Nanoparticles Tracked in a Model Food Chain

Supporting/Contributing Agencies: NIST

NIST has established a method to assess if a nanomaterial is transferred across the food chain, an important step in creating a reliable system for nanotechnology environmental health and safety assessements. There is significant concern in the risk assessment community on the potential for manufactured nanomaterials to transfer and accumulate along a particular food chain — a process called biomagnification. Such behavior has been demonstrated for toxic contaminants such as DDT and mercury, for example, leading to recommended human consumption limits for certain fish. To address possible concerns about manufactured nanomaterials, NIST researchers developed a method to investigate the dietary accumulation, elimination, and toxicity of such materials. The approach was demonstrated with two types of fluorescent quantum dots introduced into a model, laboratory-based food chain composed of two microscopic aquatic organisms—*Tetrahymena pyriformis*, a single-celled ciliate protozoan, and the rotifer *Brachionus calyciflorus* that preys on it. The method quantified the assimilation and depuration (loss) rates of quantum dots by lower trophic level aquatic organisms through the acquisition of detailed images of internalized quantum dots using microscopy. The results demonstrate the importance of considering dietary uptake of nanomaterials throughout the food chain, up to organisms such as fish likely to be eaten by people. This accomplishment will help U.S. industry and Federal regulatory agencies to assess if and how manufactured nanomaterials move in the environment and to what extent these nanomaterials are bioavailable. Such assessments are necessary to design nanomaterials that minimize their environmental impact.

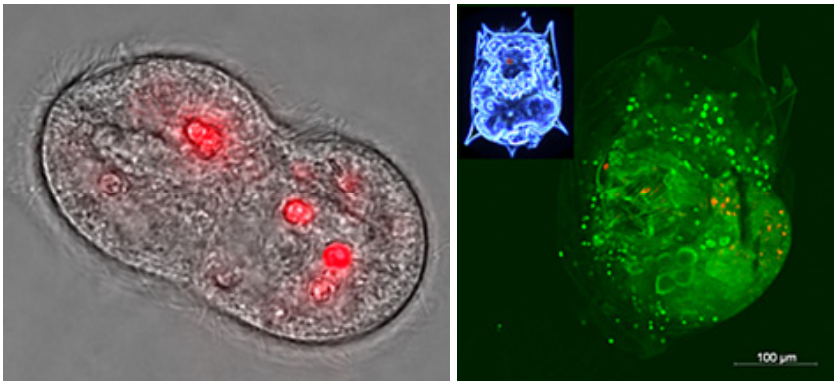

Figure 1. Photomicrograph of ciliate *T. pyriformis* (left) during cell division with accumulated quantum dots appearing red and closeup photomicrograph of rotifer *B. calyciflorus* (right, whole organism seen in upper left corner) with quantum dots assimilated from ingested ciliates appearing red.

References/Publications/Patents

Holbrook, R.D., Murphy, K.E., Morrow, J.B., Cole, K.D. Trophic transfer of nanoparticles in a simplified invertebrate food web. Nature Nanotechnology. 3(6), 352-355 (2008).