Supplementary Information

for the manuscript entitled

ZnO@PDA@Ag Nanocomposite-Mediated Delivery of 9-Bromonoscapine, an Anticancer Agent, for Enhanced Lung Cancer Therapy

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1. NMR (^{1}H and ^{13}C) & HR-MS of synthesized 9-Br-Nos drug

20 mg of 9-Br-Nos was weighed and dissolved in 0.5 ml deuterated chloroform ($CDCl_3$) to prepare the sampled of ^{1}H and ^{13}C NMR. The ^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$ on a Bruker Avance Neo NMR at 400 MHz and 100 MHz respectively. The NMR analysis was subsequently done using Mestre Nova software. 9-Br-Nos was obtained as a yellowish-brown solid. Its structure was confirmed by NMR spectroscopy. **^{1}H NMR (400 MHz, $CDCl_3$) δ:** 6.95 (d, *J* = 8.3 Hz, 1H), 6.23 (d, *J* = 8.2 Hz, 1H), 5.95 (s, 2H), 5.42 (d, *J* = 4.5 Hz, 1H), 4.26 (d, *J* = 4.6 Hz, 1H), 4.02 (s, 3H), 3.91 (s, 3H), 3.81 (s, 3H), 2.68 – 2.62 (m, 1H), 2.59 – 2.52 (m, 1H), 2.44 (s, 3H), 2.42 – 2.36 (m, 1H), 1.93 – 1.86 (m, 1H) **^{13}C NMR (101 MHz, $CDCl_3$) δ:** 166.98, 151.32, 146.81, 145.54, 140.29, 138.99, 133.18, 129.37, 118.68, 118.04, 117.35, 116.48, 100.06, 94.58, 80.29, 80.29, 61.30, 59.94, 58.43, 55.81, 47.43, 44.22, 24.94. HR-MS calculated for $[C_{22}H_{22}BrNO_7]$ $[M+Na]^+$: 514.04, found: 514.04.

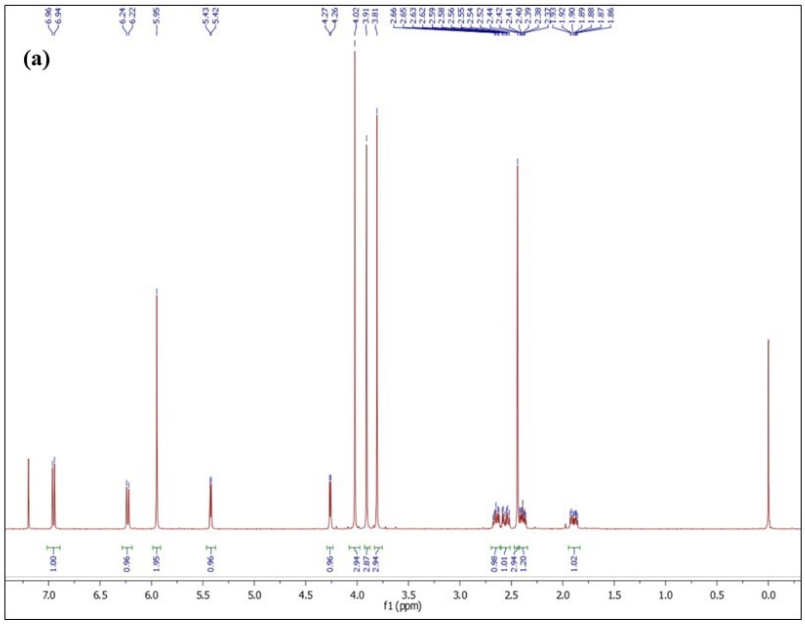

Figure S1. ^{1}H NMR of 9-Br-Nos drug

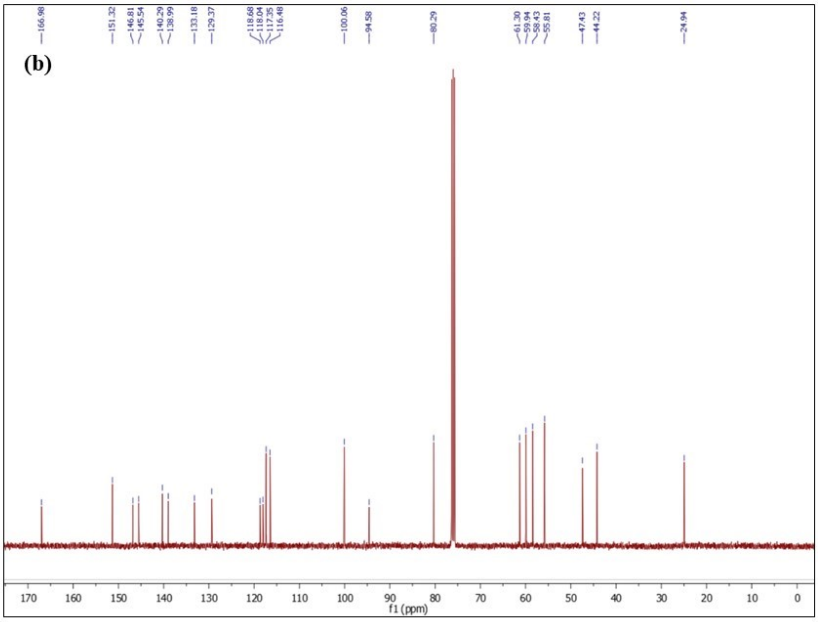

Figure S2. ^{13}C NMR of 9-Br-Nos drug

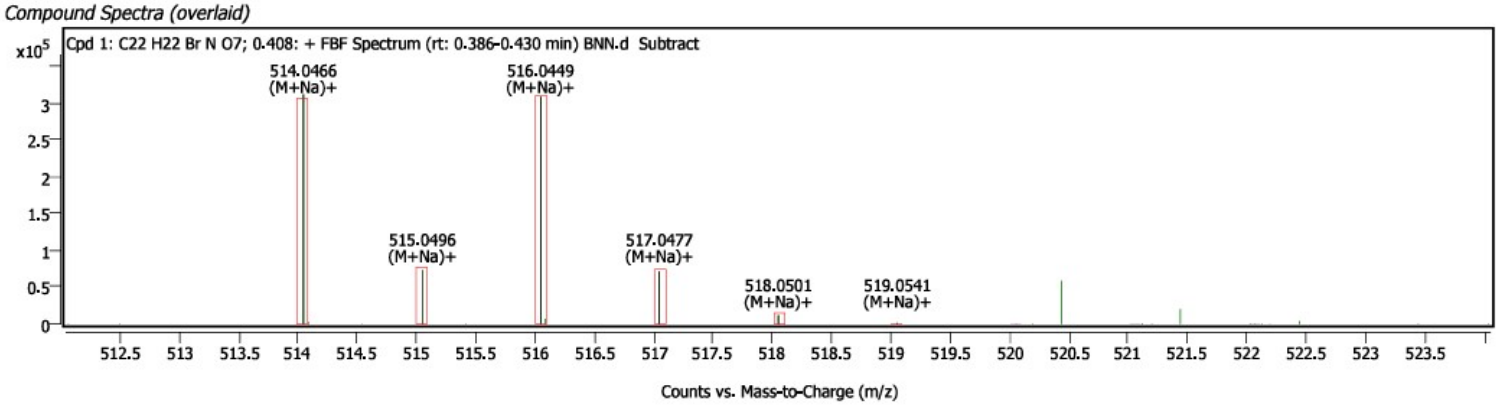

Figure S3. Mass Spectra of 9-Br-Nos drug

2. Thermogravimetric Analysis (TGA) Analysis

TGA analysis of powdered ZnO@PDA@Ag@9-Br-Nos nanocomposite was performed to assess its thermal stability, weight loss pattern, and to estimate the characteristics of organic coating and drug loading. 'Shimadzu TG/DTA instrument' operated in the temperature range from 0 ºC to 700 ºC at a heating rate of 2 ºC per min was used for the analysis.

From the TGA curve of ZnO@PDA@Ag@9-Br-Nos nanocomposite, a continuous weight loss is observed, starting from 0-150 °C (~3-5%) due to the loss of adsorbed water and moisture content from

the surface of the nanocomposite. The major weight loss between 150–500 °C (~20-25%) corresponds to the decomposition of the organic polydopamine (PDA) polymer coating and the loaded drug molecule, 9-Br-Nos. A further gradual weight loss (~10%) is seen from 500-650 °C, attributed to the residual carbonization of PDA fragments and remaining carbon content, while the thermally stable inorganic ZnO and Ag cores remain as residual weight above ~650 °C.[1,2]

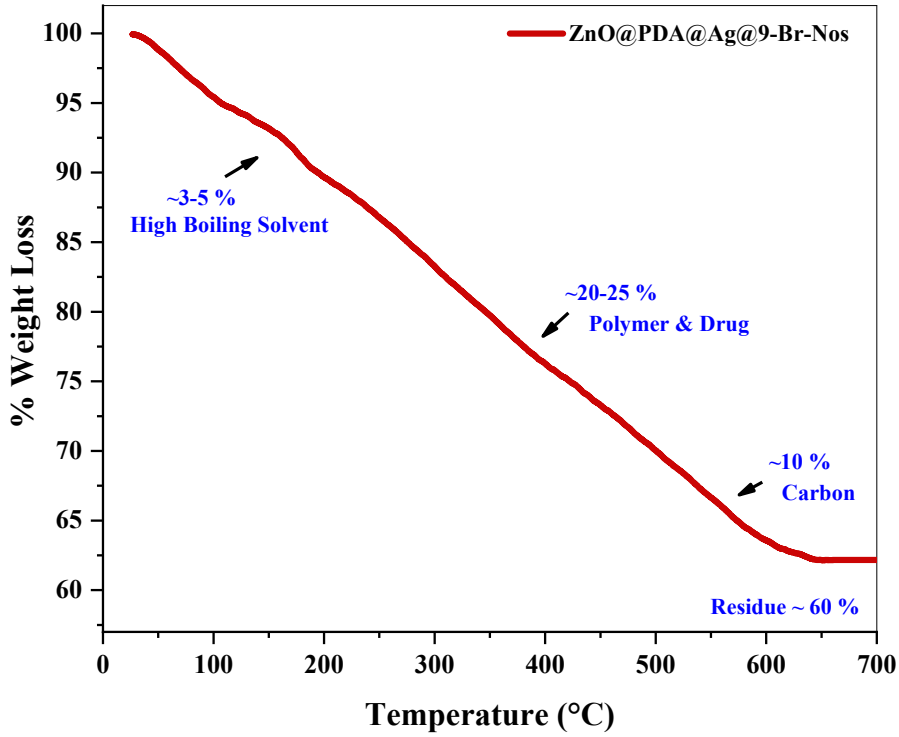

Figure S4. TGA analysis of ZnO@PDA@Ag@9-Br-Nos nanocomposite

3. Drug Release Kinetic Analysis

To gain deeper insights into the underlying drug-release mechanism, the cumulative release profiles of 9-Br-Nos at pH 5.5 and pH 7.4 were fitted to four widely accepted kinetic models, namely zero-order, first-order, Higuchi, and Korsmeyer-Peppas. Among these, the Korsmeyer-Peppas model exhibited the best goodness-of-fit, with the highest correlation coefficients for both release conditions (pH 5.5: $R^2 = 0.765$; pH 7.4: $R^2 = 0.683$). The diffusion exponent (n) obtained from this model was <0.45 in each case, indicating that the release of 9-Br-Nos is predominantly governed by Fickian diffusion.[3] The comparatively higher R^2 value and faster release observed at

pH 5.5 further suggest that the nanocomposite undergoes more efficient drug diffusion under mildly acidic environments, which closely resemble tumor microenvironmental conditions. This pH-responsive enhancement underscores the suitability of the nanocarrier for targeted drug delivery applications in cancer therapy.

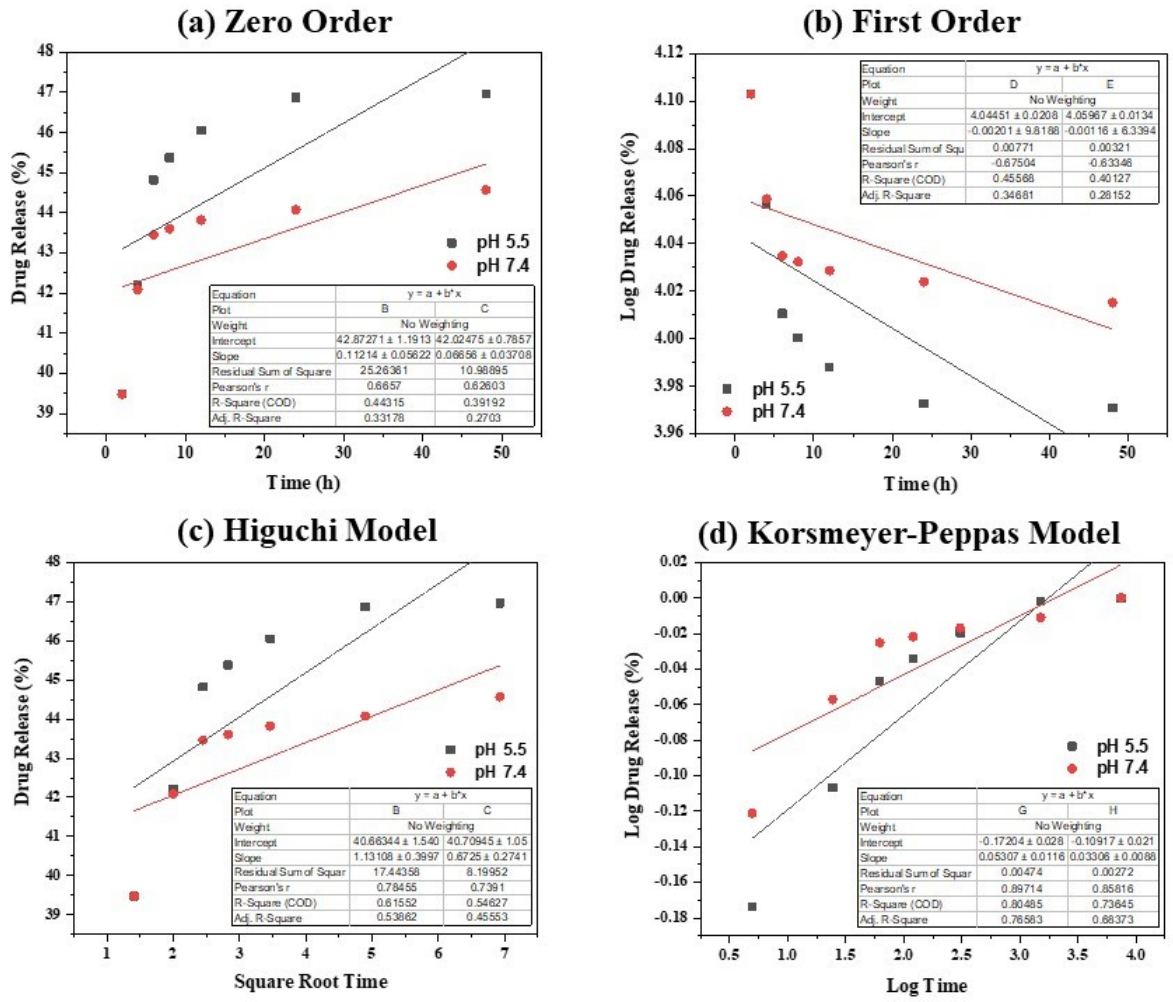

Figure S5. Drug Release data fitted to various kinetics models

References

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