The Toxicology and Effects of Gold Nanoparticles on Varying Human Cells

Jesse Fulton
First-Year Student (B.Sc. Nanoscience)
College of Physical and Engineering Science, University of Guelph, CANADA

Toxicology has been influenced by the recent discovery of gold nanoparticles and their applications in the biotechnology sector. Researchers have found that these particles are proving to be useful detectors of toxins within the body, and provide much faster results than previous techniques (Ward 2006). This is accomplished through the use of a range of gold nanoparticle sizes, equipped with specific sugars, designed to attract different substances based on their chemical composition (Ward 2006). These particles also have the capability of improving the accuracy and sensitivity of current particle-based detection schemes (Kumar 2006). Although research has been done in developing these techniques, there are still questions regarding their health effects. Do the benefits of these techniques outweigh their potential biological hazards? Several experiments have been conducted to provide insight into these questions and, ultimately, explore the realm of nanoscience and biotechnology.

The definitive effects of gold nanoparticles on the body are still to be determined. However, current studies being evaluated allow for some insight into how these particles interact with certain organelles and other areas of the body. When examining the effects of gold nanoparticles on human red blood cells, for example, the results varied. With concentrations of 44 parts per million (ppm) of 9 nanometer (nm) size gold particles, the particles were able to diffuse through the red blood cell membrane and into the cell itself without causing significant damage (Wiwanitkit 2007). However, recent tests have shown that the possibility of nanoparticles having a toxic effect on red blood cells could be expected based on the magnetic levels these particles create once internalized into the body (Soler 2007). When evaluating the effects of nanoparticles on human fetal lung cells, investigators found that, cells treated with 0.1, 0.5 and 1 nanomolar (nM) concentrations of 20 nm size gold particles over 24, 48 and 72 hours, showed no visible alterations or damage when compared to the controlled cells (Li 2007). After further examination using DNA damage tests on 19 isolated genes, the 0.1 and 0.5 nM concentrations showed slightly lowered values than the control, whereas, the 1 nM concentration displayed a significant difference, demonstrating that the higher concentration had a more damaging effect on the specified DNA sections (Li 2007). This research suggests that, with stronger concentrations, the risks also increase, and with an extensive build up of particles, the likelihood of damage may become greater.

The results from these experiments show that the use of gold nanoparticles may be safe for humans without causing acute damage. However, further study is necessary to ensure there is no long-term damage with the use of higher concentrations or from the accumulation of particles over a prolonged period. The application of nanoscience to biological problems has a promising future in healthcare and biotechnology. After further testing, gold nanoparticles may soon become a valuable tool for the detection of toxins throughout the body.

REFERENCES


