



Original Article

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

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ABSTRACT

The aim of this study was to prepare magnesium oxide nanoparticles (MgONPs) using aqueous leaf 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 MgONPs (250 mg / kg b.w) but we observed that 50% of rats have died when treated with high dose of MgONPs (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.

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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

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[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 ($Mg(NO_3)_2 \cdot 6 H_2O$) 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.

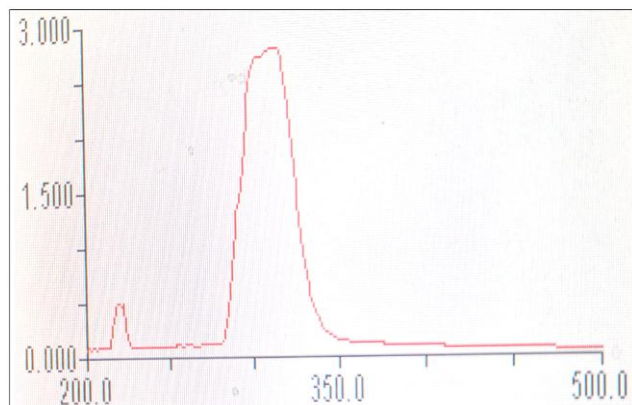


Figure 2. UV-Vis spectrum of MgO Nanoparticles

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].

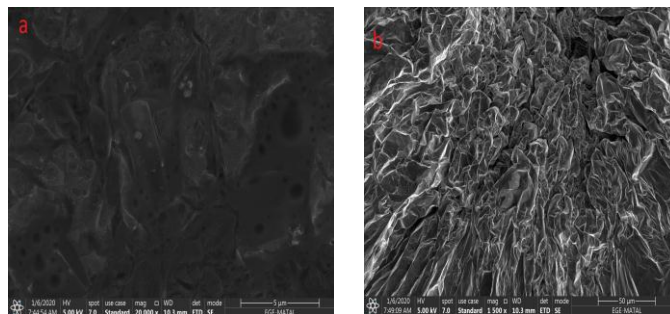


Figure 3. Scanning electron microscopy (SEM) of MgNPs measured in dimension 5 μm (a) and in dimension 50 μm (b)

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 ~600–850 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 1382 cm^{-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].

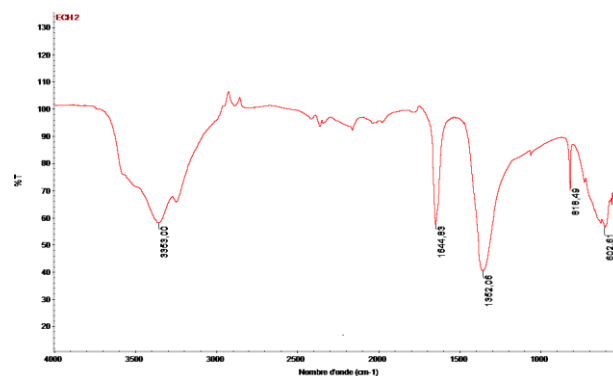


Figure 4. Infrared spectroscopy of magnesium nanoparticles

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 low 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.

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

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.

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Conflict of Interest

The authors declare that they have no conflict of interest

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