Green Synthesis of Zinc Oxide Nanoparticles for Wastewater Treatment

Amal S. Al Rahbi, Sharifa Al Awaid, Rehab Al Syiabi, Huda Al Amri, Hafsa Al Dowiki

Overview

1
- **Introduction**

2
- **Experimental**
- Green Synthesis of ZnO NPs
- Removal of Dyes from waste water

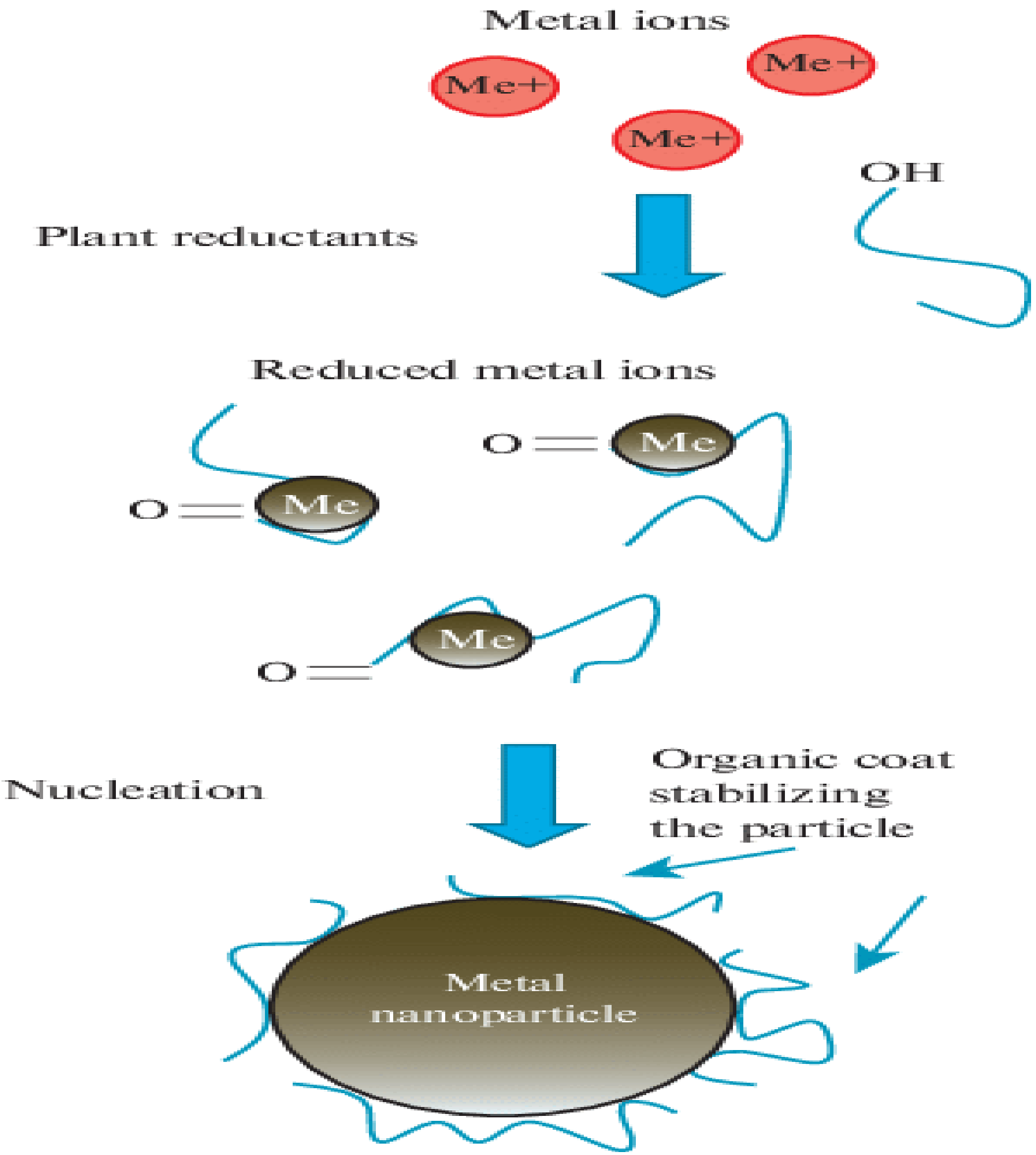
3
- **Results**
- Zinc oxide nanoparticles synthesis
- ZnO NPs Characterization
- Removal of Waste Dyes

4
- **Conclusion**

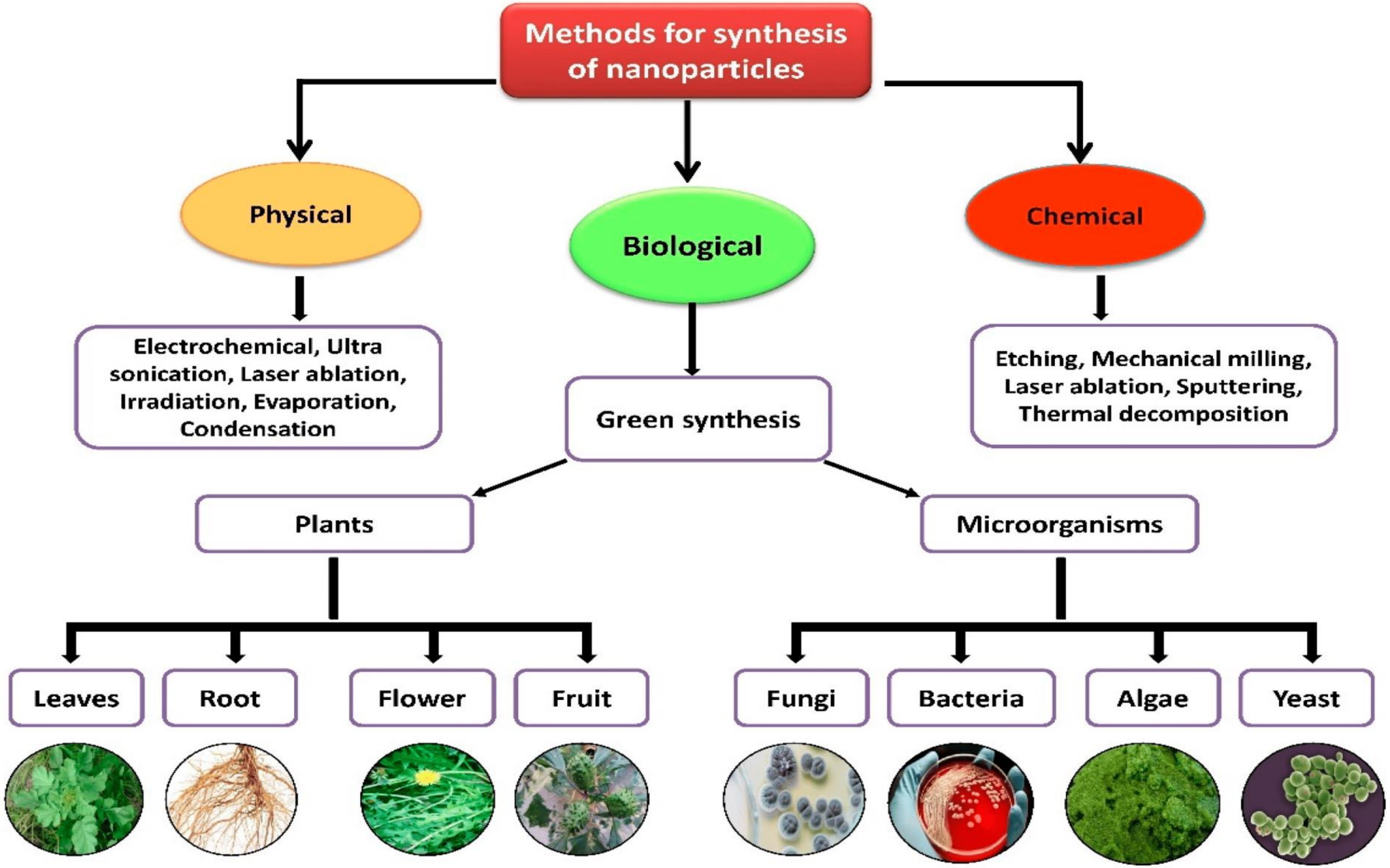
Introduction

- Zinc oxide nanoparticles (ZnO NPs) are a versatile class of nanomaterials with unique physical, chemical, and biological properties.

- Green synthesis methods provide an eco-friendly approach to producing these nanoparticles using natural, renewable resources.



Synthesis Methods



Importance of Green Synthesis Methods

1 **Environmentally Friendly**

Green synthesis techniques utilize plant extracts, microorganisms, or other natural sources, avoiding the use of toxic chemicals and hazardous waste.

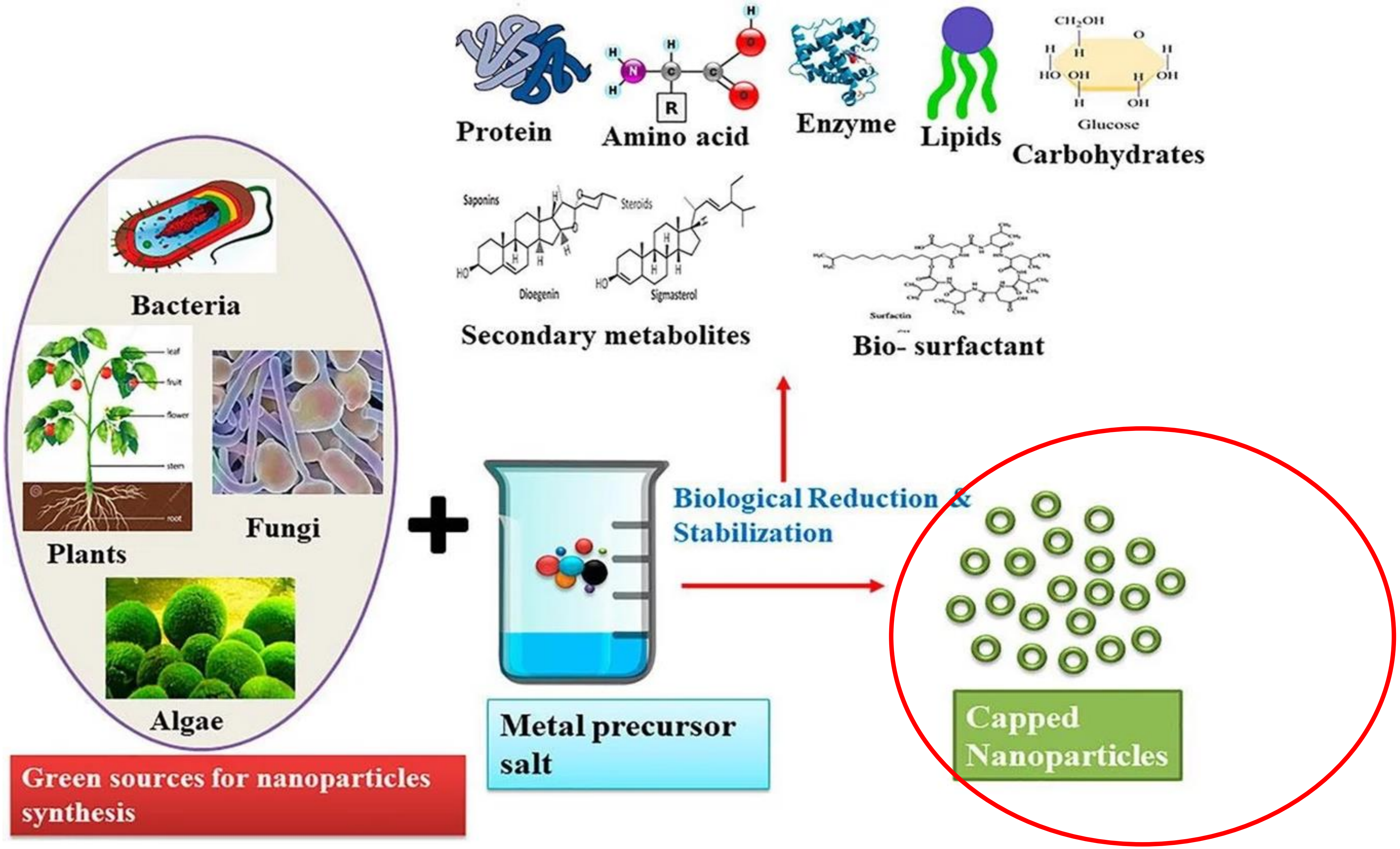
2 **Sustainable Production**

These methods are cost-effective and can be easily scaled up for industrial-scale manufacturing of ZnO NPs.

3 **Biocompatibility**

ZnO NPs produced through green routes exhibit improved biocompatibility, making them suitable for biomedical and healthcare applications.

Mechanism of NPs formation



Objectives

- The aim of the study is to synthesis ZnO NPs using Albizia lebbeck pods as a reducing and capping agent for dyes removal from aqueous solutions.

- **The following objectives were followed to achieve the project goal;**

1) Collect the plant sample from Muscat
2) Prepare the sample extracts using various plant amounts
3) Green synthesis of ZnO NPs using Albizia lebbeck pods extracts
4) Characterize the synthesized ZnO NPs using XRD, SEM, EDX, UV-VIS, and FTIR techniques
5) Application

Methodology

Collect and dry the plant pods

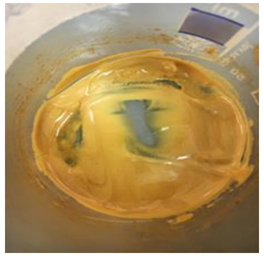
Ground it

Heated at 60°C

Filtered to get the extract

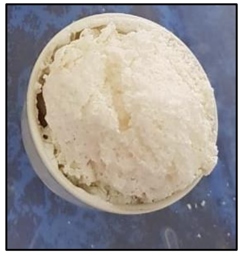
$Zn(NO_3)_2.6H_2O$ was added to extract

Heated at 60 °C & stirrer until the past was formed



Calcined at 400 °C for 2hr

Cooled at room temperature



ZnO NPs was formed

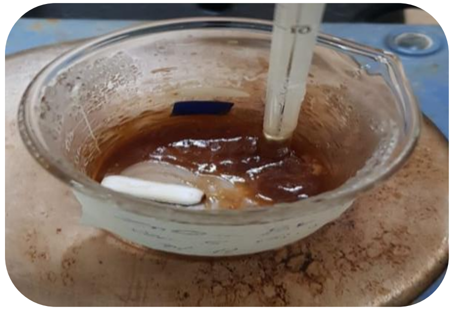
Application

MB and MO removal

Results

- **Synthesis and characterization of ZnO NPs**

❑ The boiled pod extracts changed to brown-coloured solutions



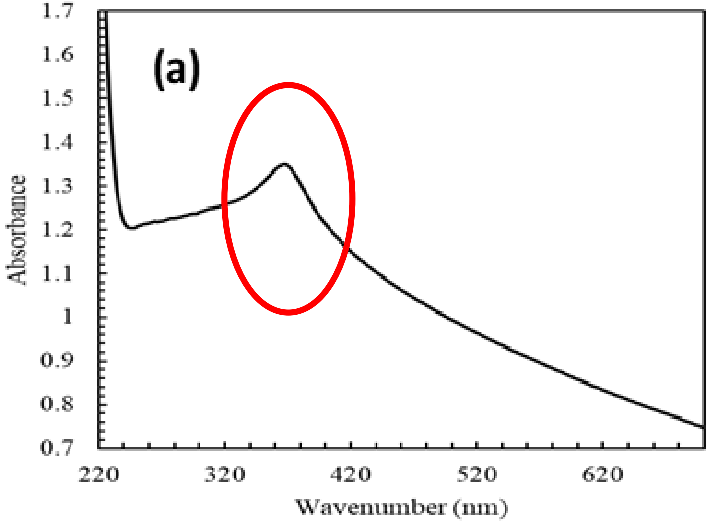
❑ The brown-coloured solution was converted into brown paste.

❑ The calcination of the paste produced a light-yellow powder.

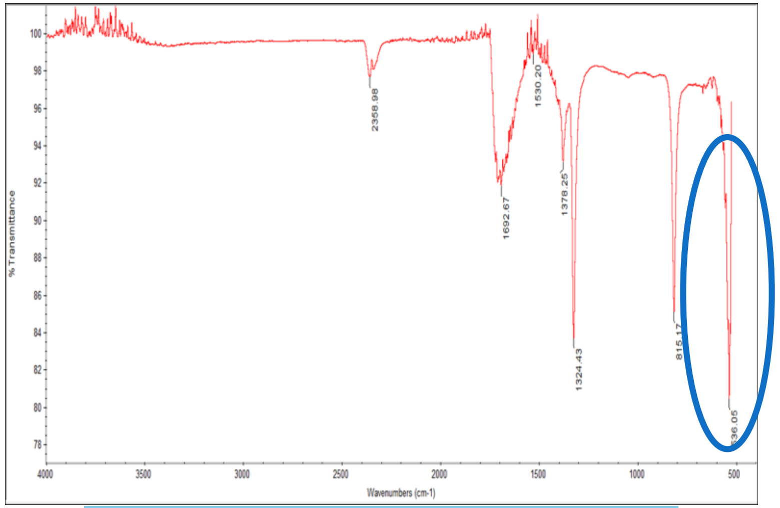
Results

ZnO NPs Characterization

UV-Vis Spectroscopy

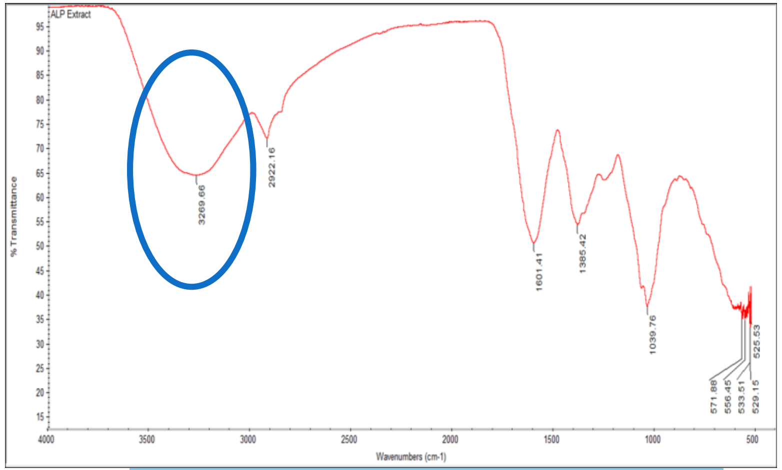


ZnO (NPs)



ZnO (NPs)

Fourier Transform Infrared Spectroscopy



Albizia lebbeck plant

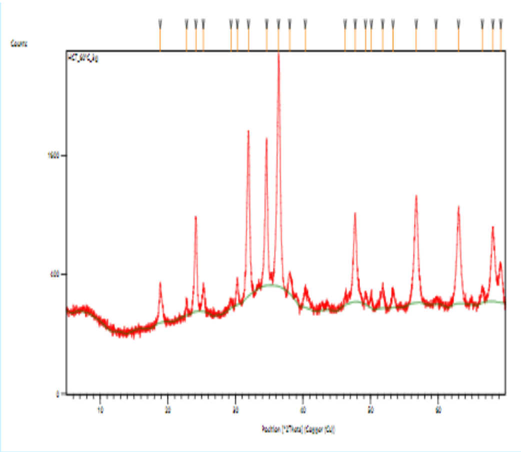
Results

ZnO NPs Characterization

X-ray Diffraction (XRD)

Scanning Electron Microscopy (SEM)

Energy Dispersive X-ray Spectroscopy (EDX)



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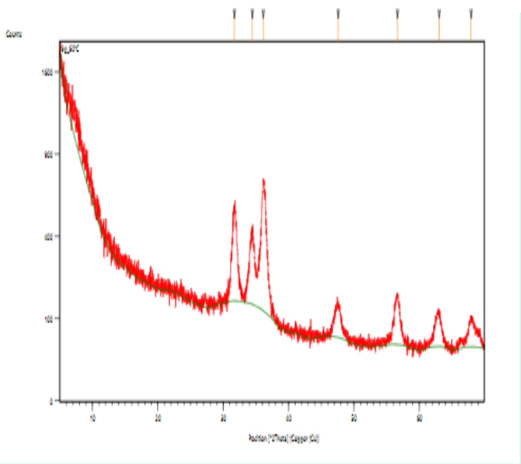

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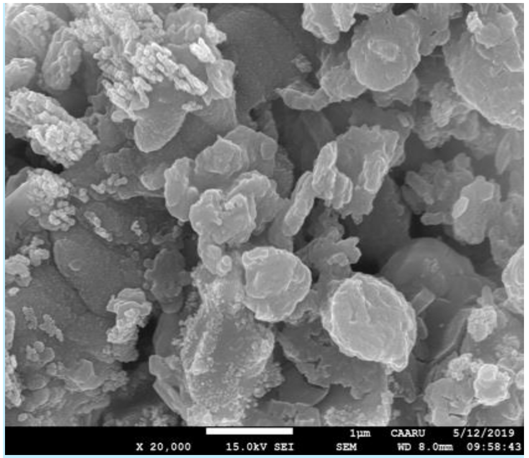

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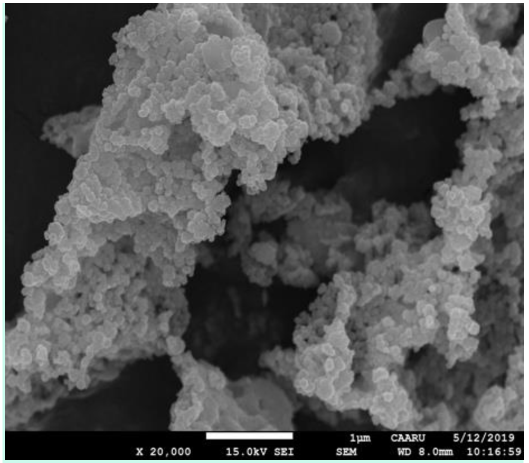

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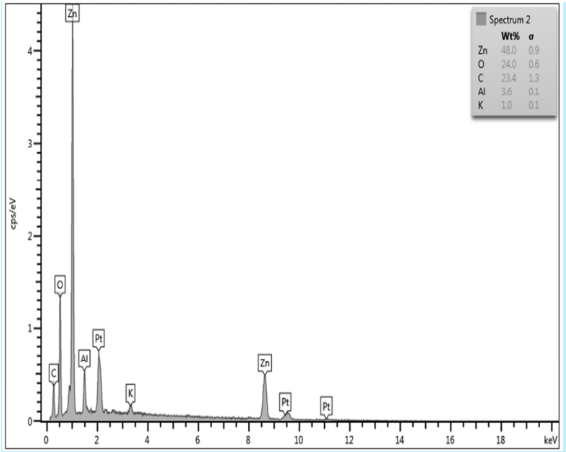

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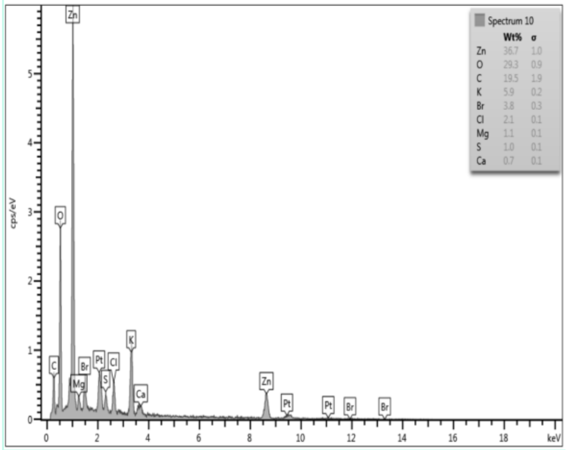

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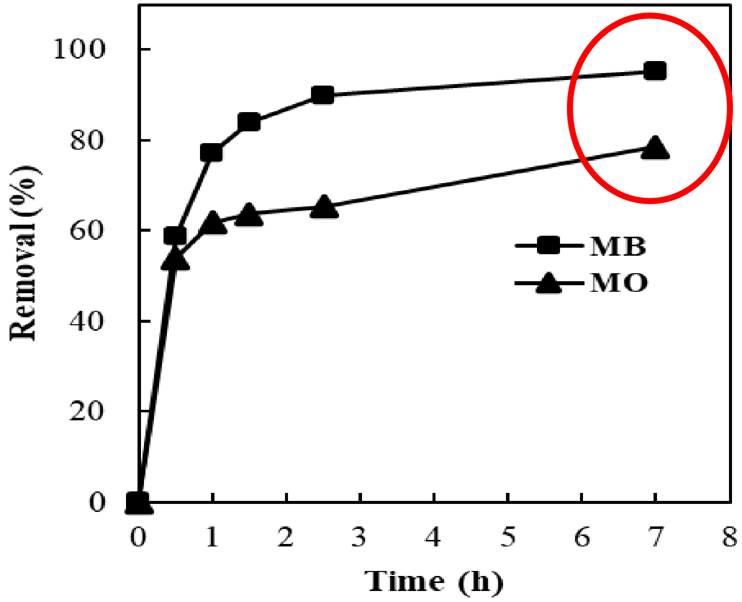
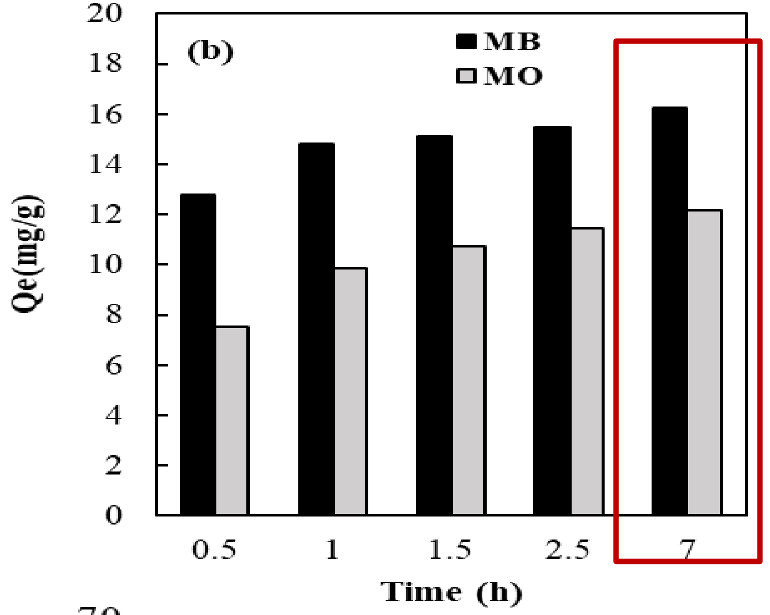
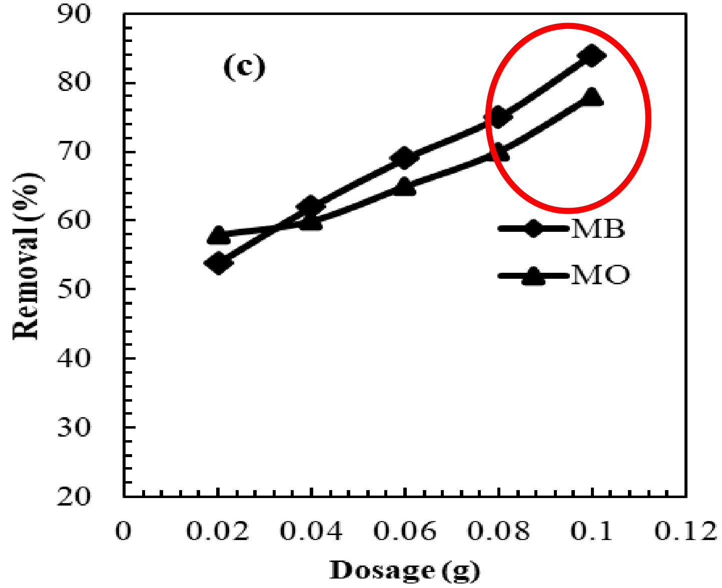
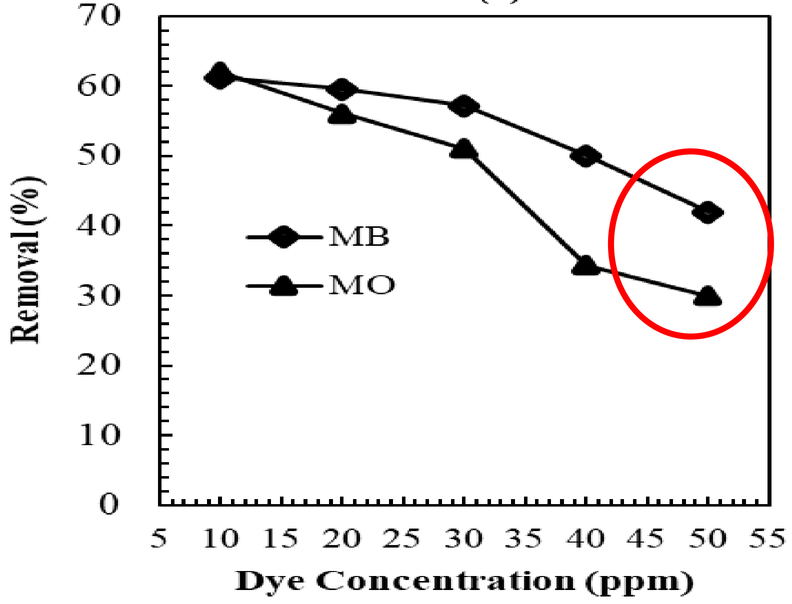
Results





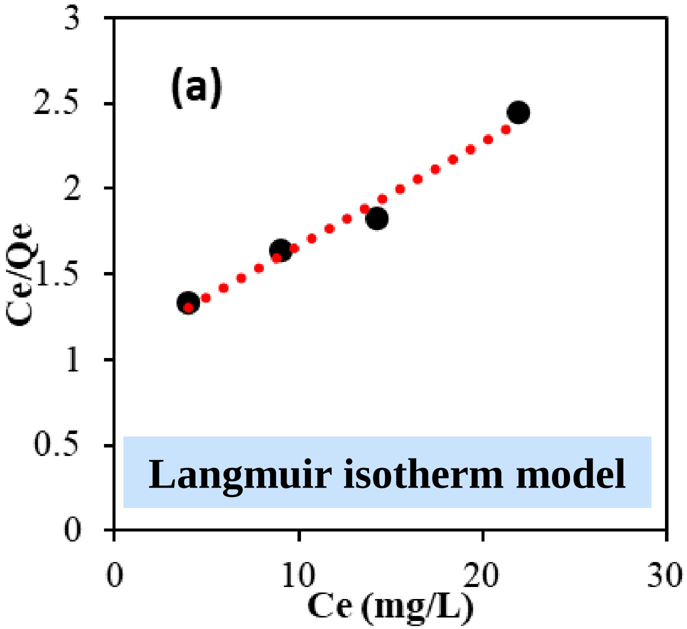
Parametric study

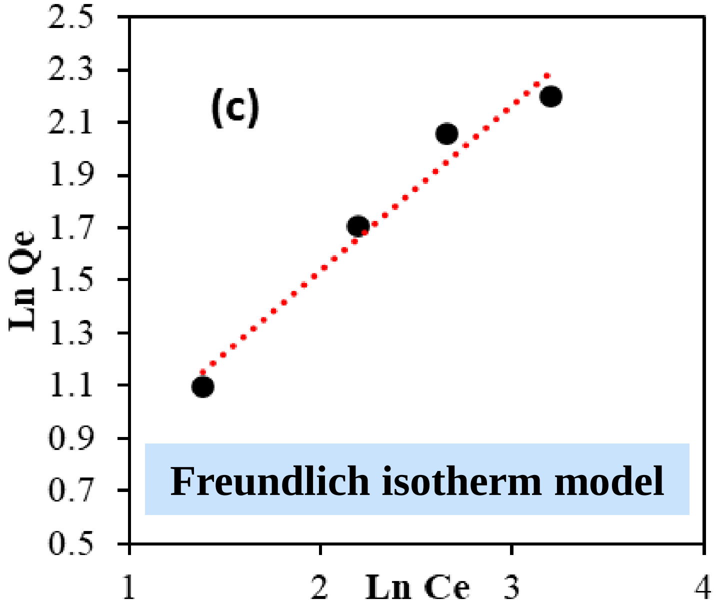


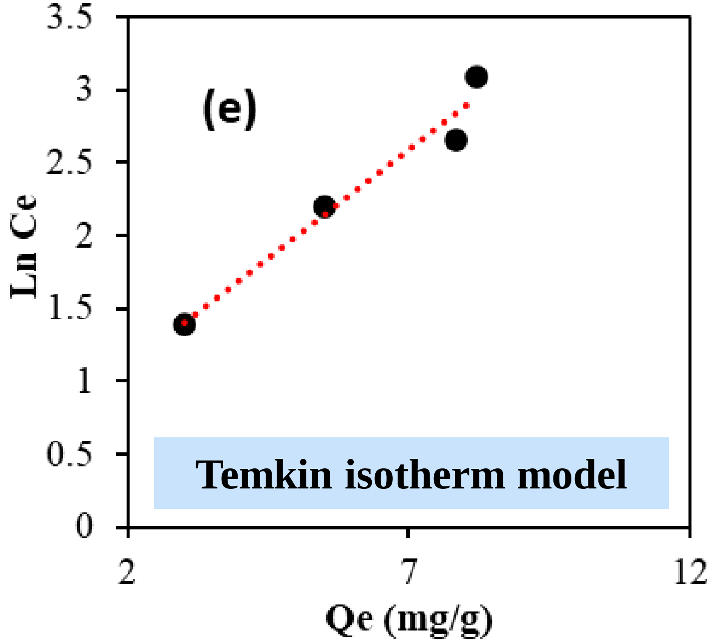


Results

Kinetic study







Samples	Dye	Langmuir isotherm model			Freundlich isotherm model			Temkin isotherm model		
		qmax (mg/g)	K_L	R^2	K_F	n	R^2	K_T	B_t	R^2
AZ3	**MB**	12	0.056	0.9779	1.329	1.594	0.965	5.548	0.297	0.965
	MO	9.5	0.052	0.9771	1.426	1.608	0.965	3.012	0.312	0.955

Conclusion

- The green synthesis of zinc oxide nanoparticles presents a sustainable and effective approach for dye removal from wastewater, showcasing its potential as an environmentally friendly solution for water purification processes.

- The Albizia lebbeck leaf extract possesses some phytochemicals which not only performs in the reduction of the particle sizes but also provide sufficient stabilization.

- The MB and MO degradation efficiency of the synthesized nanoparticles reached 84 and 78 %, respectively.


THANK
YOU!