Black Sea Journal of Health Science

doi: 10.19127/bshealthscience.1189775

Open Access Journal
e-ISSN: 2619 – 9041

Research Article
Volume 6 - Issue 1: 163-166/ January 2023

THE IMPACT OF TEMPERATURE ON THE SYNTHESIS OF SILVER NANOPARTICLES BY *CANDIDA MACEDONIENSIS*

Mirmusa JAFAROV[1,2], Khudaverdi GANBAROV[1], Ergin KARİPTAŞ[3]*, Sanam HUSEYNOVA[1], Sevinj GULIYEVA[1]

[1]*Baku State University, Faculty of Biology, Department of Microbiology, 1148, Baku, Azerbaijan*
[2]*Institute of Microbiology of the Ministry of Science and Education of the Republic of Azerbaijan, 1004, Baku, Azerbaijan*
[3]*Samsun University, Faculty of Medicine, Department of Medical Microbiology, 55080, Samsun, Türkiye*

Abstract: Nanoparticles are widely used in medical diagnosis and treatment, as carriers of drug preparations, in cosmetics, production packaging and transportation of foods and etc. Special attention is paid to the use of biological structures in the production of nanoparticles. The aim at the presented work was to investigate the influence of temperature on the formation of silver nanoparticles by *Candida macedoniensis* BSU-MI44. Wet biomass of yeast at $AgNO_3$ solution, was incubated at 25, 30, 35, 40°C. The samples have been analyzed on the UV spectrometer, the scanning electron microscope and the X-ray spectroscope. Spectrophotometric analyses showed 410 nm wavelength (peak), characteristic for silver nanoparticles in samples incubated at 25 and 30°C. By increasing temperature, the formation of silver nanoparticles has weakened and has finally stopped. The optimum temperature was between 25-30°C for the production of silver nanoparticles and the formed nanoparticles were spherical at both temperatures. The sizes of silver nanoparticles formed at 25°C and 30°C were 65.6 and 14.2-22.9 nm. The sizes of the first ones have been 2.8-4.7 times larger than the sizes of the others. Correspondingly X- ray spectroscopic analyses of the obtained samples showed the characteristic absorption peak for silver nanoparticles formed at temperatures 25 and 30°C.

Keywords: *Candida macedoniensis*, Silver nanoparticles, UV spectrum, SEM, X-ray spectrum

***Corresponding author:** Samsun University, Faculty of Medicine, Department of Medical Microbiology, 55080, Samsun, Türkiye
E mail: ergin.kariptas@samsun.edu.tr (E. KARIPTAŞ)

Mirmusa JAFAROV https://orcid.org/0000-0003-1219-2815
Khudaverdi GANBAROV https://orcid.org/0000-0002-6847-3598
Ergin KARIPTAŞ https://orcid.org/0000-0001-6513-9589
Sanam HUSEYNOVA https://orcid.org/0000-0002-3602-5643
Sevinj GULIYEVA https://orcid.org/0000-0002-8594-3600

Received: October 15, 2022
Accepted: December 03, 2022
Published: January 01, 2023

Cite as: Jafarov M, Ganbarov K, Kariptaş E, Huseynova S, Guliyeva S. 2023. The impact of temperature on the synthesis of silver nanoparticles by *candida macedoniensis*. BSJ Health Sci, 6(1): 163-166.

1. Introduction

Currently, synthesis of nanoparticles is one of the fastest growing and leading fields of the nanotechnology. Unlike large-size materials, these particles have specific biological properties that differ in physical, chemical, magnetic, thermal, optical, and quantum sizes. Nanoparticles are widely used in medical diagnosis and treatment, as carriers of pharmaceutical preparations, in cosmetics, dyestuffs, food production and packaging, transportation of foods, oil production, agriculture and finally in environmental protection (Meenal Kowshik et al., 2002; Sastry et al., 2003; Narayanan and Sakthivel, 2010; Sadowski, 2010; Ganbarov et al., 2016a). The large-scale synthesis of metal nanoparticles using physical, chemical and biological methods is carried out, in many developed countries of the world (Ganbarov et al., 2015a; Ganbarov et al., 2015b; Muthupandian et al., 2013).

Recently, special attention is paid to the use of the biological structures in the production of nanoparticles. The biological synthesis process of nanoparticles consists of three basic steps - to use medium-sized solvents for synthesis, select ecologically harmless agents, and select non-toxic materials for stabilizing nanoparticles. For the production of metal nanoparticles by biological method are used fungi, bacteria and plants (Abo–State and Partila, 2015; Egorova and Revina, 2000; Sadowski, 2010). As a result of large-scale researches carried out by scientists, it was possible to synthesize metal nanoparticles such as silver, gold, zinc, selenium, titanium and platinum by using yeasts. Silver nanoparticles attract more attention due to the surface area, unique physical, chemical and biological properties (Xiangqian et al., 2011; Ganbarov et al., 2015a; Ganbarov et al., 2015b; Ganbarov et al., 2016a; Ganbarov et al., 2016b).

In our previous studies, the ability of *Candida macedoniensis* BSU-MI44 to form silver nanoparticles was studied. Depending on the amount of biomass, silver nanoparticles formation has been studied and the amount of optimal biomass was determined (Bhainsa and D'Souza, 2006; Bharde et al., 2006; Anal et al., 2008; Ganbarov and Musayev, 2012). The main purpose of the presented work was to study the influence of temperature on the silver nanoparticles production by

Candida macedoniensis BSU-MI44.

2. Materials and Methods

As an object of a research was used *Candida macedoniensis* BSU-MI44 taken from the culture collection of the Microbiology department. For the cultivation of *Candida macedoniensis* BSU-MI44 has been used the medium with the following composition: yeast extract - 10 g, sucrose - 20 g, peptone - 20 g, distilled water - 1 litre. The cultures were separately incubated at 25, 30, 35, 40°C, for 48 hours. The biomass was separated by filtration and washed 3 times in 100 ml distilled water. Then 10 g wet biomass was resuspended in 100 ml distilled water and 1 ml of 10^{-3} molar $AgNO_3$ solution was added and incubated at 25, 30, 35, 40°C until the color change.

The formation of silver nanoparticles was primarily visualized by the change of the color of the reaction mixture from light yellow to dark brown. Then the biomass was separated by filtration and the nanoparticles in the filtrate were analyzed on the spectrophotometer at 400 to 450 nm wavelength.

Then preparation was made from cultured fluid and the shape, size of silver nanoparticles (nm) were determined on the scanning electron microscope (SEM JEOL.7600F, Japan). The nanoparticles, obtained by X-ray (EDAX) spectral analyses were determined to be silver.

3. Results and Discussion

The formation of silver nanoparticles by *Candida macedoniensis* BSU-MI44, depending on the temperatures (25, 30, 35, and 40°C) has been studied. It was shown that when the silver nanoparticles are accumulated, the colour of the reaction mixture darkens. This phenomenon is considered to be the initial indication of the existence of silver nanoparticles (Xiangqian et al., 2011; Ganbarov et al., 2015a; Ganbarov et al., 2015b; Ganbarov et al., 2016a; Ganbarov et al., 2016b). The appearance of silver nanoparticles due to the colour change was observed at 25 and 30°C (Figure 1).

Figure 1. The color change of reaction mixture during the formation of silver nanoparticles by *Candida macedoniensis* BSU -MI44: a- experiment, b-control (1– 25℃, 2 – 30℃).

Spectrophotometric analyses of the samples showed that incubated samples at temperatures 25 and 30°C had absorption at 410 nm wavelength, which is characteristic for silver nanoparticles. Spectrophotometric analyses of samples taken from incubated variants showing no colour change (at temperatures 35 and 40°C) didn't have an absorption or the absorption was very weak (Figure 2).

All the samples were analyzed on the scanned electron microscope and nanoparticles were not observed in the variants incubated at 35 and 40°C. However, silver nanoparticles of different sizes were observed in variants incubated at 25 and 30°C.

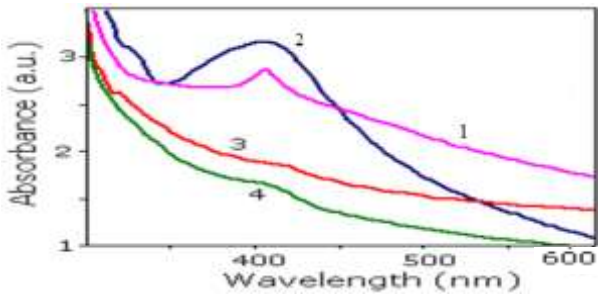

Figure 2. UV-visible absorption spectra of silver nanoparticles formed by *Candida macedoniensis* BSU-MI 44 depending on the temperatures: 1 – 25℃, 2 – 30°C, 3 – 35°C, 4 – 40°C.

The optimum temperature for the production of silver nanoparticles by the yeast cell strains was between 25 and 30°C. So, the nanoparticles formed at both temperatures had spherical forms (Xiangqian et al., 2011;

Ganbarov et al., 2015a; Ganbarov et al., 2015b; Ganbarov et al., 2016). However, the sizes of the silver nanoparticles formed at 25°C and 30°C were respectively, 22,6 nm and 22,9nm. It was determined that, the sizes of silver nanoparticles formed at 25°C was 2, 8 - 4, 7 times larger than those formed at 30°C.

X-ray-phase spectroscopic analyses of the samples incubated at 25 (1) and 30°C (2) showed (Figure 3) characteristic adsorption peak of silver nanoparticles (Ag Lal).

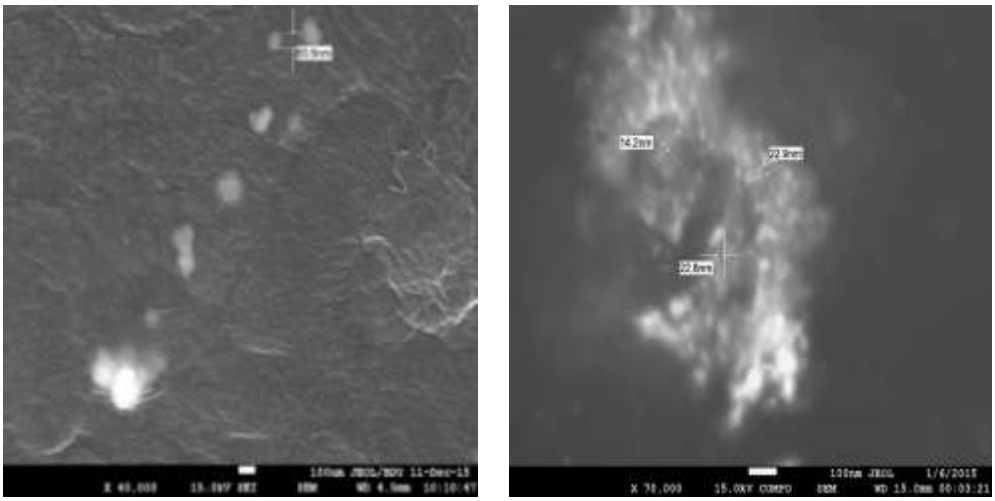

Figure 3. The shapes and sizes of silver nanoparticles, formed by *Candida macedoniensis* BSU-MI44 depending on the temperatures (1-25° and 2- 30°C) on the scanning electron microscope.

4. Conclusion

The impact of the temperature on the formation of silver nanoparticles by *Candida macedoniensis* BSU-MI44 was studied and it was determined that the optimum temperature for the synthesis of silver nanoparticles was between 25-30°C. The formation of silver nanoparticles at 35° and 40°C was not observed. The sizes of the formed nanoparticles depending on the temperatures were different. The sizes of silver nanoparticles formed at 30°C were 2.8-4.7 times smaller than the nanoparticles of 25°C.

Author Contributions

Percentages of the author(s) contributions is present below. All authors reviewed and approved final version of the manuscript.

%	M.J.	K.G.	E.K.	S.H.	S.G.
C	20	20	20	20	20
D	20	20	20	20	20
S	20	20	20	20	20
DCP	20	20	20	20	20
DAI	20	20	20	20	20
L	20	20	20	20	20
W	20	20	20	20	20
CR	20	20	20	20	20
SR	20	20	20	20	20
PM	20	20	20	20	20
FA	20	20	20	20	20

C= concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval/Informed Consent

Ethics committee approval was not required for this study because of there is no animal or human research.

In this research, no ethical statement was needed since artificial fungus cultures were used.

References

Abo–State MAM, Partila AM. 2015. Microbial production of silver nanoparticles by *Pseudomonas aeruginosa.* Cell free extract. J Eco Heal Env, 3(3): 91–98.

Anal KJha, Prasad K, Kulkarni AR. 2008. Yeast mediated synthesis of silver nanoparticles. Inter J Nanosci Nanotech, 4(1): 17-21.

Bhainsa KC, D'Souza SF. 2006. Biomimetic synthesis of nanoparticles. Colloids Surf B, 47: 160–164.

Bharde A, Rautaray D, Bansal V, Ahmad A, Sarkar I, Mohammad Yusuf S, Sanyal M, Sastry M. 2006, Extracellular biosynthesis of magnetite using fungi. Small, 2(1): 135-141.

Egorova EM, Revina AA. 2000. Synthesis of metallic nanoparticles in reverse micelles in the presence of quercetin. Colloids and Surfaces A: Physicochem Engin Aspects, 168: 87-96.

Ganbarov KhG, Jafarov MM, Hajiyeva FT, Bozkurt HC, Ramazanov MA, Eyvazova GI, Aghamaliyev ZA, Ahmedov IS, Abdulhamidova SM. 2015a. The study of the ability of *Candida macedoniensis BSU-MI44* to synthesize silver nanoparticles. J Qafqaz Univ Chem Biol, 2015: 139–142.

Ganbarov KhG, Jafarov MM, Hajiyeva FT and Bozkurt HC. 2015b. Studying of capacity of strains of yeast fungus *Candida macedoniensis BDU-Mİ44* to synthesize nanoparticles of silver. Modern Mycology in Russia. In Proceeding of Materials of III International Mycological Forum, Moscow, Russia, 4: 82.

Ganbarov KhG, Jafarov MM, Hajiyeva FT, Bozkurt HC, Ramazanov MA, Eyvazova GI. 2016a. The formation of silver nanoparticles by *Candida macedoniensis BSU-MI44* depend*ing* on the amount of biomass. In Proceeding of International Scientific-Practical Conference On Actual Problems Of Modern Chemistry And Biology, May 12, Ganja, Azerbaijan, 2016:161–165.

Ganbarov KhG, Jafarov MM, Hajiyeva FT, Bozkurt HC, Ramazanov MA, Eyvazova QI, Aghamaliyev ZA, Akhmedov IS. 2016b. Mycogenic Formation of Silver Nanoparticles by the Azerbaijanese environmental isolate *Candida macedoniensis* BDU–Mİ44. Inter J Res Stud in Biosci, 5: 1–5.

Ganbarov KhG, Musayev EM. 2012. Microorganisms forming nanoparticles. Transaction of the Institute of Microbiol Azerbaijan National Acad, 10: 78–84.

Kowshik M, Ashtaputre SH, Kharazi SH, Vogel W, Urban J, Kulkarni SK, Paknikar KM. 2003. Extracellular synthesis of silver nanoparticles by a silver- tolerant yeast strain MKY3 Nanotechnol, 14(1): 95 – 100.

Li X, Xu H, Chen ZS, Chen G. 2011. Biosynthesis of nanoparticles by microorganisms and their applications. J Nanomaterial, 11(8): 1–17.

Muthupandian S, Amelash T, Negash L, Gebreyesus A, Selvaraj A, Rayar V and Dheekonda K. 2013. Extracellular biosynthesis and biomedical application of silver nanoparticles synthesized from baker's yeast. Inter J Res Pharma Biomed Sci, 4(3):822 – 828.

Narayanan KB and Sakthivel N. 2010. Biological synthesis of metal nanoparticles by microbes. Advances in Colloid Interface Sci, 156 (1,2): 1–13.

Sadowski Z, Maliszewska IH, Grochowalska B, Polowczyk I, and Koźlecki T. 2008. Synthesis of silver nanoparticles using microorganisms. Materials Sci, 26: 2419–2424.

Sadowski Z. 2010. Biosynthesis and application of silver and gold nanoparticles. Wroclaw Univ Technol, 11: 257–276.

Sastry M, Ahmad A, Khan MI, Kumar R. 2003. Biosynthesis of metal nanoparticles using fungi and actinomycete. Current Sci, 85: 162–170.