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Superhigh-Capacity Polymeric Micelles for Chemo/Immunotherapy of Cancer

Alexander Kabanov is a Distinguished Professor at the Eshelman School of Pharmacy, UNC-Chapel Hill, where he also directs the UNC Center for Nanotechnology in Drug Delivery, the Carolina Institute for Nanomedicine, and NCI's T32 training program in Cancer Nanotechnology. He earned his Ph.D. and D.Sc. in Chemical Sciences from Moscow State University in 1987 and 1990, respectively.

Kabanov has made significant contributions to nanomedicine, pioneering the use of polymeric micelles, polyelectrolyte complexes, nanogels, and exosomes for delivering small drugs, nucleic acids, and proteins therapeutically. His work resulted in the first clinical trial involving a polymeric micelle drug. He is a highly cited researcher in Pharmacology and Toxicology, with over 340 scientific papers (>52,000 citations, Google h-index >117), 36 US patents, and co-founding several pharmaceutical companies.

He has mentored over 80 graduate students and postdocs, with a strong commitment to diversity. Kabanov also established symposium series in nanomedicine and drug delivery www.nanodds.org, chaired Gordon Research Conferences, and received numerous honors and awards, including the Lenin Komsomol Prize, NSF Career award, George Gamow award, and Controlled Release Society (CRS) Founders award.

He is an elected member or fellow of prestigious academies and organizations, including Academia Europaea, Russian Academy of Sciences, National Academy of Inventors, American Association for the Advancement of Science, American Institute for Medical and Biological Engineering, and CRS. He has served as the past President and current CEO of the Russian American Science Association, director-at-large for CRS (2019-2022), and chair of the CRS College of Fellows sub-committee (2022-2023).

Abstract: The lecture focuses on the use of Poly(2-oxazoline) (POx) based polymeric micelles (PMs), which have the unique ability to carry a high load of water-insoluble drugs. This capability enhances the solubility, stability, efficacy, and safety of these drugs. The shape of the micelle influences the drug's performance.

For instance, spherical micelles accumulate rapidly in tumors and demonstrate more potent anti-tumor effects compared to worm-like micelles. The latter accumulate at a slower rate and release the drug into the bloodstream. Micelles loaded with two drugs exhibit superior anti-tumor activity compared to micelles carrying a single drug or a combination of drugs, as well as a combination of free drugs. This strategy, termed “drug design by co-formulation”, holds promise for cancer immunotherapy. The presentation will discuss the relationship between drug loading, the critical micelle concentration, the partitioning of micelles and serum proteins, pharmacokinetic and toxicokinetic profiles, and efficacy. These innovative approaches hasten the application of novel PMs for therapeutic uses in cancer and other diseases. The research was funded by NIH grants CA198999 and CA264488. The conflict-of-interest statement indicates an affiliation with DelAQUA Pharmaceuticals.

Key words: polymeric micelles, poly(2-oxazoline), cancer, paclitaxel, TLR7/8, CSF1R