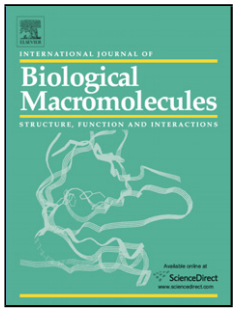

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Authors: Toktam Sajed, Aminoddin Haji, Mohammad Khajeh Mehrizi, Majid Nasiri Boroumand

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<AT>Modification of wool protein fiber with plasma and dendrimer: effects on dyeing with cochineal

<AU>Toktam Sajed[a], Aminoddin Haji[b*] ##Email##ahaji@iaubir.ac.ir##/Email##, Mohammad Khajeh Mehrizi[c], Majid Nasiri Boroumand[d]
<AFF>[a]Ardakan Carpet Department, Yazd Science and Art University, Yazd, Iran
<AFF>[b]Textile Engineering Department, Birjand Branch, Islamic Azad University, Birjand, Iran
<AFF>[c]Textile Engineering Department, Yazd University, Yazd, Iran
<AFF>[d]Department of Carpet, Shahid Bahonar University of Kerman, Kerman, Iran

<ABS-HEAD>Abstract

<ABS-P>In this study, plasma treatment and a poly(propylene imine) dendrimer were employed to improve the dyeability of wool fibers with cochineal natural dye. FESEM, EDX, AFM and FTIR techniques were employed to investigate the effects of these treatments on chemical and physical properties of wool fibers. The etching of surface layer of wool fibers and increased roughness after plasma treatment was confirmed by FESEM and AFM images. EDX and FTIR analyses confirmed the creation of oxygen-containing groups and attachment of dendrimer molecules on wool fibers after plasma and dendrimer treatments respectively. The effect of different dyeing parameters on dye absorption and the applicability of different isotherm and kinetic models on the dyeing process were investigated. The results showed that the kinetics of absorption of cochineal on raw, plasma-treated and dendrimer-treated fibers was best fitted with the pseudo-second-order model and the isotherms of the dyeing processes followed the Freundlich model.
<KWD>Keywords: Wool;; Plasma; Dendrimer.

<H1>1. Introduction

An increasing attention has been paid in textile research and development to environmentally benign and non-toxic bio-based colorants and garments due to the public concern about health issues and eco-protection [1-2]. Natural dyes derived from plants, animals, bacteria and fungi are believed to be bio-compatible, safe and renewable alternatives to synthetic colorants because of their biodegradability and low allergic reactions [3-4].

Wool as one of the most popular natural fibers is usually used in high quality textiles and hand-woven carpets. The existence of hydrophobic scales on the surface of wool fibers makes the diffusion of dye molecules difficult [5-6]. This problem is more pronounced when applying natural dyes on wool due to the low affinity of these dyes to protein fibers. Traditionally metal mordants like aluminum, tin, copper, chromium and iron salts are employed to improve the exhaustion and fastness of natural dyes on wool fibers by complex formation between the wool polymeric structure, dye molecule and the metal atom [7-9]. Today it is known that metal mordants are more or less toxic and may impose hazards to human being, animals and environment. So, different studies have been done to minimize the use of metal mordants in natural dyeing recipes or replace them with more environmentally friendly alternatives [7, 10-11].

The use of high energy radiations is one of the vastly studied approaches for surface modification and improving the dyeability of textile fibers by natural and synthetic dyes [12]. The ultrasonic technique was used for increasing the color strength of wool fabric when dyeing with natural dye extracted from grape pomace [13]. This method reduced the dyeing time, temperature and energy consumption of the dyeing process [13-14]. Microwave radiation improved the dyeability of wool and cotton fibers with natural and synthetic dyes [15-16]. Pretreatment of woolen fabric with gamma radiation prior to dyeing with pomegranate rinds as a natural dye increased the sorption capacity of the natural dye and