Simplified Review Paper presentation of "Synthesis of ultrasonic assisted co-precipitated Ag/ZnO nanorods and their profound anti-liver cancer and antibacterial properties".

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Synthesis of ultrasonic assisted co-precipitated Ag/ZnO nanorods and their profound anti-liver cancer and antibacterial properties.

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NanoScience

Basic recap:

•Nano science is the study of stucture and material on the scale of nano meter.

• Nano meter is a billionth time of meter.

• 1 nm = 10^-9 m.

• When any matter is divided into such small particle it expresses change in physical and chemical properties such as Mechanical, Electrical, Optical, Magnetic and etc.

Nano particle taken: Ag/ZnO.

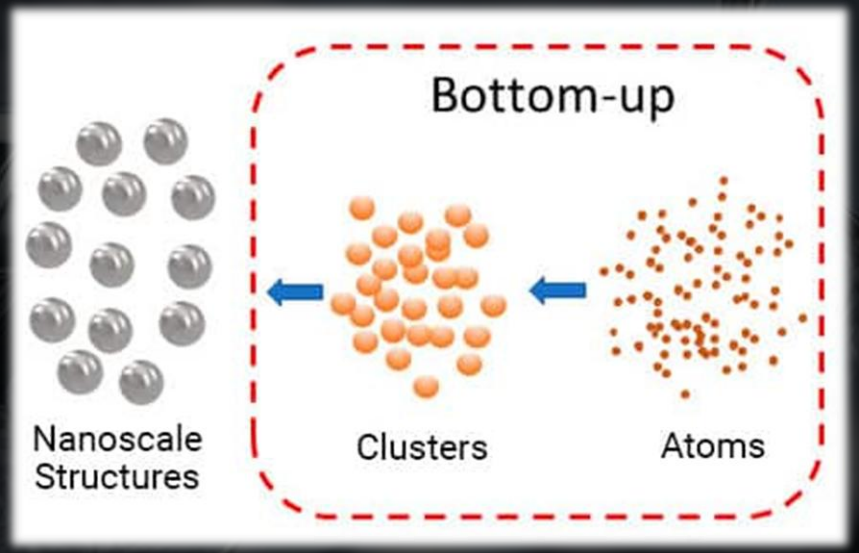
This paper covers,

- The procedure involved in the preparation of Ag doped ZnO Nanomaterial.

- Estimation and evaluation.

- <u>Application in the medical field:</u>

1. Anti-inflammation agent.
2. Anti-biotic.
3. Anti liver cancer treatment.



The nano particle here is prepared by bottom up approach.

I) Methods used for the preparation of Ag/ZnO:

- Co- precipitated and Ultrasonic method.

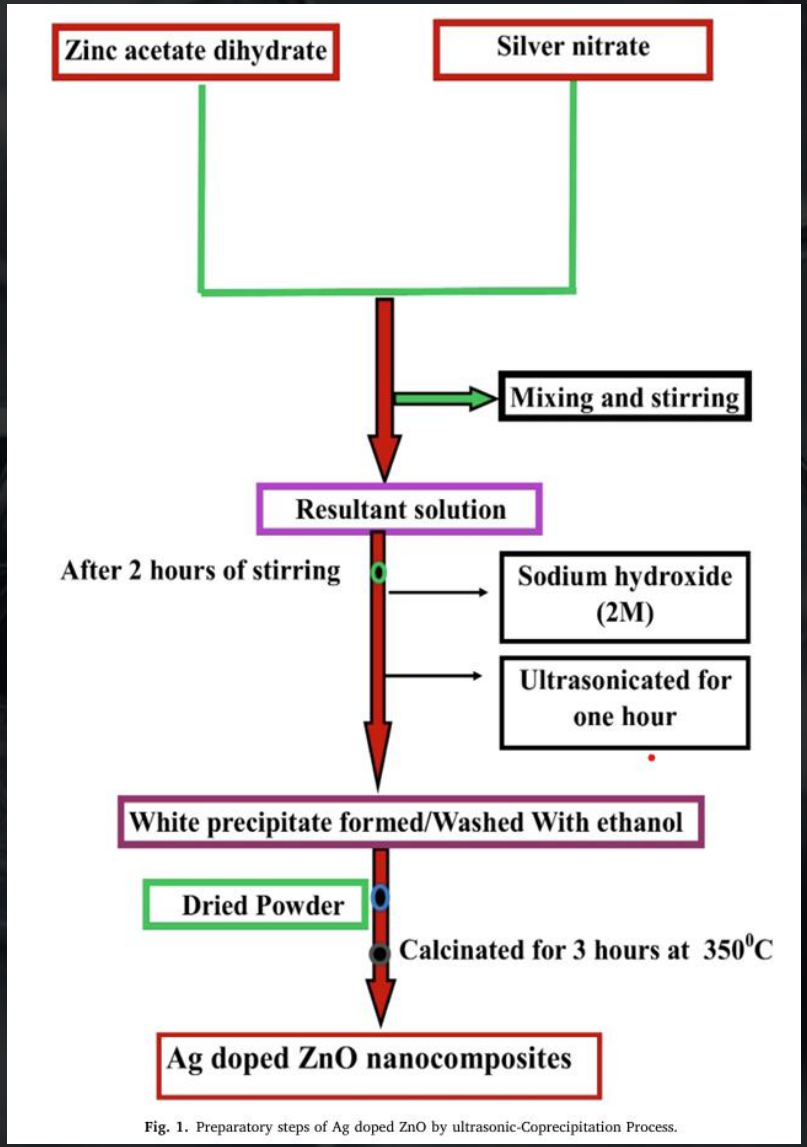


Fig. 1. Preparatory steps of Ag doped ZnO by ultrasonic-Coprecipitation Process.

II) Test done to confirm the formation of Ag/ZnO Nano-rod from Nano plates:

To determine the particle size:

- X ray Diffraction.
- Selected Area Electron Diffraction [SAED] patterns.

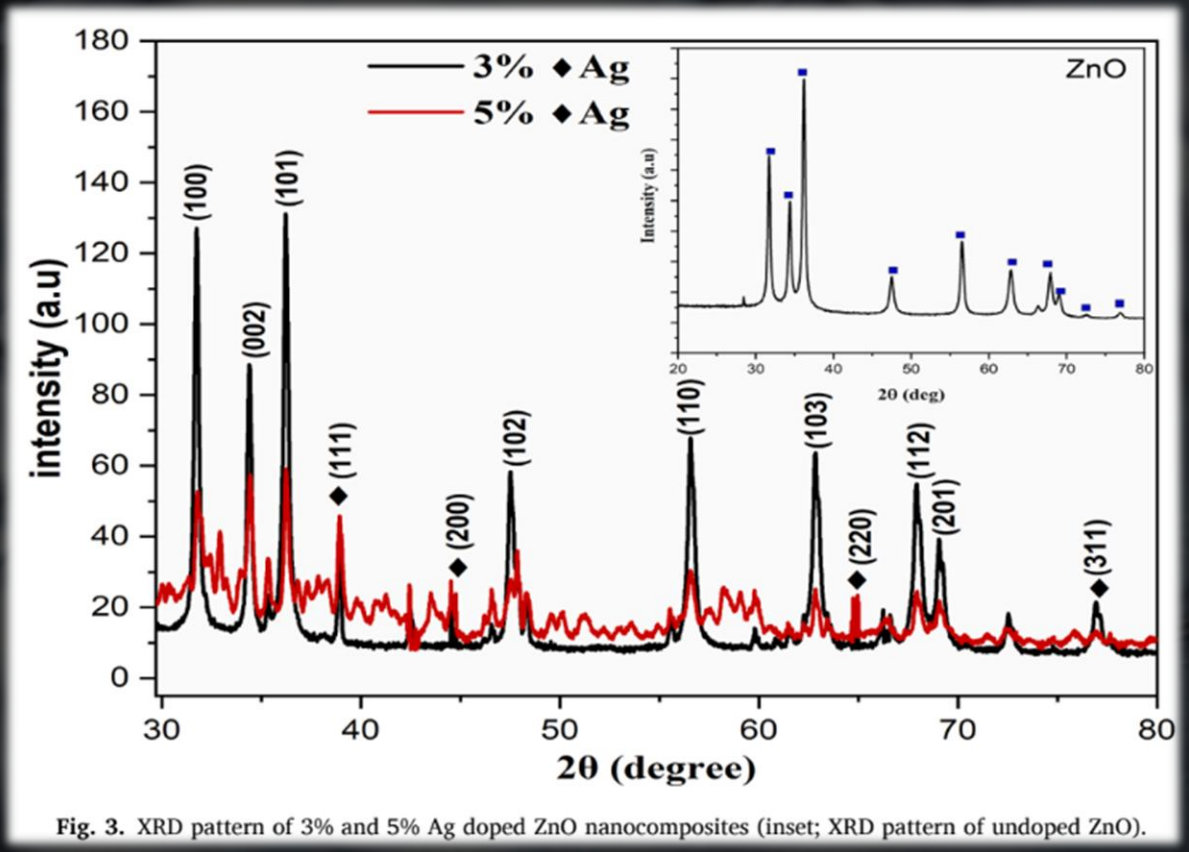
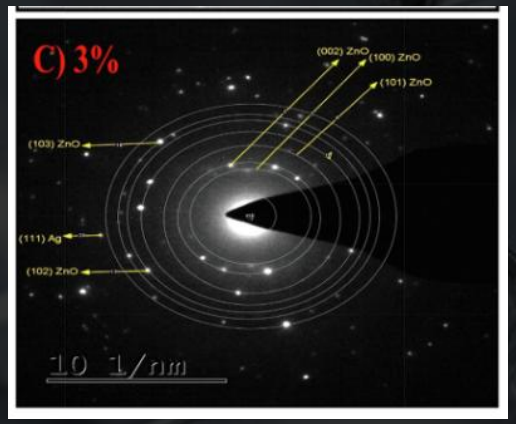
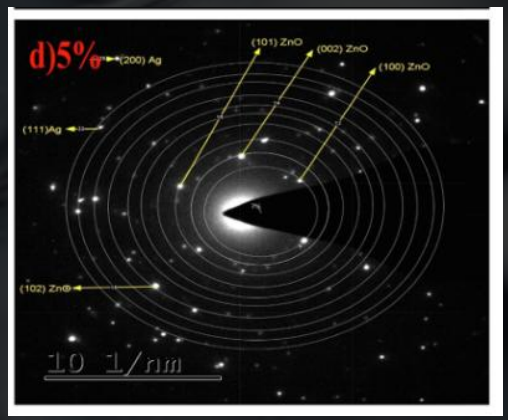


Fig. 3. XRD pattern of 3% and 5% Ag doped ZnO nanocomposites (inset; XRD pattern of undoped ZnO).





Average crystalline size ‘D101′ has been estimated using Debye- Scherrer’s formula for (101) plane.

$$D101 = K \lambda / (\beta 101 \cos\theta)$$

Here,
wavelength of radiation (λ) has the value 1.54 Å, constant (K)

• β101 is width at half maximum of 101 plane and cosθ is peak position at 101 planes.

•The crystalline sizes of 3% and 5% Ag doped ZnO samples were estimated as crystal size (47 and 44) nm,

To Indicate that more hydroxyl ions are evolved from 5% silver :

- Fourier Transform Infrared Spectrum [FTIS].

To prove whether the Ag/ZnO Nano structure formed properly:

- Dynamic Light Scattering [DLS].

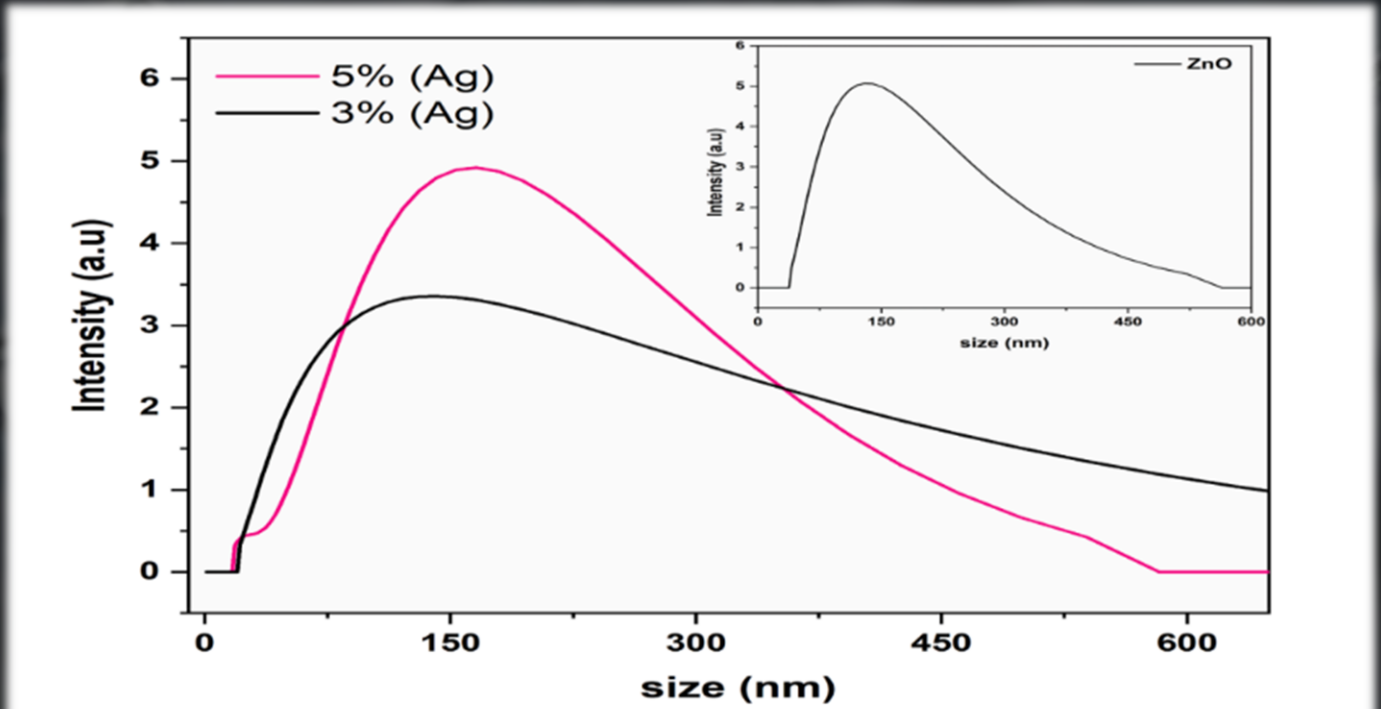
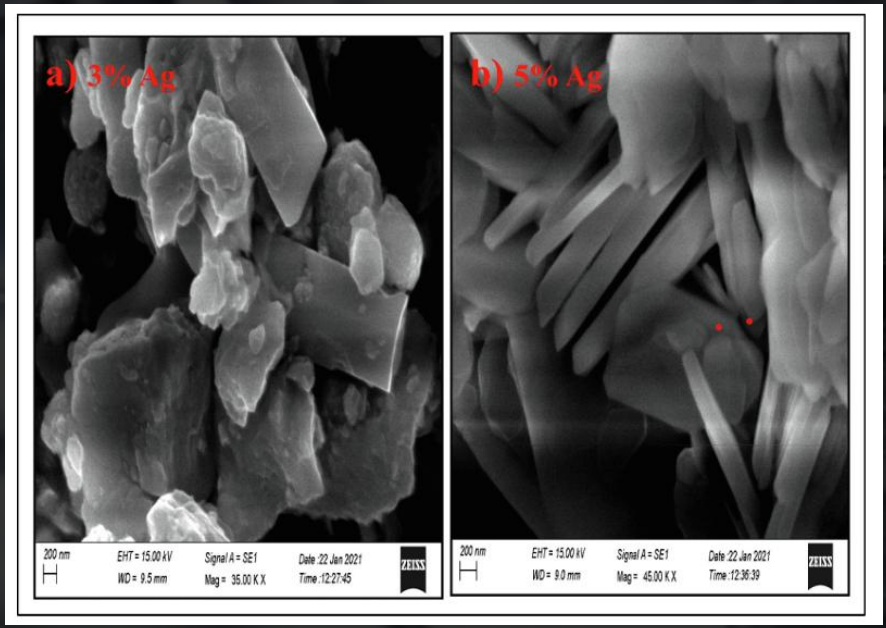


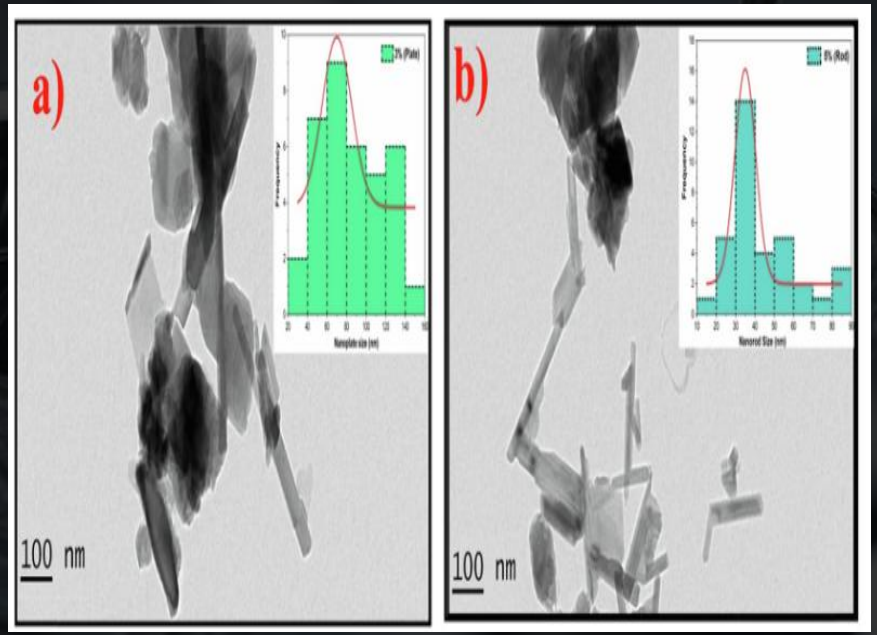
Fig. 9. Dynamic light scatter spectrum of 3% and 5% Ag doped ZnO nanocomposites (inset: DLS spectra of undoped ZnO).

To visualize Ag/ZnO Nano plate and Nano rod:

- Scanning Electron Microscope [SEM].
- Transmission electron microscopy [TEM].



SEM



TEM

III) Applications of nano particle: Ag doped ZnO.

1) Anti-Inflammation:

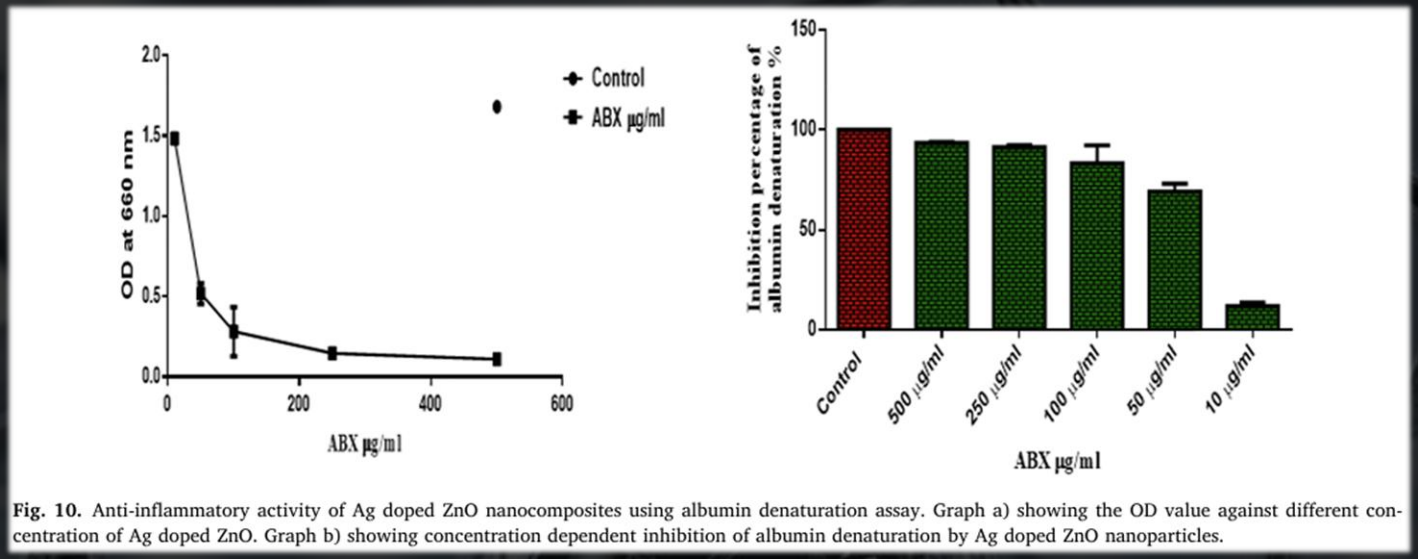


Fig. 10. Anti-inflammatory activity of Ag doped ZnO nanocomposites using albumin denaturation assay. Graph a) showing the OD value against different concentration of Ag doped ZnO. Graph b) showing concentration dependent inhibition of albumin denaturation by Ag doped ZnO nanoparticles.

Inhibition =100 ((A1-A2)/A0) * 100)

Where,

A1 is the absorbance of the initial value.

A2 is the absorbance of the final value.

A0 is the absorbance of the positive control.

IC50 Value of Ag/ZnO is 36.69 µg/ml.

Table 1
1nhibition percentage of albumin denaturation verses concentration of Ag/ZnO samples.

S. No	Tested sample concentration (µg/mL)	Inhibition percentage albumin denaturation (%) (In duplicates)			Mean Value (%)
1.	Control	100	100	100	100
2.	500 µg/mL	94.17	93.39	92.92	93.49
3.	250 µg/mL	92.08	91.79	90.12	91.33
4.	100 µg/mL	89.29	87.74	72.87	83.3
5.	50 µg/mL	70.55	64.96	72.21	69.24
6.	10 µg/mL	9.87	12.49	13.14	11.83

2) Anti-biotic properties:

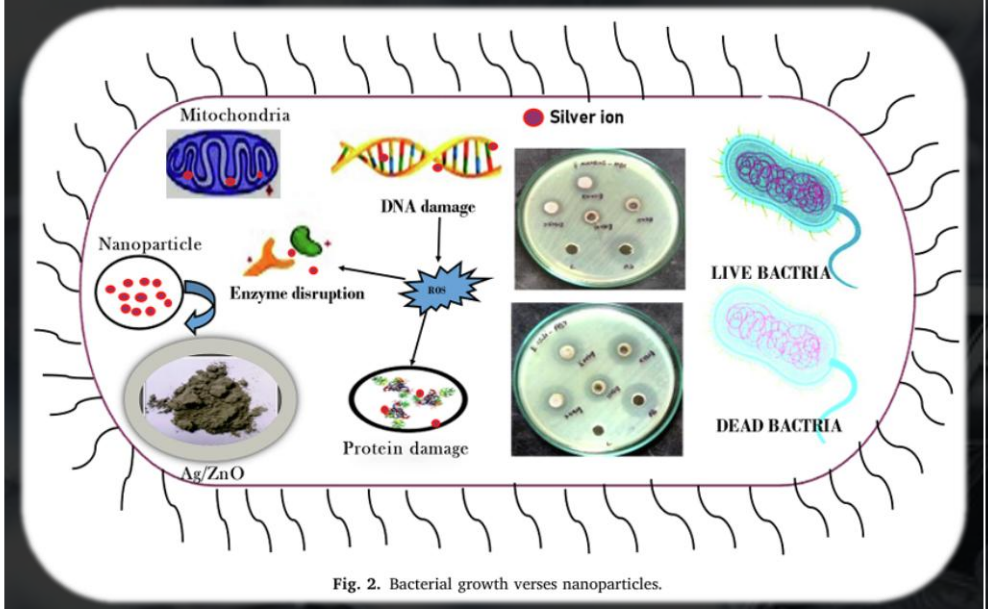


Fig. 2. Bacterial growth verses nanoparticles.

Species used:

- E.coli (Gram-Negative bacterium).
- Staphylococcus aureus (Gram-Positive bacterium).

- Ag/ZnO is biocidal photo catalyst have capability to yield reactive oxygen species (ROS).

- The direct contact of Ag/ZnO with cell walls causes the release antimicrobial Ag ions and ROS formation.

- Ag/ZnO-ROS species generate high reactive superoxide and hydroxyl radicals, which enter into the cells,

i) Inhibit the antioxidant defence system.
ii) Prevent ATP production.
iii) Destructing the bacterial cell integrity and results in mechanical damage to the cell membrane.

- Production of more hydroxyl and superoxide radicals in the 5% Ag doped ZnO catalyst damage DNA and protein oxidation.

3) Application of Ag/ZnO nanorods against Human liver cancer-HepG2 cell:

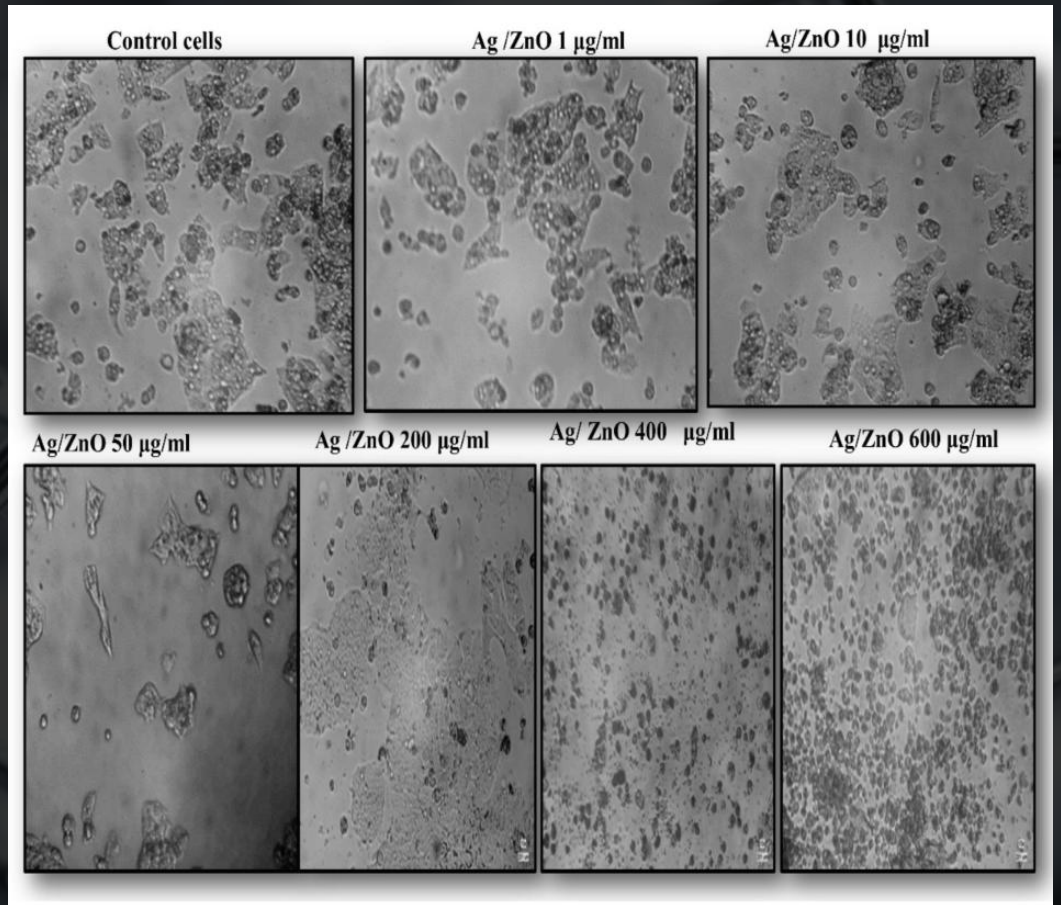


Fig. 12. Different Images of control cells and Ag doped ZnO treated cell with different concentration of human liver cancer cell line (HepG2).

Table 2b
Calculation of IC_{50} Value of treated cancer cells.

S.no	Sample name	IC_{50} Value
1	Ag doped ZnO	38.04

Conclusion:

• Ag/ZnO Nanorods will be more efficient than Ag/ZnO Nanoplates.

•The reduction in surface area with respect to volume makes the silver ion/ZnO nano rods feasible in further therapeutic applications.

Proved:

1. By the addition of Ag ions, the inflammatory cells can be cured .

2. The nanocomposite exhibits positive response against the liver HepG2 cancer cell line in in-vitro culture.

3. Ag/ZnO effective against bacterial growth.

Since,

Ag/ZnO nanorods have potential against bacterial growth, reduce cell inflammation and control growth of liver cancer cells, this present research opens new avenues for in vivo estimation of this nanocomposites against liver cancer.

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I appreciate your time.

Have a nice day.