הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

Monday, August 11th, 2025 at 13:30

Room 6

Size-Dependent Distribution and Retention of Biomimetic Nanoparticles in the Central Nervous System

Anat Lyubin Haimov

MSc Seminar

Advisor: Dr. Assaf Zinger
Department of Chemical Engineering, Technion-Israel Institute for Technology

Delivery of therapeutic and imaging agents to specific sites in the body – especially the brain – remains a major challenge. The blood-brain barrier (BBB) tightly regulates the passage of ions, cells, and molecules to preserve the neuronal microenvironment. Strategies to facilitate drug delivery across this barrier include modifying drug delivery systems (DDSs) to enhance permeability or utilizing alternative delivery routes that bypass it entirely.Intranasal administration offers a promising non-invasive route, but further optimization of the DDS is required to improve distribution and retention. Biomimetic nanoparticles – liposomes functionalized with membrane proteins – present a tailored approach by harnessing intrinsic cellular capabilities and mimicking extracellular interactions to facilitate targeted delivery.

Two formulations of Neurosomes – liposomes embedded with neuronal membrane proteins from SH-SY5Y cells – were fabricated at 100 nm and 200 nm and compared to size-matched empty liposomes. All nanoparticles were validated for physicochemical properties, including size, zeta potential, morphology (TEM), and protein presentation.

In vivo experiments involved intranasal administration in awake mice. Particle distribution and retention were analyzed ex vivo using ChemiDoc MP fluorescent imaging and tracked dynamically using two-photon microscopy up to 3 hours post-delivery. Small liposomes were rapidly cleared from the brain via both the olfactory and trigeminal pathways. Along the olfactory route, both small and large Neurosomes outperformed small liposomes. In the trigeminal pathway, large Neurosomes demonstrated the highest retention compared to all other formulations.

These findings emphasize the role of size and membrane composition in determining the fate of nanoparticles in the CNS and suggest that larger biomimetic nanoparticles delivered intranasally offer a promising non-invasive strategy for drug delivery to the brain.

Refreshments will be served at 13:15.