

### Supporting Information

#### Green synthesis and antibacterial activity of zinc oxide nanoparticles using *Croton macrostachyus* Hochst. ex Delile extracts

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**Table S1:** Debye–Scherrer-based crystallite size analysis for ZnO nanoparticles

2θ(degrees)	Wavelength of X-ray (λ)	F.W.H.M(β) (degrees)	Scherrer's constant(k)	Crystallite size (nm)	Average crystallite size
<b>MLEZ-1 NPs</b>					
31	1.54056	0.21967	0.94	39.177	41.166
31.8	1.54056	0.19970	0.94	43.184	
34.5	1.54056	0.19206	0.94	45.218	
36.5	1.54056	0.20856	0.94	41.849	
47.6	1.54056	0.24902	0.94	36.4039	
<b>MLEZ-2 NPs</b>					
31.1	1.54056	0.21062	0.94	40.8754	<b>40.285</b>
31.9	1.54056	0.20182	0.94	42.7419	
34.5	1.54056	0.20205	0.94	42.9832	
36.4	1.54056	0.21819	0.94	40.0153	
47.7	1.54056	0.26051	0.94	34.8118	
<b>MSEZ-1 NPs</b>					
31	1.54056	0.20199	0.94	42.6115	42.003
31.8	1.54056	0.19718	0.94	43.7368	
34.5	1.54056	0.191	0.94	45.4699	
36.3	1.54056	0.21015	0.94	41.5343	
47.6	1.54056	0.24724	0.94	36.6661	
<b>MSEZ-2 NPs</b>					
30.9	1.54056	0.21878	0.94	39.3318	<b>41.408</b>
31.8	1.54056	0.19685	0.94	43.8101	
34.4	1.54056	0.1913	0.94	45.3863	
36.3	1.54056	0.20763	0.94	42.0384	
47.6	1.54056	0.24853	0.94	36.4758	

**Table S2:** Comparison of FTIR Bands (Before vs After Nanoparticle Formation)

Functional Group / Band (Typical Assignment)	Before (MLE) (cm <sup>-1</sup> )	Before (MSE) (cm <sup>-1</sup> )	After (MLEZ-2) (cm <sup>-1</sup> )	After (MSEZ-2) (cm <sup>-1</sup> )	Key change on NPs formation
O–H stretch (broad, H-bonded)	3266	3283	3422	3431	O–H remains; shift to higher wavenumber in NPs (consistent with surface-bound hydroxyl groups/capping).
Aliphatic C–H stretch (–CH <sub>2</sub> /–CH <sub>3</sub> )	–	–	2928, 2855	2926, 2858	Clear C–H bands are present after NP formation, indicating organic residue on ZnO surface.
Band near 2130 cm <sup>-1</sup>	2132	2131	–	–	Diminishes/vanishes in NPs which indicates involvement in reduction of Zn <sup>2+</sup> .
Amide I (C=O, proteins)	1640	1640	1640	– (not labeled)	Protein/carbonyl features are retained in MLEZ 2, but are not labeled on the MSEZ 2 trace.
Amide II / N–H bend & C–N stretch	–	–	1555	–	Seen in MLEZ 2 indicating the role of proteins in stabilization/capping.
Carboxylate / C=O–O <sup>-</sup> region	–	–	1412	1434	Carboxylate signatures that are prominent after NP formation (capping).
C–O / C–N (fingerprint)	1230	1279	1062	1086	The bands in the fingerprint region change, indicating interaction of the phytochemicals with ZnO.
Other labeled mid-IR band	–	–	–	1806, 2518	Further features noted only in MSEZ 2 trace.
Low-frequency extract features	664	676	–	–	Present in extracts only, no Zn–O prior to formation of NPs
Zn–O (lattice vibrations, fingerprint)	–	–	580, 437	449, 544, 725 (also 870 labeled)	Emerge only after the formation of NP that verifies ZnO.

**Table S3:** Antibacterial activity of MLEZ-2 and MSEZ-2 ZnO nanoparticles and leaf and seed crude extracts from *Croton macrostachyus* Hochst. ex Delile plant against pathogenic bacteria.

Samples	Concentration ( $\mu\text{g/mL}$ )	Bacteria train		
		<i>S.aureus</i>	<i>P.aeruginosa</i>	<i>K.pneumoniae</i>
MLEZ-2	10	11.66 $\pm$ 0.94	10.66 $\pm$ 0.47	8.66 $\pm$ 0.7
	20	12.66 $\pm$ 0.47	12.33 $\pm$ 0.47	10.33 $\pm$ 0.47
	40	15.66 $\pm$ 0.47	13.66 $\pm$ 0.47	13.33 $\pm$ 0.47
Gentamicin	10	26 $\pm$ 0.81	24 $\pm$ 0	22 $\pm$ 0
DMSO		0	0	0
MSEZ-2	10	9.33 $\pm$ 0.9	8.66 $\pm$ 0.94	8.33 $\pm$ 0.47
	20	10 $\pm$ 0	9.66 $\pm$ 0.94	9.33 $\pm$ 0.47
	40	14 $\pm$ 0.81	11.66 $\pm$ 0.47	11.33 $\pm$ 0.47
Gentamicin	10	23 $\pm$ 0	19 $\pm$ 0	18 $\pm$ 0
DMSO		0	0	0
LE	10	4 $\pm$ 0	3 $\pm$ 0	2.33 $\pm$ 0.47
	20	5.33 $\pm$ 0.47	4.66 $\pm$ 0.94	3.33 $\pm$ 0.47
	40	8.66 $\pm$ 0.4	6.66 $\pm$ 0.47	6 $\pm$ 0
Gentamicin	10	25 $\pm$ 0	22 $\pm$ 0	21 $\pm$ 0
DMSO		0	0	0
SE	10	2.33 $\pm$ 0.47	1.66 $\pm$ 0.94	1.33 $\pm$ 0.47
	20	5.66 $\pm$ 0.47	4.66 $\pm$ 0.47	4.33 $\pm$ 0.94
	40	7.66 $\pm$ 0.47	6.33 $\pm$ 0.47	6 $\pm$ 0
Gentamicin	10	25 $\pm$ 0	20 $\pm$ 0	19 $\pm$ 0
DMSO		0	0	0