How buckyballs hurt cells

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A new study into the potential health hazards of the revolutionary nano-sized particles known as 'buckyballs' predicts that the molecules are easily absorbed into animal cells, providing a possible explanation for how the molecules could be toxic to humans and other organisms.

Using computer simulations, University of Calgary biochemist Peter Tieleman, post-doctoral fellow Luca Monticelli and colleagues modeled the interaction between carbon-60 molecules and cell membranes and found that the particles are able to enter cells by permeating their membranes without causing mechanical damage. Their results are published in the current Advance Online Publication of *Nature Nanotechnology*, the world's leading nanotechnology journal.

"Buckyballs are already being made on a commercial scale for use in coatings and materials but we have not determined their toxicity," said Tieleman, a Senior Scholar of the Alberta Heritage Foundation for Medical Research who specializes in membrane biophysics and biocomputing. "There are studies showing that they can cross the blood-brain barrier and alter cell functions, which raises a lot of questions about their toxicity and what impact they may have if released into the environment."

Tieleman's team used the high-powered computing resources of WestGrid, a partnership between 14 Western Canadian institutions, to run some of the cell behaviour simulations. The resulting model showed that buckyball particles are able to dissolve in cell membranes, pass into cells and re-form particles on the other side where they can cause

damage to cells.

Spherical carbon-60 molecules were discovered in 1985, leading to the Nobel Prize in physics for researchers from the University of Sussex and Rice University who named the round, hollow molecules Buckminsterfullerene after renowned American architect Richard Buckminster Fuller, the inventor of the geodesic dome.

Popularly known as buckyballs, carbon-60 molecules form naturally in minute quantities under extreme conditions such as lightning strikes. They can also be produced artificially as spheres or oblong-shaped balls, known as fullerenes, and can be used to produce hollow fibers known as carbon nanotubes. Both substances are considered to be promising materials in the field of nanotechnology because of their incredible strength and heat resistance. Potential applications include the production of industrial materials, drug delivery systems, fuel cells and even cosmetics.

In recent years, much research has focused on the potential health and environmental impacts of buckyballs and carbon nanotubes. Fullerenes have been shown to cause brain damage in fish and inhaling carbon nanotubes results in lung damage similar to that caused by asbestos.

“Buckyballs commonly form into clumps that could easily be inhaled by a person as dust particles,” Tieleman said. “How they enter cells and cause damage is still poorly understood but our model shows a possible mechanism for how this might occur.”

Source: University of Calgary

https://phys.org/news/2008-05-buckyballs-cells.html