Common Ingredient in Big Macs and Sodas Can Stabilize Gold Nanoparticles for Medical Use

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The future of cancer detection and treatment may be in gold nanoparticles – tiny pieces of gold so small they cannot be seen by the naked eye. The potential of gold nanoparticles has been hindered by the difficulty of making them in a stable, nontoxic form that can be injected into a patient. New research at the University of Missouri-Columbia has found that a plant extract can be used to overcome this problem, creating a new type of gold nanoparticle that is stable and nontoxic and can be administered orally or injected.

Because gold nanoparticles have a high surface reactivity and biocompatible properties, they can be used for in vivo (inside the body) molecular imaging and therapeutic applications, including cancer detection and therapy. The promise of nanomedicine comes from the high surface area and size relationships of nanoparticles to cells, making it possible to target individual cells for diagnostic imaging or therapy. Gold nanoparticles could function as in vivo sensors, photoactive agents for optical imaging, drug carriers, contrast enhancers in computer tomography and X-ray absorbers in cancer therapy. Despite their promise, however, scientists have been plagued with problems making nontoxic gold nanoparticle constructs.

Kattesh Katti, professor of radiology and physics in MU's School of Medicine and College of Arts and Science, and director of the University of Missouri Cancer Nanotechnology Platform, worked with other MU scientists in the fields of physics, radiology, chemistry and veterinary medicine. The team tested plant extracts for their ability as nontoxic vehicles to stabilize and deliver nanoparticles for in vivo nanomedicinal applications. The researchers became interested in gum arabic, a substance taken from species of the acacia tree, because it is already used to stabilize everyday foods such as yogurt, Big Macs and soda. Gum arabic has unique structural features, including a highly branched polysaccharide structure consisting of a complex mixture of potassium, calcium and magnesium salts derived from arabic acid. The scientists found that gum arabic could be used to absorb and assimilate metals and create a "coating" that makes gold nanoparticles stable and nontoxic.

Katti and Raghuraman Kannan, assistant professor of radiology, have been collaborating on the development of biocompatible gold and silver nanoparticles for medical applications.

"We found that gum arabic can effectively 'lock' gold nanoparticles to produce nontoxic, nanoparticulate constructs that can be used for potential applications in nanomedicine," Katti said. "We have developed a new class of hybrid gold nanoparticles that are stable and can be administered either orally or through intravenous injection within the biological system."

This finding could lead to the development of readily injectable gold nanoparticles that are nontoxic and stable. Mansoor Amiji, professor of pharmaceutical sciences in the Bouve College of Health Sciences' School of Pharmacy and co-director of the Nanomedicine Education and Research Consortium at Northeastern University in Boston, said this represents a major scientific discovery that will initiate a new generation of biocompatible gold nanoparticles.

"The excellent in vivo stability profiles of such gold nanoconstructs will open up new pathways for the intratumoral delivery of gold nanoparticles in diagnostic imaging and therapeutic applications for cancer," Amiji said.

The new generation of trimeric amino acids peptides discovered by Katti in 1999 (referred to by Amijii as 'Katti Peptides') have provided a solid chemical platform and have become sources of a number of other discoveries. Their applications in the development of drugs for Wilscons' disease; their utility for the generation of a wide spectrum of metallic nanoparticles, including gold and silver; and as amphiphilic building blocks in a variety of drug designs were demonstrated by Katti, in collaboration with Kannan and MU's Stan Casteel.

A paper describing the team's recent findings, "Gum arabic as a Phytochemical Construct for the Stabilization of Gold Nanoparticles: In Vivo Pharmacokinetics and X-ray Contrast-Imaging Studies," was recently published in the February edition of the journal *Small*.

Source: University of Missouri-Columbia

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