Scientists get first look at nanotubes inside living animals

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Rice University scientists have captured the first optical images of carbon nanotubes inside a living organism. Using fruit flies, the researchers confirmed that a technique developed at Rice -- near-infrared fluorescent imaging -- was capable of detecting DNA-sized nanotubes inside living fruit flies.

"Carbon nanotubes are much smaller than living cells, and they give off fluorescent light in a way that researchers hope to harness to detect diseases earlier than currently possible," said research co-author Bruce Weisman, professor of chemistry. "In order to do that, we need to learn how to detect and monitor nanotubes inside living tissues, and we must also determine whether they pose any hazards to organisms."

Researchers have studied how carbon nanotubes interact with tissues of rabbits, mice and other animals, but Weisman and co-author Kathleen Beckingham, professor of biochemistry and cell biology, chose something smaller -- the fruit fly Drosophila melanogaster -- to attempt the first-ever detection of nanotubes inside a living animal.

"Drosophila is one of biology's preeminent model organisms," said Beckingham. "We have a wealth of knowledge about the genetic and biochemical workings of fruit flies, and this presents us with unique opportunities to explore the effects and fate of single-walled carbon nanotubes in a living organism."

Weisman and Beckingham's research, which is available online, appeared in the September issue of *Nano Letters*, the American Chemical Society's journal.

In the study, fruit fly larvae were raised on a yeast paste that contained carbon nanotubes. The flies were fed this food from the time they hatched throughout their initial feeding phase of 4-5 days. Fruit flies are ravenous eaters during this period and gain weight continuously until they are about 200 times heavier than hatchlings. Then they become pupae. As pupae, they do not eat or grow. They mature inside pupal cases and emerge as adult flies.

"Developmentally, the first few days of a fruit fly's life are critical," Beckingham said. "We provided larval flies with a steady diet of food that contained carbon nanotubes and checked their weight just after they emerged from their pupal cases. We found no significant differences in the adult weight of nanotube-fed flies when compared to control groups that were not fed carbon nanotubes."

The nanotube-fed larvae also survived to adulthood just as well as the control group.

Using a custom-built microscope, the team aimed a red laser beam into the fruit flies. This excited a fluorescent glow from the carbon nanotubes, as they emitted near-infrared light of specific wavelengths. The researchers were able to use a special camera to view the glowing nanotubes inside living flies. Videos constructed from these images clearly showed peristaltic movements in the digestive system.

When the researchers removed and examined tissues from the flies, they found the near-infrared microscope allowed them to see and identify individual nanotubes inside the tissue specimens. The highest concentration of nanotubes was found in the dorsal vessel, which is analogous to a main blood vessel in a mammal. Lesser concentrations were found in the brain, ventral nerve cord, salivary glands, trachea and fat. Based on their assays, the team estimates that only about one in 100 million nanotubes passed through the gut wall and became incorporated into the flies' organs.

Source: Rice University