Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Synthesis and Degradation Mechanism of Renal Excretable Gold Core Shell Nanoparticles for Combined Photothermal And Photodynamic Therapy

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Table S1 Various types of biodegradable nanoagents for cancr therapy

S.No	Nanomaterial	Advantages	Disadvantages	References
1.	**Liposomes**	Can synergize PTT-chemotherapy Temperature-sensitive Heat controlled drug release possible Increases drug loading efficiency.	Low stability Low circulation times in the blood Production Cost is high Physical/chemical stability	[1,2]
2.	**Organic Dye based Nanoparticles (eg- Indocyanine Green)**	strong near-infrared absorbance High light to heat conversion efficiency great biocompatibility Can be used as a near infrared fluorescence probe.	Limited aqueous stability low fluorescence quantum yield in aqueous solution Rapid body clearance Poor cellular uptake. a challenge in distinguishing malignant from inflammatory tissue.	[3–5]
3.	**Polymer nanoparticles** **Eg- polypyrrole PEG nanoparticles (NPs)**	Customizable molecular structures Large absorption coefficient Non-toxic Used as drug delivery systems	Low Photothermal conversion efficiency	[6]
4.	**Gold nanoparticles** **(Au NPs)**	Biocompatible Can be delivered locally into the tumor location while reducing non-specific distribution. Can penetrate deep into biological tissues. Easily modified. ROS scavenging	Size greater than 20 nm which is a major roadblock in renal clearance of the Nanoparticles. Can be overcome by liposomal coating. Lack of stability in the body	

		ability.		
5.	**Gold Nanoshell**	Disintegrable system Stimuli-responsive Biocompatible	Can be expensive Stability	[7,8]
6.	**Two-dimensional (2D) nanomaterials** **Ex- MXene**	The number of layers of the material can be changed Large surface area for housing drug molecules Amenable to surface modification.	PEGylation of 2D Nanoparticles leads to production of anti-PEG antibodies. Low yield Untargeted toxicity Low clinical translation	[9,10]
7.	**Transition Metal Dichalcogenides (TMDs) / quaternary chalcogenide nanocrystal**	Strong X-ray attenuation ability that can be used for CT imaging of tumors. Can be used for combined PTT-PDT. Can be also used as a drug delivery system.	Low water solubility Non-uniformity Low colloidal stability.	[11]
8.	**Semiconductor quantum dots**	Small size Easy penetration into cells Generate Reactive oxygen species (ROS). Can be used in fluorescent imaging	Quantum dots (QDs) are composed of heavy metals so can be toxic.	[12,13]

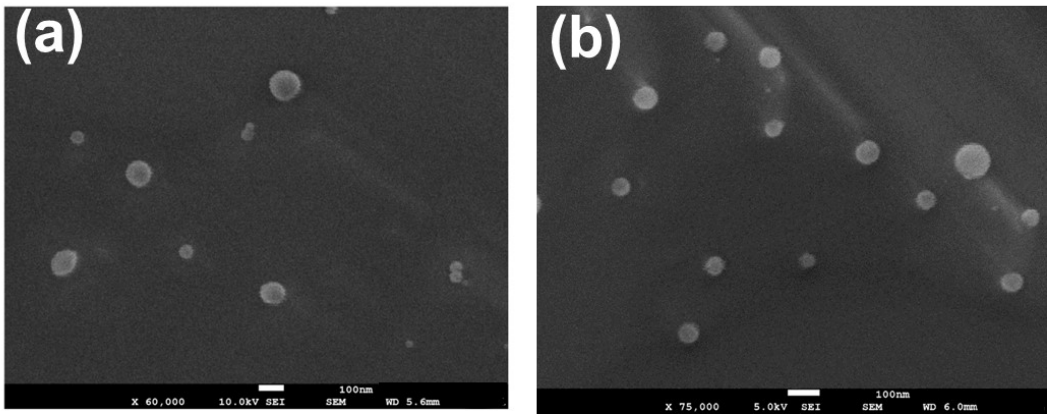

Figure S1 scanning electron microscopy (SEM) images of Zein NPs (a) 10 mL batch (b) 60 mL batch [scale: 100nm]

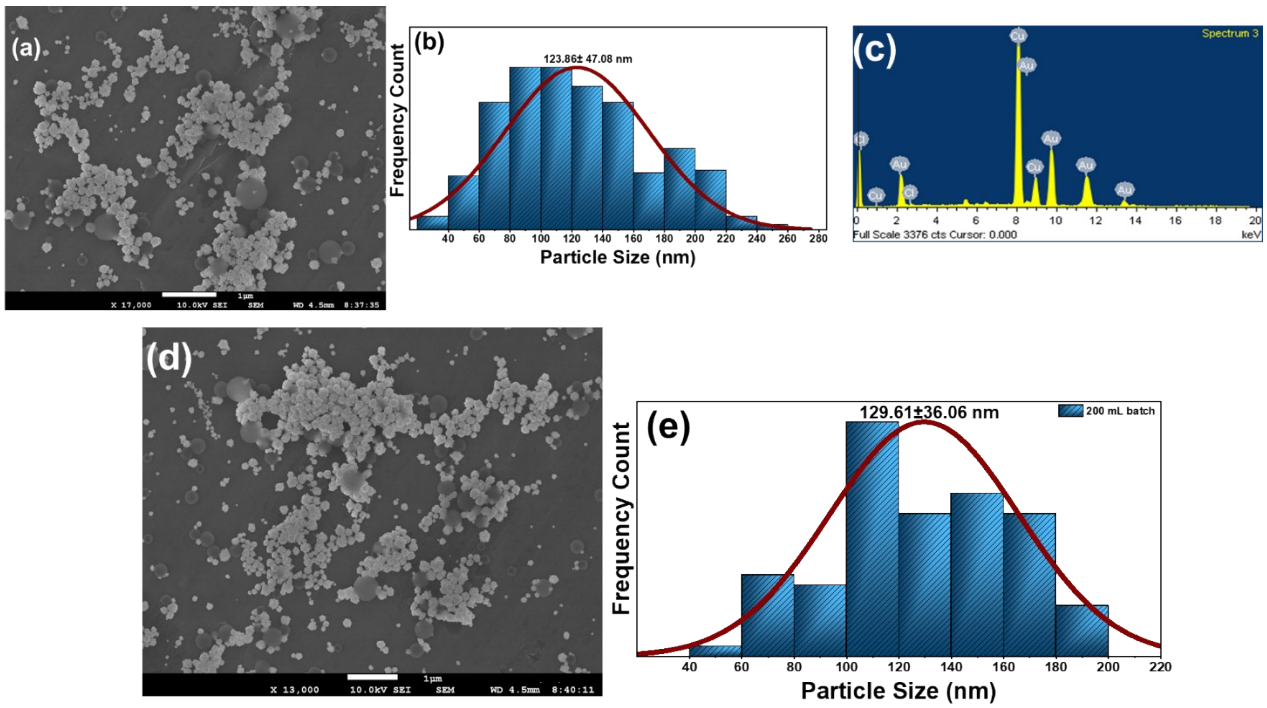

Figure S2 SEM images of Au_{Zein} and size distribution of Au_{Zein}(a-b) 500µl batch (c-d) 200 mL batch [scale: 1µm]

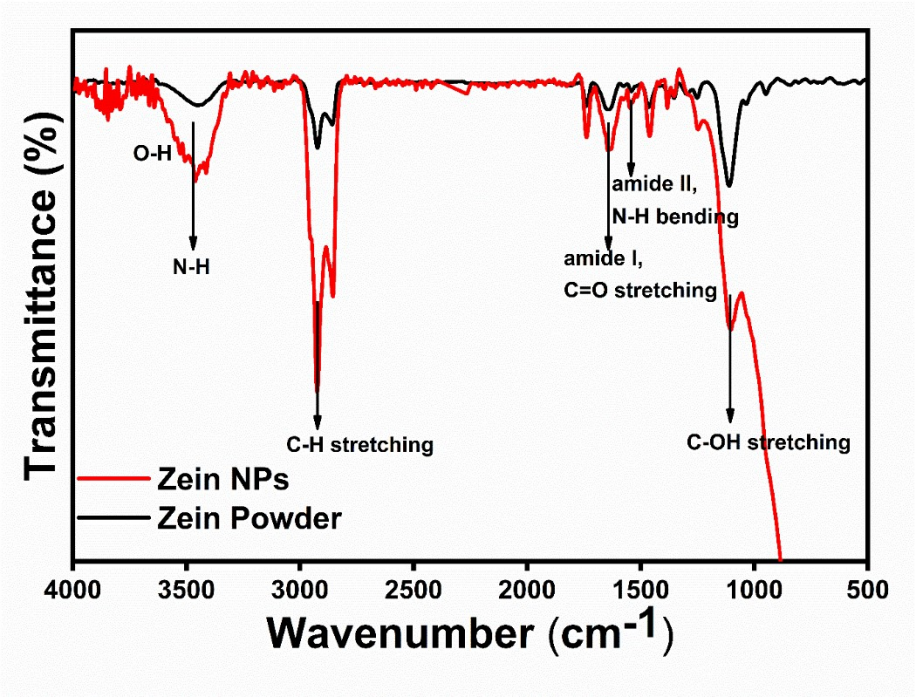

Figure S3 FTIR spectra of Zein powder and Zein NPs

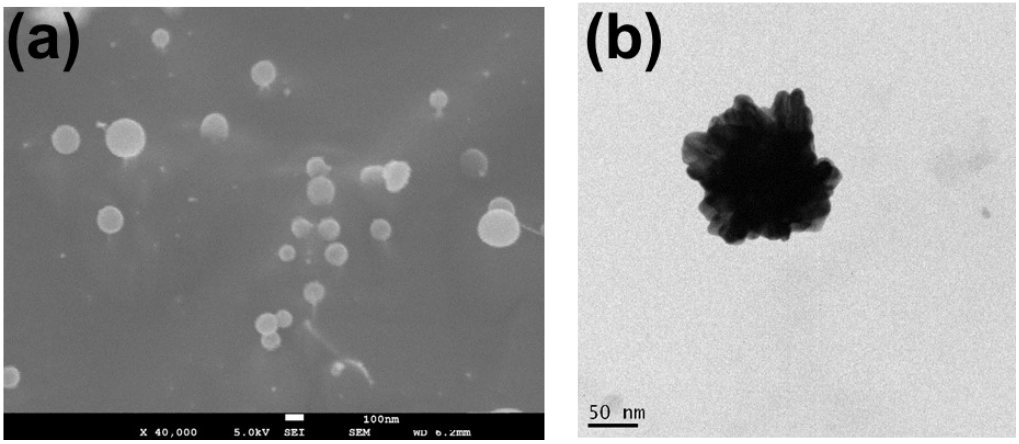

Figure S4 Morphological characterization of gAu_{Zein} (a)SEM image (b)TEM image

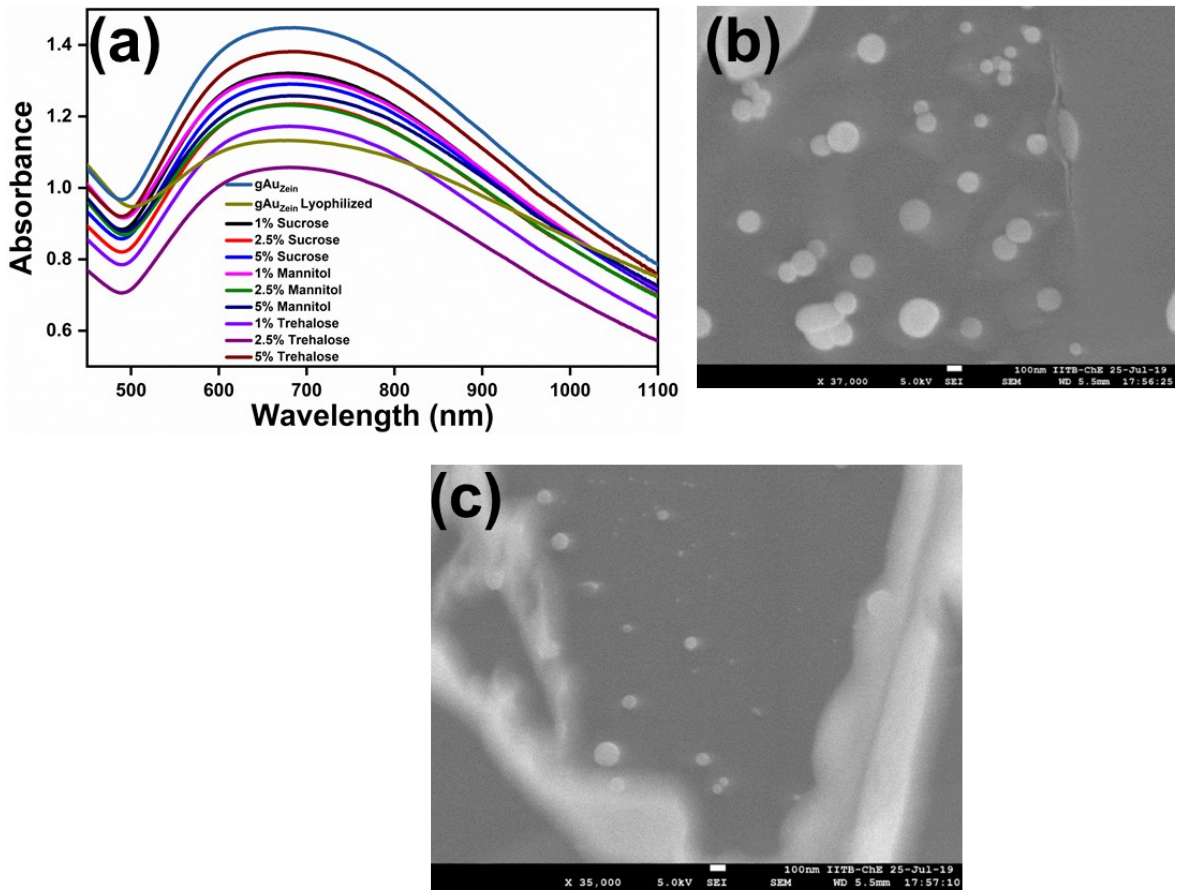

Figure S5 Effect of different cryopreservants on (a) UV-vis spectrum (b-c) SEM images of gAu_{Zein} lyophilized along with 1% Sucrose. [scale:100nm]

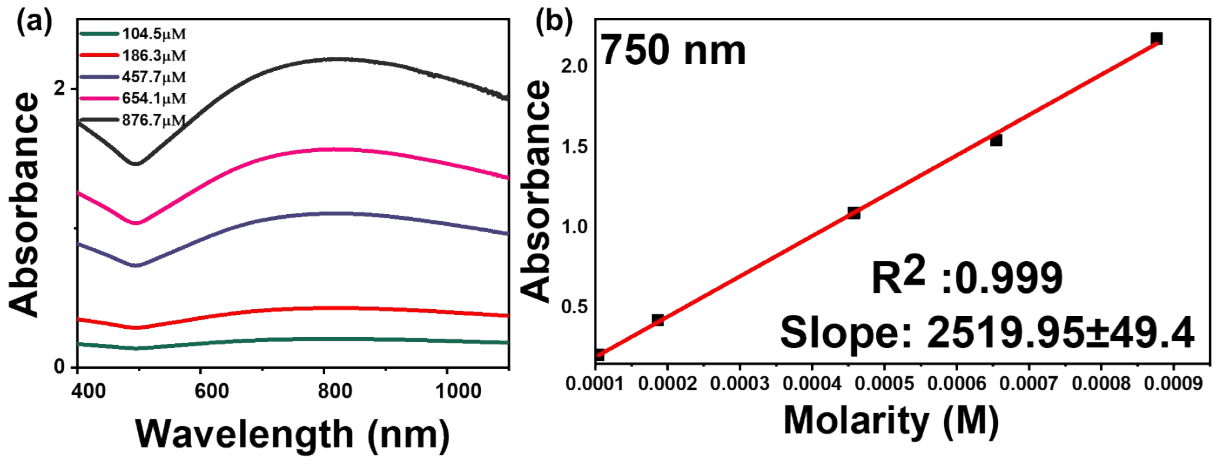

Figure S6 (a) Absrobance spectra of gAu_{Zein} at various concentration (b) The molarity vs. absorbance of gAu_{Zein} at absorption wavelength of 750 nm

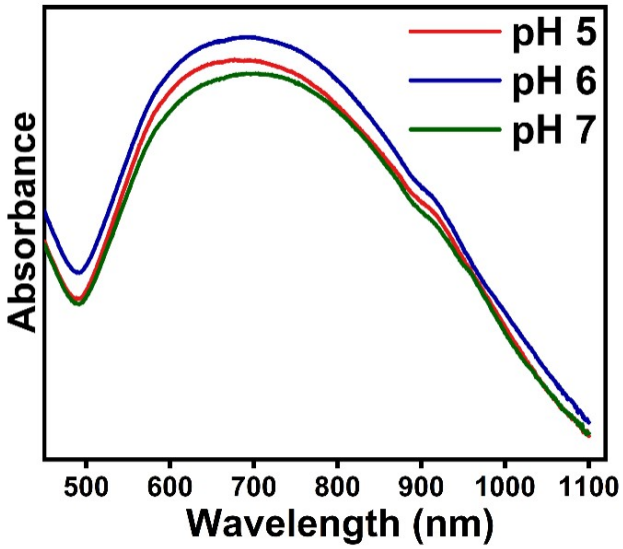

Figure S7 (a) Absorbance spectra of gAu_{zein} at different pH range from 5-7

(a)

pH	Zeta potential (mV)	Std. Dev
5	19.4	0.210713
6	16.10667	0.075719
8	17.38	0.156205
9	17.01667	0.650333

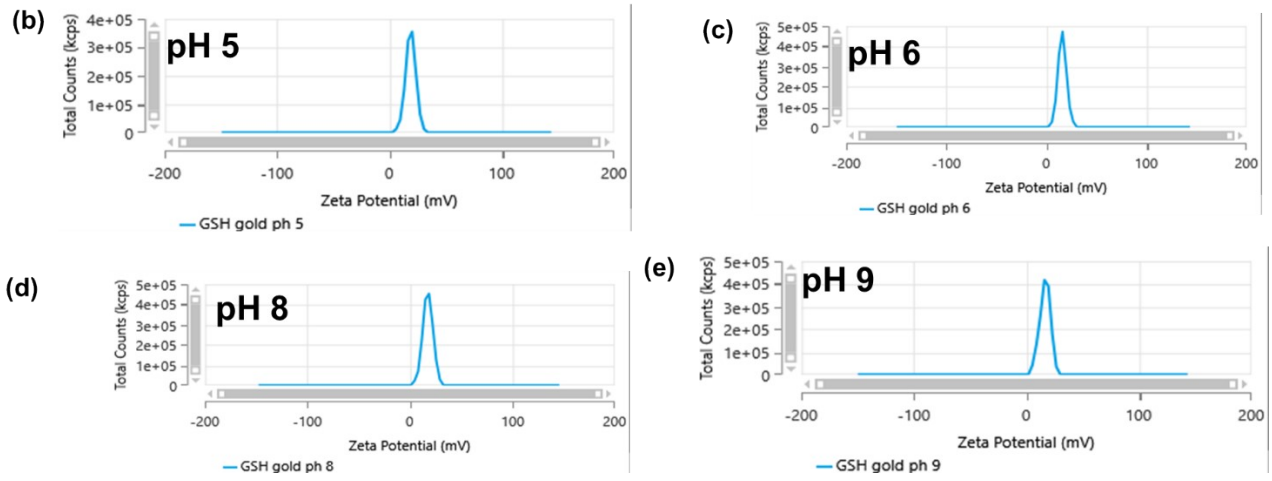

Figure S8 Zeta Potential of gAuzein at different pH range from 5-9

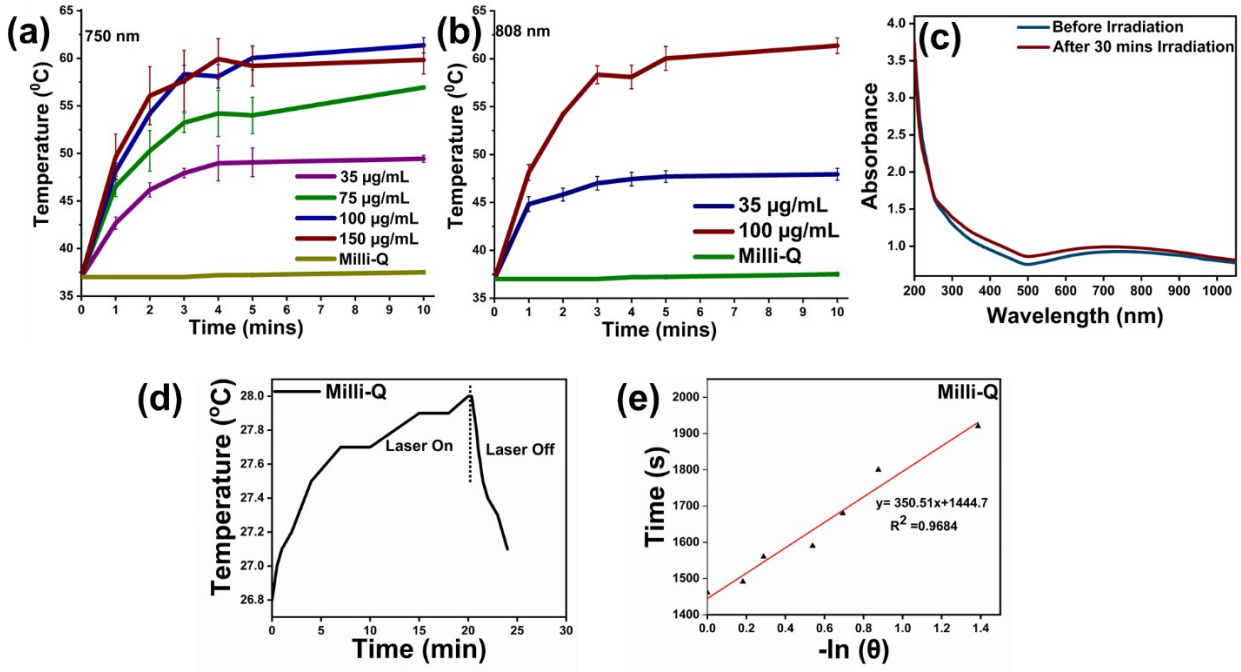

Figure S9 Photothermal properties of gAu_{zein} (a) Temperature profile at 767 mW using 750 nm (b) Temperature profile at 767 mW using 808 nm (c) absorbance spectra of gAu_{zein} after continuous irradiation of 750 nm laser for 30 minutes(d) Heating and cooling kinetics of Milli-Q when laser irradiation is on and off, respectively (d) Graphical representation of time vs natural logarithm of temperature (θ) to calculate thermal constant τs for Milli-Q

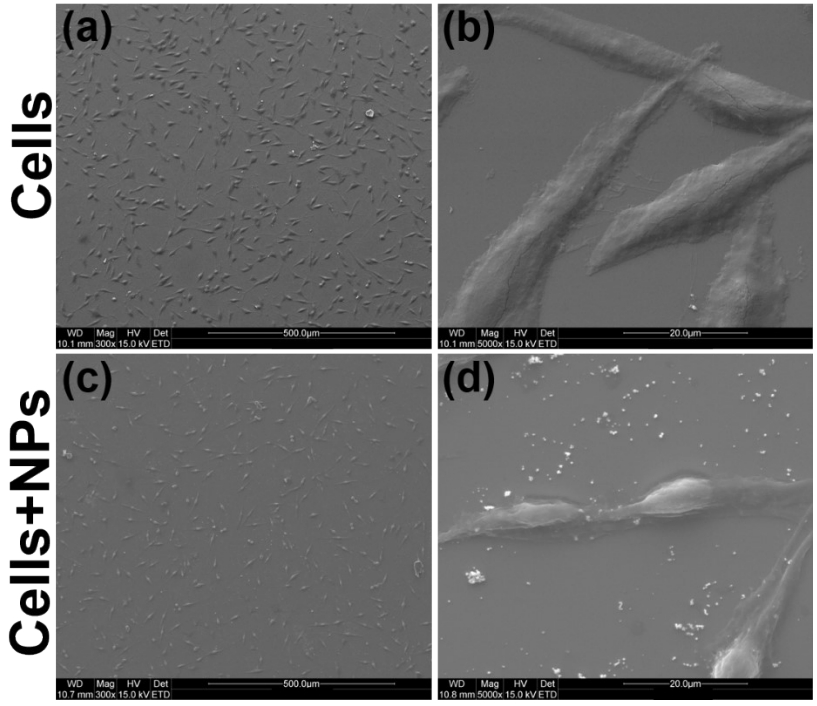

Figure S10 SEM images of (a-b) control cells (c-d) cells incubated with gAu_{Zein}

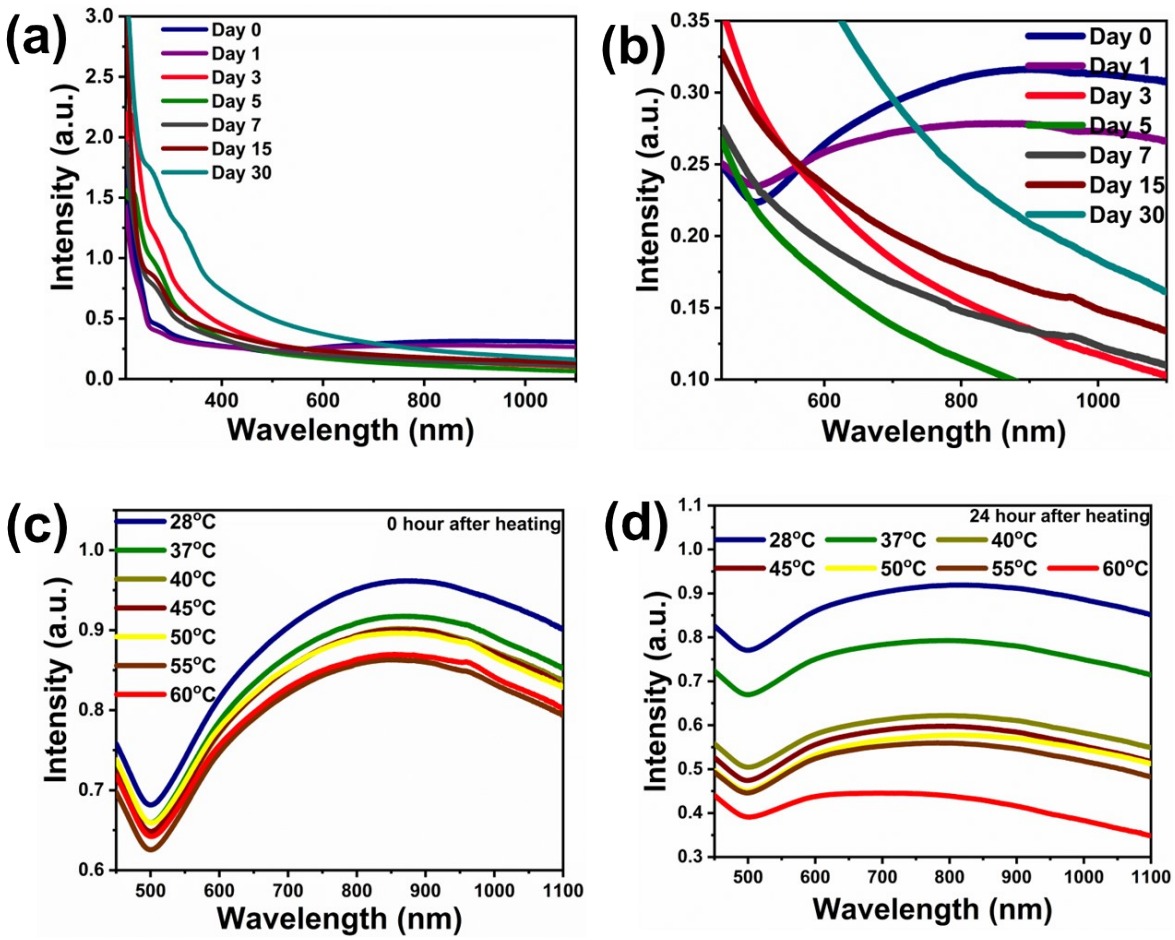

Figure S11 (a) absorbance spectra of gAu_{Zein} dispersed in PBS at different time period (b) absorbance reading in the wavelength range 500-1100.(c) absorbance spectra at time 0 minutes after heating at different temperature (d) absorbance spectra after heating at different temperature and then incubating at 37^0C for 24 hours

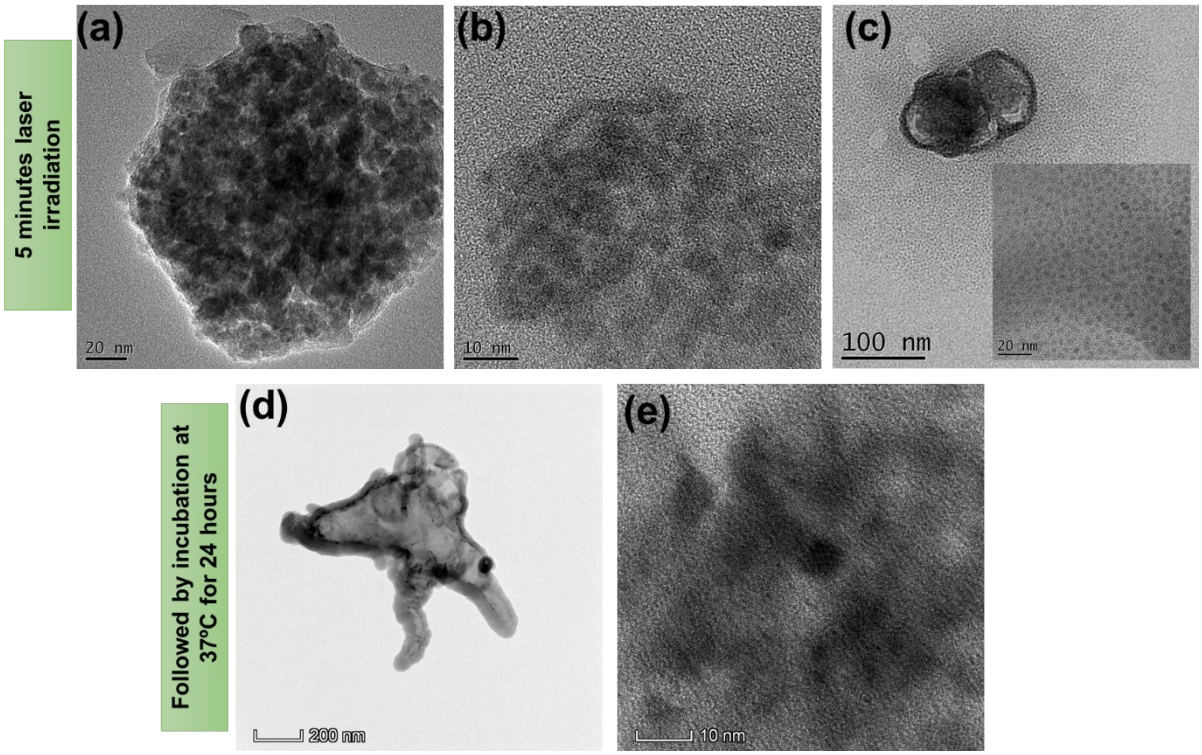

Figure S12 TEM images to show disintegration of gAu_{Zein} (a-c)5 minutes after laser irradiation (inset- tiny gold seeds under <20 nm) (d-e) observed after incubation at 37°C for 24 hours. The material loses its morphology and releases small gold seeds.

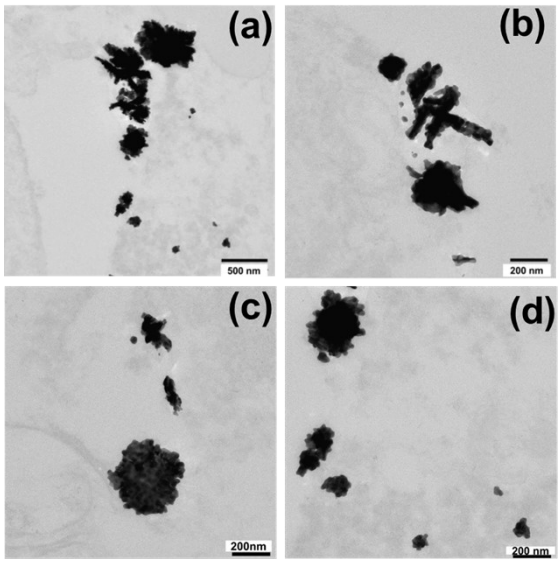

Figure S13 Partial degradaed gAu_{Zein} in Tumor section.

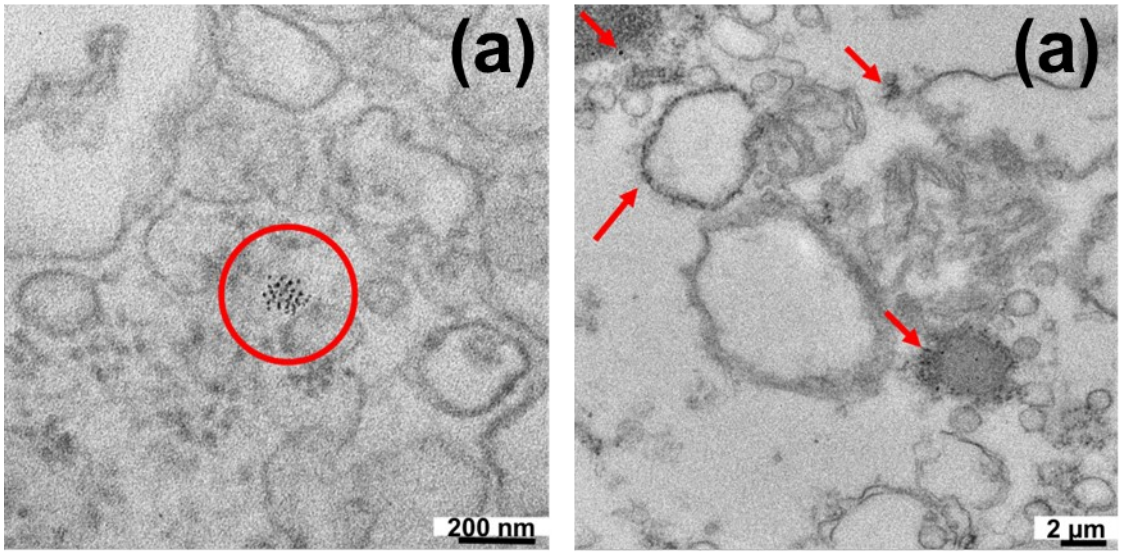

Figure S14 Small gold seeds observed in kidney in control mice

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