jung and Park, 2014; Park and Jung, 2014). The study targeted to analyze the staining of silk by the coat of onion and *C. sinensis* var. *assamica*-fermented leaf with the treatment of mordants. Dye extracted natural products, e.g., onion, leaf seemed not to have any toxicity which implied to study biological activity and microscopical usage such as haematoxylin. Haematoxylin is extracted from the heart wood of the log wood tree (*Haematoxylum campechianum*) and its basophilic complexes are used to stain cell nuclei prior to examination under a microscope (Titford, 2005). It is applicable for cellular staining of dark blue. In our study, the coat of onion and *C. sinensis* var. *assamica*-fermented leaf showed clear brown in fabric silk. Of course, the mordants induced the change of its colors. Iron (II) sulfate induced near black which was completely different from the only staining by onion dye without any mordant. Aluminum potassium sulfate induced very clear shiny yellow and iron (II) sulfate did the mix of brown and gray in the staining of *C. sinensis* var. *assamica*-fermented leaf. If applicable, materials used in this study can open the possibility of cellular staining like the haematoxylin.

RECOMMENDATION

Our study would be useful to comparatively analyze the staining changes by the coat of onion and *C. sinensis* var. *assamica*-fermented leaf. Further study will be processed to evaluate them as a biological usage.

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