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A Study on Dyeing with Reactive Yellow 15 Dye and Its Effect on Modified Mulberry Silk /Wool Blended Fabric.

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ABSTRACT

A study on dyeing with reactive yellow 15 dye and its effect on modified mulberry silk/wool blended fabric was conducted. In this study enzymatically unmodified and enzymatically modified samples were dyed under optimized dyeing conditions viz. dyeing pH 6, dyeing time 60 min, dyeing temperature 800C and dyeing concentration 4% (owf). The optical density, CIE Lab K/S values and colour fastness properties of both enzymatically unmodified and enzymatically modified fabric were compared. It was found that the enzymatically modified dyed samples showed significantly increased dye absorption when compared to the enzymatically untreated dyed samples whereas no significant difference in the CIE Lab and K/S values of enzymatically unmodified and modified dyed samples was observed. The enzymatically modified showed slight change in the colour fastness properties.

KEYWORDS : Covalent bond, Optical density Reactive dyes, Spectrophotometer

INTRODUCTION

Reactive dyes are so called because their molecules react chemically with the fibre polymers of some fibres to form a covalent bond between the dye molecule and the fibre polymer. Reactive dyes are applied to protein fibres under slightly acid conditions. The reactive dyes used for protein fibres can form covalent bonds with one of the many groups in the protein fibre: the terminal and side chain amino groups, the –SH group of cystein and the hydroxyl group of tyrosine amino acid residue. In this study mulberry silk/wool blended fabric and enzymatically modified mulberry silk/wool blended fabric was dyed with reactive dye reactive yellow 15.

METHODOLOGY

Mulberry silk/wool blended fabric in the ratio of 65:35 with plain weave was used in the study. Enzymatically unmodified control and enzymatically modified fabric samples were dyed with Reactive yellow 15 under optimized dyeing parameters. For enzymatically modified samples fabric was treated with a proteolytic enzyme (Greasenz PWE liquid) at pH media 8.5, 1% enzyme concentration for 45 minutes treatment time.

Recipe for dyeing

Dye : 4%

M: L : 1:30

Dyeing pH : 6

Sodium sulphate : 30g/l

Soda ash : 2g/l

Temperature : 80^{0}C

Time : 60 minutes

The dye bath was setup with 4% dye concentration. After wetting the enzymatically unmodified control and enzymatically modified fabric samples. These were entered into the separate dye bath and the temperature was raised to optimized temperature. After 10 minutes half portion of sodium sulphate was added, and then the samples were worked for 10 minutes. Later the remaining portion of sodium sulphate was added and the samples were worked for half an hour. Soda ash was added to the dye bath for fixing the colour and dyeing was carried out for another 30 minutes. After dyeing, the samples were taken out for washing and soaping to remove the excess dye. The exhaustion values of dyed samples were measured by taking absorbance of the dye liquor sample (before and after dyeing) using an UV-visible spectrophotometer and then compared for enzymatically unmodified and enzymatically modified samples. For taking the CIE Lab and K/S values colour flex spectrophotometer was used.

RESULT AND DISCUSSION

The results in table 1 showed that the optical density of the enzymatically modified samples dyed with reactive yellow 15 had much higher absorbency than the enzymatically unmodified control. The statistically analysed values of optical density for enzymatically modified samples and enzymatically unmodified control were 63.4±0.02 percent and 36.4±0.08 percent respectively, which were significantly different from each other. Sumeet also observed the more dye absorption in enzymatically treated samples of wool dyed with natural dyes when compared with enzymatically untreated samples. According to Montazer and Ramin protease treatment helps to remove some of the hydrophobic compounds on wool surfaces, which enhance the surface properties, such as moisture and dye absorption. In the present study, the hydrophobic compounds on the wool surface were removed by the application of proteolytic enzyme resulting in the increased dye uptake percent.

The mean L value observed from the table 1 revealed that the mean value was lower for enzymatically unmodified control (70.97± 0.23) than the enzymatically modified samples (73.03±0.62) dyed with reactive yellow 15. Statistically analysed data indicated that the enzymatically unmodified control was darker as compared to enzymatically modified samples dyed with reactive yellow 15.

Table.1 Effect of enzymatic modification on optical density, CIE Lab and K/S values of samples when dyed with reactive yellow 15

		EUM	EM	t- value
Reactive yellow 15	Optical density	36.4±0.08	63.4±0.02	294.99*
	L	70.97±0.23	73.03±0.62	3.47*
	a	19.65±0.78	18.97±0.43	0.95^{NS}
	b	79.85±0.23	78.75±0.36	1.84^{NS}
	K/S	12.10±0.08	12.35±0.08	1.75^{NS}

EM= Enzymatically Modified, EUM= Enzymatically Unmodified ControlNS = Non Significant at 5 % level of significance

*** = Significant at 5 % level of significance**

Data regarding the a value revealed that the enzymatically modified samples dyed with reactive yellow 15 were slightly less red when compared to enzymatically unmodified samples. The mean values of enzymatically modified and enzymatically unmodified control dyed with reactive yellow 15 were 18.97±0.97 and 19.65±0.78 respectively, which were statistically at par to each other.

The mean b values were 78.75±0.36 and 79.85±0.23 of enzymatically modified and enzymatically unmodified samples respectively, which were statistically at par to each other. This indicates no effect of enzymatic pre treatment on the b values of samples dyed with reactive yellow 15

Similarly, the mean K/S values were 12.35±0.08 and 12.10±0.08 for enzymatically modified samples and enzymatically unmodified control samples respectively, which were statistically at par to each other. This revealed that there was no significant change in the colour strength due to the enzymatic modification for the reactive yellow 15 dye.

The results of colour fastness properties of the samples have been presented in table 2. The light fastness grades of reactive yellow 15 were 5 for both enzymatically modified and unmodified control. For reactive red 198 and reactive yellow 15 the washing fastness grades in terms of colour change for enzymatically unmodified control were 5 and 4/5 respectively, whereas the grades for enzymatically modified samples were 4/5 and 5. The rubbing fastness grades showed no change in the terms of colour change grades for both enzymatically unmodified and modified samples, indicating no effect of enzymatic pre treatment on the colour change of reactive yellow 15 dyed samples in dry (4/5) and wet (4) conditions. In terms of colour staining the grades were 4/5 for enzymatically unmodified control and 4 for enzymatically modified samples in dry conditions, while in wet conditions the colour staining grades were 4 for both enzymatically unmodified and modified samples.

Table 2. Colour fastness grades for enzymatically unmodified and modified mulberry silk /wool blended samples dyed with reactive yellow 15 dye.

Dye	Fabric	Light Fastness Grades	Washing Fastness Grades			Rubbing Fastness Grades				Perspiration Fastness Grades					
			CC	CS		Dry		Wet		Acidic			Alkaline		
				W	C	CC	CS	CC	CS	CC	CS		CC	CS	
											W	C		W	C
Reactive yellow 15	EUM	5	4/5	4/5	4/5	4/5	4/5	4	4	4/5	4/5	5	4/5	5	5
	EM	5	5	5	5	4/5	4	4	4	5	4/5	5	5	5	5

EM= Enzymatically Modified, EUM= Enzymatically Unmodified Control

The perspiration fastness grades of reactive yellow 15 dye in terms of colour change were 4/5 in both acidic and alkaline media for enzymatically unmodified control, whereas the enzymatically modified samples showed improvement in grades and increased to 5. The colour staining grades were 4/5 for both enzymatically unmodified control and enzymatically modified samples for wool fabric in acidic medium. No colour staining was observed on cotton for both enzymatically unmodified control and enzymatically modified samples in acidic medium. In alkaline medium the enzymatically unmodified control and enzymatically modified samples showed no colour staining for both wool and cotton fabric.

The results of the study concluded that the enzymatic modification significantly increased the dye absorption percentage of the mulberry silk/wool blended fabric. It was observed that the colour strength and colour value remained same for both enzymatically pre-treated and enzymatically untreated samples. There was a negligible change in the colour fastness properties of the samples for reactive yellow 15 dye.

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