ECO-FRIENDLY SYNTHESIS OF HEMATITE NANOPARTICLES USING CHICKPEA (*Cicer arietinum*) SEED EXTRACT

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GOAL

Nanotechnology in the field of agriculture currently focuses on precision farming that involves the use of nanoparticles with their unique properties to enhance plant health and crop productivity [1].

The goal of the present study is:

- Green synthesis of hematite nanoparticles using a seeds extract of *Cicer arietinum* L..
- Preparation of Fe_2O_3 loaded with a seed extract.
- Study of the phase and chemical composition as well as the structure of the synthesized nanoparticles and seeds of *Cicer arietinum* L..

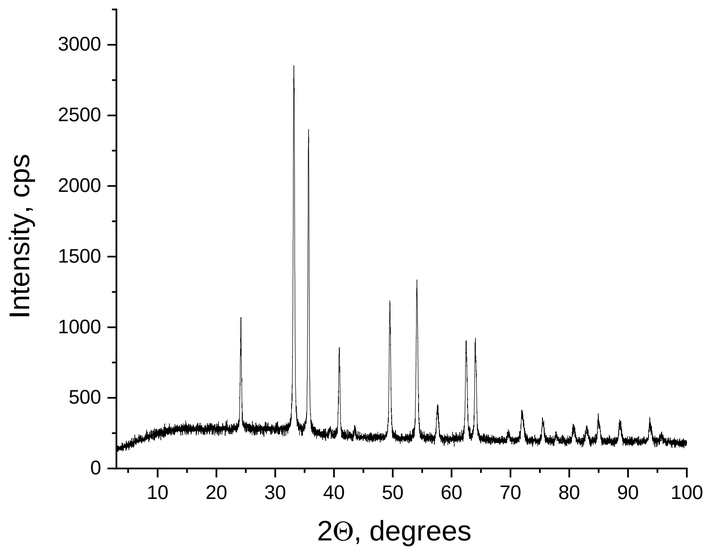
SYNTHESIS

Fe_2O_3 nanoparticles were prepared by green synthesis using seeds extract of *Cicer arietinum* L., via Pluronic - assisted co-precipitation. Tri-block copolymer Pluronic P123 (Sigma-Aldrich, Mw = 5800), $FeCl_3 \cdot 6H_2O$, urea and ammonia (Valerus Co., Sofia, Bulgaria) were used as initial precursors. The aqueous solution of Pluronic P123 (0.86 g P123 in 7.5 mL distilled water) was added to the 120 mL aqueous solution of 0.47M $FeCl_3 \cdot 6H_2O$. Additionally the 3M urea (6 mL) was added. Then, the following were added to the mixture sequentially: 14 mL ammonia (25%) by drops until pH = 9 and finally an ethanol aqueous solution seeds extract of *Cicer arietinum* L. (9 mL). After precipitation, the suspension was stirred for about 1 h at room temperature. The obtained precipitates were filtered and washed with distilled water, dried up in an oven at 75 °C, and thereafter calcined at 500 °C for 2 hours and 30 minutes in air media. The other sample Fe_2O_3 -NPs were prepared by same procedure without seeds extract. The prepared sample was loaded with 1 mL seeds extract. The obtained Fe_2O_3-NPs were designated N1 (green synthesized Fe_2O_3) and N2 (Fe_2O_3 nanoparticles loaded with a seed extract).

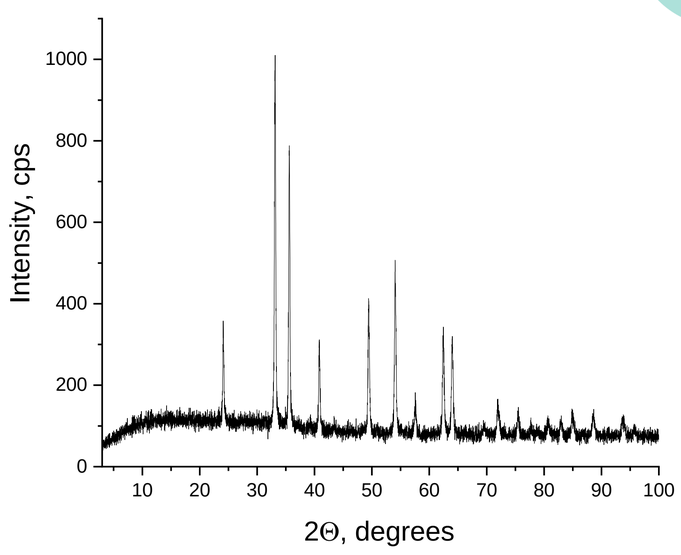
PHYSICOCHEMICAL CHARACTERIZATION

The phase composition and structure of the hematite nanoparticles were characterized by powder X-ray diffraction and Fourier-transform infrared spectroscopy. The seeds of *Cicer arietinum* L. were investigated by X-ray fluorescence spectroscopy and Fourier-transform infrared spectroscopy.

RESULTS



Powder XRD pattern of green synthesized Fe_2O_3 nanopowder (N1).



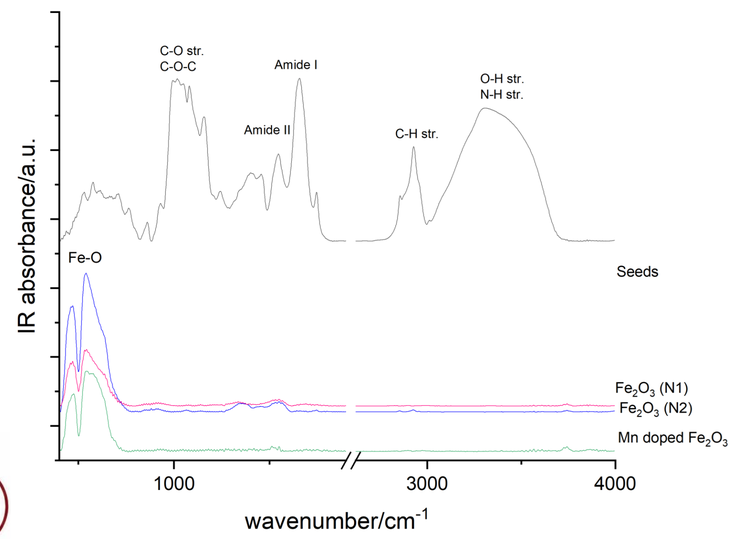
Powder XRD pattern of Fe_2O_3 nanopowder loaded with a seeds extract (N2).

Elemental composition (mass%) of seeds *Cicer arietinum* L, determined by XRF analysis.

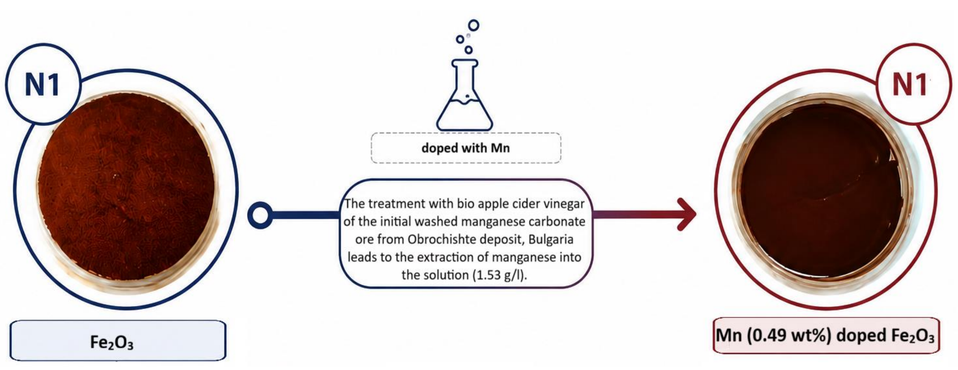
Elements	Mg	Al	Si	P	S	Cl	K	Ca	Mn	Fe	Cu	Zn	Mg	Al
Result (mass%)	2,21	0,655	1,56	7,67	5,71	1,15	57,4	20,3	0,654	1,23	0,574	0,838	2,21	0,655

Calculated values of mean crystallite size (D), lattice strain (ε) and unite cell parameter (a) of Fe_2O_3 phases.

Sample	D, nm	ε, a.u	a, Å
Fe_2O_3 (N1)	24	$1,6x10^{-3}$	5.030
Fe_2O_3 (N2)	22	$1,7x10^{-3}$	5.028



FT-IR spectra of green synthesized Fe_2O_3 (N1); Fe_2O_3 nanoparticles loaded with a seeds extract (N2); Mn doped Fe_2O_3 (N1) and seeds powder of *Cicer arietinum* L.



CONCLUSION

- Fe_2O_3 nanoparticles are successfully green synthesized using a seeds extract of *Cicer arietinum* L..
- The prepared Fe_2O_3 materials are nanodimensional with a mean crystallite size of 22-24 nm.
- The XRF analysis established that green synthesized Fe_2O_3 were doped with 0.49 wt% Mn .

REFERENCES

1. A. Singh, N. B. Singh, I. Hussain, H. Singh, S.C. Singh, International Journal of Pharmaceutical Science Invention, 2015, 4 (8), 25-40.

Acknowledgements

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