



***An in vitro* assessment of the potential toxicity of Cadmium Selenide nanoparticles**

A thesis presented by

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Submitted in fulfilment for the award of the degree of

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Abstract

Nanotechnology is steadily finding its application in all aspects of the consumer industry, science and engineering. At a relative pace Cadmium Selenide (CdSe) nanoparticles are gaining increased attention for their potential use in biomedical applications such as bio-imaging of tissues, disease diagnosis and biological labelling due to its unique optical and electronic properties. Exposure of these particles to humans and other biological systems raise huge concerns with regards to their safety. In this study, water soluble cysteine capped CdSe nanocrystals, were prepared through a one pot green route method. The prepared CdSe nanocrystals were characterized using Transmission electron microscopy (TEM), High resolution transmission electron microscopy (HRTEM), Ultra violet spectroscopy (UV) and Photoluminescence (PL) analysis to establish the size, shape, dispersion, aggregation state, crystalline nature and optical properties of CdSe nanoparticles. The *in vitro* effects of CdSe nanoparticles on DNA stability, red blood cells (RBC's) and blood platelets were evaluated. DNA was exposed to CdSe nanoparticles and its assessment on DNA stability was confirmed by agarose gel electrophoresis and spectrophotometry. Damage to DNA structure was observed at 200 $\mu\text{g/ml}$ of CdSe. *In vitro* assays carried out on RBC damage included reducing power and chelating activity of iron. The results showed that the CdSe nanocrystals exhibited high reducing power and sufficient chelating activity, which would be able to impair the function of haemoglobin. CdSe nanoparticles promoted platelet aggregation in a dose dependent manner. Based on the findings of this study the biosafety of CdSe nanoparticles is not guaranteed and further studies need to be conducted to ascertain the safety of CdSe nanoparticles for possible use in biological systems.

Dedication

This study is dedicated to my late Gurudev, Sri Saathiya Sai Baba. I am blessed everyday just knowing that you live forever in my heart. Thank you for always guiding me.

Declaration

I declare that this dissertation is my own, unaided work. It has been submitted for the degree of Master's in Science at the University of Zululand. It has not been submitted before for any degree or examination at any other University. I also state that all the sources that I have used have been duly acknowledged.

This _____ day of _____ 2012.

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List of Abbreviations and symbols

CdSe	Cadmium selenide
RBC's	Red blood cells
NaBH₄	Sodium borohydride
TEM	Transmission electron microscope
HRTEM	High resolution transmission electron microscope
UV	Ultra- violet
PL	Photoluminescence
DNA	Deoxyribonucleic acid
EDTA	Ethylenediaminetetra-acetic acid
TiO₂	Titanium dioxide
TAE	Tris-acetic EDTA
TCA	Trichloro acetic acid
ADA	Acid dextrose anti-coagulant

List of symbols

°C	Degrees Celsius
µg	microgram
ng	nano gram
bp	base pairs
nm	nanometers
ml	microliters
A₂₆₀	Absorbance at 260 nm
A₄₁₅	Absorbance at 415 nm
A₇₀₀	Absorbance at 700 nm

List of research outputs

Dunpall, R., Opoku, A. R., Nejo A. A., Revaprasadu, N. and Shonhai A.

An *in vitro* assessment of the potential toxicity of Cadmium selenide quantum dots. “Rejuvenating Science in Zimbabwe.” Harare, Zimbabwe, 26 October 2011. (Oral presentation)

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