

Photofading of Wool Colored by Tryptophan Color Reactions

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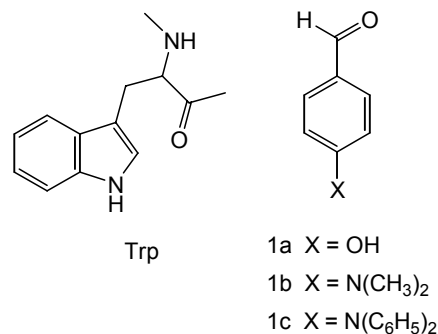
Abstract

Treatment of wool fabric with aromatic aldehydes followed by oxidation with hydrogen peroxide gave rise to coloring reaction. The colored fabric was bleached by reduction and recovered the color by oxidation. The oxidation in ethanol solution gave higher k/s values than that in aqueous solution. Photo-stability of the colored fabric was improved by treating with nickel sulfate.

1. Introduction

Dyeing industries face increasing demands for environmental protection. Recently Donowaki has developed a new method of coloring wool and silk by treating them with an acetic acid solution of trifluoroacetic acid in the presence of aromatic aldehyde derivatives and proposed a mechanism involving reactions at the tryptophan units (**Trp**) of the polypeptides¹.

In this work we examined the coloring reaction of wool using aromatic aldehydes and investigated their photofading reactions.



2. Experimental

Aromatic aldehydes used were *p*-hydroxybenzaldehyde (**1a**), *N,N*-dimethyl-*p*-aminobenzaldehyde (**1b**) and *N,N*-diphenyl-*p*-aminobenzaldehyde (**1c**). Fabrics of wool were treated with ethanol solutions or aqueous solutions of 3.0 % hydrogen chloride containing 0.5 wt% of aldehydes in liquor ratios of 1:50 at 60 °C for 12 h. After washed with water and then with ethanol, the fabrics were subjected to an oxidation process by treating them with an ethanol solution or an aqueous solution of 3.0 wt% hydrogen chloride containing 0.25 wt% hydrogen peroxide in liquor ratio of 1:50 at 60 °C for 1 h.

The colored fabrics were exposed to a 366 nm irradiation of mercury lamp equipped with a filter. Reflectance at the absorption maxima of the fabric gave k/s value of Kubelka-Munk equation. Photofading of colored wool fabrics treated with 10 wt% nickel sulfate solution were also examined.

3. Results and discussion

As shown by Fig. 1, the fabric colored by **1a** was bleached on treatment with an aqueous solution of sodium dithionite. The fabrics recovered the color on treatment with aqueous solution of hydrogen peroxide. Comparison with model compounds implied that the color change involves reduction and oxidation processes at the tryptophan unit (**Trp**) of wool.

Table 1 shows k/s values of colored fabrics. As to the wool treated with **1a**, **1b** and **1c**, oxidation in ethanol solution gave k/s values about 4.3, 5.4 and 20 times higher than those in aqueous solution, respectively.

The colored fabrics were exposed to ultraviolet irradiation for 24h. Table 1 summarizes the relative k/s obtained as a ratio of k/s of the exposed fabric against the value at the initial stage of the reaction. The **1a** as well as **1b**-colored fabrics that were treated with hydrogen peroxide in ethanol solutions showed little differences in photo-stability from those in the aqueous solution. The wool fabrics treated with **1c** increased k/s value on irradiation, implying photo-oxidation of the color precursor which survived oxidation with H₂O₂ in aqueous solution.

Treatment with a nickel sulfate solution improved the photo-stability of **1a**-colored wool, implying a mechanism of photoreaction involving a singlet oxygen intermediate. Photo-stability of **1a**-colored fabric was decreased by 60 % in an atmosphere of high humidity.

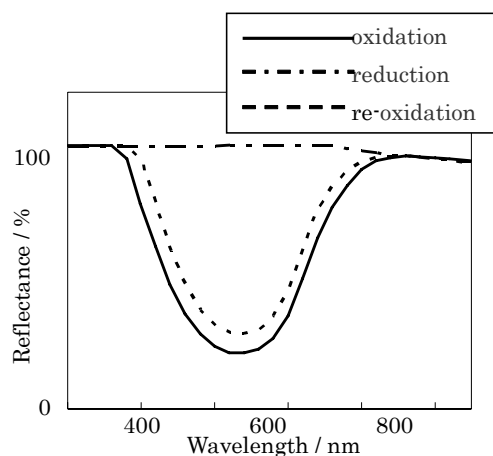


Fig. 1. Reflectance spectra of wool colored with **1a**.

Table 1. Condition of coloring of wool, k/s and relative k/s after irradiated for 24 h

Aldehyde	Treatment ^{a)}		k/s (0h)	Relative k/s (24h)
	I	II		
1a	A	A	0.19	0.60
1a	A	B	0.59	0.64
1a	B	A	0.19	0.65
1a	B	B	0.82	0.66
1b	A	A	0.54	0.54
1b	A	B	2.8	0.52
1b	B	A	0.30	
1b	B	B	2.9	0.67
1c	B	A	0.095	1.1
1c	B	B	1.9	0.59

a) I: Aldehyde treatment; II: Oxidation.

A: in aqueous solution; B: in ethanol solution.

4. References

1. K. Donowaki, *Jpn. Kokai* 2001055672 (2001); *C. A.*, **134**, 209240 (2001).