Plutonium tricks cells by 'pretending' to be iron

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Researchers learned that, to get into cells, plutonium uses iron as a "trojan horse."

(PhysOrg.com) -- Plutonium gets taken up by our cells much as iron does, even though there's far less of it to go around.

Researchers at the U.S. Department of Energy's Argonne National Laboratory and Northwestern University have identified a new biological pathway by which plutonium finds its way into mammalian cells. The researchers learned that, to get into cells, plutonium acts like a "Trojan horse," duping a special membrane protein that is typically responsible for taking up iron.

This discovery may help enhance the safety of workers who deal with plutonium, as well as show the way to new "bio-inspired" approaches for separating radioactive elements from other metals in used nuclear fuel.

Because the bodies of mammals have evolved no natural ability to recognize plutonium—the element was first produced in 1941—scientists were curious to know the cellular mechanisms responsible for its retention in the body. The researchers exposed adrenal cells from rats to minute quantities of plutonium to see how the cells accumulated the radioactive material.

Using the high-energy X-rays provided by Argonne's Advanced Photon Source, the researchers were able to characterize a particular protein known as "transferrin," which is responsible for bringing iron into cells. Each transferrin is made up of two subunits, known as N and C, that normally bind iron. When another protein—the transferrin receptor—recognizes both the N and C subunits, it admits the molecule to the cell. However, when both the N and C subunits contain plutonium, the transferrin receptor doesn't recognize the protein and keeps it out.

Contrary to their expectations, the researchers discovered that in one of the mixed states—when an iron-containing N-subunit is combined with a plutonium-containing C-subunit—the resulting hybrid so closely resembles the normal iron protein that the uptake pathway is "tricked" into allowing plutonium to enter the cell.

"Although the interaction between plutonium and bodily tissues has been studied for a long time, this is the first conclusive identification of a specific pathway that allows for the introduction of plutonium into cells," said Mark Jensen, an Argonne chemist who led the research.

The results of the study were published online on the website of *Nature Chemical Biology* on June 26. The research was funded by the U.S. Department of Energy's Office of Science as well as by the National Institutes of Health.

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