Assessment of the Therapeutic Efficacy of Curcumin –Loaded Nanoparticles as a Natural Anticancer Agent

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List of abbreviations

AuNPs	Gold nanoparticles
AuNPs-Cur	Curcumin- reduced gold nanoparticles
cm	Centimeter
CS	Chitosan
CSAuNPs	Chitosan reduced gold nanoparticles
CSAuNPs-Cur	Curcumin loaded chitosan reduced gold nanoparticles
CSNPs	Chitosan nanoparticles
CSNPs-Cur	Curcumin loaded Chitosan nanoparticles
Cur	Curcumin
DLS	Dynamic light scattering
DS	Dextran Sulphate
DSCSNPs	Dextran Sulphate-Chitosan nanoparticles
DSCSNPs-Cur	Curcumin loaded Dextran sulpahte nanoparticles
hr	hours
FTIR	Fourier transform infrared spectroscopy
i.p	Intraperitoneal
i.v	Intravenous

LE	Loading efficiency
ml	Milliliters
MSNPs	Mesoporous silica nanoparticles
MSNPs-Cur	Curcumin loaded Mesoporous silica nanoparticles
nm	Nanometer
NPs	Nanoparticles
TEM	Transmission electron microscope
ug	Microgram
TPP	Sodium tripolyphosphate

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ABSTRACT

Cancer is a lethal disease caused by damage in the genetic material (i.e. DNA) which leads to uncontrollable cell division. Chemotherapy is one of the three main methods of cancer treatment including surgical interference and radiotherapy. Chemotherapy is characterized with its applicability to all types and stages of cancer. The major problem associated with chemotherapy is the inability to deliver pharmaceuticals to a specific site of the body without inducing normal tissue toxicity. As a consequence, the development of an alternative modalities using 'Natural anticancer agents' open up new avenue for future cancer therapy due to their safety. Curcumin is one of the most promising natural anticancer agents, however, its medical application has been limited by its poor water solubility and bioavailability. Attempts have been made to encapsulate curcumin in different carriers, but the interest in nanocarriers for cancer chemotherapy is growing to develop a biodegradable controlled drug delivery vehicles that improve the bioavailability and solubility of curcumin.

The current study, focused on designing a biocompatible delivery systems to be used as nanocarriers of the natural anti-cancer curcumin allowing their applications either *in vitro* or *in vivo*. Therefore, five nanoparticles with different based fabrications were prepared as a nanocarrier for curcumin. These nanoparticles fall under three categories of nanoparticulate delivery systems including: gold nanoparticles, polymeric nanocarriers and inorganic nanocarriers (mesoporous silica). The physicochemical properties of the prepared nanocarriers were investigated using different techniques. Transmission electron microscopy (TEM) which revealed the spherical smooth surface of all nano-formulations. Dynamic light scattering (DLS) for measuring the hydrodynamic sizes of all the nanocarriers. The stability of the

five nano-formulations was also studied by zeta potential measurements indicating their high stability. The optical properties of the prepared NPs were investigated using UV-VIS and fluorescence spectroscopy. Fourier transform infrared spectroscopy (FTIR) assessment revealed that curcumin was successfully loaded on or in the nanocarriers. *In vitro* studies elucidated that curcumin loaded nanoparticles have more potent therapeutic effect than free curcumin against both HCT-116 and MCF-7 cancer cells. *In vivo* studies for a selective curcumin loaded nanocarriers proved that such nanoparticles can provide a high therapeutic efficacy represented by the inhibition in tumor growth. Furthermore, curcumin loaded mesoporous silica NPs (MSNPs-Cur) revealed higher anti-angiogenesis potential compared with that for free curcumin. Therefore , curcumin-loaded nanoparticles provide an opportunity to expand the clinical repertoire of this efficacious agent by enabling ready aqueous dispersions.