

Effect of Mordants on Dyeability and Antimicrobial Properties of the Mordanted and Natural-Dyed Fabrics

-Light and Burial-Induced Changes in the Color and Tensile Properties-

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Introduction

Natural dyes found on historic textiles are not particularly light fastness or fast to soil burial conditions, and changes in the shade and depth of shade of dyed textiles can occur during these weathering process. Mordanting of natural-dyed textiles with metal salts also can affect their color. Also certain metal salts are known to have antimicrobial properties. To obtain a better understand of the effect of mordants on sunlight and burial weathering processes, the dyeability and biological properties of mordanted and natural-dyed cotton and silk substrates was investigated.

Experimental

Dyes and Mordants : Two natural red dyes were extracted from *Caesalpinia Sappan* L.(CSL) and *Rubia Akane Nakai*(RAN) by boiling water. Five representative metal salts of Al, Cr, Cu, Fe and Sn were used as mordanting agents.

Dyeing and Mordanting Procedure : Silk and cotton fabrics were dyed three times in the dyeing-mordanting process at a suitable temperature, which was carried out with a laboratory dyeing machine.

Evaluation : λ_{max} in VIS spectra of the dyeing solution, and K/S value and color of dyed fabrics were measured by a MacBeth Color-Eye 3000 color spectrophotometer. The quantity of the mordant absorbed in the dyed fabrics was measured by Atomic Absorption Spectrophotometer. Strength loss after soil burial test was determined with an Instron to evaluate the antifungal activity of the dyed fabrics.

Results and Discussion

1) Mordant-Induced Color Change

In the case of the fabrics mordanted and dyed with CSL, K/S value increases and λ_{max} shifts to the longer wavelength as mordant concentration increases. Colors of the fabrics dyed with CSL and RAN change to redder, bluer and lighter after mordanting. As the number of repetition of dyeing-mordanting process increases, the colors of the dyed fabrics tend to be redder, bluer and darker. Mordanted dyes with Al and Sn make chroma brighter. The quantity of mordant absorbed in the silk fabric increases as mordant concentration increases. More Fe is absorbed in silk than Cr is.

2) *Light-Induced Color Change*

After being exposed to light, the fabrics dyed with CSL and RAN change to less red. Fe and Cu mordanting yield better colorfastness to light than others does. Natural-dyed fabrics exposed to light tend to be faded and whitened in a CIELAB chromaticity co-ordinates. So, we might trace back the original color of ancient faded fabrics by changes in color of natural dyes.

3) *Burial-Induced Color Changes and Tensile Properties*

The soil-buried cotton is more susceptible to mildew and rot than the silk is. Antimicrobial activity of the natural-dyed cotton and silk can be enhanced by Cu and Cr mordanting respectively. Soil fungi and other microorganism are killed by metal ions and particularly by Cu and Cr ions.

Conclusions

Light and burial-induced changes in the color and tensile properties of cotton and silk fibers dyed with natural dyes and mordanted are dependent on the fiber type and the dye-mordant combination used on the fiber. Also light induced weathering of these materials is very different than burial-induced weathering.