Green Nanomaterials: Cancer Research

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ABSTRACT

The nanoparticles used in Cancer research have both metallic and nonmetallic nanoparticles. Among nanomaterials, metal nanoparticles have an added advantage due to their Surface Plasmon Resonance (SPR) and the Surface enhanced Raman scattering (SERs) properties. Gold nanoparticles s are most favored biocompatible, nanoparticles but the reducing agent use in the synthesis of GNPs could be toxic in *in vitro* and *in vivo* systems. The use of naturally occurring biomolecules for the synthesis of nanoparticles has bridged the green chemistry with the nanotechnology. We have synthesized GNPs from grape fruit extracts which had SERS properties and therapeutic potential in cancer cells. The polyphenols of grapes with antioxidant and anticancer properties elicited synergistic performance when used in preparing GNPs. When these GNPs were conjugated to antioxidant peptides, the resultant nanoparticles exhibited superior free-radical scavenging properties. Additionally, when these GNPs were conjugated to peptide targeting MDM2 increased therapeutic potential of the peptide by eliciting P53 mediate response. Future direction should be using more environmental friendly nanomaterials for research application.

The non-metallic nanomaterial that received significant attention in cancer research is Graphene, which is one atom thick having a two-dimensional carbon atoms arranged as sheets and has a large number of amazing properties. It has superior electrochemical properties and canbe made into any shape and has highest Young's modulus (0.5 – 1TPa) among any known material. Furthermore graphene can be conjugated to other polymers and gold nanoparticles for various biological applications. The biocompatibility of Graphene has been tested in several cancer cell linessuch as U87MG human glioblastoma and MCF-7 human breast cancer cell lines. In cancer research Graphene and its derivatives have been used in early detection of cancer, photodynamic therapy enhancers, vehicles for gene delivery, cancer biomarker discovery, delivery of chemotherapeutic drugs and tumour imaging. Most actively studied compound for cancer research application was Graphene oxide. However the Oxygen molecule in the graphene has elicited reactive oxygen species (ROS) causing damage to the cell. This is a good option to kill a cancer cell for therapy but if we are looking for lesser toxic nanomaterial for gene delivery application a safer nanomaterial is needed. Towards this end replacing oxygen atoms with more

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inert elements is a better option. Studies on the fabrication of such materials and mechanism of biological pathways should enable synthesis of more safe nanomaterials for gene delivery studies. Another area of cancer research is making scaffolds for growing cancer cells that can mimic tumour growth *invivo*. These 3D cancer cell models should bring down the cost of preclinical cancer drug research before proceeding to expensive animal models for drug testing. Studies using graphene and its derivatives are in available for neural stem cell growth and bone cell regeneration. Graphene with its highest tensile strength should be explored for developing preclinical 3D models for cancer cell growth. Additionally, more ecofriendly Graphene nanomaterials synthesized using green nanotechnology for 3D cancer cell growth applications is need of the hour.

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