

Abstract

Nanotechnology has a widespread application in textile fields especially in technical textiles, finishing, and dyeing processes. Accordingly, in this research, we investigated the effect of nanogold as a mordant for woollen textile dyeing. The purpose of this research was to produce a multifunctional woollen textile. Therefore, after the yarn purification and neutralization, the yarns were pre-treated with nanogold (60ppm) in boiling water for 1 hour and then were dyed (on chrome method). Then nanoparticles and colorant yarns were assessed through DLS, EDS, FESEM, SEM, washing fastness, light fastness, and antibacterial property. The obtained results indicated that nanogold was absorbed by the wool and the washing and light fastness were enhanced. Besides, nanogold did not show any staining or roughness on the yarns. In addition, the yarns showed high antibacterial property against Gram-positive (*Escherichia*) and Gram-negative (*Staphylococcus aureus*) bacteria.

Objective

Applying nanogold as mordant in dyeing process of wool for production of multi-functional finishing

Material and Method

2.1 AuNPs properties

Nanogold was purchased from Nanopadsharif Co. (Tehran, Iran) Chemical and particle size analysis of AuNPs were investigated through EDS, DLS, and FESEM.

2.2 Yarn preparation

To eliminate contaminants from the yarns, an alkaline scouring technique was used according to table1. After 5 minutes, samples were rinsed with distilled water and acid acetic neutralized.

Table 1: Scouring bath materials and condition

Materials	
Na ₂ CO ₃	1 (g/l)
Detergent	1-3 (g/l)
Temperature	60 (°C)
Time	5 (min)
L:R	1:30

-Dyeing process

According to the onchrome dyeing method, the coloring procedure consists of two steps: first, the wool fibers were treated with nanogold (60ppm), potassium dichromate (9% w/w), and acid formic (6% w/w), and then the specimens were dyed (2g/l) in a fresh bath with selected chromic colors. Crom Fast Blue BGL was also used in the coloring process. Merck Chemicals was used to purchase other chemicals [9].

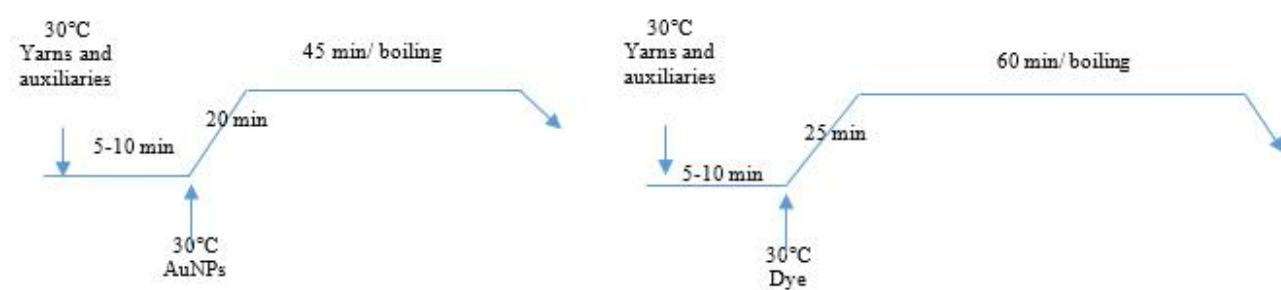


Figure 1: The graph of mordanting and dyeing process

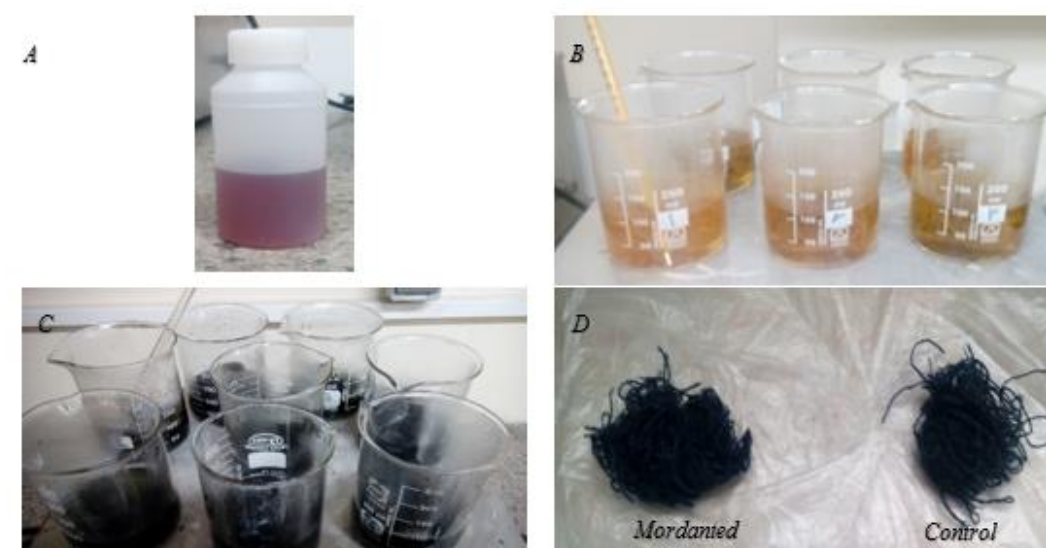


Figure 2: AuNPs colloid (A), mordanting (B) and dyeing (C) process and dyed yarns (D)

Results

-AuNPs characteristics

Table 2. Element composition of gold nanoparticles

Element	Weight (%)	Atomic (%)
O	7.34	18.50
Na	20.24	35.51
Cl	33.41	38.00
Au	39	7.99
Total	100	100

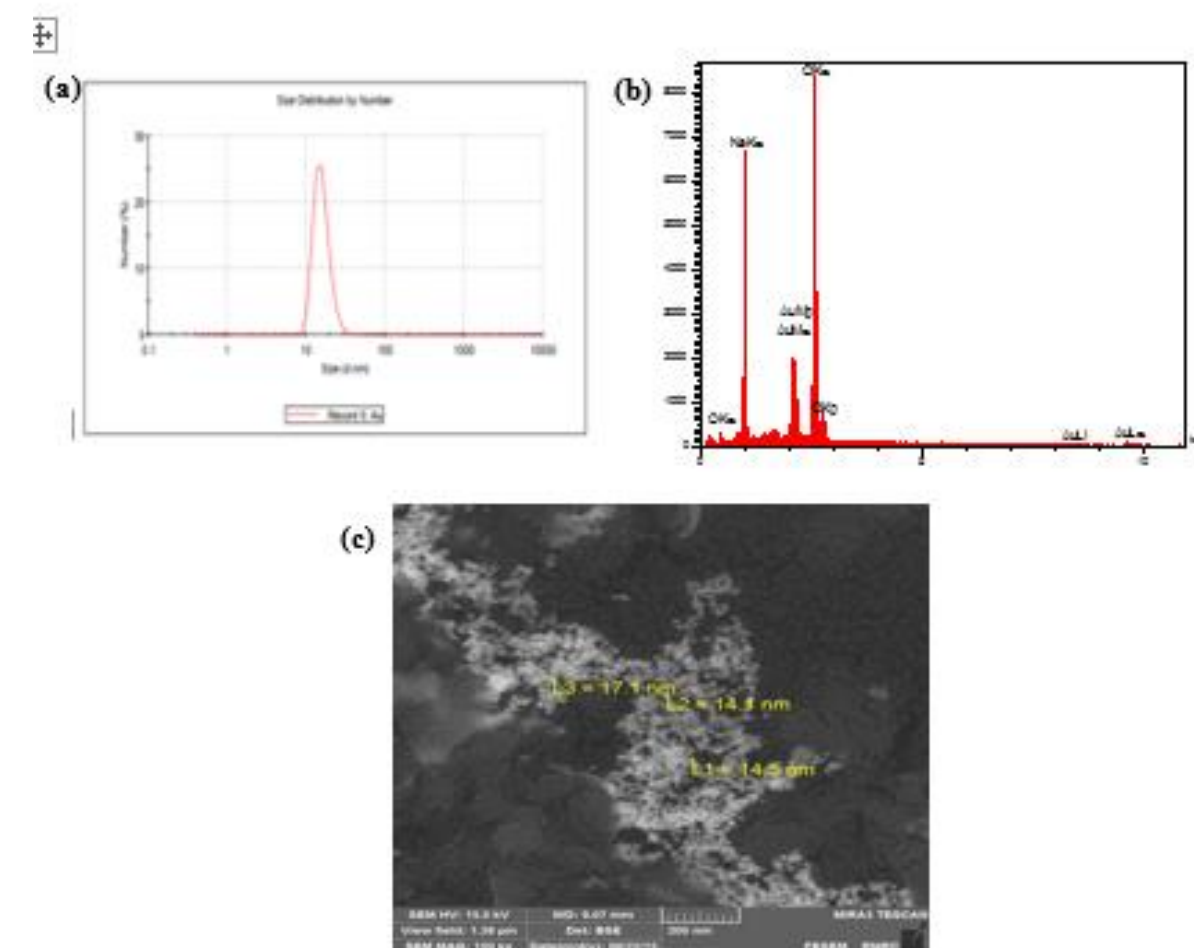


Figure 3: DLS (a), EDS (b), and FESEM image (c) of gold nanoparticles

-Color fastness

Table 3: Colour fastness of mordanted and normal dyed woollen yarns

sample	Wash fastness	Light fastness	Staining on white wool fibers	Staining on other white fibers
Untreated woollen yarn	4	5	4-5	5
mordanted woollen yarn	5	5	5	5

-SEM observation

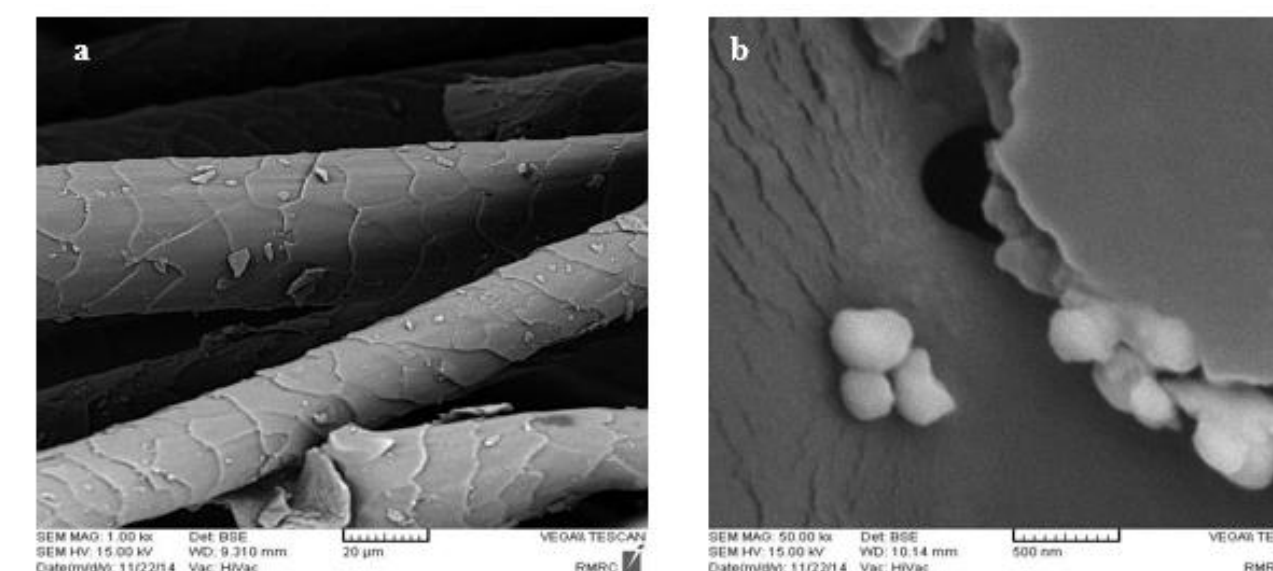


Figure 4: SEM images of mordanted woollen yarns

-Antibacterial property

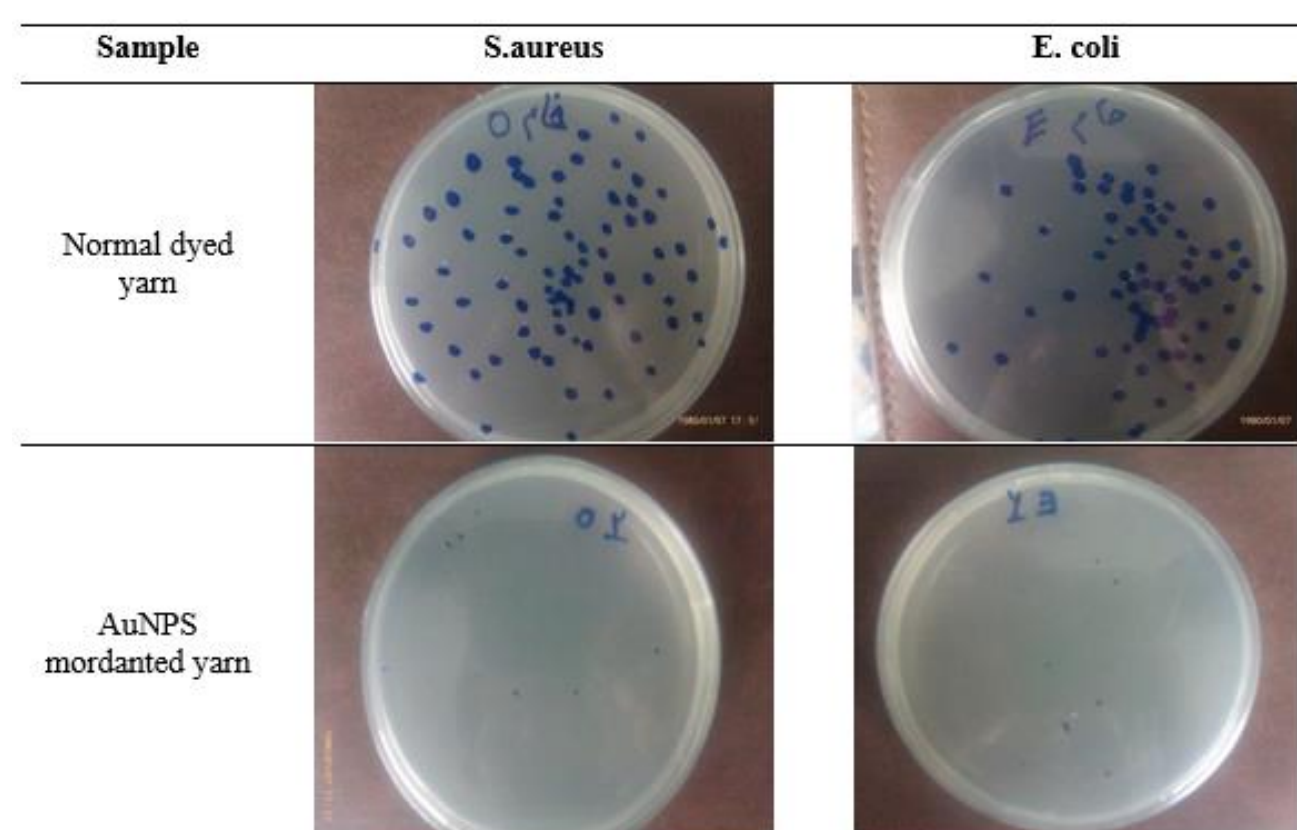


Figure 5: Antibacterial property of normal dyed woollen yarns and AuNPs mordanted one against *Staphylococcus aureus* and *Escherichia coli*

Conclusion

Gold nanoparticles have become one of the most important areas of nanometal study in recent years. AuNPs have unique qualities such as surface properties, antibacterial activity, biocompatibility, and UV absorption, making them a good contender for industrial and medicinal use. Textile industry employed it for dyeing and luxury cloth production, among other things. We used nanogolds as a mordant material to improve color fastness and created a multi-functional finishing for woollen textiles in this study. The results showed that mordanting wools with gold nanoparticles boosted wash fastness while AuNPs had no negative impact on textile hand feel. Furthermore, the treated fabric has good potential against infection bacteria.

Reference

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