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Evaluation of the Biological Activity of Saccharomyces Boulardii in the Synthesis of Silver Nanoparticles

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A B S T R A C T

The intention of this study was to determine the efficacy of Saccharomyces boulardii as a biological catalyst.to generate silver nanoparticles using silver nitrate. Diffraction of X-rays (XRD) .The atomic force microscope (AFM) was employed to investigate the surface traits of the produced silver nanoparticles. According to the conclusions, silver nanoparticles with a standard crystalline size of 14.25 nm, as determined by x-ray spectroscopy (xrd), may potentially be manufactured. The Standard X-ray diffraction (XRD) chart for silver nanoparticles (JCPDS silver: 04-0783) revealed four diffraction values at the two values: 38.6, 44.2, 64.2, and 77.3, which equate to 111, 200, 220, and 311 respectively. Additionally, the silver nitrate solution's color changed to brown with constant shaking after being added to a solution of suspended S. boulardii, which proved that nanoparticles were formed. The appearance of these peaks between the specific wavelength of silver nanoparticles, which ranges between 200 and 800 nm, indicates the presence of nanoparticles. The results of the UV/Vis Spectrophotometer revealed the emergence of three peak levels of absorption at 234, 355, and 488 nm in wavelength. The outcomes also showed that silver nanoparticles' surface topography by atomic force microscopy has a mean diameter of 49.61 nm.

1. INTRODUCTION

Medicinal plants and fungy are the major sources of numerous valuable chemicals and drugs[1-6]. Medicinal plants have been discovered since prehistoric times and they were used in traditional medicine. Hundreds of chemical components have been synthesized from plants for using in combating insects, fungi, diseases, and herbivorous mammals. Many phytochemicals with proven or potential biological activity have been known, but the fact that a single plant possesses a large number of diverse chemical substances makes the effect of using the whole plant ineffective, and prevents the evaluation of the activities related to these substances found in many plants in precise scientific research aimed at determining their effectiveness and safety it has been the basis of treatment of various diseases [7-11].

According to [12], the term "nano" is Greek in derivation and refers to an item that is one billionth (9–10) of a meter in size. It also implies "dwarf" in this context.

Groups of atoms between 1 and 100 nanometers in size are referred to as nanoparticles, and the physical and chemical characteristics of nanomaterials can differ significantly from those of the same substance in a greater mass form That is, it deals with atomic clusters ranging from five atoms to a thousand atoms. These dimensions are much smaller than the dimensions of bacteria and a living cell. So far, this technology is not specific to biology, but rather is concerned with the properties of materials, and its fields vary widely from semiconductors to completely modern methods based on molecular self-assembly. This limitation in scale is matched by a broadening of the nature of the materials used, as nanotechnology deals with any phenomena or structures at the nano-level. Such nanoscale phenomena could involve quantum confinement that leads to new electromagnetic and optical phenomena for matter whose size is between the size of a molecule and the visible size of a solid [13].

According to [14], nanoparticles are the essential building blocks of nanotechnology. They are defined as pieces with multiple dimensions , a size of 100 nanometers or fewer, and a number of characteristics that differ from conventional size. Due to their excellent conductivity to heat and electricity, chemically stable nature, strong enzyme activity, and antibacterial characteristics, silver nanoparticles have received particular attention from researchers [15]. Due to its use in industries as varied as medical treatment, coverings, packaging, electronics, and biological technology, silver

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nanoparticles (AgNPs) have attracted a lot of attention [16].

For the aforementioned purposes, silver nanoparticles can be used in several kinds of industries, including clothing, wound care, and other sectors [17].

In general, there are various approaches to manufacture silver nanoparticles: 1: Physical methods 2: Chemical methods Biological modalities

The disadvantages of physicochemical synthesis techniques include higher costs, energy consumption, environmental toxicity, and unsuitability for biological applications because they employ dangerous and toxic substances that can lead to a variety of biohazards [18]. The use of hazardous chemicals during the manufacture of silver nanoparticles (AgNPs) may restrict their use. As a result, finding alternative agents that can reduce silver salts to form nanoparticles without endangering human health or the environment is crucial for science Animal studies indicate that carbon nanotubes and carbon nanofibers can cause pulmonary effects including inflammation, granulomas, and pulmonary fibrosis, and are of similar or greater potential when compared with other known fibrogenic materials such as silica, asbestos, and ultrafine black carbon. Some studies in cells or animals have shown genotoxic or carcinogenic effects, or systemic cardiovascular effects from pulmonary exposure. Although the extent to which data from animal studies may predict clinically significant pulmonary effects in workers is unknown, the toxicity demonstrated in short-term animal studies suggests a need for preventative action for workers exposed to these nanomaterials.

As an alternate to physical and chemical synthesis, natural materials derived from terrestrial and marine living organisms (microorganisms, animals, and plants) were used to create nanoparticles. For the sake of the aforementioned and in order to find alternative, safe, non-harmful and inexpensive methods were used, The objective of the research was to assess Saccharomyces boulardii's efficiency in producing silver nanoparticles [19].

2. MATERIALS AND METHODS

S. boulardii is used in the biological manufacture of silver nanoparticles. This investigation looked at the viability of employing S. boulardii as a biological catalyst to convert silver nitrate into silver nanoparticles in the manner described below.

2.1. The S. Boulardii

The S. boulardii, were obtained from Al-Ameen Center for Research and Advanced Biotechnology in Al-Ataba Al-Alawiya - Najaf.

2.2. Development and Activation of S. Boulardii

Based to the manufacturer's instructions, solid PDA medium was made by dissolving 39 g of powder in 1 liter of distilled water, adjusting the pH to 7, sterilizing in an autoclave at 121 °C and under 1 atmosphere for 15 minutes, then pouring into Petri dishes. Bacterial culture was then performed on the solid PDA medium, and the results were reported by [20].

2.3. Preparation of S. Boulardii Solution

The yeast solution was created by putting 10 ml of deionized water into every Petri dish, harvesting the yeast by scraping off the top layer with a sterile razor, and then collecting the solution made up of the yeast and deionized water in opaque cans until it was used to create nanoparticles. This method was modified slightly from [21].

2.4. Prepare a Silver Nitrate Solution [22]

Followed the method of preparing a silver nitrate fluid with a concentration of 1 mM (0.169 mg) and 2 mM (0.340 mg) of silver nitrate in 1 liter of deionized water under dark conditions, covering the glass beaker with commercial aluminum (silophone) and keeping the solution. In a dark way until use.

E-Synthesis of silver nanoparticles mediated by the S. boulardii for the purpose of producing silver nanoparticles using yeast, [23] method was adopted with a few modifications. To do this, 10 ml of the yeast solution prepared as described in paragraph 3 was added in drops to 90 ml of the silver nitrate solution prepared as described in paragraph 4, and 30 minutes were spent stirring the substance on a Magnatic. at a temperature of 35 °C. Once the color change was visible, which was red, the procedure was complete.

3. RESULTS AND DISCUSSION

Evaluation of the effectiveness of S. boulardii synthesis of silver nanoparticles .This investigation examined the potential for employing S. boulardii as a biological catalyst to create silver nanoparticles from silver nitrate. After 120 hours, the hue gradually changed to brown, indicating the production of silver nanoparticles and the reduction of silver nitrate. The reason for the color change can be explained by the role of yeast, as well as the plant, in manufacturing nanoparticles, as the yeast and plant absorb metal ions from the environment or the solutions surrounding them and convert these metal ions into the form of a nano-sized element through enzymatic reduction, as indicated by the change in color is due to the excitation of surface plasmon vibrations in metal nanoparticles. Silver nanoparticles show interesting optical properties that are directly related to the surface plasmon resonance, which depends greatly on the appearance of the nanoparticles.

The rate of reduction and nanoparticle formation can be further increased by increasing the incubation time under experimentally controlled conditions. The reason for the color change can be explained by the role of yeast, as well as the plant, in manufacturing nanoparticles, as the yeast and plant absorb metal ions from the environment or the solutions surrounding them and convert these metal ions into the form of a nano-sized element through enzymatic reduction . The change in color also indicates the excitation of surface plasmon vibrations in metal nanoparticles. Silver nanoparticles, the rate of reduction and formation of nanoparticles can also be increased further by increasing the incubation time under experimentally controlled conditions, and thus the color intensity increases with increasing reaction time.This shows interesting optical properties that are directly related to the surface plasmon resonance, which depend greatly on the appearance of the nanoparticles. Thus, the color intensity increases with increasing reaction time, as illustrated in Figures. 1 and 2 .

Figure 1. The color change during the synthesis of silver nanoparticles by the S. boulardii .A- Silver nitrate solution + S. boulardii solution after 1 hour. B- Silver nitrate solution only. C- Silver nitrate solution + S. boulardii solution after 120 hours.

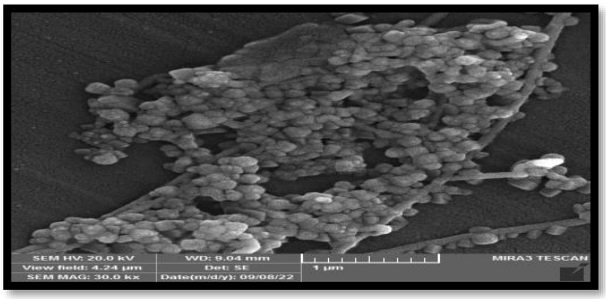

Figure 2. Different shapes and sizes of silver particles formed by S. boulardii under a scanning electron microscope (SEM) at a unit of measurement of 1 col.

4. CONCLUSIONS

The study proved that the possibility of manufacturing silver nanoparticles from S. boulardii .the outcomes also showed that silver nanoparticles' surface topography by atomic force microscopy has a mean diameter of 49.61 nm.

5. APPLICATIONS

In this study, male laboratory rats were used, weighing between (140-160) grams, which were placed in plastic cages and examined in the laboratory by the veterinarian to ensure their safety, then they were given food and water, and then the experiment was carried out.

6. REFERENCES

1. A.S., Abd and L.H. Saqban . “Study of the effect of cytotoxicity of extracts from Origanum Majorana leaves on human breast cancer cell line” (AMJ13) in vitro. AIP Conference Proceedings 2414, 020027 (2023).
2. Z.A., Mezher and L.H., Saqban. “The cytotoxicity effect for the crude extract of Cyperus esculentus tuber on human breast cancer cell line” (MCF-7)in vitro.Indian Journal of Forensic Medicine and Toxicology .vol.14.No.4.2020.
3. M.N., Al-Darraji1, L.H., Saqban,M., Rasheed, A.J., Hussein, T.F., Mutar . “Association of candidate genes polymorphisms in Iraqi patients with chronic kidney disease”. J Adv Biotechnol Exp Ther. 5(3): 687-701.2022.
4. H. H. Obaid, L. H. Saqban and L. Y. Mohammed. “Cytotoxic Effect of Vinca rosea Aqueous Extracts on (L20B) Cell Line In Vitro. Indian Journal of Public Health Research & Development”, Vol. 10, No. 11.2019.
5. L. H., Saqban , A.M., Mezher and H., Ali. “Cytotoxic Effect of the Crude Alcoholic Extract of the Fruits of Citrullus Colocynthis on Human Hepatocyte Carcinoma” (Hep-G2) Archives of Razi Institute, Vol. 77, No. 4 ,1389-1395.2022.
6. N A Abu-Serag, N I Al-Gara,awi, A M Ali, M A Alsirrag. “Analysis of bioactive phytochemical compound of (Cyperusaucheri Jaub.)” by using gas chromatography – mass spectrometry . IOP Conf. Series: Earth and Environmental Science 388 ,012063.2019.
7. N.I., Al-Garaawi, N.A. Abu-Serag, K.A. Shaheed, and Z.K.A., Bahadly. “Analysis of bioactive phytochemical compound of (Cyperus alternifolius L.) by using gas chromatography-mass spectrometry” , IOP Conference Series: Materials Science and Engineering 571(1):1-19.2019.
8. N., AlGaraawi, I., AlAmery, S, F., M. A.,Alwahed Alsirrag. “First record of phytochemical and the antifungal activity of methanol extracts from vegetative parts of Juncus rigidus plants in Iraq”. Caspian Journal of Environmental Sciences, 20: 1011-1021.2022.
9. S.F., AlAmery & N.I., AlGaraawi, “Phytochemical profile and antifungal activity of stems and leaves methanol extract from the Juncus maritimus linn. Juncaceae fam”.2020.
10. N.I., Al-Gara,awi , A.H., AL Edhari and F.K., ALAsadi, “Molecular taxonomic study for the genus juncus l”. (juncaceae) in iraq based on chloroplast gene rpl16. ann. for. res. 65(1): 6313-6319, 2022.
11. Y. K. Alghanimi, and A., Ghasemian , “Inhibitory trait of Dendrosome Curcumin(DNC)on breast cancer compared to curcumin single compound.Journal of Gastrointestinal cancer” 51:527-533.2022.

12. S., Bykkam, ,M., Ahmadipour, S.,Narisngam, V. R., Kalagadda, & S.C., Chidurala . "Extensive studies on X-ray diffraction of green synthesized silver nanoparticles". Adv. Nanopart, 4(1), 1-10.2 .2015.
13. L., Castro, M.L., Blázquez, F.G.,González &A., Ballester . "Mechanism and applications of metal nanoparticles prepared by bio-mediated process". Reviews in Advanced Sciences and Engineering, 3(3), 199-216.2014.
14. A., Fariq, T., Khan & A.,Yasmin . "Microbial synthesis of nanoparticles and their potential applications in biomedicine". Journal of Applied Biomedicine, 15(4), 241-248.2017.
15. J., Harley and L., Prescott. "Laboratory exercises microbiology". 5th ed. WCB. The Mcgraw-Hill, Companies. New York.2002.
16. B., Koul , A. K., Poonia , D.,Yadav & J.O., Jin. "Microbe-mediated biosynthesis of nanoparticles: Applications and future prospects". Biomolecules, 11(6), 886.2021.
17. P.,Kouvaris ; A., Delimitis; V.,Zaspalis ;D., Papadopoulos ; S.A.,Tsipas and N., Michailidis. "Green synthesis and characterization of silver nanoparticles produced using Arbutus Unedo leaf extract". Materials Lett, 76: 18-20.2012.
18. A., Labanni, Z., Zulhadjri,D., Handayani,Y., Ohya andS., Arief . "The effect of monoethanolamine as stabilizing agent in Uncaria gambir Roxb". mediated synthesis of silver nanoparticles and its antibacterial activity. Journal of Dispersion Science and Technology, 41(10), 1480-1487.2020.
19. X., Li, H., Xu, Z.S., Chen &G., Chen, "Biosynthesis of nanoparticles by microorganisms and their applications. Journal of Nanomaterials", 2011.
20. X., Li, H., Xu, ,Z.S., Chen &G., Chen "Biosynthesis of nanoparticles by microorganisms and their applications". Journal of Nanomaterials, 2011.
21. Q.A., Naseer, X., Xue, X., Wang, S., Dang, S. U., Din & J., Jamil. "Synthesis of silver nanoparticles using Lactobacillus bulgaricus and assessment of their antibacterial potential". Brazilian Journal of Biology, 82.2021.
22. N., Saifuddin,C.W., Wong &A., Yasumira, " Rapid biosynthesis of silver nanoparticles using culture supernatant of bacteria with microwave irradiation. E-journal of Chemistry, 6(1), 61-70.2009.
23. S.S., Salem, &A., Fouda . "Green synthesis of metallic nanoparticles and their prospective biotechnological applications: an overview. Biological Trace Element Research", 199(1), 344-370.2011.

Arabic Abstract

تهدف هذه الدراسة إلى تحديد مدى فعالية Saccharomyces boulardii كمحفز بيولوجي لتوليد جسيمات الفضة النانوية باستخدام نترات الفضة. حيود الأشعة السينية (XRD) تم استخدام مجهر القوة الذرية (AFM) لفحص الصفات السطحية. من جسيمات الفضة النانوية المنتجة. وفقا للاستنتاجات، من المحتمل أن يتم تصنيع جسيمات الفضة النانوية ذات الحجم البلوري القياسي البالغ 14.25 نانومتر، كما هو محدد بواسطة التحليل الطيفي للأشعة السينية (xrd). كشف مخطط حيود الأشعة السينية القياسي (XRD) لجسيمات الفضة النانوية (JCPDS Silver: 04-0783) عن أربع قيم حيود عند القيمتين: 38.6، 44.2، 64.2، و77.3، والتي تعادل 111، 200، 220، و311. على التوالي، بالإضافة إلى ذلك، تغير لون محلول نترات الفضة إلى اللون البني مع الاهتزاز المستمر بعد إضافته إلى محلول معلق S. boulardii، وهو دليل على تشكل الجسيمات النانوية. وظهور هذه القمم بين الطول الموجي المحدد لجسيمات الفضة النانوية والذي يتراوح بين 200 و800 نانومتر يدل على وجود الجسيمات النانوية. كشفت نتائج مقياس الطيف الضوئي للأشعة فوق البنفسجية/المرئية عن ظهور ثلاثة مستويات ذروة للامتصاص عند 234، 355، و488 نانومتر في الطول الموجي. كما أظهرت النتائج أن تضاريس سطح جسيمات الفضة النانوية بواسطة مجهر القوة الذرية يبلغ متوسط قطرها 49.61 نانومتر.