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Synthesis of the silver nanoparticles with the using of camomile plant

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ABSTRACT

In this study, silver nanoparticles were synthesized by using of camomile plant extract as a reducing agent for $AgNO_3$. The effects of different solvents including water, ethanol, normal hexane and dimethylsulphoxide (DMSO) on the extraction were investigated and the role of anionic (SDS), cationic (CTAB) as well as non-ionic (OC-30) surfactants in developing size of nanoparticles was examined. The results showed that the best solvent was DMSO and that the size of particles was reduced to 1.4 nm in the presence of CTAB. The nanoparticles were characterized through UV-Vis spectroscopy, dynamic light scattering (DLS) and transmission electron microscopy (TEM). Also, the results suggested that the nanoparticles could exhibit antibacterial activity against Escherichia coli.

Keywords: Camomile, Extract, Silver nanoparticles, Surfactant, Solvent

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INTRODUCTION

In recent years, special attention has been given to nanomaterials not only because of their attractive dimension related properties but due to their potential for different applications such as optics, electronic industry, environmental protection, etc.[1-6] Nanoparticles can develop in a solution. They form clusters at once requiring stabilizers in the form of surfactant. Silver nanoparticles may hold great potential for household applications such as textiles, food industry and medical devices due to their antimicrobial property.[7] This study was aimed at synthesizing nano sized silver from $AgNO_3$ aqueous solution by using a mixture of camomile extract as a reducing agent and different surfactants as stabilizers.

MATERIALS AND METHODS

Silver nitrate, cethyltrimethyl ammonium bromide (CTAB), sodium dodecyl sulphate (SDS), hexadecyl poly oxyethylene-30 alcohol (OC-30) were purchased from Merck co.(Germany) All solvents were high purity grade, thus were used without further purification. Doubly distilled water was used in all experiments.

Preparation of plant extract

20 g of powdered camomile was extracted by using 300 mL of ethanol at 50C via Soxhlet method to obtain a clear extract. This procedure was repeated using dimethyl sulphoxide (DMSO), H_2O and hexane. The extracts were evaporated and the resultant pasty material was refrigerated. [8, 9]

Characterization methods

UV-Vis spectroscopy (CW009 Digital) was used in order to determine λ_{max}. To prepare the specimens for TEM studies, drops of silver nanoparticle solution were placed on carbon-coated TEM grids. Dynamic light scattering

(DLS) measurements were carried out on Brookhaven Instrumental (90 Plus Particle Size Analizer).

Synthesis of silver nanoparticles

1.5 mM $AgNO_3$ was added to 1g of each extract for making 50mL final solution.The plant extract developed brown color indicating the formation of nanoparticles. The absorbance values and peaks were read on UV-Vis upon dilution and λ_{max} was measured 415nm. This value is in good agreement with the findings reported in the literature. [10,11] The same operation was repeated using 1.0% surfactant (SDS,CTAB and OC-30).

Antibacterial activity

Muller Hinton Agar plates were prepared, sterilized and solidified. The bacterial clusters were swabbed on these plates after solidification. The nanoparticles were centrifuged to which the pellets at the same concentration. They were incubated at 37℃ for 24 hour. The plates then were examined for inhibitory zones.

RESULTS AND DISCUSSION

The silver nanoparticles were successively synthesized through green methods by use of camomile extract. It is well known that silver nano particles develop yellowish-brown color in aqueous solutions because of excitation of surface Plasmon vibrations in the nanoparticles. Yellowish-brown color appearing in the systems is an indicator of the silver nanoparticles formation. Ag ions in aqueous solutions were reduced when exposed to the herbal extract resulting in the formation of silver hydrosol.[12,13] The time required for color development was determined by measuring UV-Vis spectrum in the reaction medium.The UV-Vis spectrum of colloidal solutions of silver nanoparticles synthesized using camomile extract showed absorbance peak at 415nm within 12h in ethanol via Soxhlet-extraction method. The maximum absorbance was recorded for DMSO after 75min without Soxhlet System. Fig.1,2 Optimum extraction was not achieved by using water and hexane.

The results of using different surfactants (SDS, CTAB and OC-30) showed that the sizes of nanoparticles were reduced when CTAB was used as surfactant. The reason is the electrostatic repulsion between Ag^+ ions and positively charged CTAB. The results have been demonstrated by DLS and TEM images. TEM and DLS images of Ag nanoparticle/OC-30 presented in Fig.3,4 show that the particles are poly disperse. [14] And the particle size distribution in this system is 7.5nm, keeping in mind that TEM and DLS analyze the particle size in different ways as DLS analysis includes the ligand shell and determines the hydrodynamic size while TEM considers only the metallic core. The averaged particle size in the presence of CTAB was 1.4 nm. The obtained values from DLS are in agreement with the values recorded by TEM.

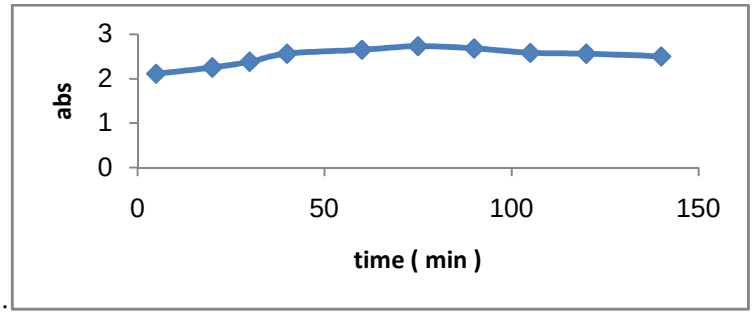


Fig1. Variation of absorbance versus time at λ_{max}= 415nm

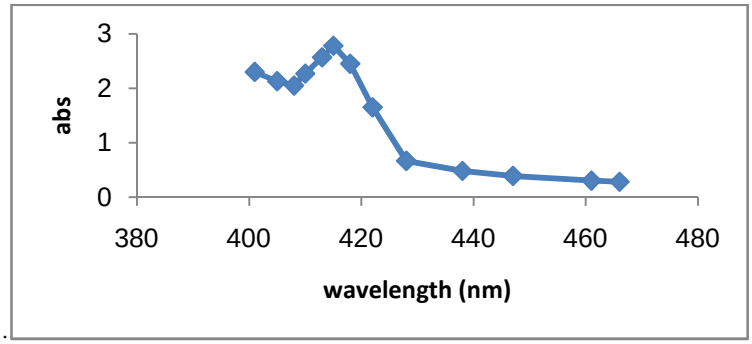
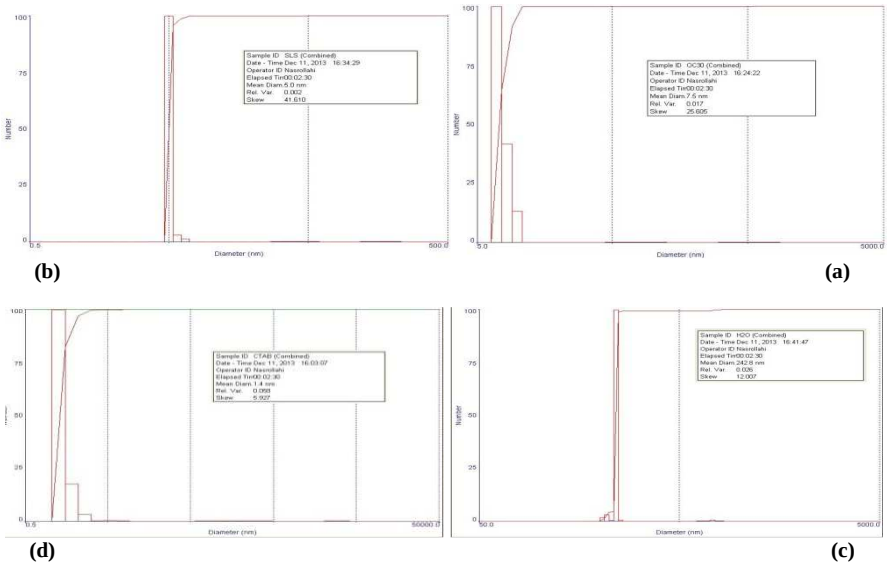


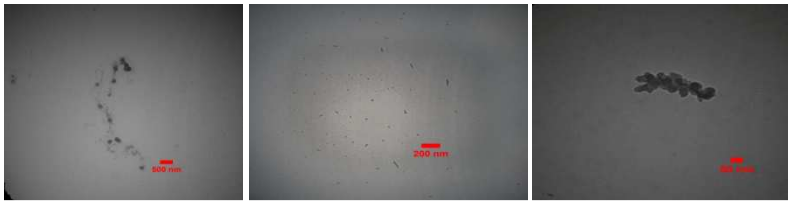
Fig2. UV-Vis spectra of silver nanoparticles



(b) **(a)**

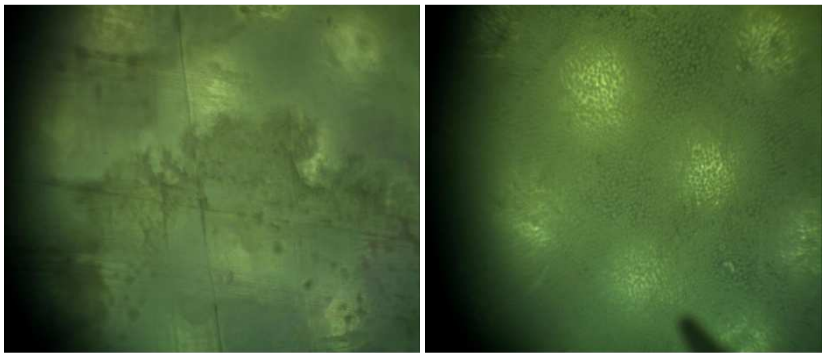
(d) **(c)**

Fig3. Particle size distribution for silver nanoparticles (a) in the presence of OC-30 (b) in the presence of SDS (c) in the absence of surfactant (d) in the presence of CTAB



(a) **(b)** **(c)**

Fig4. TEM images for silver nanoparticles (a) in the presence of OC-30 (b) in the presence of CTAB (c) in the presence of SDS



(a) **(b)**

Fig5. Inhibitory effect of (a) $AgNO_3$ (b) silver nanoparticles against E.Coli growth

The present study demonstrated the medicinal value of camomile and also introduced a simple, rapid and economic way for synthesis of silver nanoparticles with the capability of exerting antimicrobial effects. In addition, the silver nanoparticles may promote the therapeutic efficiency and medicinal value of camomile plant. Fig.5

CONCLUSION

In this study, silver nanoparticles were synthesized by using camomile extract. The results showed that the suitable solvent for extraction was DMSO. Also, it was found that the sizes of nanoparticles were reduced to 1.4nm in the presence of cationic surfactant CTAB. The optimum time of extraction at 25C without using Soxhlet system was recorded as 75min. The synthesized nanoparticles exhibited good inhibitory activity against E.coli. Nanoparticle size distribution was determined by TEM and DLS and the optimum wavelength was recorded as 415nm.

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