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Antimicrobial Activity of Sulphamethaxazole Nanoparticles Synthesized by Sol-gel Method

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Abstract

Sulphamethaxazole is antibiotic used to treat several types of bacterial infections and gives double effect when used with trimethoprim by 1 to 5 of sulphamethaxazole. It has a broad spectrum effect on the positive and negative bacteria of Gram and fungi. The objective of this research is to convert sulfamethasazole to nano sulfamethasazole by Sol-gel method by using additive material like acetic acid, distilled water and ethanol with temperature 80°C and probe sonicator machine as catalyst and hydrolysis factor. Nano sulphamethoxazole solution analyzed by atomic force microscope (AFM) was show average of nano particles at size (50±10) nm. Scanned by TEM and SEM shows nano particles as a band of hollow tubes with a diameter less than 100 nm., beside the EDS pattern show high peaks of sodium, carbon and oxygen along with some other constituents. The antibacterial activity of nano solution shows respectable inhibition activity compared to slandered solution.

1. Introduction

Nanomaterial has become interest at last years. The interesting of nanoscale materials depend on the size or shape particularly under 100 nm [1,2]. The sol–gel technique is one of the modest and generally used method depend on chemical reaction involving the presence of various intermediates by using low-temperature provides good homogeneity for the preparation of nanoparticles mainly thermally stable [2] with superior properties. In terms of reaction velocity, high surface area, sensitivity and the nano solution is a colloid the fine particle aggregates or distributed with size ranging from 1 nm to 100nm in liquid phase [3,4]. Sulfamethoxazole, the chemical structure "4-Amino-*N*-(5-methylisoxazol-3-yl) benzene sulfonamide" and the powder slightly soluble in water and dissolve in dilute solutions of sodium hydroxide [5]. Sulfamethoxazole belong to antibiotic group active against gram positive and negative bacteria such as Escherichia coli, Enterococcus faecalis, and Staphylococcus aureus, aspergillus, leishmania parasite and Fusarium fungi [6,7] by inhibit the synthesis of nucleic acids of bacteria [8] through inhibit glutamic acids an essential component of folic acid synthesis Sulfa has broad range of biological activities, including antifungal, antibacterial, antimalarial, antiproliferative, anti-inflammatory, antiviral and antipyretic property.

2. Experimental Procedure

Preparation of Nano-Sulfamethasazole

The nanoparticle of sulfamethasazole 1% was prepaerd Sol gel method is simplest, it has ability convert the particle size by using material acetic acid 3ml in water be volume 100ml and mix 80 ml with 20ml ethanol to be volume 100ml at temperature 60°C the mixture was treated by Probe Sonicator as catalyst which the transformation into the nano scale state observed in final stage as a special whirlpool at low temperature of solution decreased observed a white cloud.

Antibacterial Activity

In antimicrobial study used different strain (*S. aureus*), (*E. coli*), (*P. aeruginosa*) and *candida*. All of the bacterial strains were grown and maintained on Muller Hinton agar at 37 °C for 24 h. At the end of the period, the inhibition zone was measured.

3. Results and Discussion

After preparation the sulfamethasazole nanoparticles by sol gel method was take special whirlpool while shape with crystal and when the temperature of solution decreased observed a white cloud as in Figure (1).

Figure (1). Formation of nano sulfamethoxazole.

Nano Characterization

Atomic Force Microscope (AFM)

Is a high-resolution imaging technique that uses a small probe (tip and cantilever) to provide topographical information on surfaces in liquid media for measured the nanoparticle size, which found that Avg. Diameter: 60.05 nm and 10% of nanosulfa at average of 40 nm, 50% at diameter 60nm and 90% at diameter 75 nm as shown in Figure (2).

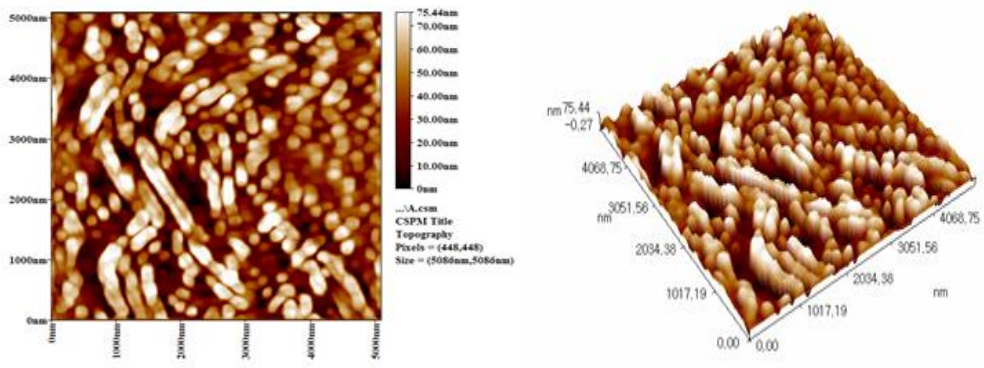

Figure (2). Show the distribution of particle and the scale show the particle size from 0 nm to 100nm of sulfamethaxazol nanoparticles.

Scanning by Electron Microscopy (SEM)

Scanning Electron Microscopy (SEM) is scan a sample with an electron beam to produce a magnified image for analysis. The sulfamethoxazole nanoparticles prepared with Sol Gel method confirm different morphological size of NPS with average size (50±10) nm as in Figure (3).

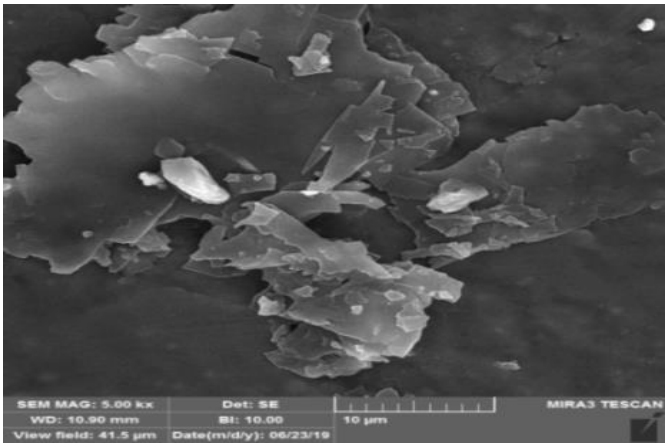

Figure (3). Images of Scanning electron microscope SEM.

EDS pattern of nanoparticles was shown high peaks of sodium, oxygen and Carbone along with some other constituents as Sulphur, magnesium, aluminum, silicon and calcium which acted as a capping agent to nanoparticles Figure (4).

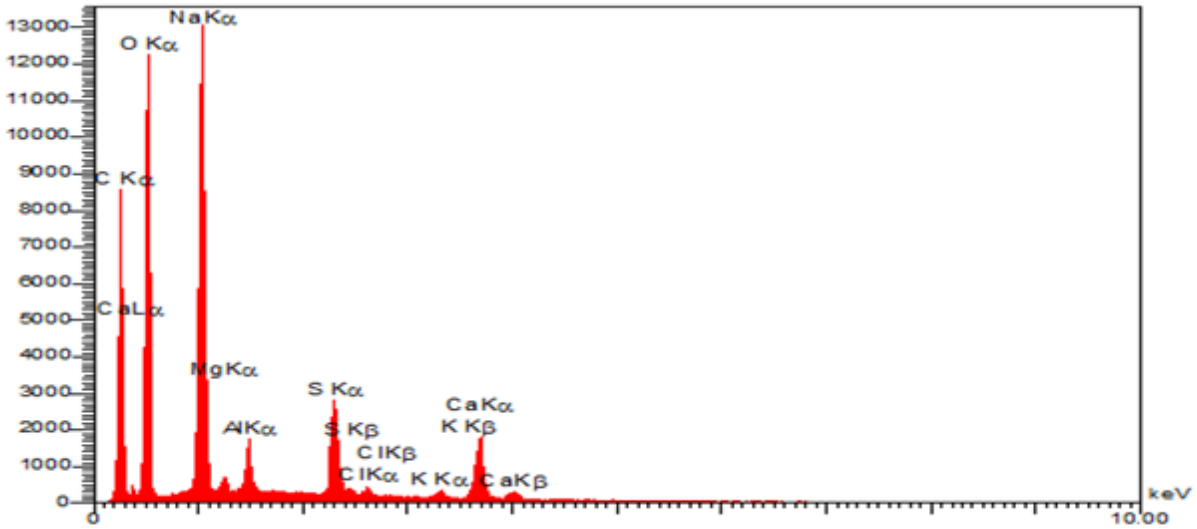

Figure (4). EDX pattern of sulfamethoxazole nanoparticles.

Transmission Electron Microscopy (TEM)

Electron microscopy shows a band of hollow tubes distributed collectively in nanoscale liquid with a diameter of less than 100 nanometers, shown in Figure (5).

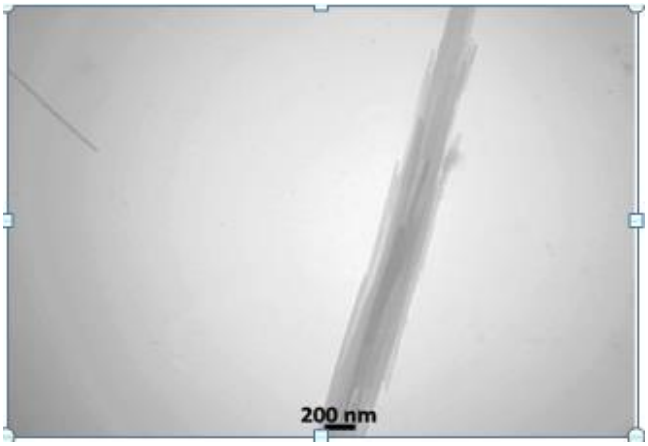

Figure (5). TEM images of nano sulfamethoxazole.

Bacteriological Test

Antibacterial activity of nano sulfamethoxazole in gram- positive bacteria (*St.aureus*) shown in Figure (6) was 52mm, gram- negative bacteria (*E.coli*), in *Pseudomonas* was 62mm and in *Candida albicans* it 30mm compared to stander salphamethoxazole solution which have the antibacterial activity range (30,30,32,and 20)mm as in table 1. The results indicated that nano sulfamethoxazole solution show good bacteriostatic activity against different bacteria by passed the cell wall and interfered with the condensed the DNA and slow the development of bacterial production and that conjugate mainly with decreasing in the size of particles lesser than 100 nanometers. Which mean transformation to nanoparticles made the material more powerful in action, in addition to the tubular shape of the particle gave it the ability to bind with the bacterial cell more strongly than normal solution [9].

Table (1). Antibacterial activity of Nano sulfamethoxazole by using different bacterial and fungi.

Sample	*E.coli*	*St.aureus*	*Pseudomonas*	*Candida albicans*
Sulfamethoxazole St.	30mm	30mm	32mm	20mm
Sulfamethoxazole nanoparticles	56mm	52mm	62mm	30mm

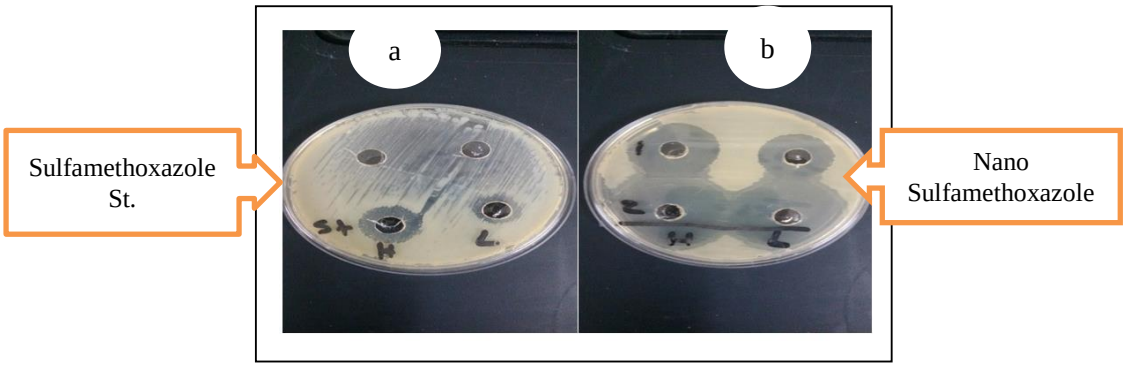

Figure (6). antibacterial activity of sulfamethoxazole nanomaterial (a) and standard (b) according to gram-positive bacteria *St. aureus*.

4. Conclusions

In this research of nano technology to prepare sulfamethoxazole nanoparticle by using Sol gel method with temperature less than 80°c and probe sonication. The scanned nanoparticles throgh AFM show size ranged (50±10) nm beside the hollow tubes were presence when scanned by SEM and TEM with presence of different peaks gave the material power activity. The antibacterial activity of nano Sulphamethaxazole was two folds against standard material in *Staphylococcus aureus* and *Escherichia coli* and *Candida albicans*.

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