The efficiency of contaminated water treatment by using Nano_colloidal silver technique

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Abstract

This work investigates natural antibiotic material for drinking water by using nano_ colloidal silver technique. The nano colloidal silver suspension (CSS) prepared using electrochemical method and characterized physically. The efficiency of bacterial treatment of Dyala river water and Tigris river water from the side of Gherai't using nano- colloidal silver suspension was studied. The silver concentration as antibacterial agent was examined for water samples took from different sides of Dyala River. The results of these tests show that good activity can be obtained of nano-collidal silver as new purification technique for contaminated water.

Keywords. Colloidal silver solution CSS , bacteriology water treatment, characteristic of nano-colloidal silver, water purification, water inspection.

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كفاءة تعقيم المياه الملوثة بأستخدام تقنية عالق الفضة النانومتري

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الخلاصة

استخدم هذا البحث ماده عالق الفضه النانومتري كمضاد حيوي طبيعي لتعقيم مياه الشرب عن طريق استخدام تقنية عالق الفضة النانومتريه .عالق النانو فضة (CSS) أعد باستخدام طريقه كهروكيميائية، وتم توصيفه فيزيائيا. تمت دراسة كفاءة العلاج الجرثومي لنماذج مياه نهر ديالى ومياه النهر دجله من جانب منطقة الكريعات باستخدام عالق الفضة النانومتري . استخدمت عدة تراكيز من الفضة كعامل مضاد للجراثيم تم اختبارها لعينات من المياه من مواقع مختلفة من نهر ديالى ومن نتائج هذه الاختبارات تبين أنه يمكن الحصول على نشاط جيد من عالق الفضه النانومتري كوسيله جديده لتعقيم المياه الملوثة.

Introduction

Nano scale materials have received attention as novel antimicrobial agents due to their high physical properties. The importance of bactericidal nano materials study is because of the increase in new resistant strains of bacteria against antibiotics. Silver ions particles have been demonstrated to be useful and effective in bactericidal applications [1, 2].

The bactericidal action of silver ions and nano colloidal silver particles with size (20-140 nm) dispersed in different medium is well known [3,4].

Multifunctional materials, containing silver nano colloidal particles in reactive or non-reactive player networks, are in top of research for applications as biocides products, biomaterials, drugs supports, etc, [5,6]

Break through silver nano technology that can render existing medical devices impervious to infection-causing bacteria. Unlike and other infection control technology available today. [7].

Ag solution containing Ag ions have been used as antimicrobial agents in various fields because of their growth, Inhibitory capacity against micro organisms. In contrast, silver nano particle (SNP) allowed growth of the contact surface of Ag with micro organisms and Ag ions are released gradually.

Although the NPs kill a great number of micro organisms, like virus, fungus and bacterium, however it is known as a non-toxic and does not cause skin irritation [8, 9, 10].

Methods

Electrochemical Technique

By using Dc power supply (30 V) and two Ag high purity rods immersed in distilled water as shown in Fig (1). We get (CS) simply, cheaply, clean and faster than other methods.

We prepared samples in different applied voltage (10 - 30 V) for hr. and samples in same voltage with a different time (20 min - 1 hr).

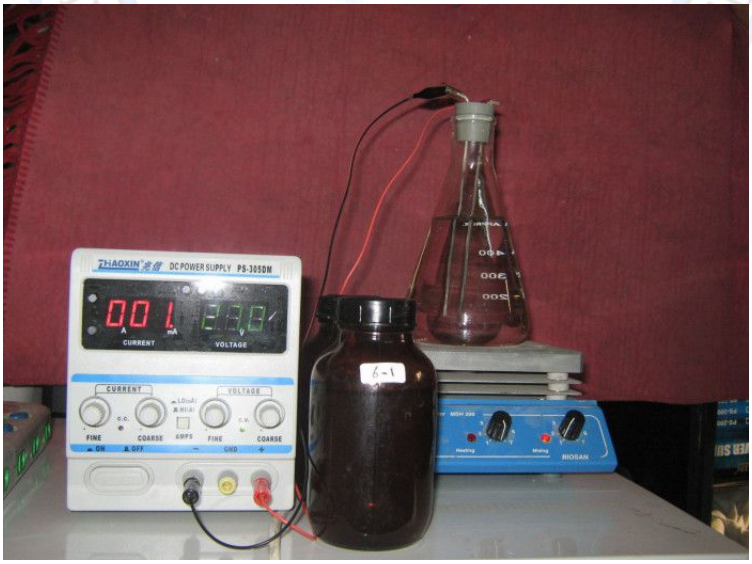

Figure (1): The electrochemical method

Characterization Of Ag nano colloidal (CS)

The Ag colloid solutions were examined optically using UV-Visible spectrophotometer (type shamedzo 20), and by using ultrasonic spray paralysis technique. Silver solutions were sprayed on glass substrates for size distribution determination by AFM (Angstrom dvancedtypeAA3000). The silver thin films samples were also subjected to x-ray diffraction to study their structure.

Antimicrobial efficiency evaluation

To evaluate the antimicrobial efficiency, the following steps were followed.

A) Five Samples of contaminated water from five different places had been taken from Dyala riverbank water, and sample from Al- Gherai't riverbank water. Each one from the above samples treated using the CSS technique.

B) Evaluation of CSS as antimicrobial efficiency achieved by standard methods for water inspection which contained the nutrient agar were used for aerobic total count of bacteria inspection and macconky broth for coliform and fecal coliform bacteria inspection [11,12,13].

Results and Discussion

Characterization Of Ag nano colloidal (CS) result:

The results of Characterization Of Ag nano colloidal (CS) as follows

- Figure (2) shows the AFM image of spherical Ag particles prepared by electrochemical technique with size distribution (40-500) nm.

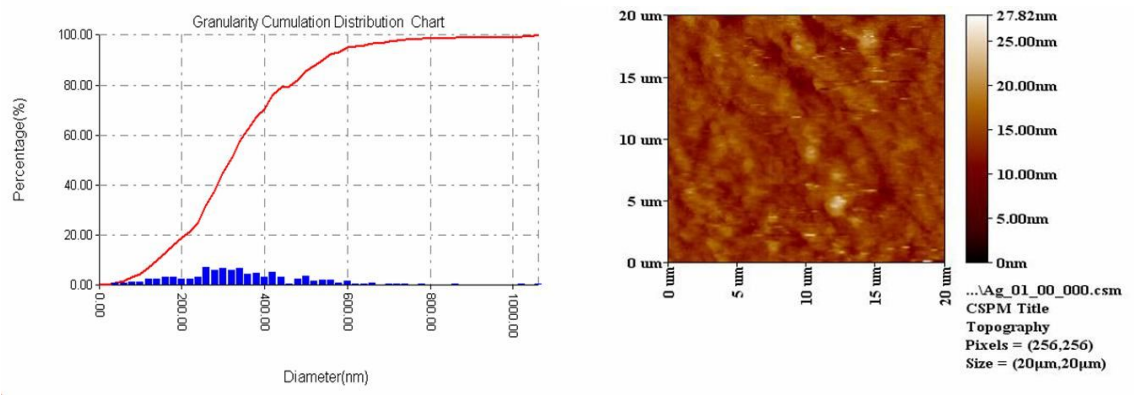

Figure (2). AFM image of Ag particle

- Figure (3) shows typical UV-visible absorption spectra for the silver colloid suspension. The figure shows maximum absorbance in some band of spectra. We see dominate plasmonic resonance absorption peak at (420 nm).

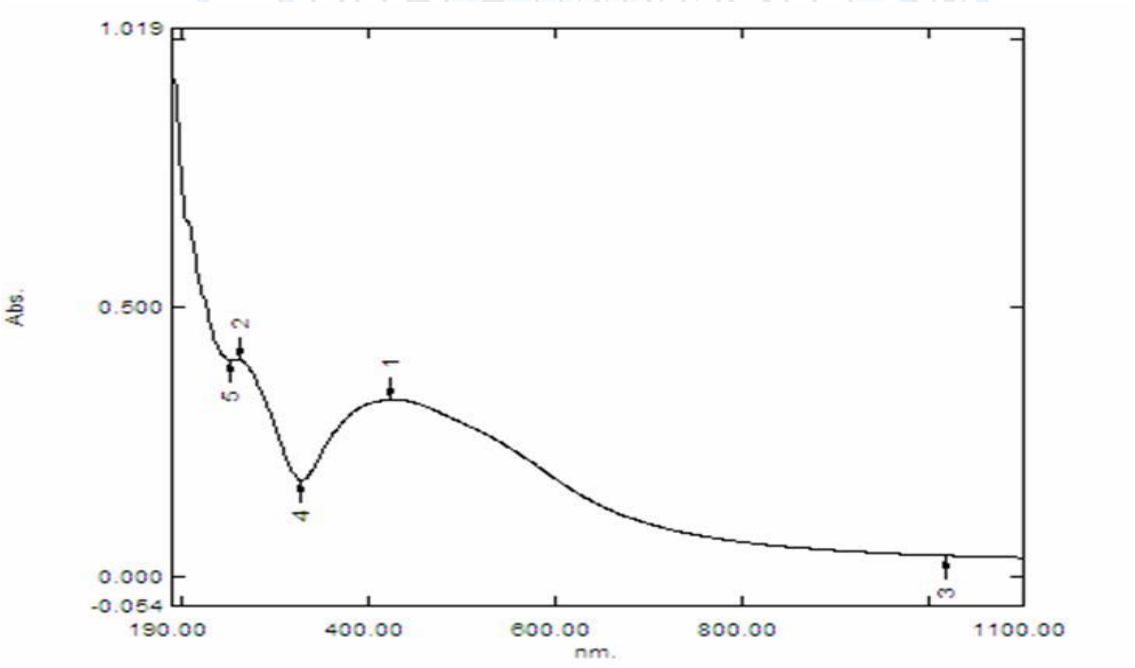

Figure (3). The UV-VIS spectra of CS samples

- Figure (4) shows the x-ray diffraction diagram of the silver samples in order to study their structure and it shows the crystalline patterned with characterized peak position 2Θ (33.0337) degree with high relative intensity (100%) to plane (111) and second peak position 2Θ (43.9817) degree with relative intensity (52%) to plane (200) and these results was agreed with other studies[14].

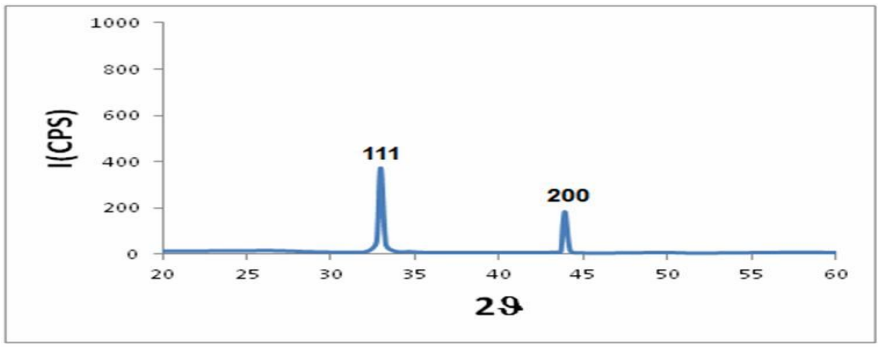

Figure (4): XRD diagram of silver thin film

Antimicrobial efficiency evaluation

Evaluation of the antimicrobial efficiency of CSS technique was achieved by water samples were taken from Dyala river water and Al_Gherai't city river side were examined using standard methods for water inspection. From the results shown in table (1) and table (2) one can see that good activity can be obtained using CSS technique as antimicrobial water bacteria. Figure (5) shows typical images for total count inspection of water samples. Also one can notice that good agreement is obtained between the efficiency of CSS in each of smples of Al_Gherai't and Dyala despite of the high contamination founded in water samples of Dyala river water compared with Al_Gherai't samples, and the using of different concentration as shown in table (2) of silver dose not exhibit any inhabitation in the bacteriological purification.

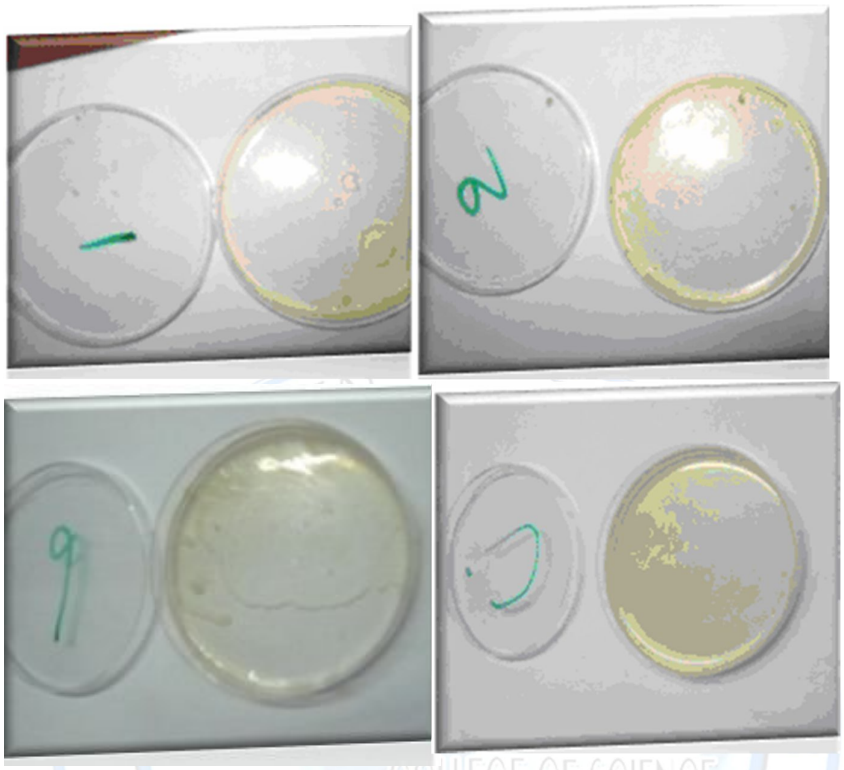

Figure (5). Typical image for total count inspection of water samples

Table (1) shows the bacteriology effective treatment of CSS on contaminated Al_ Gherai't side river water.

Sample number	ppm (CSS)	Total count	Coliform	Fecal coliform
1	5.3	0.0	0.0	- ve
2	7.05	0.0	0.0	- ve
3	12.83	0.0	0.0	- ve
5	14.87	0.0	0.0	- ve
6	28.09	9	0.0	- ve
7	33.03	0.0	0.0	- ve

Table (2) shows the bacteriology effective treatment of CSS on contaminated water along the edge of the bank of Dialya river water.

Sites	**Water/Ag ratio**	**Total account**	**coliform**	**Fecal coliform**
Sit (1)- Alsdur	(3:1)	1	0.0	**- ve**
Sit (2)-Baquba	(3:1)	1	0.0	**- ve**
Sit (3)-Bridge - Dyala	(3:1)	2	0.0	**- ve**
Sit (4)- new bridge Dyala	(3:1)	1	0.0	**- ve**
Sit (5)- Join Dyala with Tigris	(3:1)	2	0.0	**- ve**

The results shown in table (1) the silver (5.3-33.03)ppm concentration which used for each sample and the impressive activity which obtained. Also one can notice that sample (6) exhibit number of aerobic bacteria, the number is accepted according to the Iraq standard for bacteriology water inspection. The fact that Dyala river water contamination huge compared with Al_Gherai't riverbank water which pushed us to use greater silver concentration (33.03) ppm in purification of water samples of Dyala river water. Also from table (2) was aerobic bacteria in Bridge – Dyala site and Join Dyala with Tigris site slightly greater than the other sites due to high contamination in these sites than the others.

Conclusions

1- Colloidal silver solution (CSS) with particle size distribution of (40-500) nm produced using electrochemical method.

2- The production process can be achieved by economic and available method, tools and materials.

3- Colloidal silver solution has been successfully developed for bacteriological water purification and proved their efficiency at different concentration and for different samples of contaminated water.

4- The use of different concentration of (CSS) for Al_Gherai't riverbank water samples (5.3-33.03) ppm give positive results.

5- The use of (33.03) ppm (CSS) with (3:1) water/Ag ratio for different samples of Dyala river water gives also positive result.

6- Moor studies about bacteriological sides effects of nano silver on human body and the acceptable deposited concentration must determine.

7- Finally the obtained results may open the way to new era in solving the environmental problems.

References

1. J.R. Morones, J.L. Eiechiguerra, A.Ccamchu. J.T.Amirez, Nanotechnology, 16, 2346 – 53 (2005).
2. J.S. Kim, E.Kuk, K.N. Yu, J.H.Kim, S.J. Paris, H.J. Leebiol. Med, 3, 2, 3-10(2007).
3. J.L. Eiechiguerra, J.L.Burt, J.R. Morones, A.Camachun., et. Al., Journal of nano bio technology 3(6)(2005).
4. Uspatent APPL.Pub.No.0003603 Al, (Jan 4/2007) Antimicrobial silver compositions.
5. C. N. Lok., C. N. HO., R. Chen, et.al. 2007," silver nanoparticles: Partial oxidation and antibacterial activities,"J.Biol.Inorg.chem.12:527-534.
6. S. Pal., Y. K. Tak., J. M. Song ., 2007,"Does the antibacterial activity of silver nanoparticles depend on the shape of the nanoparticles ? Astudy of the Gram-negative bacteria E.coli ",Appl.Environ.Microbiol ,73 1712-1720.
7. I. Sondi., Salopek –Sondi B.,2004, "Silver nanoparticles as antimicrobial agent :acase study on E.coli as amodel for Gram-negative bacteria",J.colloid Interface Sci.275:177-82.
8. N.Vermerie., C.Malbrou., N, Mazr., P.Arnaud., pharmacy worlds science, 19(4_/97-207(1997).
9. H. J. Lee., S.Y. Yeo., S. H. Jeong, Journal of material science. 38, 2199-2204 (2003).
10. J. Stephen., Nano technology the nexus of science education, April 4(2008).
11. V.Laurian., antibiotic in clinical medicine 2nded, William and Wilkins Baltimore (1986).
12. k. S. Al- dolaimee. " علم الاحياء المجهرية للأغذية (الجزء العملي) " جامعة مديرية دار الكتب للطباعة والنشر, الموصل,(1988).
13. T. Hanonda., A. Mye., B. Donovan., A. Shih., and J. D. Reater., et.al. 2000,"Anovel surfactant nanoemulsion with auniqe non-irritant topical antimicrobial activity agansit bacteria enveloped viruses and fungi ",Microbiol Res. 156:1-7.
14. S. sarkar., P. Kumar., and S. Jana., “Nano Silver Coated Pattered Silica Thin Film By Sol-Gel Based Soft Lithography Technique” Journal of Sol-Gel Science and Technology, V.61, N.3, Pp.577-584, 2012.