International Journal of Biological Macromolecules 109 (2018) 476–482

Contents lists available at ScienceDirect

International Journal of Biological Macromolecules

journal homepage: www.elsevier.com/locate/ijbiomac

Production of cotton fabrics with durable antibacterial property by using gum tragacanth and silver

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ARTICLE INFO

Article history:
Received 3 October 2017
Received in revised form
24 November 2017
Accepted 17 December 2017
Available online 21 December 2017

Keywords:
Gum tragacanth
Silver
Antibacterial
Cotton

ABSTRACT

A simple and inexpensive procedure has been devised to prepare antibacterial cotton fabric using silver nanoparticles (AgNPs) and bio degradable gum tragacanth (GT). For this, different concentrations of GT (2, 4 and 6 g/L) along with a constant amount of Ag (5%; according to weight of dry GT used in the solutions) were applied to investigate the efficacy of antibacterial potency against *Escherichia coli* and *Staphylococcus aureus* and their effect on physical, mechanical and biological characteristics of cotton fabric. Our study exhibited the presence of small amount of AgNPs in the composite structure was enough to increase the antibacterial activity of fabrics compared to fabric that were treated by only GT. Moreover, the treated cotton with GT-4%/Ag indicated proper tensile strength and stiffness compared to treated fabric with GT-6%/Ag composite. The biocompatibility of the GT and GT/Ag treated fabrics was verified through MTT assay on fibroblast cells.

1. Introduction

In recent years, global competition in developing advanced textile-based medical products has created many challenges for textile researchers and industrialists due to increased human awareness of individual health and safety [1]. Antimicrobial-finished fabrics with enhanced functionality find diverse applications such as infection control as well as other health and hygiene uses [2]. The Surface of several fabrics is a suitable place to grow bacteria and fungi. The presence of moisture and heat allow the growth of bacteria on fabrics and creation of disease, infection and bad smell [3]. Cellulosic fabrics such as cotton are extensively used in the field of clothing and medical applications because of their renewability, ecofriendly nature, comfortability, hydrophilic surface and air permeability [4]. It should be noted that, because of porosity, hydrophilic nature and high capacity in holding water, oxygen and other nutrients, these textile fabrics are more vulnerable to microbial attacks than synthetic textile fabrics and show high promotion in bacterial growth [5]. Recently, the textile industry has introduced anti-bacterial and anti-fungal fabrics for medical, sanitary, disinfection with good stability against home and hospital washings, proper strength, inexpensive and easy care [6]. Among all the materials known today as antibacterial agents, materials based on polymers or polymer composites are used extensively [7]. Polysaccharides such as chitosan has attracted a great deal of interest for treatment of different fabrics as a coating or finishing agent due to have a very good antibacterial property [8,9]. The effect of chitosan on the characteristics of different type of fabrics such as wool fabrics as an antibacterial and antifelting agent [10], silk as a factor affecting the breaking strength and wrinkle resistance [11], as well as on cotton fabrics has been investigated. The production of antibacterial textiles treated with natural materials along with nanoparticles protects the body from harmful bacteria. Lately, most researchers are considering the possible applications of nanotechnology for generating more attractive and high performance value-added textile materials [12]. Surface modification of textiles with nanomaterials is the useful technique for production of highly active textile surfaces with a range of functionality [13]. Silver as a low-toxic nanoparticles is the most common strong antimicrobial agent against numerous bacterial strains with a broad range of activity, unbelievable physical, chemical and biological characteristics [14]. But, adhesion of silver nanoparticles (AgNPs) on textile materials has been challenged due to its low charge density. Cotton fabrics, along with the natural polymer of chitosan and AgNPs, have been widely developed for antibacterial applications. Arif et al. reported preparation of antibacterial cotton with using chitosan-AgNPs (CS-AgNPs). Their results on the antibacterial effect of CS-AgNPs treated fabrics confirmed that synthesized nanoparticles imparted high potency to fabrics agains Eschrichia coli, Pseudomonas aeruginosa and Bacillus cereus [7]. Aryabadie et al. synthesizing chitosan-poly (amidoamine) dendrimer then

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https://doi.org/10.1016/j.ijbiomac.2017.12.093
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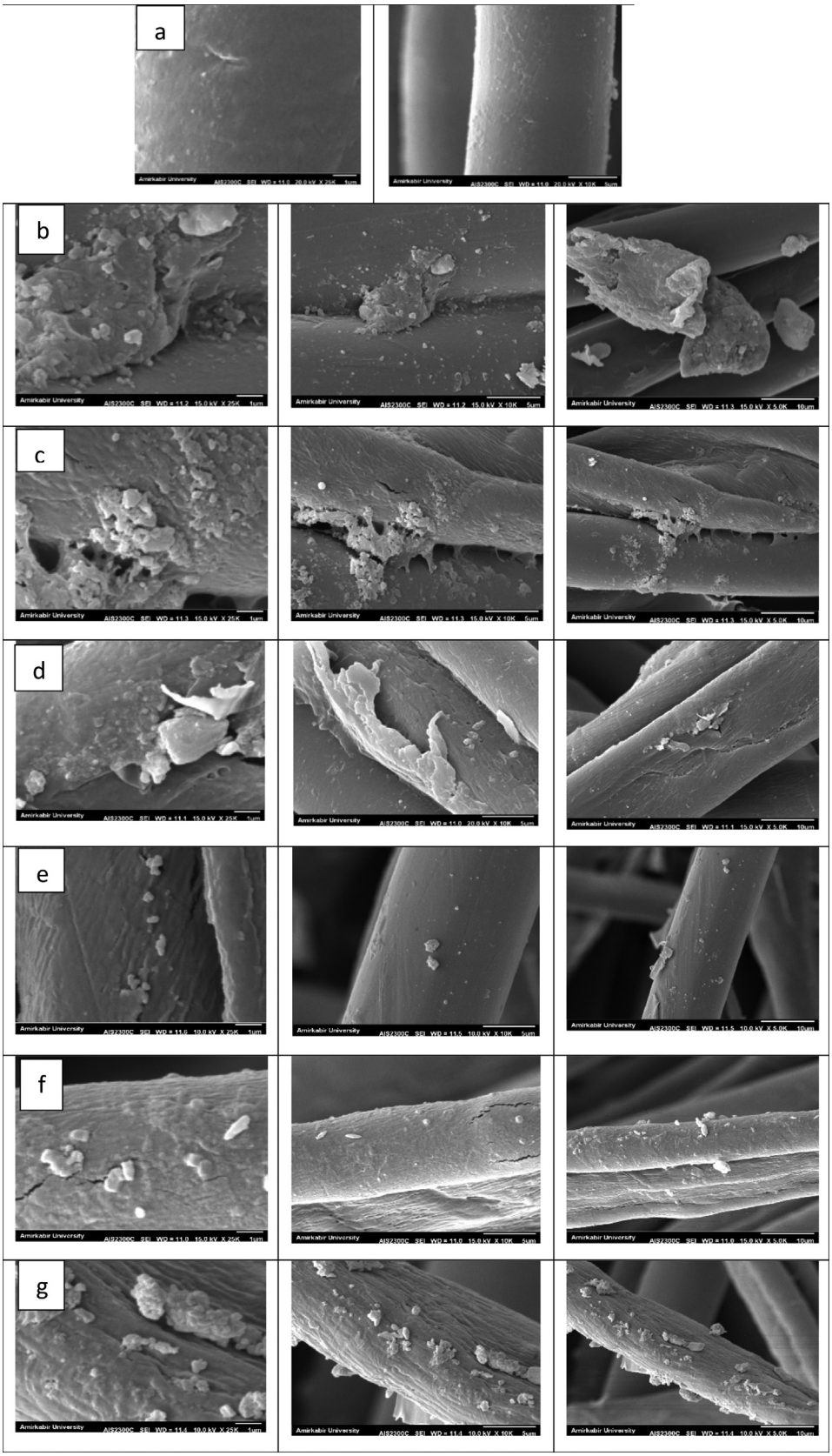

Fig. 1. SEM images of (a) untreated cotton, (b) Co/GT-2% (c) Co/GT-4%, (d) Co/GT-6% (e) Co/GT-2%-Ag (f) Co/GT-4%-Ag (g) Co/GT-6%-Ag in three different magnifications.

applied it on to cotton fabrics with pad-dry-cure technique. Their results revealed that the treated fabrics had strong antibacterial properties and enhanced dyeing capability with reactive dyes [15]. There are more investigations about using chitosan as media for silver and treating cotton with this composition, but it should be kept in mind that chitosan is a relatively expensive polymer and its