Biosynthesis of iron nanoparticles and oxides prepared by aqueous extract of chili pepper plant

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Abstract

Nanomaterials were prepared using an Eco - friendly, that is both safe, inexpensive, and cost – effective method using pepper extract. The extract contains reducing agents that transform simple raw materials into small nanomaterial with unique and distinctive physical and chemical properties, making them applicable to diverse fields such as medicine, industry, electronics, food, military and energy.

Keywords : Nanotechnology , Biosynthesis , Eco -Friendly , Reducing agents .

التخليق الحيوي لجسيمات الحديد النانوية واكاسيده المحضر باستخدام المستخلص المائي لنبات الفلفل الحار

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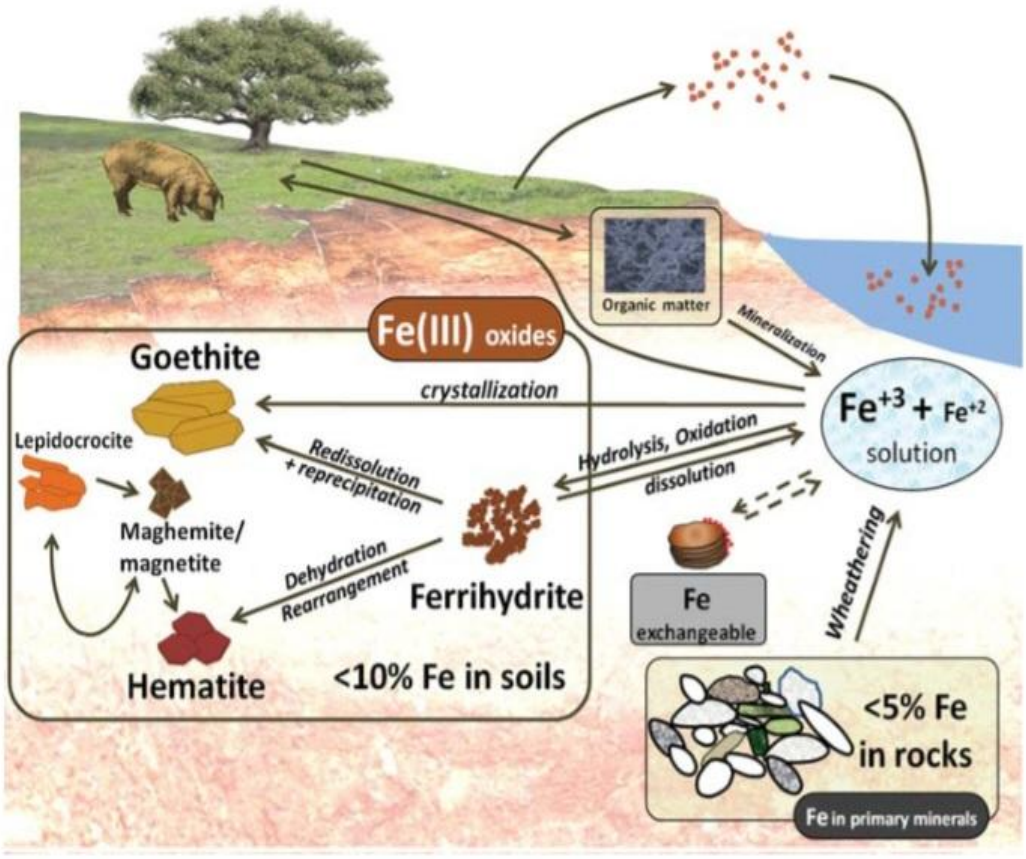
الملخص

تم تحضير المواد النانوية بطريقة صديقة للبيئة وهي طريقة امنة ورخيصة وغير مكلفة اقتصاديا باستخدام مستخلص الفلفل اذ يحتوي المستخلص على عوامل مختزلة تعمل على تحويل المواد الأولية البسيطة الى مواد نانوية صغيرة الحجم ذات خصائص فيزياوية وكيميائية فريدة ومميزة جعلتها تدخل في مجالات متنوعة مثل المجالات الطبية والصناعية والالكترونية والغذائية والعسكرية ومجالات الطاقة .

الكلمات الافتتاحية : النانو تكنلوجيا , التخليق الحيوي , الطريقة الصديقة للبيئة , العوامل المختزلة .

Introduction

Nanotechnology is defined as the use and manipulation of matter at a scale called the " nanometre scale," ranging between 1and 100 nanometres. The word " nano" is of Greek origin and means " dwarf " or small. There are various definitions of nanotechnology, among which we mention that this technology means the engineering, development, and use of devices whose size does not exceed a few nanometres (from to 100 nanometres) and it also means " the development of approach and technology at the nuclear , partial , or big molecular standard with a length gauge ranging between almost one and one hundred nanometres, in order to supply an essential conception of epiphenomenon and substances at the nanoscopic , and to invented structures, devices, and regimes that have new characteristic and duties due to the little and medium dimension [1]. This widespread interest in small-scale technology dates back to the period between 1996 and 1998 when the world technology Assessment Centre (WTEC) in the United States studies the subject and behave a preparation of small-scale technology research also its account in technological invention. The research complete for several key matters, including: nanotechnology has a promising future in all fields, including medicine, martial, facts technology, electronic, petrochemicals, praedial, biology, with others. Furthermore, small-scale technology has diverse foundation, drawing on principles of physics, chemistry, electrical and chemical engineering, as well as biology and pharmacy [2]. The concept of nanotechnology relies on particles smaller than 100 nanometers, which impart new properties to the materials they comprise. This is because nanoparticles possess unique physical and chemical properties, leading to novel behaviors dependent on their minute size. Changes in electronic structure, such as reactive conductivity and melting point, as well as the mechanical properties of matter, have been observed at the nanoscale. In other words, the closer a



material's nanoscale is to atomic dimension, the more it obeys the laws of quantum mechanics rather than the laws of classical physics, the dependence of a material's behavior on its size allows to control the engineering of its properties , based on this , researchers have concluded that this concept has significant technological implication, encompassing a wide range of application , including : the production of lightweight and strong material's , reducing the delivery time of nanomedicine to the human circulatory system , increasing the capacity of magnetic tapes, and manufacturing high – speed computer keys, among others [3].

Figure (1-1) Cycle of Fe oxide in natural environments [4]

Materials and Methods

Chemicals

Fe (NO3)3.9H2O purity 99 % , its molecular weight is 404 g\mol , its density is 1.68 g\cm^3 were Purchased from Sigma Aldrich ,Chili pepper plants, Filer paper, absolute ethanol was buy from Merck (KGaA, Germany) and (DDW) is used the work.

Instruments

X – ray diffraction (Xrd – 6000 Japan), Field Emission - Scanning electron microscope (FE-SEM), (JEOL JSM-6515L V Japan), Furnace (K – MFO3 K&K Scientific, Korea), Ultrasound path (405 power sonic, Hwashin, koura), Hot plate stirrer (KMS-1003 Labtech, Korea).

Preparation of extract

prepared chili pepper extract by collected fresh vegetates were carefully cleaned and distilled (H2O) with dried in air. Then, the dried plants were divided into short parts (250) g adding 2L of deionized water. Then heating at 60 ℃ for 15 minutes then prepared extract was filtering utilization whatman filter leaf [5].

Synthesis of Iron Oxide nanoparticles

Iron oxide nanoparticles were produced use adding (0.1) g from Fe (NO3)3.9H2O into (50) ml from chili pepper extract which was previously prepared and left at room temperature until color changed to brown. Indicating the formation of nanoparticles of Iron oxide.

Result and discussion

X – ray Diffraction pattern (XRD)

They technicalities are depending on view the dispersed density of an X - ray radiation infection a pattern as action of incident with dispersed corner dipolar, and wavelength or power. X- ray diffraction products the atomic composition of substances with depends on flexible dispersed of X-rays for the electron dimly of the singular atoms in the concert [6]. XRD patterns of the iron oxide nanoparticles showed sharp peaks with have good crystallized structure [7]. the

Debye Scherer parity was applied to account the average crystal dimension of the resulting [8].

$$D = K \lambda / \beta \cos \Theta \quad \text{---------- (1)}$$

K = is the so-called shape factor (0.9)

λ = is the wavelength (0.15418 nm)

β = is the full width at half maximum (FWHM)

Θ = is the diffraction angle

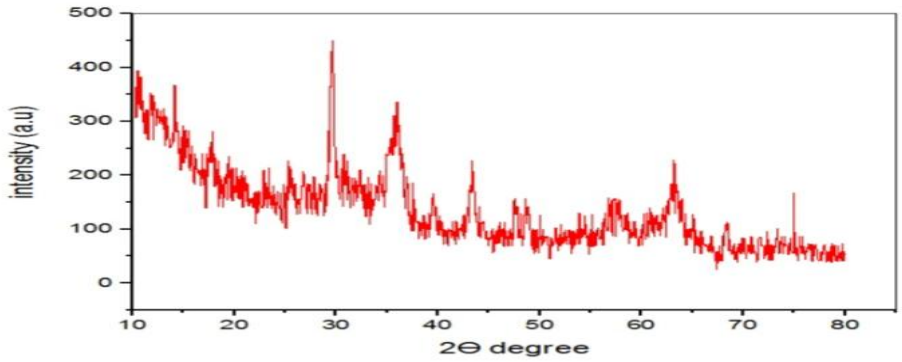
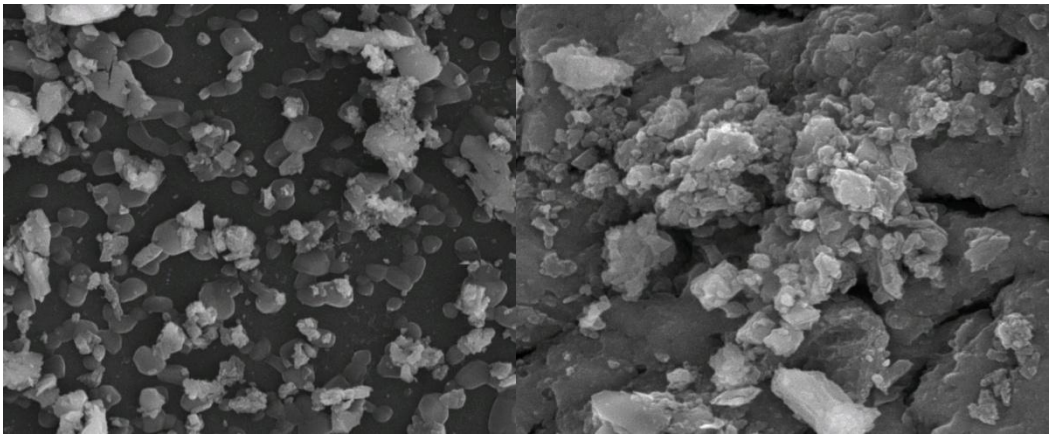


Figure (2-1) XRD patterns of synthesized (iron oxide NPs)

Field Emission - Scanning Electron Microscopy (FE-SEM)

The scanning electron microscope is utilization to view nanostructure and examine the surface morphology of samples. It is noted from the shapes that there are dense flakes and hexagonal, elliptical of particles. In addition, that appear to the irregularly shaped and gathered into irregularly shaped particles, some of which are large and others are much smaller with irregular size. It is clear from the images that there is agglomerated and are multiform. Structure bulks of different bioactive reducing factors, down capping ability of leaf extract, H-binding approaching in bioactive molecules could be the cause for the agglomeration of the nanoparticles. [9,10 ,11].



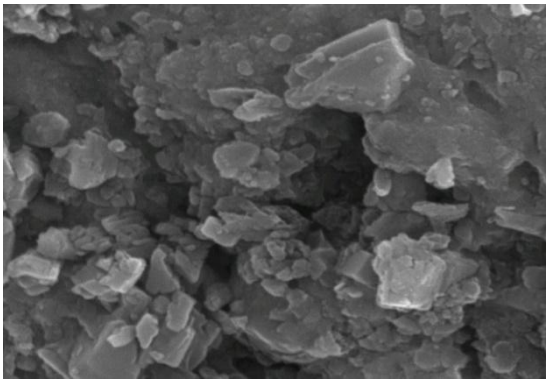


Figure (3-1) FE-SEM images of synthesized (iron oxide NPs)

References

[1] - Khaled Saud (2021) Nanotechnology in the Arab World: past, Present, and Future Prospects. Foresight (6) 6, 74 -101

[2] -Jadawi & Sidi Mohamed Amine. (2023) Nanotechnology and its Role in Criminal Evidence. ELSA Journal of Research and Studies, 8(1), 164-181.

[3]-Touahri Touahri & Sabrina. Liteature review on the preparation characterization and description of organometallic nanomaterials (Doctoral dissertation, Kasdi Mehbah University of Ouargla).

- [4] Claudio, C., lorio, E. D., Liu, Q., jiang, Z., & Barron, V. (2017) Iron oxide nanoparticles in soils Environmental and agronomic importance Journal of Nanoscience and Nanotechnology, 17 (7), 4449-4460.

[5]- Ahmad, T., phul, R., Khatoon, N., & Sardar, M. (2017). Antibacterial efficacy of Ocimum santum leaf extract-treated iron oxide nanoparticles. New Journal of Chemistry, 41(5), 2055-2061.

[6]- Rahman, M. M., Khan, S. B., Jamal, A., Faisal, M., & Aisiri, A. M. (2011). Iron oxide nanoparticles. Nanomaterials, 3, 43-67.

-[7] Hashem, F. A. H. I. M. A., Nasr, M. O. H. A. M. E. D., & Ahmed, Y . O. M. N. A. (2018). Preparation and evaluation of iron oxide nanoparticles for treatment of iron deficiency anemia. Int J pharm pharm Sci, 10(1), 142-146.

[8]- Lassoued, A., Dkhil, B., Gadri, A., & Ammar, S. (2017). Control of the shape and size of iron oxide (α-Fe2O3) nanoparticles synthesized through the chemical precipitation method. Results in physics, 7, 3007-3015.

-[9] Osama Adnan Salman Kanaan Khalil Ahmed & Ayad shatee Daye, (2018). Preparation and characterization of iron oxide nanoparticles using an extract of the Iraqi lemon plant. Journal of the College of Basic Education, 24(100), 59-66

[10]- Ustun, E., Onbas, S. C., Celik, S. K., Ayvay , M. C., & sahin . N. (2022). Green synthesis of iron oxide nanoparticles by using Ficus carica leaf extract and its antioxidant activity. Bionterface Res. Appl. Chem, 12(12), 2108-2116.

[11]- Das, S., Divali, S., Vinothini, G., Perumalsamy, B., Balakrishnan, G., Ramasamy, T., …& Biswas, B. (2020). Synthesis, morph;logical analysis, antibacterial activity of iron oxide nanoparticles and the cytitoxic effect on lung cancer cell line . Heliyon, 6(9).