At Duquesne University’s Mylan School of Pharmacy, Dr. Jelena Janjic is in pursuit of catching drugs in action, ‘infraRED-handed.’ The assistant professor of pharmaceutics, based in Pittsburgh, PA, is devising unique theranostic agents that can deliver a drug and simultaneously trace its course, thus giving an insight into drug uptake and biological distribution.

Dr. Janjic’s group synthesizes a ‘nanoemulsion’ (droplet about 100-200 nm in diameter) theranostic using hydrocarbon and perfluorocarbon oils, embedded with near-infrared (NIR) reporter dyes. These can be loaded into pharmaceutical formulations or directly administered to small animals. The theranostic’s dual imaging capabilities allow biodistribution analysis via fluorescence detection systems and 19F MRI. “Our nanoemulsions are biocompatible and completely non-toxic. We are able to produce them on a sizeable scale and can do a lot of quality assurance before they are used in animals,” says Janjic.

From in vitro to in vivo to ex vivo with Near-Infrared Fluorescence

Janjic’s lab extensively uses the Odyssey® Infrared Imaging System and Pearl® Impulse Small Animal Imaging System (instruments are shared with several researchers). Janjic adds, “We use the Odyssey and Pearl Systems as the first pass-through to all of our analyses.”

Integration between the two systems has synchronized the process of probe characterization and nanoemulsion testing - in vitro, in vivo and ex vivo - for the lab. “The two work best in combination,” she says.

At the time of probe development, the lab assesses photostability and signal quality of NIR reporter dyes incorporated in nanoemulsions on the Odyssey System1,2. “By monitoring fluorescent signals over time, we can tell if a dye is optically stable. It is like classical product control,” says Janjic.

For in vitro studies, the group quantifies nanoemulsion loading in plated cells as well as cell pellets with the Odyssey Imager3,4. “On the Odyssey System, we can assess how well nanoemulsions are being taken up by cells of interest. We are able to establish correlation between this data and fluorine MRI signals.”

After careful quality assessment, Dr. Janjic administers the nanoemulsion to animal models for in vivo imaging, on the Pearl System (in collaboration with Dr. Wilson Meng and Dr. John Pollack). The nanoemulsion is taken up by macrophages, which aids in imaging inflammatory response5,6. “I don’t have to worry about using a different formulation for in vivo studies. As I transition from in vitro analysis on the Odyssey Imager to in vivo analysis on the Pearl Imager, everything is the same in terms of the ‘fluorescence setting’. Our results have been very reproducible,” Janjic says.

They further analyze biodistribution of the nanoemulsion in animal tissues on the Odyssey System5,6. “After we have injected the..."
nanoemulsion and imaged the animal in vivo, we excise those very tissues and use the Odyssey Imager to get a macroview analysis of where the theranostic has accumulated. We are also able to quantify areas of fluorescence which correlates to levels of inflammation,” she says.

**A Synergistic Combination for Process Improvement**

Before using the Odyssey System, Janjic attempted her *in vitro* theranostic assessments on other imaging modalities, but with limited success. The Odyssey Imager’s multifunctional platform was able to support the kind of rigorous analysis she needed. “We have this tandem of Odyssey and Pearl Imaging Systems that is perfect for our work in theranostics,” she says.

Using the two instruments in synchrony enabled the lab assess their theranostics stringently. “When the nanoemulsion goes into an animal, we know it will work, unless the biology is surprising us. This gives us reproducible results.”

Moreover, her emphases on quality control and *in vitro* testing have helped the lab reduce the number of animals needed for *in vivo* studies. “Data from the Odyssey and Pearl Systems completely complement each other, which makes it easier to transition from cells to animals and back. We get more out of one animal compared to traditional methods.”

Pioneering scientists like Janjic are bringing synergy and reproducibility to their research with multifaceted Odyssey and Pearl Imaging System platforms.

**Papers citing Odyssey Imaging System and Pearl Impulse Imaging System:**


