Nanoparticle gives antimicrobial ability to fight Listeria longer

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(PhysOrg.com) -- A Purdue University research team developed a nanoparticle that can hold and release an antimicrobial agent as needed for extending the shelf life of foods susceptible to *Listeria monocytogenes*.

Yuan Yao, an assistant professor of food science, altered the surface of a carbohydrate found in sweet corn called phytoglycogen, which led to the creation of several forms of a nanoparticle that could attract and stabilize nisin, a food-based antimicrobial peptide. The nanoparticle can then preserve nisin for up to three weeks, combating *Listeria*, a potentially lethal foodborne pathogen found in meats, dairy and vegetables that is especially troublesome for pregnant women, infants, older people and others with weakened immune systems.

Controlling *Listeria* at deli counters, for example, is especially problematic because meat is continually being opened, cut and stored, giving *Listeria* many chances to contaminate the food. Nisin alone is only effective at inhibiting *Listeria* for a short period - possibly only a few days - in many foods.

"People have been using nisin for a number of years, but the problem has been that it is depleted quickly in a food system," said Arun Bhunia, a Purdue professor of food science who co-authored a paper with Yao on the findings in the early online version of the Journal of Controlled Release. "This nanoparticle is an improved way to deliver the antimicrobial properties of nisin for extended use."

Yao used two strategies to attract nisin to the phytoglycogen nanopoarticles. First, he was able to negatively charge the surface of the nanoparticle and use electrostatic activity to attract the positively charged nisin molecules. Second, he created a partially hydrophobic condition on the surface of the nanoparticle, causing it to interact with partially hydrophobic nisin molecules. When the particles are hydrophobic, or repel water, they become attracted to each other.

"Both strategies may work together to allow nanoparticles to attract and stabilize nisin," Yao said, "This could substantially reduce the depletion of nisin in various systems."

For practical use, Yao said a solution containing the nanoparticles and free nisin could be sprayed onto foods or included in packaging. The solution requires a balance of free nisin and nisin on the nanoparticles.

"When you reduce the amount of free nisin, it will trigger a release of more nisin from the nanoparticles to re-establish the equilibrium," Yao said. "There will be a substantial amount of nisin preserved to counteract the *Listeria*."

Using a model, Yao said a sufficient amount of nisin to combat *Listeria* could be preserved for up to 21 days.

Yao and his colleagues are working on using other food-based antimicrobial peptides and nano-constructs to combat Listeria other foodborne pathogens such as E. coli O157:H7 and salmonella. The U.S. Department of Agriculture and the National Science Foundation funded their research.

More information: Designing Carbohydrate Nanoparticles for Prolonged Efficacy of Antimicrobial Peptide, Lin Bi et al., *Journal of Controlled Release*.

Provided by Purdue University