Study could impact noninvasive treatment of cancer tumors

Ram Devireddy, assistant professor of mechanical engineering at LSU, recently co-authored an article with Todd Monroe, assistant professor of biological and agricultural engineering, investigating the complex effects of nanoparticles on cell freezing. The report was published in the prestigious journal *Nanotechnology*.

The results of their study – while not what they expected – could end up impacting cancer treatment. Devireddy and Monroe initiated a study to investigate the effects of gold-based nanoparticles, or microscopic particles equal to one-thousandth the thickness of a single strand of human hair, on cell transport and the response of those cells after being frozen. Their hypothesis: nanoparticles would alleviate the damaging effects generally caused by the freezing process.

“Most cells are like bags of water,” Devireddy said. “Ice crystals have sharp edges that tend to poke the cells and break them up, causing damage. That is why, for example, frozen food, when thawed and cooked, tends to be ‘mushier’ that fresh produce.”

The researchers, along with graduate students Sreedhar Thirumala and Julianne Audiffred, used the nanoparticles to replace dimethylsulfoxide, a commonly used cryoprotective agent.

“Cryoprotective agents, or CPAs, have long been used to alleviate freezing injury and to enhance the number of cells that survive the freezing process,” said Thirumala. The drawback is that CPAs can also cause cell death when used in high concentrations and need to be removed from cells immediately after freezing.

Devireddy and Monroe believed that nanoparticles might act as a benign replacement for CPAs. To test this, they added commercially available gold nanoparticles to cells suspended in a culture medium.

However, contrary to their initial hypothesis, Devireddy and Monroe found that the nanoparticles did not significantly change the freezing response of either HeLa cells, which are derived from a specific cervical cancer cell line, or Jurkat cells, cancer cells commonly used in research due to their abnormally rapid growth rate in lab conditions.

While test results showed that the nanoparticles were not as effective in protecting frozen cells as the more traditional CPAs, there was significant damaging interaction between the nanoparticles and both HeLa and Jurkat cells, suggesting the need for more research.

Potential practical applications for such research includes improved cryosurgical procedures, which are non-invasive procedures used to eradicate cancer tumors inside the body by cooling them to extremely low temperatures.

Both Devireddy and Monroe plan to pursue this project, citing their teamwork as a driving factor in the effectiveness of their research and teaching.

“The benefit of having each other to ‘cross-train’ our students also better prepares them for future careers in bioengineering research,” said Monroe.

Source: Louisiana State University