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Comparison study for synthesis Silver Nanoparticle (Ag NPs) By Ficus Caria and Tannic acid for coating cotton fibers as antimicrobial

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Abstract Cotton fibers were coated chemically with silver nanoparticles to increase the antibacterial efficacy. Silver nanoparticles were synthesized by agreen method and coated on cotton fabric using dipprocess using extracted of Ficus Caria and Tannic acid. The process includes the activation of cellulose fibres in alkaline solution, followed by reduction of silver nitrate to Ag NPs in the second stage, while the last stage of process involves washing of fibres. In situ preparation of Ag NPs with plant and Tannic acid show nanoparticles were about 70 nm in size. The synthesized silver nanoparticles were characterized using ultraviolet visible spectra, particle size distribution.The treated cotton fibers by silver nanaoparticles showed antimicrobial effects by killing and/or suppressing growth of a broad spectrum of microbes such as Escherichia coli and Staphylococcus aurues bacteria.

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Introduction:

Recently, the commercial market for antibacterial fibers has grown rapidly due to the increased need of consumers. Polymeric materials, such as cotton, wool and flax, provides an excellent substrate for bacteria growth because they are contaminated easily with microorganisms under the appropriate environmental conditions **(Borkow & Gabbay, 2008; Gao & Cranston, 2008).** Microbial proliferation eventually causes damage to the fiber materials and induces human infections **(Pekhtasheva, Neverov, Kubica, & Zaikov, 2012)**. The applications of silver nanoparticles have been applied widely to fiber materials because their strong inhibitory and antibacterial properties results from the large contact areas with microorganisms **(Chen et al., 2009; Dubas & Pimpan, 2008).** One of the main technological hindrances of surface modification of textile surfaces involving NPs is their relatively low permanence, especially against washing **(Geranio, Heuberger, & Nowack, 2009)**. Due to this reason, the main purpose of this study was to develop a simple, low cost and time-saving method for silver particles incorporation into cellulose fibres, which will have a sustained antimicrobial activity even after several washing cycles. In this study the Ag NPs prepared by two methods, involves

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activation of cellulose fibres in alkaline solution, reduction of silver nitrate to Ag NPs, washing and neutralization of fibres. This also lead to low degree of leaching of Ag NPs from the fibres.

2. Experimental

2.1. Materials and Methods:

The Silver Nitrate (99%), Sodium hydroxide(98%), sodium Carbonate(99.5%) and Tannic acid (99%) was purchased from Sigma Aldrich (KSA). Ficus Caria leaves were collected from JAZAN area (KSA). Cotton fibers were obtained from Ihram clothes Company (KSA).

2.2. Preparation of Ag NPs-coated cellulose fibers

Swelling of fibres in 3% NaOH solution is performed with boiling for 30 minutes with stirring. NaOH have the ability to open up the surface and internal pores of cellulose fibres, allowing Ag NPS to penetrate into the fibres. The samples was taken out of NaOH solution then washed by distilled water several times and neutralized with 0.01M Na_2CO_3 solution. At the first process the treated fibres with NaOH were immersed into (0.1 M) solution of $AgNO_3$ in presence of (0.1 M) Tannic acid solution as reducing and

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stabilizing factor with vigorous stirring at temperature, 70^0C, for 60 min then Ag NPS were be formed. The second process, started by preparing 10% extracted solution of Ficus Caria leaves as reducing agent for $AgNO_3$ solution with boiling at 70^0C with stirring for 60min.The present solution were filtrated and added to fiber and (0.1 M) solution of $AgNO_3$ with the same condition of first process. The samples were finally dried in drying oven 120^0C. This is consistent to previous study **(Jolanta et al., 2016 & Tanja et al., 2017).**

2.3. Characterization:

The Absorbance of Ag NPs in solution was measured by a Shimadzu spectrophotometer (UV-1800, ENG 240 V, soft Japan). Size distribution data of Ag NPs investigated by Malvern Nanosizer (Zetasizer Nano ZS- from UK).

2.4. Antibacterial test

The cotton fibers were tested with two pathogenic bacteria, Escherichia coli (ATCC 25922) and a methicillin-resistant Staphylococcus aureus MRSA (ATCC 43300). The bacterial strain were in microbiology lab-faculty of science, Jazan university, maintained on suitable medium 4^0C and sub cultured on MacConkey agar and Mueller Hinton Broth at 37^0C for 18hrs

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before testing. Each cotton fiber disk (0.4 cm diameter, length 5cm) was soaked in 0.3 mL of a diluted bacterial cell solution in a tube and incu-bated at 37^0C for 24 h. A disk diffusion assay was performed to test the antibacterial strength visually. The method was modified from that previously described **(Bauer et al., 1966).** Diameter of the inhibition action of cotton fiber for the microbial growth is then measured in millimeter.

3. Results and discussion:

3.1. UV/VIS spectra of silver nanoparticle:

Fig. 3 presents the UV/VIS spectra of the silver nanoparticle suspension solutin. A characteristic peak originating from the silver nanoparticles can be seen. Its absorbance maximum falls between a wavelength of 400 and 450 nm. In contrast the absorbance of $AgNO_3$ solution was 300nm .This study is agreement with **(Jolanta et al., 2016).**

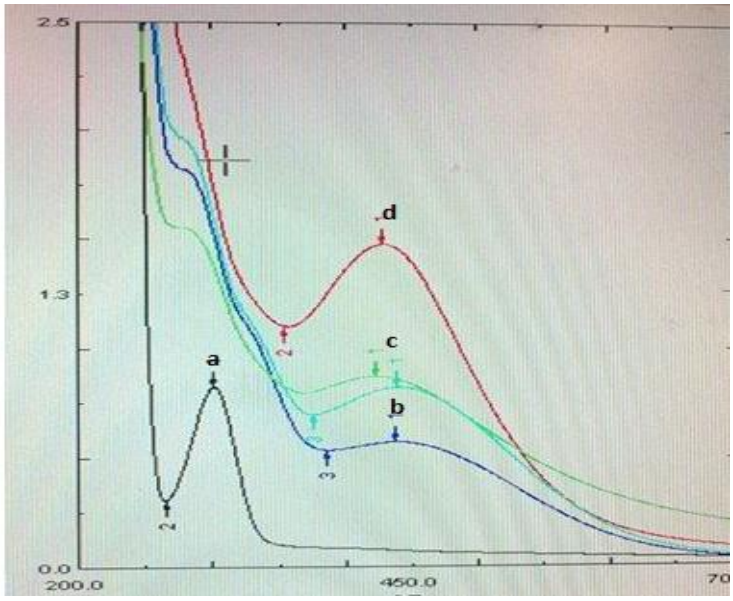

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Fig.(1) The UV/VIS spectra of a- peak for silver nitrate b,c and d peaks for formation of synthesized Ag NPS in solution.

3.2. Particle size of silver nanoparticle:

Careful examination of Fig 2 reveals that size distribution data of synthesized silver Nanoparticles Ag NPS in colloidal solution were 70 nm.

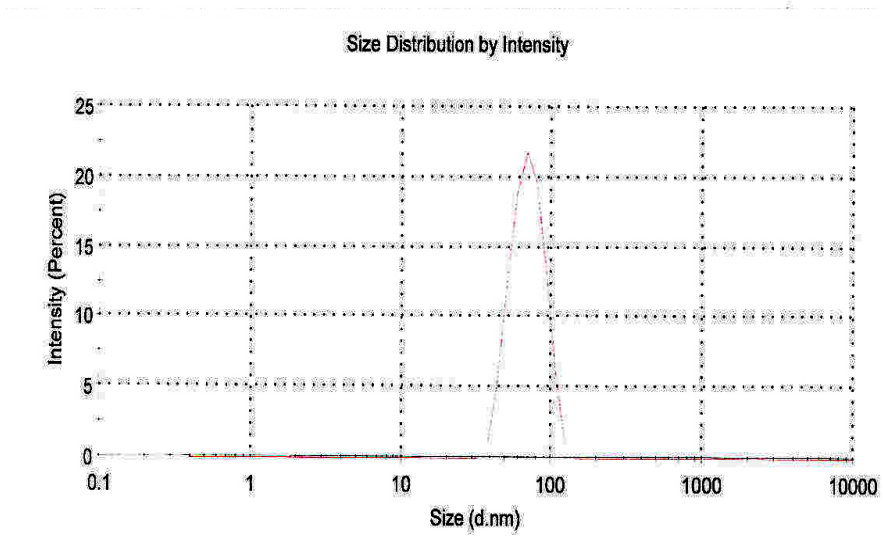

Fig. (2) Determination the size distribution of synthesized Ag NPS silver in colloidal solution.

. **3.3. Antimicrobial activity:**

Both samples fiber coated with Ag NPs produced through Tannic acid and fiber coated with Ag NPs produced through Ficus Caria

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showed antimicrobial activity against Gram negative *Escherichia coli* and Gram positive *Staphlococcus aureus*. While, the control strand did not show any antimicrobial activity. Antimicrobial activity was measured as zone of clearance on the Nutrient agar plate. The cotton fiber coated with Ag NPs produced through Tannic acid showed nearly the same action on both the microorganisms where as fiber coated with Ag NPs produced through Ficus Caria was highly active against Gram negative *Escherichia coli*.

Nano-silver particles have an extremely large relative surface area, thus increasing their contact with bacteria and vastly improving their bactericidal and effectiveness. Nano-silver is very reactive with proteins. When contacting bacteria, it will adversely affect cellular metabolism and inhibit cell growth. Furthermore, it inhibits the multiplication and growth of those bacteria and fungi which cause infection, odour, itchiness and sores. This is identical to study consistent to **(Lee et al., 2003)**.

Table (1). Antimicrobial activity of Fiber- Ag NPs-Tannic acid and Fiber- Ag NPs- Ficus Caria

Sample No.	specification	Zone of Clearance for *Staphylococcus aureus (mm)*	Zone of Clearance for *Escherichia coli (mm)*
1	Fiber- Ag NPs-Tannic acid	7	6
2	Fiber- Ag NPs- Ficus Caria	6	11

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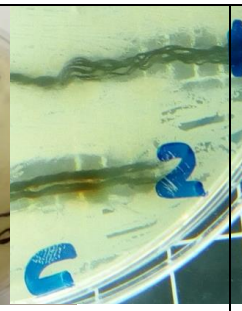
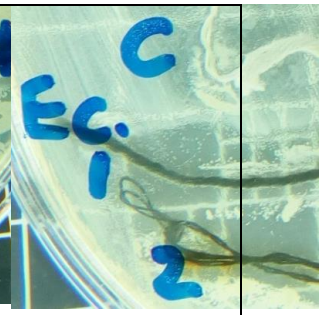
3	Fiber without Ag NPs(c-control)	No clearance	No clearance

			
Sample 1, Sample 2 and Control were Spread on Nutrient agar plate with *Escherichia coli*.	Sample 1, sample 2 and control Were spread on Nutrient agar plate With *Staphylococcus aureus.*	Antimicrobial activity of sample 1, sample 2 and Control on *Staphylococcus aureus.*	Antimicrobial activity of sample 1, sample 2 and Control on *Escherichia coli.*

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