Supplementary Information:

Biogenic Synthesis and Characterization of MgO Nanoparticles Using *Verbascum sinaiticum*: Antibacterial, Free Radical, and Reactive Oxygen Species Scavenging Activities

Wubshet Mekonnen Girma,[a,*] Muluset Shiferaw Aragie, [a] Biniyam Abdu Berehe, [a] and Ayalew H. Assen [a,b]

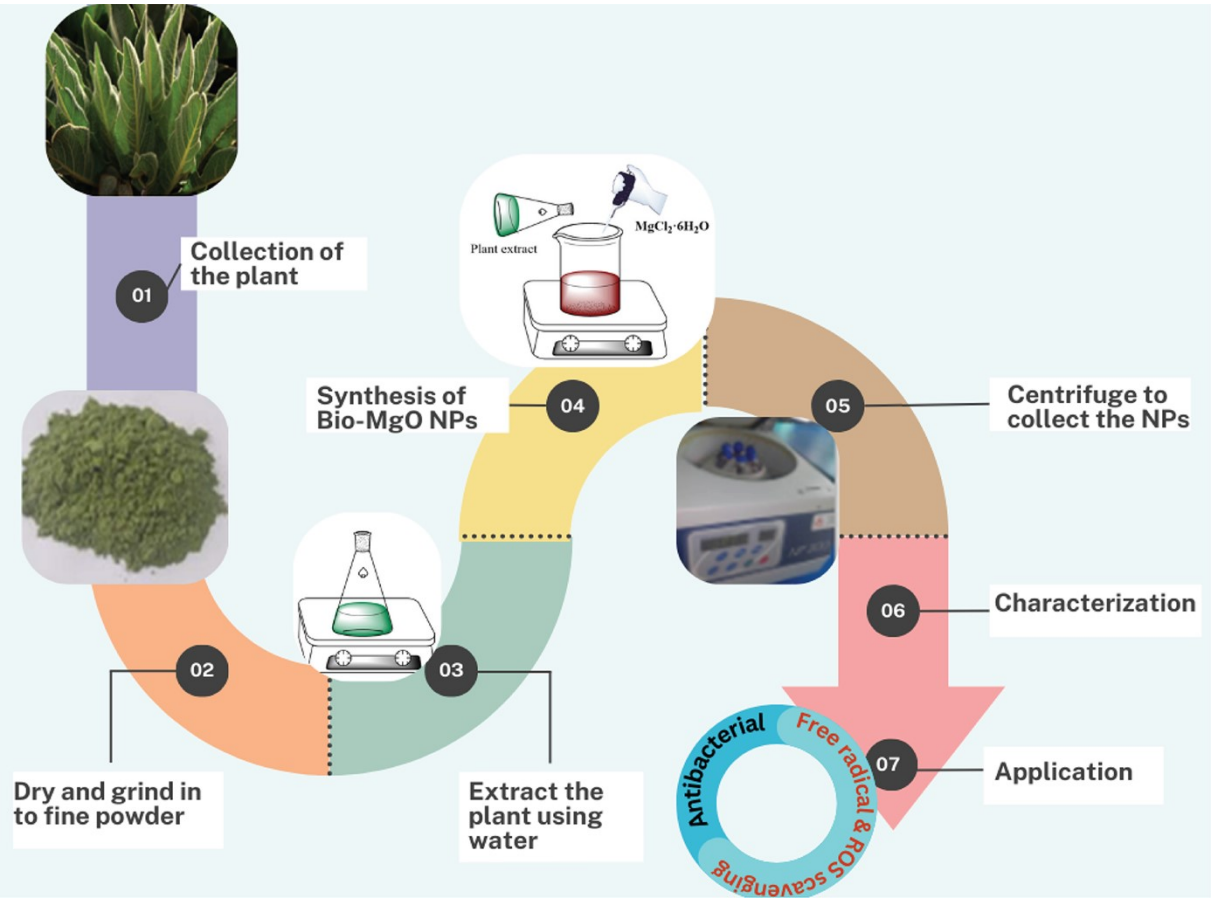
[a] Department of Chemistry, College of Natural Science, Wollo University, P.O. Box:1145, Dessie, Ethiopia.

[b] Applied Chemistry and Engineering Research Centre of Excellence (ACER CoE), Mohammed VI Polytechnic University (UM6P), Lot 660 - Hay Moulay Rachid, 43150 Ben Guerir, Morocco.

*Corresponding author: Wubshet Mekonnen Girma

E-mail: wubshet.mekonnen@wu.edu.et

Tel.: +251-910804026.



Scheme S1. The schematic illustration for the synthesis of Bio-MgO NPs and its application for antibacterial, free radical and reactive oxygen species scavenging activity.

Discussion of BET pore distributions of Bio-MgO NPs

The BET pore distribution analysis provides insights into the pore characteristics of various MgO samples synthesized using different volumes of *Verbascum sinaiticum plant* extract (10 mL, 20 mL, 30 mL, and 40 mL) in comparison to chemically synthesized MgO (Chem-MgO). The pore volume distribution for Chem-MgO shows a relatively uniform distribution across pore widths ranging from 10 to 100 nm (Figure Sa). The pore volume peaks at around 0.21 cm^3/g, indicating a well-developed mesoporous structure. This suggests that the chemically synthesized MgO has a

consistent and accessible pore network. 10 mL Bio-MgO (Figure Sb) exhibits a broader pore size distribution, with pore volumes reaching up to 0.35 cm^3/g. The distribution extends up to 120 nm, indicating the presence of larger mesopores and possibly some macropores. This increased pore volume and wider distribution suggest that the plant extract influences the formation of a more heterogeneous pore structure. 20 mL Bio-MgO shows a narrower pore size distribution compared to the 10 mL sample, with pore volumes peaking at around 0.10 cm^3/g (Figure Sc). The distribution is concentrated within the 10-100 nm range, indicating a more uniform mesoporous structure. This suggests that increasing the extract volume to 20 mL leads to a more controlled pore formation. 30 mL Bi-MgO (Figure Sd) exhibits a pore volume distribution similar to the 20 mL sample but with slightly lower pore volumes, peaking at around 0.15 cm^3/g. The distribution remains within the 10-100 nm range, indicating a stable mesoporous structure. This consistency suggests that the 30 mL extract concentration maintains the material's textural properties. 40 mL Bio-MgO (Figure Se) shows a further reduction in pore volume, with a peak at around 0.12 cm^3/g. The pore size distribution remains within the mesoporous range (10-100 nm), but the overall pore volume is lower compared to the other samples. This indicates that higher concentrations of the plant extract may lead to denser or less porous structures, possibly due to increased organic content affecting the MgO formation process. *Verbascum sinaiticum* plant extract in the synthesis of MgO NPs significantly influences the pore structure and volume. Lower volumes of the extract (10 mL) result in a broader and more heterogeneous pore distribution, while higher volumes (20-40 mL) lead to more uniform but reduced pore volumes, highlighting the role of the plant extract in tailoring the material's textural properties.

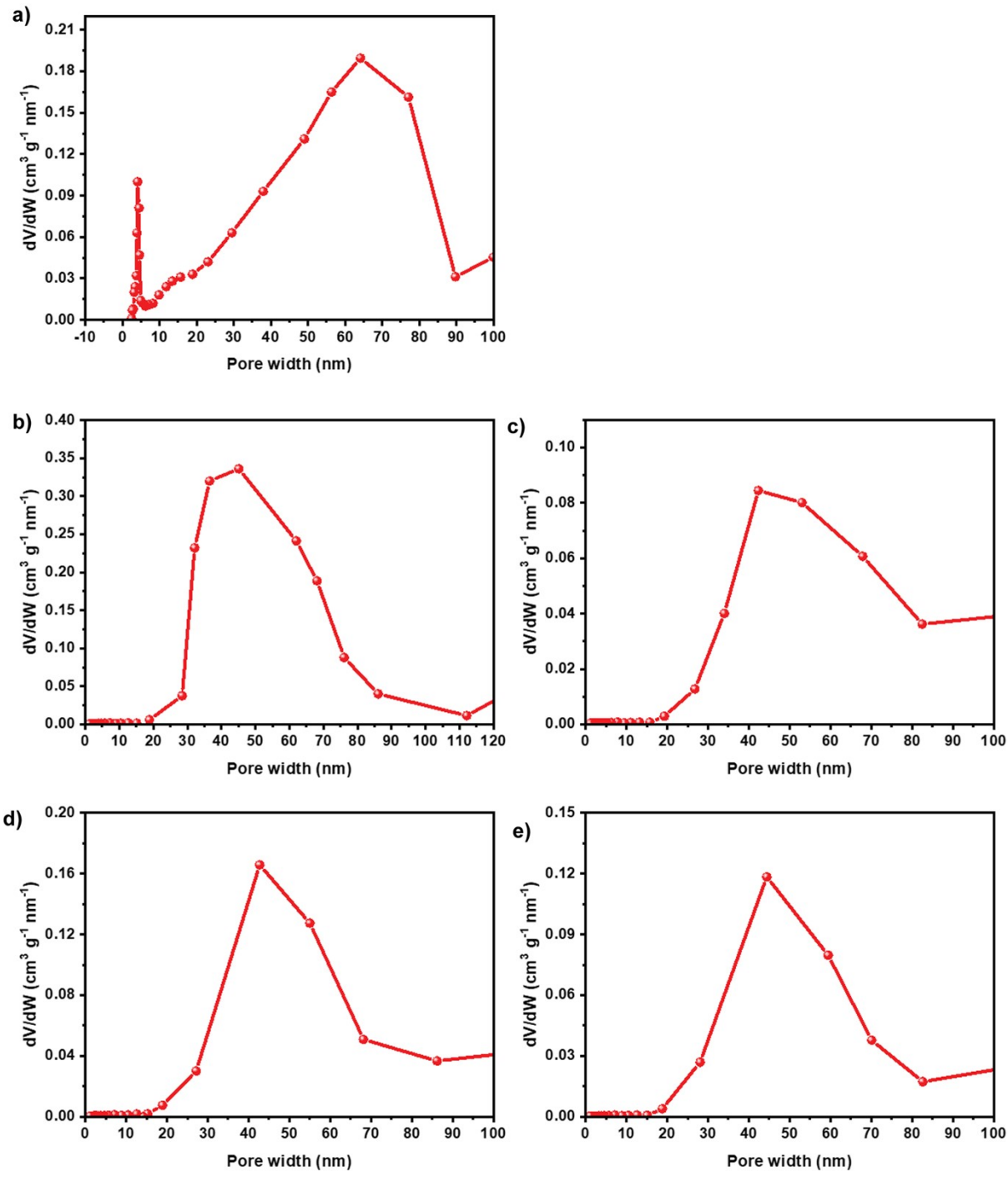


Figure S1. Pore size distribution of a) Chem-MgO b) 10 mL Bio-MgO c) 20 mL Bio-MgO d) 30 mL Bio-MgO e) 40 mL Bio-MgO

Table S1: Antibacterial activity of MgO NPs synthesized at different concentrations of plant extract, Chem-MgO and plant extract alone against selected pathogens at different concentrations.

Sample		Bacteria	**Inhibition Zone (mm)**			
			Concentration (µg/mL)			
			50	**100**	**200**	**Chloramphenicol (30 µg/mL)**
Bio-MgO	10 mL	*E. coli*	7.31	8.45	10.31	19.97
		L. monocytogenes	7.66	9.28	10.85	21.76
		S. aureus	7.00	8.00	9.50	16.10
		K. pneumoniae	7.00	8.10	9.77	21.14
	20 mL	*E. coli*	7.45	8.68	10.50	19.97
		L. monocytogenes	7.77	9.22	10.92	21.76
		S. aureus	7.00	8.10	9.80	16.10
		K. pneumoniae	7.13	8.23	9.90	21.14
	30 mL	*E. coli*	7.55	8.86	10.70	19.97
		L. monocytogenes	7.93	9.24	11.13	21.76
		S. aureus	7.00	8.13	9.83	16.10
		K. pneumoniae	7.17	8.30	9.87	21.14
	40 mL	*E. coli*	7.65	9.30	11.10	19.97
		L. monocytogenes	8.13	9.59	12.35	21.76
		S. aureus	7.27	8.33	10.17	16.10
		K. pneumoniae	7.68	9.20	10.86	21.14
Chem-MgO		*E. coli*	7.67	9.63	10.28	19.97
		L. monocytogenes	8.81	9.85	10.60	21.76
		S. aureus	7.50	8.95	10.43	16.10
		K. pneumoniae	8.12	9.36	10.53	21.14
Plant extract		*E. coli*	7.00	8.57	9.28	19.97
		L. monocytogenes	7.22	8.50	9.42	21.76
		S. aureus	7.00	8.43	9.30	16.10
		K. pneumoniae	7.00	8.77	9.36	21.14

Table S2. Scavenging Activity of MgO NPs using DDPH assay

Concentration (µg/mL)	DDPH Scavenging Activity (%)						
	Chem-MgO	Plant extract	Bio-MgO				Ascorbic acid
			10 mL	20 mL	30 mL	40 mL	
50	57.5	59.2	60.8	71.9	75.8	79.8	82
100	62.5	65.3	70.3	76.0	80.5	82.6	84.5
150	71.6	73.2	75.1	80.2	82.7	85.8	85.8
200	77.4	78.4	78.3	82.8	85.1	88.3	90
250	81.8	83.3	84.2	89.9	91.0	93.9	96

Table S3. Scavenging Activity of MgO NPs using peroxide assay

Concentration (µg/mL)	Peroxide Scavenging activity (%)						
	Chem-MgO	Plant extract	Bio-MgO NPs				Ascorbic acid
			10 mL	20 mL	30 mL	40 mL	
50	62.23	63.25	64.79	67.67	71.54	89.87	90.87
100	64.13	65.34	73.76	73.78	78.56	91.48	93.48
150	70.86	71.25	78.25	81.48	84.38	93.68	94.68
200	72.45	72.35	81.48	84.67	86.41	93.79	95.59
250	75.57	77.23	85.57	88.43	91.45	95.34	96.54