Materials Science and Engineering Department

# Fall Seminar Series

## From Farm to Pharmacy: A Strawberry-Derived Solution to Oral Protein Delivery


**Prof. Kathryn Whitehead**
**Chemical Engineering**
**Carnegie Mellon University**


**October 13, 2021**

**3-4PM**

**Zoom Link:** https://drexel.zoom.us/j/85659605634

Oral delivery is the most patient-friendly mode of drug administration. Unfortunately, it is not possible for protein and other macromolecular drugs because the gastrointestinal tract is not permeable to undigested large molecules. Although many chemical permeation enhancers have been identified that improve the intestinal absorption of biologics, they often cause cytotoxicity or damage the intestinal mucosa. To address this issue, we sought to identify a permeation enhancer derived from fruits and vegetables, hypothesizing that the compounds found in natural foods would be well-tolerated by the gastrointestinal tract. Following a screen of over 100 fruits, vegetables, herbs, and fungi, we identified strawberry as a potent enhancer of macromolecular permeability both in vitro and in vivo. Natural product chemistry techniques revealed pelargonidin, an anthocyanidin, as the active compound in strawberry. In mice, pelargonidin enabled 100% bioactivity of oral insulin relative to the current gold standard of subcutaneous injection, without causing toxicity following 30 days of daily treatment. These results underscore the potential of naturally derived compounds in biomedical applications and demonstrate pelargonidin as an especially potent new enhancer for the oral delivery of biologics.

Kathryn A. Whitehead is an Associate Professor and Dean's Career Fellow in the Departments of Chemical Engineering and Biomedical Engineering (courtesy) at Carnegie Mellon University. Her lab develops drug delivery systems for RNA, proteins, and applications in maternal and infant health. She obtained bachelor and doctoral degrees in chemical engineering (Univ. of Delaware; Univ. of California, Santa Barbara) before an NIH Ruth L. Kirschstein Postdoctoral Fellowship at MIT. Prof. Whitehead is the recipient of numerous awards, including the NIH Director's New Innovator Award, the DARPA Director's Fellowship, and the ASEE Curtis W. McGraw Research Award. She has also received the Controlled Release Society's Young Investigator Award and served on its Board of Directors. Prof. Whitehead is an elected Fellow of the American Institute for Medical and Biological Engineering and was named as a Pioneer on the MIT Technology Review's Innovators Under 35 list and as one of the Brilliant Ten by Popular Science. Most recently, she gave a TED talk on the lipid nanoparticles (i.e., "fat balls") used in the in the COVID-19 mRNA vaccines. Her publications have been cited over 7,000 times, and several of her patents have been licensed and sublicensed for reagent and therapeutic use.

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