Seminars in Biotechnology BTEC 591 & BTEC 691

"Nanotheranostics and Its Applications in Medicine"

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13:30

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Ömer Aydın completed his undergraduate studies in 2007 in the Department of Biomedical Engineering at Baskent University. He started his MSc in Biotechnology Graduate Program at Yeditepe University, under Prof. Mustafa Çulha's supervision in the field of nanobiotechnology. After earning his MSc degree, he started his PhD education in Cellular and Nanoterapeutics Lab in the Department of Biomedical Engineering at the University of Michigan under supervision of Prof. Mohamed Elsayed. After receiving his PhD in 2016, he worked as a postdoctoral research fellow at the National Institute of Health (NIH, Bethesda, MD), Clinical Center Radiology and Imaging Sciences, where he joined Joe Frank's group for focused ultrasound therapy immunomodulation effects on in vivo cancer models. In 2018, he moved back to Turkey and started his independent career in Erciyes University, Department of Biomedical Engineering as an Assistant Professor. His main research interests are gene/drug delivery with smart nanoparticles, focused ultrasound therapy, and developing strategies related to SERS-based biodiagnostics platforms. Dr. Aydin is the author of 15 articles, and he is currently principle investigator of 4 research projects funding from EU-COST, TUSEB, and TUBITAK-1001 projects.

Abstract

This talk will present a brief description of nanotheranostics, which means combinations of therapeutics and diagnosis simultaneously with nanomaterials, which is highly relevant of our research group's research interests. In the first part of the talk, I will mention about nanomedicine based-gene therapy strategies including our "smart" polymeric nanoparticles and gold nanoparticles, which are able to efficiently pass a couple of biological barriers such as nuclease stability, enhanced cellular internalization, endosomal escape. Thus, our engineered nanocarriers show higher transfection rate comparing to commercially available products. We are currently using these strategies to carry siRNA and CRISPR plasmids for the treatment of cancer.

In the second part of the talk we will take a look how we have developed fast, and reliable detection strategy by using nanomedicine tools like Surface-enhanced Raman Spectroscopy coupled with machine learning techniques for antibiotic resistance bacteria (MRSA) than sensitive form of the same bacteria (MSSA). By using k-nearest neighbors (kNN) classification algorithm, we got superior classification performance with 97.8% accuracy among the traditional classifiers including support vector machine (SVM), decision tree (DT), and naïve Bayes (NB). Our results indicate that SERS combined with machine learning can be used for the detection of antibiotic-resistant and susceptible bacteria and this technique is a very promising tool for clinical applications and be expanded to detect other biological contents (cells, proteins, etc.).

References:

1. Kaushal et al. ""Smart" Nanoparticles Enhance the Cytoplasmic Delivery of Anti-RhoC Silencing RNA and Inhibit the Migration and Invasion of Aggressive Breast Cancer Cells", *Mol. Pharmaceutics*, 2015, 12 (7), 2406.
2. Aydin *et al." The proteomic effects of pulsed focused ultrasound on tumor microenvironments of murine melanoma and breast cancer models"* Ultrasound in Med and Bio, 2019, 45 (12), 3232.
3. Ciloglu *et al.* "Identification of methicillin-resistant Staphylococcus aureus bacteria using surface-enhanced Raman spectroscopy and machine learning techniques" *Analyst*, 2020, 146.