Algerian Journal of Biosciences

Journal homepage: http://www.ajbjournal.periodikos.com.br

Original Article

Characterization and acute toxicity evaluation of the MgO Nanoparticles Synthesized from Aqueous Leaf Extract of *Ocimum basilicum L*

DEROUICHE Samir [a,b], GUEMARI Imane Yousra[a], BOULAARES Islam [a]

[a]*Department of Cellular and Molecular Biology, Faculty of the Sciences of Nature and Life, El-Oued University, El-Oued 39000, El Oued, Algeria*

[b]*Laboratory of Biodiversity and application of biotechnology in the agricultural field, Faculty of the Sciences of Nature and Life, University of El Oued, El-Oued 39000, Algeria*

ARTICLE INFO

Article history:
Received 01 Aug 2020
Revised 16 Aug 2020
Accepted 30 Aug 2020

Keywords:
Ocimum basilicum;
Nanoparticles;
Magnesium oxide;
Characterization;
Toxicity.

ABSTRACT

The aim of this study was to prepare magnesium oxide nanoparticles (MgONPs) using aqueous leave extract of *Ocimum basilicum L.* and to evaluate their acute toxicity. The characteristics of biosynthesized MgO powder was analyzed by UV–Vis spectroscopy, scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR). The acute toxicity test of MgONPs was applied in Wistar albino rats with different concentration. Results showed that the broad bell-shaped spectrum band was obtained by UV–Vis spectroscopy indicates the formation of MgO. The SEM images provided further insight into the shape and size of MgO which to be ranging under 440 nm. Fourier transform infrared (FTIR) spectroscopy detected the vibration of the Mg─O bond that indicate the presence of magnesium oxide nanoparticles (MgO). In this study, the toxicity test showed no mortality or behavioral change in low dose of MgNPs (250 mg / kg b.w) but we observed that 50% of rats have died when treated with high dose of MgNPs (500 mg/kg b.w.). This study confirmed that aqueous extract of *Ocimum basilicum L.* has potential properties as biocatalyst for the biosynthesis of MgONPs without any toxicity under dose 250 mg/kg in rats.

1. Introduction

Nanotechnology has been a known field of research since the last century [1], which has the potential to advance scientific innovation while giving an enormous advantage to society [2]. Information technology is an exciting new field in science, with many possible applications in the field of medicine [3]. Today's nanotechnology harnesses progress Current in chemistry, physics, materials science and biotechnology to create new materials that have unique properties because their structures are defined on the nanometer scale [4]. The biosynthesis for obtaining nanoparticles using naturally occurring reagents such as vitamins, sugars, plant extracts, biodegradable polymers, and microorganisms as reductants and capping agents could be considered attractive for nanotechnology [5]. Recently, increasing interest in nanotechnology applications in various fields. can be observed. Due to the increasing range of applications [6], metallic nanoparticles are of particular importance because they often exhibit volume-dependent properties that differ from bulk materials. The progress made in time is evident from the development in technology that has revealed the ability of minerals to perform specific functions better than the shape of metals [7]. The application of nanotechnology in biology requires further studies for the development of new materials in the nanosized range [8]. Magnesium (Mg) is an essential mineral component of plants and non-toxic to living organisms [9]. Magnesium nanoparticles have received the attention of most scientists due to their low cost, ecofriendly and due to their great therapeutic usefulness as anti-cancer and anti-microbial activity. [10]. Plants are an essential source of many active molecules

* *Corresponding author.* E-mail address:

DOI : https://doi.org/10.57056/ajb.v1i1.18

[11]. *Ocimum basilicum L.* is a traditionally important medicinal plant belonging to the family *Lamiaceae* and also an annual herb which is grown around the world several regions [12]. The aim of this study was to use aqueous extract of leaves *Ocimum basilicum* in order to prepare MgNPs and to evaluate the acute toxicity of MgONPs.

2. Materials and Methods

2.1. Chemicals

Magnesium Nitrate, sodium hydroxide and Sodium chloride and Ethanol were obtained from Sigma Aldrich.

2.2. Plant materials

The plant of *Ocimum basilicum* were collected in October 2019 at the full flowering stage, from El Oued region, Algeria. The leaves were washed with distilled water, then dried at room temperature, then grind to powder and stored at room temperature until use.

2.3. Preparation of plant extract

Aqueous extract was preparing by putting 10 g of dried leaves powder of *Ocimum basilicum L* with 100 ml of distilled water was boiled over low heat (50 C°) for 2 hours. After cooled and macerated to room temperature for 24 hours, then filtered through Whatman filter paper, the extract was then evaporated using a rotary evaporator according to the methods described by Derouiche et al. [13]. Which was used for the synthesis of and magnesium nanoparticles.

2.4. Biosynthesis of magnesium oxide nanoparticles

5 g of Magnesium Nitrate ($Mg(NO3)2 \cdot 6 H2O$) was added to the solution of plant extract and heated at 80°C with continuous stirring for 4 hours. The Magnesium nitrate ions were reduced to Magnesia or Magnesium Oxide nanoparticles by using *Ocimum basilicum* leaves extract. The formation of Magnesium oxide nanoparticles (MgONPs) have been observed by color change of the solution from yellow to yellowish-brown color [14].

2.5. Characterization of the Mg nanoparticles

The MgO Nanoparticles prepared by the above method was characterized using UVD 3200 UV-Vis spectrophotometer. Furthermore, the morphology and size of Nanoparticles (NPs) was determined using scanning electron microscopy (SEM). The Fourier transform infrared spectroscopy (FTIR) analysis of plant extract and biosynthesized magnesium oxide nanoparticles was recorded under identical conditions in the range 400–4000 cm−1 resolution using FTIR spectrophotometer (vector 22, Bruker, Germany).

2.6. Acute toxicity test of biosynthesized Mg NPs

The test was performed using 12 healthy albino male Wistar rats aged 10 weeks old, weighing 213.5 ± 9.31 g. Animals had free access to water and standard diet. After the adaptation period, the animals were divided into three groups of four rats in each and the test MgONPs was injected intraperitoneally at a doses 0, 250 and 500 mg/kg b.w. Animals were observed after dosing at least once during the first 30 min, periodically during the first 24 h as described in study of Kaouachi and Derouiche [15]

3. Results and Discussion

Our study reported that the addition of *O. basilicum* (Fig.1) in the synthesis of MgNPs induced to changes the color from yellow to yellowish-brown color indicating the formation of MgO. Due to phytochemicals compounds present in the aqueous extract of O. basilicum such as alkaloids, carbohydrates, tannins, phenolic compounds, flavonoids and terpenoid [16] which reduced magnesium nitrate to MgO and formed a colloidal solution.

Figure 1. Leaves of *Ocimum basilicum L.*

3.1. UV–Vis analysis

UV–Vis absorption spectrum of Mg NPs is shown in Figure 2 Broad bell-shaped spectrum band was obtained at the wavelength 300 nm from UV–Vis analysis, confirming the formation of MgO The optical properties of metal nanoparticles strongly depend on the size, shape and interaction between the particles present on the surface of the nanoparticles [17]. Mg NPs is reported to exhibit a broad absorption peak in between 260-330 nm [18]. Nanoscale MgO possesses unique optical, electronic, magnetic, thermal, mechanical and chemical properties due to its characteristic structures [19]. Magnesium oxide (MgO) is a category of the practical semiconductor metal oxides, which is extensively used as catalyst and optical material [20]. Aqueous extracts of *Ocimum basilicum* leaf was reported to exhibit carbohydrate and proteins, amino acids at highest concentration [21]. Therefore, the phytochemicals from *O. basilicum* perhaps reduce the Magnesium nitrate into Magnesium oxide nanoparticles through the bioreductional process.

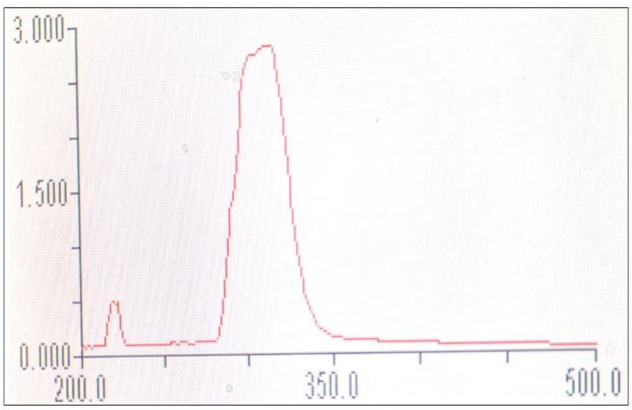

Figure 2. UV-Vis spectrum of MgO Nanoparticles

3.2. Scanning electron microscopy (SEM)

The result of Mg NPs size was showed through scanning electron microscopy (SEM) images (Figure 3). Scanning electron microscopy observation provided further insight into the shape and size of the synthesized nanoparticles [22]. In our results, SEM images indicate the size of some selected biosynthesized nanoparticles which was down to 440 nm this results according to the study of Sushma et al. [23], SEM analysis of MgO has showed the size of 50–400 nm with specific binding energies. The importance of determining the size of nanoparticles is that the MgNPs has a capacity for interaction with biological systems at the cellular level because the small size of nanomaterials favors their penetration into the cell. It is well established that nanomaterials have a greater capacity to penetrate cells [24,25].

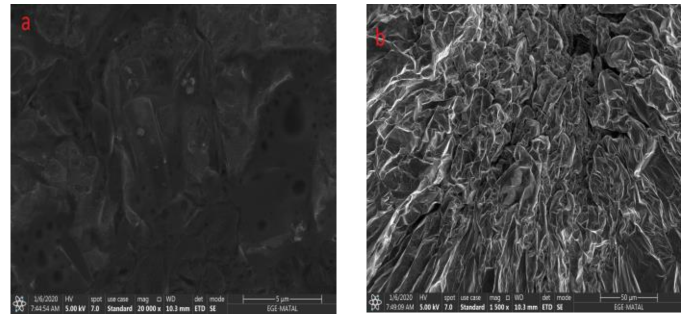

Figure 3. Scanning electron microscopy (SEM) of MgNPs measured in dimension 5µm (a) and in dimension 50µm (b)

3.3. Fourier infrared spectroscopy analysis

The functional group of MgO nanopowder was analyzed by FTIR spectrophotometer in the range 400–4000 cm-1 (Figure 4). FTIR spectra of the biosynthesized Mg NPs is shown a band 1644.80 cm-1 is ascribed to the stretching vibration of C=C in according with Solabomi et al., [10] that they found a band at 1633 cm-1. The peaks observed below 800 cm−1 confirmed the bond between magnesium and oxygen [26]. Also, the stretching vibration mode ~0600–850 cm−1 indicating Mg–O–Mg bonds [27]. Noori et al., (2019) found in their study that bands at 581 cm_1, 850 cm_1, and 890 cm_1 corresponded to stretching vibrations of the metal-oxygen bond, which corresponded to the presence of the MgO nanoparticles [28]. A broad band was observed ~3353 cm−1 due to O–H stretching vibration of water molecule which was in agreement with Balakrishnana et al., (2020) [27]. The prominent peak at 1382cm-1 is assigned to Mg–O vibration, almost the same result that we get a sharp peak on the wave number 1362.06 cm-1 [29].

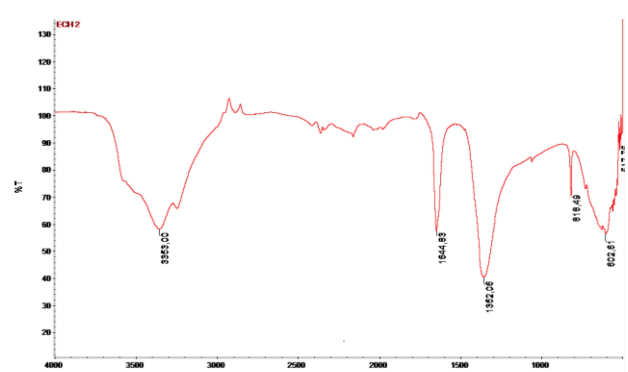

Figure 4. Infrared spectroscopy of magnesium nanoparticles

3.4. Acute toxicity test of biosynthesized Mg NPs

In this experiment the acute toxicity test was performed on albino Wister rats for 24 hours. Our magnesium nanoparticles were used with dose of 250 mg and 500 mg per kg of weight of rats. The results obtained during this test showed that no mortality was observed before 24 hours, which suggests the non-toxic effect of the magnesium nanoparticles at the law doses. The other physiological parameters of the rats were also determined during the experimental period and showed that treatment with the magnesium nanoparticles caused no symptoms or complications also no adverted effect in the rats during the treatment period in control group at dose (0 mg/ kg) and in the group at dose (250 mg/ kg), but in the group treated with dose of (500mg/ kg) we observed death rats in rate of 50% (table 1) which was in agreement with the study of Mazaheri et al., (2019) [30]. This study confirmed that Ocimum basilicum L. has a capability for the biosynthesis of Mg NPs. Moreover, the outcome of this in research determines the concentration of MgO effect and be appropriate for various applications, we found that treatment with the magnesium nanoparticles cause no toxic effect at low doses.

Conclusion

This study proved the ability of *Ocimum basilicum L.* extract for the biosynthesis of Mg NPs which characterized by different methods; UV-VIS spectroscopy, FT-IR spectroscopy and SEM analysis. In addition, acute toxicity test assessment of the biosynthesized Mg NPs appeared its non-toxic effect especially when concentrations are low doses.

Acknowledgements

The author thanks the staff of laboratory of Faculty of natural and life sciences for providing research facilities to carryout present work. This work was supported by the research project D01N01UN390120190001 funded by the ministry of higher education, Algeria and by Directorate general for Scientific Research and Technological Development.

Conflict of Interest

The authors declare that they have no conflict of interest

Table 1. Acute toxicity parameters of MgNPs in rats

Parameters	0 mg/ kg					250 mg/ kg					500 mg/ kg				
	0h	3h	7h	14h	24h	0h	3h	7h	14h	24h	0h	3h	7h	14h	24h
Death rats	0	0	0	0	0	0	0	0	0	0	0	50%	50%	50%	50%
Eyes	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sleep	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Diarrhea	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

N, Normal

References

1. Khan AI, Saeed KB, Khan I. Nanoparticles: Properties, applications and toxicities. Arab J Chem. 2019; 12: 908-931.
2. Danquah A, Mory S. Application of nanotechnology in bioengineering industry and its potential hazards to human health and the environment. J Pharm Innov. 2017; 6(7): 49-53.
3. Saini R, Saini S, Sharma S. Nanotechnology: the future medicine. J Cutan Aesthet Surg. 2010; 3(1): 32-3. doi: 10.4103/0974-2077.63301.
4. Mobasser Sh**,** Firoozi AA. Review of Nanotechnology Applications in Science and Engineering. J Civ Eng Urb. 2016; 6(4): 84-93.

5. Atoussi O, Chetehouna S, Derouiche S. Biological properties and Acute Toxicity Study of Copper oxide nanoparticles prepared by aqueous leaves extract of *Portulaca oleracea* (L). Asian J. Pharm. Res. 2020; 10(2):89-94.
6. Baranowska-Wójcik E, Szwajgier D, Oleszczuk P, Winiarska-Mieczan A. Effects of Titanium Dioxide Nanoparticles Exposure on Human Health—a Review. Biol Trace Elem Res. 2020; 193: 118–129. doi.org/10.1007/s12011-019-01706-6
7. Vergheese M, Vishal SK. Green synthesis of magnesium oxide nanoparticles using Trigonella foenum-graecum leaf extract and its antibacterial activity. J Pharmacogn Phytochem. 2018; 7(3): 1193-1200.
8. Chetehouna S, Atoussi O, Derouiche S. Biological Activity and Toxicological Profile of Zinc Oxide Nanoparticles Synthesized by *Portulaca oleracea (L)* Leaves Extract. Adv Nanomed Nanotechnol Res. 2020; 2(2): 125-133.
9. Cai L, Chen J, Liu Z, Wang H, Yang H, Ding W. Magnesium Oxide Nanoparticles: Effective Agricultural Antibacterial Agent Against Ralstonia solanacearum. Front. Microbiol. 2018; 9: 790. doi: 10.3389/fmicb00790.
10. Solabomi O, Ogunyemia B, Zhanga F, Abdallaha Y, Zhanga M, Wangc Y, Guochang Sunc, Qiua W, Li B. Biosynthesis and characterization of magnesium oxide and manganese dioxide nanoparticles using Matricaria chamomilla L. extract and its inhibitory effect on Acidovorax oryzae strain RS-2. Artif Cells Nanomed Biotechnol. 2019; 47(1): 2230-2239, doi: 10.1080/21691401.2019.1622552.
11. Derouiche S, Abbas K, Djermoune M. Polysaccharides and ascorbic acid content and the effect of aqueous extract of portulaca oleracea in high-fat diet-induced obesity, dyslipidemia and liver damage in albino wistar rats. Algerian J arid environ. 2017; 7(2): 16-26.
12. Balasubramani S, Kumar-Moola A, Vivek K, Ranjitha-Kumari KD. Formulation of nanoemulsion from leaves essential oil of Ocimum basilicum L. and its antibacterial, antioxidant and larvicidal activities (Culex quinquefasciatus)., Microb Pathog. 2018; 125: 475–485.
13. Derouiche S, Degachi O, Gharbi K. Phytochemistry analysis and modulatory activity of Portulacae oleracea and Aquilaria malaccensis extracts against High-fructose and high-fat diet induced immune cells alteration and heart lipid peroxidation in Rats. Int Res J Biol Sci. 2019; 8(4): 6-11.
14. Prasanth R, Dinesh Kumar S, Jayalakshmi A, Singaravelu G, Govindaraju K, Ganesh-Kumar V. Green synthesis of magnesium oxide nanoparticles and their antibacterial activity. Indian J Mar Sci. 2019; 48(8): 1210-1215.
15. Kaouachi A, Derouiche S. Phytochemical analysis, DPPH antioxidant activity and Acute toxicity of bark aqueous extracts of Pinus halepensis. Res. J. Chem Env Sci. 2018; 6(3): 86-91.
16. Khair-ul-Bariyah S, Ikram M. Ocimum Basilicum: A Review on Phytochemical and Pharmacological Studies. Pak J Chem. 2012; 2(2):78-85.
17. Enobong RE, Violette NA, Anastecia OO, Davies ON. Biogenic synthesis of magnesium oxide nanoparticles using *Manihot esculenta* (Crantz) leaf extract. Int. Nano Lett. 2020; 10:43–48.doi.org/10.1007/s40089-019-00290-w
18. Almontasser A, Parveen A, Azam A. Synthesis, Characterization and antibacterial activity of Magnesium Oxide (MgO) nanoparticles. Mater Sci Eng. 2019; 577: 1-10. doi:10.1088/1757-899X/577/1/012051.
19. Narendhran S, Manikandan M, Shakila PB. (). Antibacterial, antioxidant properties of Solanum trilobatum and sodium hydroxide-mediated magnesium oxide nanoparticles: a green chemistry approach. *Bull Mater Sci.* 2019; *42*(3). 1-8.

20. Nemade KR, Waghuley SA. Synthesis of MgO Nanoparticles by Solvent Mixed Spray Pyrolysis Technique for Optical Investigation. *Int J Met. 2014*, 1-4. doi:10.1155/2014/389416
21. S. C. Prasanna, M. Poongani, S. Karpagam, IOSR Journal of Pharmacy and Biological Sciences 10 (2015) 24-27.
22. Yasmine A, Solabomi-Olaitan O, Amro A, Muchen Z, Xianxian H, Ezzeldin I, Afsana H, Hatem F, Bin L, Jianping C. The Green Synthesis of MgO Nano-Flowers Using *Rosmarinus officinalis* L. (Rosemary) and the Antibacterial Activities against *Xanthomonas oryzae* pv. *Oryzae*. Biomed Res Int. 2019; 2019: 5620989. doi: 10.1155/2019/5620989
23. Sushma JN, Prathyusha D, Swathi G. Facile approach to synthesize magnesium oxide nanoparticles by using Clitoria ternatea—characterization and in vitro antioxidant studies. Appl Nanosci. 2016; 6: 437- 444. doi.org/10.1007/s13204-015-0455-1.
24. Nabeshi HT, Yoshikawa K, Matsuyama Y, Nakazato A, Arimori M, Isobe S, Tochigi S, Kondoh T, Hirai T, Akase T, Yamashita K, Yamashita T, Yoshida K, Nagano Y, Abe Y, Yoshioka H, Kamada T, lmazawa N, Itoh S, Tsunoda I, Tsutsumi Y. Size-dependent cytotoxic effects of amorphous silica nanoparticles on Langerhans cells". *An Int J Pharm Sci.* 2010; *65(3):* 199-201. doi : 10.1691/ph.2010.9268
25. Sakai N, Matsui Y, Nakayama A, Tsuda A, Yoneda M. Functional-dependent and size-dependent uptake of nanoparticles in PC 12. *J Phys Conf Ser.* 2011; *304(1)*: 1-10. doi : 10.1088/1742-6596/304/1/012049..
26. Imani MM, Safaei M. Optimized Synthesis of Magnesium Oxide Nanoparticles as Bactericidal Agents J Nanotechnol. 2019: Article ID 6063832, 6 pages. doi.org/10.1155/2019/6063832.
27. Balakrishnana G, Velavan R, Mujasam KB, Raslan EH. Microstructure, optical and photocatalytic properties of MgO nanoparticles. Results Phys. 2020*; 16*: 103013. doi.org/10.1016/j.rinp.2020.103013.
28. Noori AJ, Kareem FA. The effect of magnesium oxide nanoparticles on the antibacterial and antibiofilm properties of glass-ionomer cement. *Heliyon* 2019; 5: 1-7. doi.org/10.1016/j.heliyon.2019.e02568.
29. Avadhesh KY, Prabhakar S. A Review of Structure of Oxide Glasses by Raman Spectroscopy. RSC Advances. 2015. doi: 10.1039/c0xx00000x.
30. Mazaheri N, Naghsh N, Karimi A, Salavati H, (). In vivo Toxicity Investigation of Magnesium Oxide Nanoparticles in Rat for Environmental and Biomedical Applications. Iranian J Biotech. 2019; 7 (1): 9 pages. doi: 10.21859/ijb.1543.

Recommended Citation

DEROUICHE S,GUEMARI IY, BOULAARES I. Characterization and acute toxicity evaluation of the MgO Nanoparticles Synthesized from Aqueous Leaf Extract of *Ocimum basilicum L. Algerian Journal of Biosciences*. 2020, 01;01:001-006.