Magnetic Nanoparticle-Loaded Exosomes for Targeted Cancer Therapy

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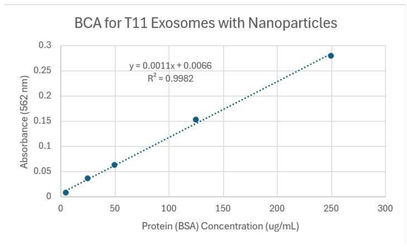
INTRODUCTION

Current cancer therapies often suffer from significant side effects due to their lack of specificity. These treatments fail to effectively distinguish between cancerous and healthy cells, leading to widespread damage throughout the body. Research has been underway in engineering cancer exosomes (extracellular vesicles) to carry therapeutic agents directly to cancer cells. Exosomes modified with magnetic nanoparticles enables them to kill cancer cells when exposed to a magnetic field due to the action of magneto-mechanical actuation. These magnetic exosomes have the potential to revolutionize cancer treatment by combining a targeted delivery system with a relatively non-toxic therapeutic agent.

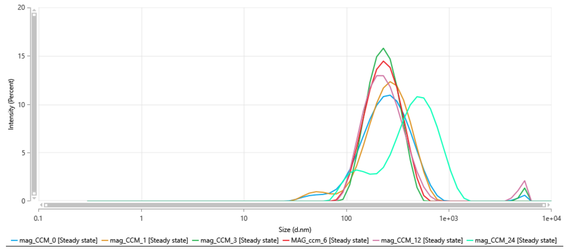
MATERIALS & METHODS

Exosomes were collected by sequentially centrifuging used cell culture media from flasks seeded with T11 breast cancer cells. One group of flasks also had iron oxide nanoparticles introduced during the proliferation process for uptake by exosomes. Exosomes were then characterized via Bicinchoninic Acid Assay (BCA), Transmission Electron Microscopy (TEM), Vibrating Sample Magnetometry (VSM), Western blotting, Dynamic Light Scattering (DLS), and Confocal Microscopy. The cytotoxic effect of magnetic nanoparticle-loaded exosomes in T11 breast cancer cells was then assessed through in vitro cytotoxicity assays.

RESULTS

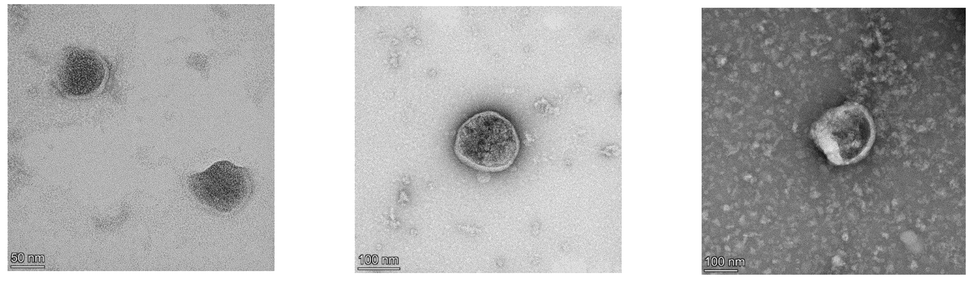


DLS of Magnetic Exosomes in Cell Culture Media Over Time

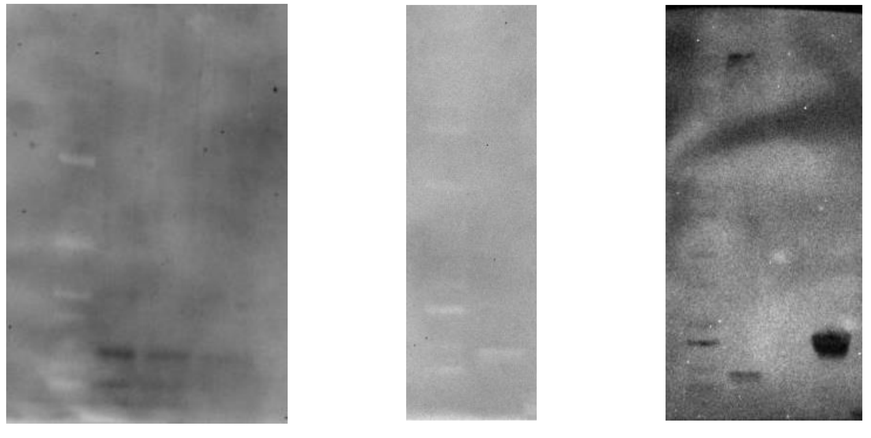


Name	Mean	Standard Deviation	RSD	Minimum	Maximum
Z-Average (nm)	239.6	49.23	20.54	213.2	339.5
Polydispersity Index (PI)	0.2943	0.03491	11.86	0.2616	0.3389
Peak 1 Mean by Intensity ordered by area (nm)	302.1	110.4	36.55	241.1	524.9
Peak 1 Area by Intensity ordered by area (%)	95.67	5.408	5.653	85.25	100
Peak 2 Mean by Intensity ordered by area (nm)	3142	2786	88.68	56.13	5318
Peak 2 Area by Intensity ordered by area (%)	5.195	5.562	107.1	1.023	14.75

TEM of T11 Breast Cancer Exosomes



Western Blots of T11 Exosomes and Commercial MDA-MB-231 Exosomes



DISCUSSION

The exosome isolation protocol did indeed yield exosomes, but further optimization is required to purify exosome samples and better internalize magnetic nanoparticles. In purifying exosomal samples, serum-free cell culture media may need to be introduced during the cell proliferation phase. The aggressive, triple-negative T11 breast cancer cell line may also be inadequate for the collection of pure exosomes. Finally, increasing the concentration of magnetic nanoparticles during cell growth may also yield better results in terms of the internalization of magnetic nanoparticles.

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