Summary

In recent years, nanobiotechnology is one of the most popular field of nanotechnology, which acknowledged the most attention from the researchers, due to its eco-friendly procedures to generate particles. Metal nanoparticles are of great importance due to their high surface area chemistry. In particular, gold nanoparticles are employed in many fields: biosensing, catalysis, electronics and cancer therapy among others. Presently, biological nanoscience has drawn very much attention due to its innovative nature and the efficacy of produced nanoparticles in biomedical applications. Biomolecules are found to have significant advantage due to their non-biocompatible nature. In the present cram, a simple biosynthetic method using indole-3-carbinol is addressed herein for synthesizing gold nanoparticles.

Biogenic AuNPI3Cs were characterized by DLS, UV–Vis spectrometry, FTIR, XRD, Fe-SEM and TEM, AFM, NMR study. They have an average size of 6.858 nm and they are crystalline having spherical in shape.

In acute toxicity study, it was found that AuNPI3Cs were non-toxic up to the dose level of 2500µg ml^{-1} against brine shrimp, zebrafish model. AuNPI3Cs were relatively non-toxic up to the dose level of 4mg/kg body wt in sub-chronic toxicity study in mice model.

AuNPI3Cs revealed potent anti-proliferative and antineoplastic efficacy against the human T-cell leukaemia producing Jurkat cells, breast cancer, MCF-7 cells and Dalton lymphoma ascites (DLA) cells, Ehlrich ascites carcinoma (EAC) cells at dose-dependent manner. The IC_{50} value of AuNPI3Cs against Jurkat, MCF-7, EAC and DLA cells were 5.5µg ml^{-1}, 7.5 µg ml^{-1}, 5 µg ml^{-1} and 10 µg ml^{-1} respectively. Increased ROS formation, disruption of mitochondrial membrane potential (MMP), DNA fragmentation and cell cycle arrest in AuNPI3Cs-treated cancer cells suggest the possible influence of apoptosis. The results of pro-apoptotic and anti-apoptotic protein blotting showed the up-regulation of Bax, caspase-3 and down-regulation of

Bcl-2. Apoptosis was also confirmed by flow cytometric detection of apoptosis by Annexin V-FITC and PI staining of treated EAC cells. All these results indicated the cytotoxic, antineoplastic and apoptotic potentials of AuNPI3Cs.

AuNPI3Cs decreased tumour volume, tumour cell count and increased the mean survival time in EAC and DLA bearing mice. Immunohistochemistry showed significant inhibition of Ki-67, CD-31 expression in AuNPI3Cs treated EAC induced solid tumours. Enhanced activities of antioxidant enzymes and restoration of redox status were also observed after the treatment of AuNPI3Cs for 14 consecutive days in EAC and DLA bearing mice. On the other hand normalization of histo-architecture of liver and kidney of EAC and DLA induced host mice were seen after the treatment of AuNPI3Cs. The antiproliferative, antioxidant and antiangiogenic potentials of biogenic gold nanoparticles (AuNPI3Cs) may produce a opportunity to develop a potent anticancer drug candidate in future.

AuNPI3Cs showed increased scavenging activities of 2, 2-diphenyl-1-picrylhydrazyl (DPPH), nitric oxide, hydroxyl radical, hypochlorous acid, superoxide anion lipid peroxidation, peroxynitrite free radical equal to standard antioxidant ascorbic acid. The *in vitro* anti-inflammatory activity of AuNPI3Cs was assessed by human red blood cell stabilization and inhibition of protein denaturation that also comparable to standard drug diclofenac sodium. AuNPI3Cs also showed *in vivo* anti-inflammatory potential which was comparable with reference drug indomethacin in carrageenan induced mice paw edema model.

The synthesized nanoparticles, AuNPI3Cs, are eco-friendly, non-toxic to different animal models as well as human normal cells and have antioxidant, anti-inflammatory, antineoplastic activities. So AuNPI3Cs could be a promising candidate for several biomedical applications in future.