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ASSESSMENT OF ANTIMICROBIAL ACTIVITY OF PHYTOFABRICATED IRON OXIDE NANOPARTICLES

Aliyaa A. Urabe* and Wisam J. Aziz

Department of Physics, College Science, Mustansiriyah University, Baghdad, Iraq.

Abstract

In this study, a method was used to prepare a feiend for processing of the (Fe_2O_3 NPs) using simple plant extracts and available (*Allium cepa* and *Ricinus communis*), Thus we obtained the nanoparticles and calculated the crystalline size by means of X-ray diffraction, fining the energy gap that was (3.5 eV) *Allium cepa* extract and (3.4 eV) with *Ricinus communis* extract using spectroscopy of UV-vis and calculating the grain size by means of the analysis of FE-SEM showed small particles from (25-72nm). The benefit of Iron Oxide nanoparticles application of antibacterial activity obtained a good inhibitory zones was *S. aureus* (16 mm) *P. aeruginosa* (17 mm) with *Allium cepa* extract and *S. aureus* (22 mm) *P. aeruginosa* (25mm) with *Ricinus communis* extract at 40ìg/ml concentration.

Key words: synthesis, Iron oxide nanoparticles, *Allium cepa*, *Ricinus communis*, extract, antibacterial activity.

Introduction

Molecular nanotechnology industry using plant extracts high technology environmentally friendly and give high properties and nanoparticles are discouraged and treated as a bioreduction for compiling nanoparticles characteristics optimization (Abou El-Nour, 2010). Preparation of thermal alkali used with plant extracts huh chemical reduction resulting from the chemical reaction (Padil and Èerník, 2013). electrochemical procedures (Hoseyni, 2017). micro emulsion (Phukan, 2017). A typical procedure involves growing nanoparticles in a liquid medium containing various reactants, in particular reducing agents, such as sodium borohydride or potassium bitartrate (Ragupathi, 2014) or methoxy polyethylene glycol (Samui, 2016) or hydrazine (Sundrarajan, 2015). A nanometer is a 10^{-9}. The bacterial membrane contains sulfur-containing proteins, and the Iron oxide nanoparticles interact with these proteins in the cell. The Fe_2O_3 NPs in the bacterial enhancing their bactericidal activity (Raveendran, 2003). The present review focuses on the synthesis of Fe_2O_3 NPs with particular emphasis on biological synthesis using plant extracts and most commonly proposed mechanisms regarding the antibacterial properties of nanoparticles (Patil, 2012).

***Author for correspondence :** E-mail : aliyaa.a@yahoo.com

Materials and methods

Chemicals and reagents

In this study, has been used Iron nitrate hexahydrate ($Fe(NO_3)_2.9H_2O$), (99%), (Reagent World, USA, purity 99.99%), Sodium hydroxide, *Allium cepa* and *Ricinus communis* were purchased from markets. Distill water (DW) was used as a solvent.

Preparation of green reducing and stabilizing agent

A Red onion root (*Allium cepa*) and Castor seeds (*Ricinus communis*) were collected from local markets, (Baghdad). The plants have been cut into small pieces and washed with distilled water and take *Allium cepa* (30g) and 200 mL (DW) were homogenized at 80 °C on stirring, in cooled down and filtered. The filtrate (Light yellow color) was collected and used for the synthesis of Iron oxide nanoparticles; the same procedure was donning for green tea leaves.

Fe_2O_3 NPs Synthesis

To synthesize the Iron oxide nanoparticles, freshly extract (30 mL) was added to (0.02 M) and of $FeNO_3$ hex hydrate, on 75°C till precipitates appeared. The mixture was kept overnight at room temperature and then centrifuged at 14000 rpm ten minutes and washed water distilled several times. The obtained precipitates

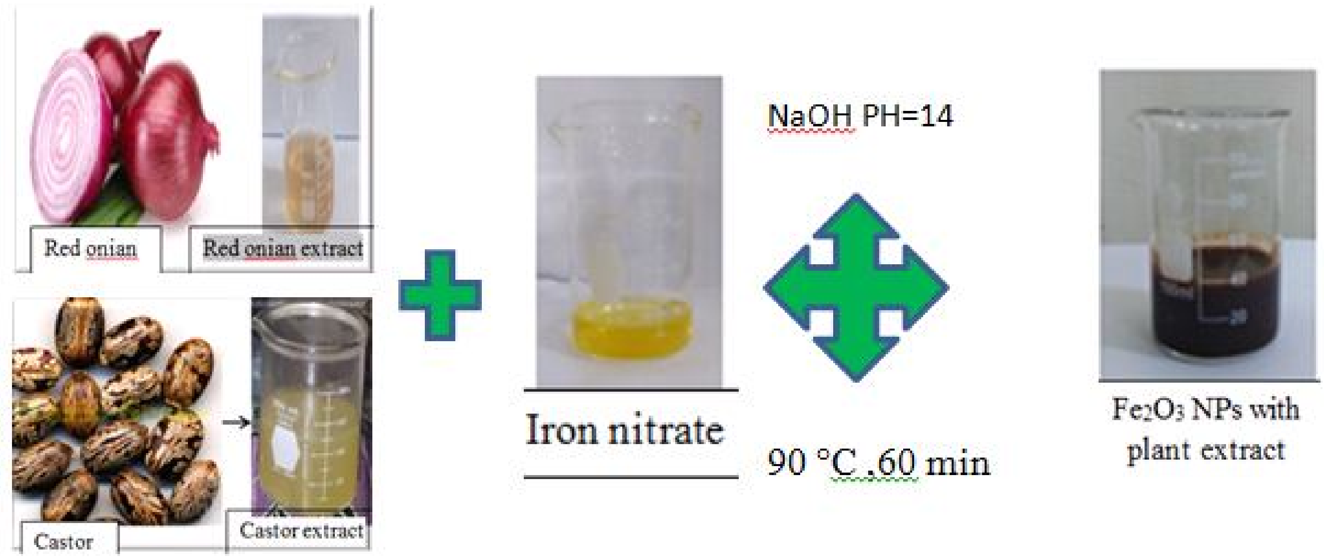

Fig.1: Synthesis of Fe_2O_3 NPs using plant extracts *Allium cepa* and *Ricinus communis* with Iron nitrate

were dried in an furnace at 400°C for 2 h, grinded and subjected to characterization, Fe_2O_3 NPs Synthesis by plant extracts and mixing it with Iron nitrate and turning it from yellow to brown forming the Iron oxide. The process to synthesis of Fe_2O_3 NPs with plants is show in fig.1.

Results and discussion

X-Ray analysis

Fig.2 reveal X-ray of Iron oxide nanoparticles using *Allium cepa* and *Ricinus communis* extracts. Such as Bragg diffraction values are [(002), (020), (022), (110), (111), (023), (040), (200), (130), (203), (132), (113), (220), (151), (200), (044)] of Iron oxide nanoparticles with *Allium cepa* extract. Fig.3 show the Iron oxide nanoparticles formed with crystalline in nature with a mixed phase structure (Orthorhombic) in peaks [(111), (220), (10-4), (311), (222), (21-2), (102), (440), (20-5), (422), (511), (104), (440), (533), (620), (622)] *Ricinus communis* extract, XRD pattern shows the Fe_2O_3 NPs formed are crystalline in nature with a mixed phase structure (Cubic).possible account the average crystallite size of (Debye-Scherrer equation):

$$D = \frac{k\lambda}{\beta cos\theta} \qquad \text{......... (1)}$$

Where: D is the particle size (nm), k is a constant equal to 0.94, λ is the wavelength of X-ray radiation (1.541A), b is the full-width at half maximum (FWHM) of the peak (in radians) and 2 Theta is the Bragg angle (in degrees). The average crystalline size was found to be in the range of (12-52 nm) from *Allium cepa* extract and (20-99 nm) from *Ricinus communis* extract.

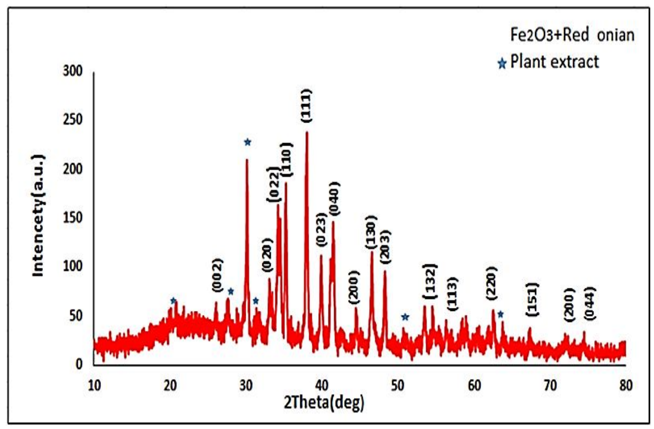

Fig.2: X-ray pattern of Fe_2O_3 NPs using *Allium cepa* extract.

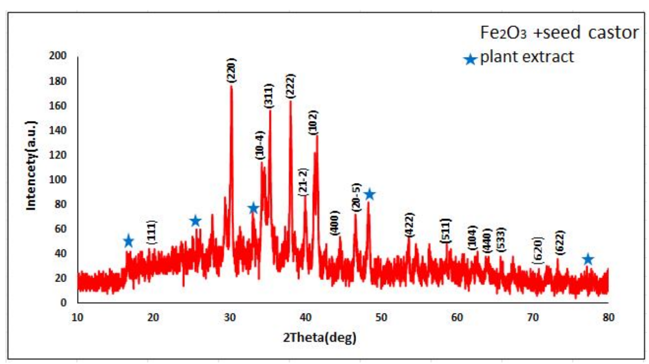

Fig.3: Using X-ray pattern of Fe_2O_3 with Ricinus communis extract.

FE-SEM analysis

The FE-SEM images of Fe_2O_3 NPs are shown in Fig. 4. The morphology a nanoparticles indicates irregular, cubic and hexagonal shapes of various sizes that are

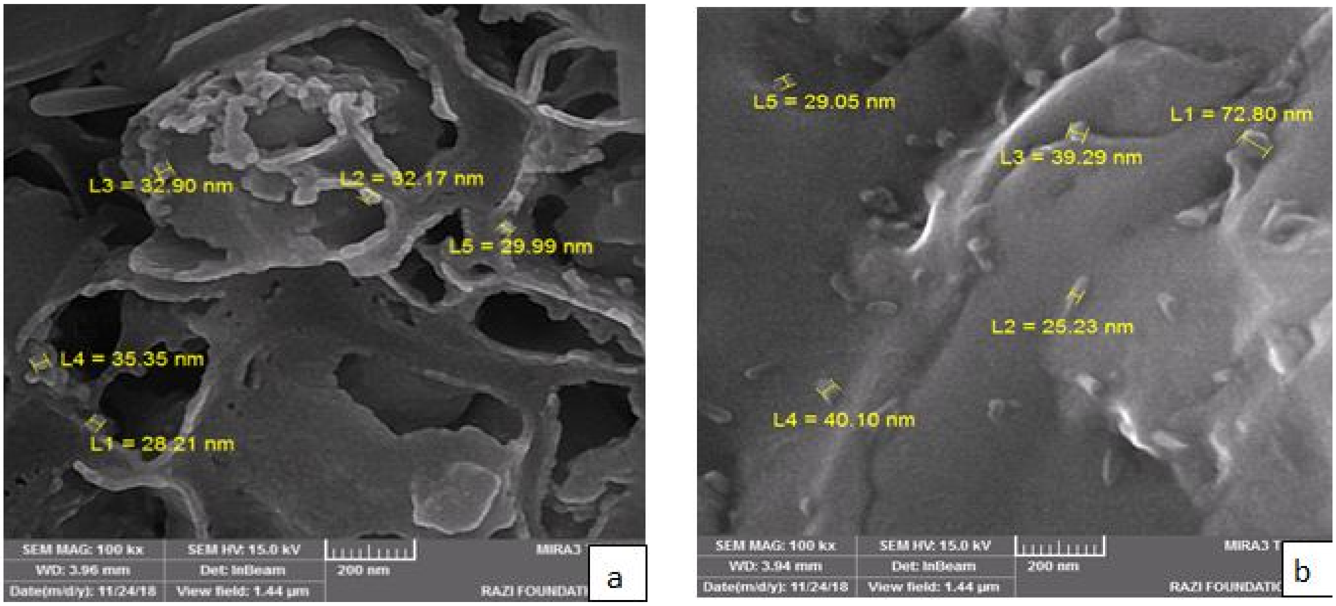

Fig. 4: FE-SEM of Iron oxide nanoparticles preparing using a) *Allium cepa* and b) *Ricinus communis* extract.

agglomerated. Further observations with higher magnifications reveal these images possess smooth surfaces. At much higher magnification the images are seen as large particles which can be attributed to aggregation or clustering of smaller particles.

UV-visible spectroscopy:

The formation of Fe_2O_3 NPs was followed is frequently used to characterize synthesized Fe_2O_3 NPs. Fig. 5 shows The maximum absorption peaks are (223 nm) for *Allium cepa* and (210 nm) for *Ricinus*

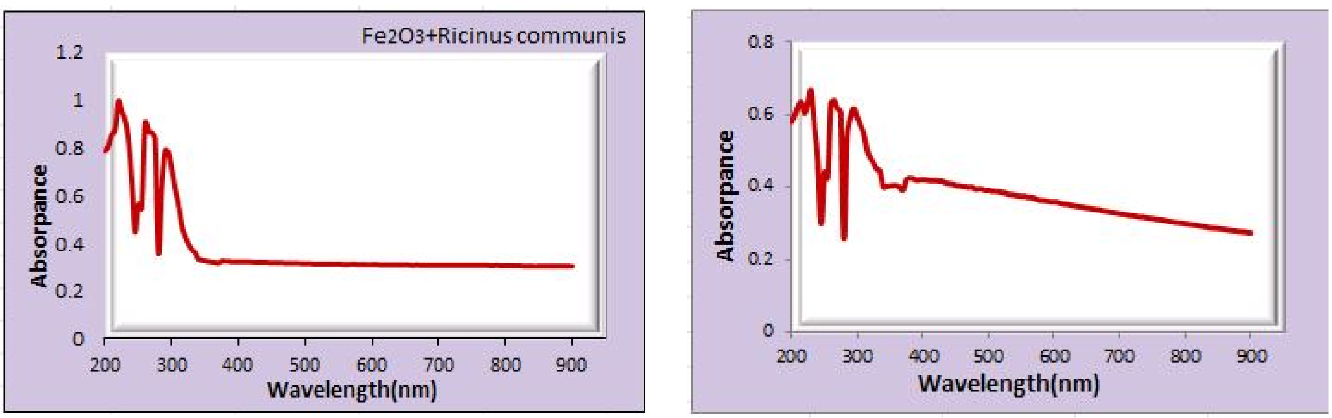

Fig. 5: UV-Vis *absorption spectrum* of Fe_2O_3 NPs with *Allium cepa* extract and *Ricinus communis* extract.

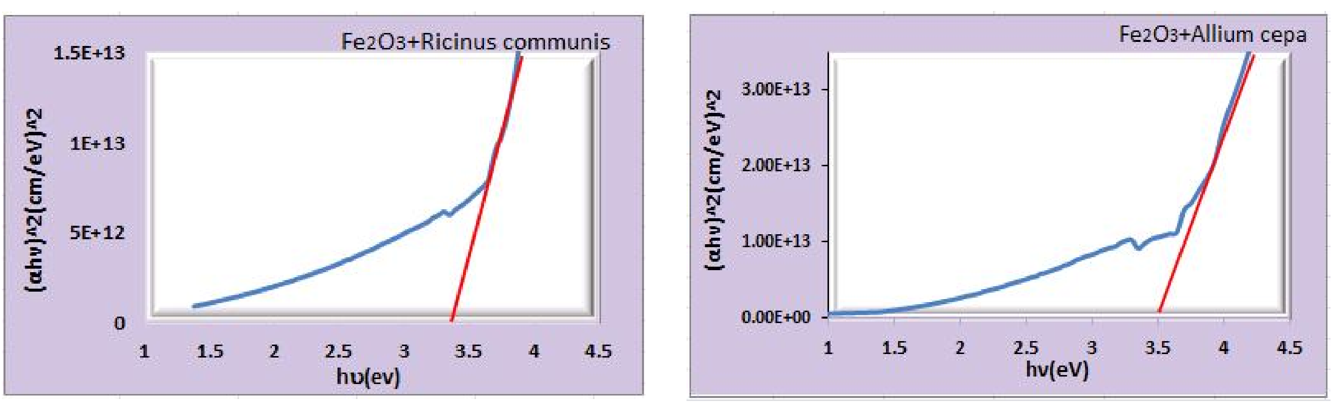

Fig. 6: The energy band gap of Iron oxide Nanoparticles with *Allium cepa* extract and *Ricinus communis* extract

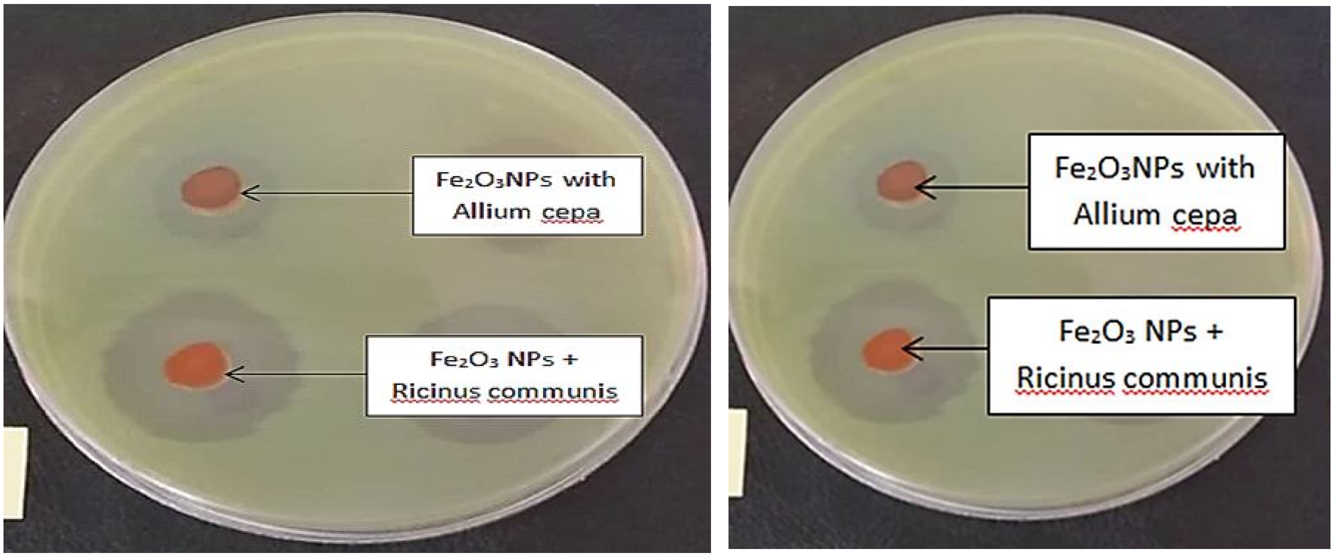

Fig. 7: Rate of inhibition for bacteria *Pseudomonas aeruginosa* a) *S. aureus* b) *P. aeruginosasa* for Iron oxide NPs of plant extracts.

Table 1: Zone Inhibition (mm) of cobalt oxide NPs against pathogens.

Type of material nanoparticles used	Zone of inhibition (mm) at 200µg/ml concentration *S. aureus*	Zone of inhibition (mm) at200µg/ml concentration *P. aeruginosa*	Percentage of Inhibition(%) *S. aureus*	Percentage of Inhibition(%) *P. aeruginosa*
Fe_2O_3NPswith *Allium cepa*	17	18	18.8	20
Fe_2O_3NPs with *Ricinus communis*	21	25	23.3	27.7

communis, The energy band gaps are (3.5eV) of *Allium cepa* extract and (3.4eV) of *Ricinus communis* extract as a result of quantum confinement and small molecules as shown in Fig. 6.

Antibacterial susceptiAbility assay:

The inhibition zone of Iron oxide nanoparticles biofabricated from the *Allium cepa* and *Ricinus communis* extracts against two pathogens is shown in fig. 7, table 1. And both each of (*P. aeruginosa*) gram-negative and (*S. aureus*) gram-positive bacteria organisms were used in this study. The surfaces of Iron oxide nanoparticles might have interacted directly with the membrane outside bacterial and causes then the interaction cytoplasm cell and then her death . So, the antibacterial activity exhibited by the Iron oxide nanoparticles here is attributed to their small size and high surface to volume ratio, which allows them to interact closely with microbial membranes. Result was used as a positive control in the experiment. Note that Fe2O3 NPs with *Ricinus communis* seed extract increasing the proportion of negative bacterial inhibition by (27.7%) and (23.3%) for positive bacteria either Fe2O3 NPs with *Allium cepa* root extract inhibition rate was (18.8 %) percent for his negative bacteria and (20%) positive for bacteria**.**

Conclusion

The used plant extracts in synthesis iron oxide Nanoparticles for less grain size with *Ricinus communis* seeds extract and obtain the highest peak (111) and less crystalline size (12-52 nm) with a *Allium cepa* root extract and after using UV-vis spectroscopy was getting on top of absorption (223 nm) and increase energy band gap (3.5eV) with *Allium cepa* root extract but the percentage inhibition of bacteria associated with *Ricinus communis* seeds extract with iron oxide Nanoparticles (25 mm) on the shape and size of grains.

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