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
Wednesday, October 28th, 2020 at 13:30

Online seminar via Zoom
https://technion.zoom.us/j/97591164072

Layan Habib & Aseel Shomar

Design of a novel mucoadhesive system based on freeze-dried liposomes for local drug delivery

Layan Habib

MSc Seminar

Advisor: Prof. Havazelet Bianco-Peled
The Interdisciplinary Program for Biotechnology, Technion-Israel Institute for Technology

Trans-mucosal drug delivery involves absorbance of therapeutic agents through the mucosa. It offers multiple benefits over both injectable and enteral approaches, such as being a relatively painless administration method and having higher bioavailability due to the evasion of first pass metabolism, the immune system and natural barriers that defend the body.

In the current research, we focused our attention on the development of a mucoadhesive delivery system for treatment of oral cancer. Oral cancer is the sixth most common cancer. In over 90% of all cases, the tumur is an oral squamous cell carcinoma (OSCC), which estimate to account for 124,000 incidences of annual mortality.

We created and characterized a novel system in the form of a dry dissolvable mucoadhesive tablet that deliver doses of liposomes loaded with doxorubicin. The tablet is based on dry liposomes, which were dehydrated in the presence of trehalose used as lyoprotectant. The mucoadhesive component was alginate. The liposomes show high stability and no drug leakage owing to the inclusion of trehalose during the freeze-drying process. By varying the alginate content and its distribution within the tablets we were able to tune both the adherence to mucosal tissue and the release rate of an anti-cancer drug. In addition, high efficiency in treating cancer cells was demonstrated.

This new approach, treatment as dissolvable tablets, can be used for treating oral cancer for eligible patients in a convenient way, by allowing them to take medication at home or facilitate the available treatment in the clinic and can be utilized for other local drug delivery applications.

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Local and global features of genetic networks supporting a phenotypic switch

Aseel Shomar

Mid-PhD Seminar

Advisors: Brenner N.[1,2] and Barak O.[2,3]

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Phenotypic switches are associated with alterations in the cell's gene expression profile and are vital to many aspects of biology. Previous studies have identified local motifs of the genetic regulatory network that could underlie such switches. Recent advancements allowed the study of networks at the global, many-gene, level; however, the relationship between the local and global scales in giving rise to phenotypic switches remains elusive. In this work, we studied the epithelial-mesenchymal transition (EMT) using a gene regulatory network model. This model supports two clusters of stable steady-states identified with the epithelial and mesenchymal phenotypes, and a range of intermediate less stable hybrid states, whose importance in cancer has been recently highlighted. Using an array of network perturbations and quantifying the resulting landscape, we investigated how features of the network at different levels give rise to these landscape properties. We found that local connectivity patterns affect the landscape in a mostly incremental manner; in particular, a specific previously identified double-negative feedback motif is not required when embedded in the full network, because the landscape is maintained at a global level. Nevertheless, despite the distributed nature of the switch, it is possible to find combinations of a few local changes that disrupt it. At the level of network architecture, we identified a crucial role for peripheral genes that act as incoming signals to the network in creating clusters of states. Such incoming signals are a signature of modularity and are expected to appear also in other biological networks. Hybrid states between epithelial and mesenchymal arise in the model due to barriers in the interaction between genes, causing hysteresis at all connections. Our results suggest emergent switches can neither be pinpointed to local motifs, nor do they arise as typical properties of random network ensembles. Rather, they arise through an interplay between the nature of local interactions, and the core-periphery structure induced by the modularity of the cell.