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Application of *Gardenia jasminoides* and *Curcuma longa* to Natural Stainings

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Abstract: *Gardenia jasminoides* and *Curcuma longa* are natural plants and widely distributed in the world. In this study, whether *G. jasminoides and C. longa* could be applied into the silk fabric was analyzed for natural staining. Fruits of *G. jasminoides* and roots of *C. longa* were air-dried and resulting powders were filtered for silk stainings. *G. jasminoides* without a mordant presented a yellowish color. Aluminum potassium sulfate showed similar pattern with no mordant but shinier. *C. longa* without a mordant presented a grey color. Interestingly, copper acetate and iron (2) sulfate showed a similar darker color pattern of brown and yellow. *Gardenia jasminoides* and *Curcuma longa* are completely different plants but here, dried staining materials contained yellowish properties. This natural staining material that is natural dye may be able to be applied in biological cell staining like hematoxylin.

Key words: *Gardenia jasminoides*, *Curcuma longa*, natural staining, aluminum potassium sulfate, copper acetate and iron (2) sulfate, plants

INTRODUCTION

Gardenia jasminoides is an evergreen flowering plant of the family Rubiaceae. It is widely distributed in Vietnam, Southern China, Taiwan, Japan, Myanmar, India and South Korea. With its shiny green leaves and heavily fragrant white summer flowers, it is widely used in gardens in warm temperate and subtropical climates and as a houseplant in temperate regions. Its fruit is used as a yellow dye which is used for clothes and food. Polynesian people in the pacific islands use these fragrant blooms in their flower necklaces.

Curcuma longa is a rhizomatous herbaceous perennial plant of the ginger family, Zingiberaceae (Priyadarsini, 2014). One active ingredient is curcumin which has a distinctly earthy, slightly bitter, slightly hot peppery flavor. *C. longa* makes a poor fabric dye as it is not very light fast but is commonly used in Indian and Bangladeshi clothing such as saris and Buddhist monks's robes (Valder, 1999). A curcumin dissolved in alcohol is used for water-containing products. *C. longa* (also called Tumeric) study also called curcuma study is used in chemical analysis as an indicator for acidity and alkalinity (Ravindran *et al*., 2007). The study is yellow in acidic and neutral solutions and turns brown to reddish-brown in alkaline solutions with transition between pH of 7.4 and 9.2 (Berger and Sicker, 2009). For pH detection, turmeric paper has been replaced in common use by litmus paper. With respect of pH detection, *C. longa* may be applied in a biological use. In the previous study, apart from the application of natural staining to clothes, natural materials would be an alternative of microscopical analysis in the biological usage such as a hematoxylin of interest. In this study, whether *G. jasminoides* and *C. longa* could be applied into the silk fabric was analyzed for natural staining. Moreover, several mordants were added and which color would be further applied in biological usage was analyzed.

MATERIALS AND METHODS

Subject of study: For the natural staining, *G. jasminoides* and *C. longa* were obtained in Korea and dried to apply for silk fabrics. They were powdered to pass through the filter membrane which caused more rapid penetration into the silk fabrics.

Extraction of natural staining materials: The research targeted the staining of silk, using *G. jasminoides* and *C. longa* and tracked the changes of silk colors using a variety of mordants. In the first simple trial, silk was stained light yellowish by both materials which would produce the best clearance. For the extraction of natural staining materials, fruits of *G. jasminoides* and roots of *C. longa* were air-dried. Completely dried materials were mashed up and filtered with around a 1 mm, sized filter to get a fine powder and and this step was repeated twice.

Staining into silk fabric: In particular, *C. longa* makes different colors by acidic and alkalic pH. However, it is not yet reported that *G. jasminoides* can different color changes by the pH. For only similar color, acidic pH was

Table 1: Effect of various mordants for the staining of silk by *G. jasminoides* and *C. longa*

Mordant (amount)	Amount in *G. jasminoides*	Amount in *C. longa*	Vol. of water (mL)
Copper acetate aluminum	10 g	15 g	600
Potassium sulfate	10 g	15 g	600
Sodium tartrate plus citric acid	30 plus 90 g	30 plus 90 g	600
Iron 2 sulfate	10 g	15 g	600
Potassium dichromate	20 g	20 g	600

applied in this study. The protocol was slightly modified as compared with our previous reports (Sharma and Grover, 2011). In brief, powder was soaked with silk fabric enough extraction with 5 L of tap water for 5 days at room temperature and they were rub down for 20 min at 40°C by hands. This step was repeated twice with interval washing. pH was maintained aroud 3.5-4. The completely extracted natural dye was added with mordants, reacted with the silk fiber for 15 min again and residues were washed away. Finally, silk fibers were dried in air. Various mordants were used together in the staining of silk fibers. The mordants used are described as: copper acetate, aluminum potassium sulfate, sodium tartrate plus citric acid, Iron 2 sulfate and potassium dichromate (Table 1).

RESULTS AND DISCUSSION

Staining by *G. jasminoides*: In this study, *G. jasminoides* was applied as a natural stain and staining procedures were established. Moreover, five different mordants were applied to induce more interesting colors. The staining was performed with powder from the dried plant which implied thicker staining rather than raw natural materials (Fig. 1). The powder was taken from the fruits of *G. jasminoides* with a filter. *G. jasminoides* without a mordant presented a yellowish color. Aluminum potassium sulfate showed similar pattern with no mordant but shinier. Other three mordants except for iron (2) sulfate showed a similar color with no mordant. Iron (2) sulfate made silk stained yellow and darker brown which was caused by the component of iron.

Staining by *C. longa*: As with *G. jasminoides*, *C. longa* was made fine powder. Its dried root was typically shown brown and yellow. Silk by all five mordants presented near brown but not yellow which was derived from enough washing with water. *C. longa* without a mordant presented a grey color (Fig. 2). Sodium tartrate plus citric acid induced very similar pattern with no mordant (Fig. 2). Interestingly, copper acetate and iron (2) sulfate showed a similar darker color pattern of brown and yellow. As with *G. jasminoides*, the effect of iron was shown in *C. longa*, which made silk darker.

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

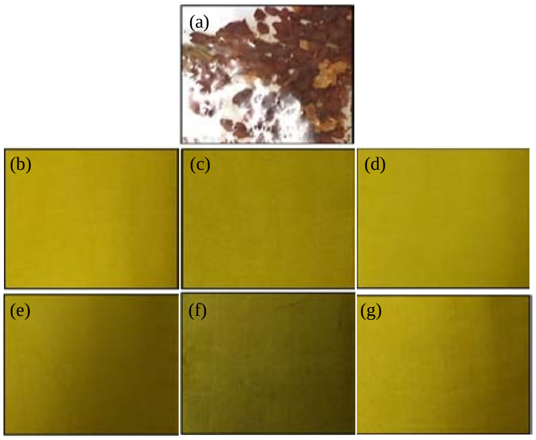

Fig. 1: Staining of silk by *G. jasminoides*. The natural material was dried in air with brownish color. None indicates no mordant and different five mordants were applied to the silk: a) Dried *Gardenia jasminoides*; b) None; c) Copper d) Acetate; Aluminum potassium sulfate; e) Sodium tartrate plus cltricacid; f) Iron (2) Sulfate and g) Potassium dichromate

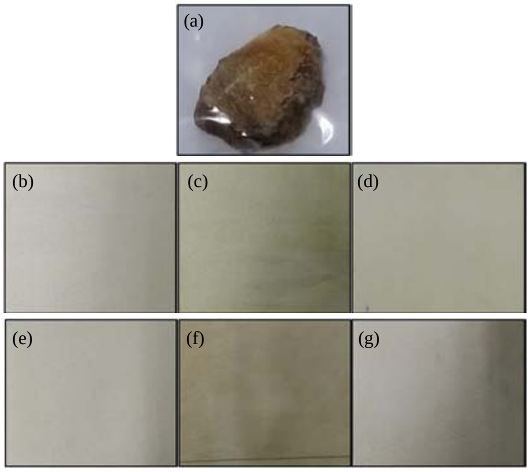

Fig. 2: Staining of silk by *C. longa*. The natural material was dried in air with brown and yellow color. None indicates no mordant and different five mordants were applied to the silk: a) Dried *Curcuma long*; b) None; c) Copper acetate; d) Aluminum potassium sulfate; e) Sodium tartrate plus cltricacid f); Iron (2) Sulfate and g) Potassium dichromate

potassium sulfate, sodium tartrate plus citric acid, iron (2) sulfate and potassium dichromate were applied to the silk fiber (Jung and Park, 2014; Park and Jung, 2014). Of course, the mordants made the colors of silk fiber change like this study. In this staining by two materials, the mordants induced color changes and the component of iron made color darker. *G. jasminoides* and *C. longa* are completely different plants but here, dried staining materials contained yellowish properties which resulted in staining of silk by yellow. This natural staining material that is natural dye may be able to be applied in biological cell staining. Hematoxylin, called natural black 1 or CI 75290 is a compound extracted from the heartwood of the logwood tree (*Haematoxylum campechianum*) and its basophilic complexes are used to stain cell nuclei prior to examination under a microscope (Titford, 2005). Hematoxylin is widely used as a natural dye and if two natural materials used in this study are applicable for cellular staining they will be very useful for those to show yellow and brown colors. Histological studies using hematoxylin and eosin (H&E) staining demonstrated that geniposide substantially inhibited lipopolysaccharides-induced alveolar wall changes, alveolar haemorrhage and neutrophil infiltration in lung tissue with evidence of reduced myeloperoxidase activity (Xiaofeng *et al*., 2012). Back *et al*. (2016) proved that the normal tissue including glandular epithelium of mucosa membrane from the patients with gastric cancer could be ideally stained with 3 μm thickness for the microscopic analysis (Back *et al*., 2016). In addition, they also emphasized that the appropriate staining time for hematoxylin was 4 min and 30 sec and for eosin was 3 min and 45 sec. Including haematoxylin, *G. jasminoides* and *C. longa* are natural products in themselves. If the natural products are used for immune staining they may be effective to observe organelles, proteins, etc., in cells and tissues. In its analysis, most of the reagents contains antibody, antigen, enzyme or fluorescein-conjugated with the antibody, etc. For an example, mutant protein of p53 of high stability was detected by immunohistochemistry technique and was used to understand the correlation of it with other clinicopathological characteristics of breast cancer patients (Sheikhpour *et al*., 2014). In the trial for the automation of immunohistochemistry images, immunohistochemistry stained breast cytology images are used for finding the protein receptors which was stained on brown color present in the nucleus (Smitha *et al*., 2015). Powder from the natural products may be purified into single compounds which may be applied into materials-conjugated with the antibody for immunohistochemistry.

CONCLUSION

This study proposed the natural staining of natural products, e.g., *G. jasminoides*, *C. longa* to silk fabrics. There is no special reason to use the silk fabrics. In other words, the natural staining also can be applied into other fabrics, e.g., cotton. In this study, whether *G. jasminoides* and *C. longa* could be applied into the silk fabric was analyzed for natural staining. Moreover, several mordants were added and which color would be further applied in biological usage was analyzed. The mordants are very useful to change colors. In particular, iron (2) sulfate made silk stained yellow and darker brown in the staining of *G. jasminoides* and copper acetate and iron (2) sulfate showed a darker color pattern of brown and yellow in the staining of *C. longa*. In fact, there are a few reports to present natural stainings by *G. jasminoides* and *C. longa*. Experimental results suggest protocols for staining with silk fabrics and in future possibility to be applied with histochemical and cellular-staining such as the haematoxylin staining.

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