A nature-inspired coating to keep drugs from breaking down too early

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Credit: Miriam Alonso from Pexels

Chemists have developed a coating that could make certain medications and other materials more stable by covering them with an outer layer much thinner than the width of a human hair.

That coating secures whatever is inside, the researchers said, and could make it possible for medications to have fewer additives used to keep them from breaking apart early.

"Think about it like a row of coins—a stack of quarters—and the stack on its own will probably fall apart," said Jon Parquette, senior author of the study and a professor of chemistry at The Ohio State University. "But if you get a stack of quarters from the bank, they put a plastic coating on the stack, and that plastic coating holds all the coins together. That's exactly what we've done here."

The difference: The researchers created this coating from polydopamine, a material inspired by nature but created in a laboratory. And they used it to cover peptide nanofibers, very small chains of amino acids that are the building blocks of proteins. Peptide nanofibers are some of the building blocks of materials we use regularly, including medications, and form by a process called "self-assembly." Think of the stack of coins: Each peptide molecule is like one coin; the entire stack itself is a peptide nanofiber. The coating makes that stack impervious to environments that could cause the stack to fall.

Their research was published earlier this year in the journal *Chemistry. A European Journal*.

Parquette's lab focuses on materials at the nanoscale. A nanometer is one one-millionth of a millimeter, and about 75,000 times smaller than the width of a human hair.

The team had been trying to find a way to keep medications that fight cancer more stable inside the human body. Those medications are composed of the drug itself and additives to keep the drug intact until it reaches its intended target inside the human body.

"It's like bricks on a house—they have to be held together by something," Parquette said. "But those bonds—the "mortar"—can be easily disrupted if you change conditions. And the environment of the human body can be very aggressive."

That means that drug makers often have to build medications that include higher percentages of both drugs and additives in order for those medications to be effective. That can make medications more expensive. It also can create more side effects.

The researchers had been working in the lab to find a coating when Mingyang Ji, a researcher in Parquette's laboratory and co-author of this study, tried polydopamine. Polydopamine is a form of dopamine, the neurotransmitter that is linked to feelings of pleasure in the brain. As a coating, polydopamine is very strong. And it works well in the human body because it is built on dopamine, something the body already understands.

"With polydopamine, we can create a wrapping layer that is much more stable and that can withstand the complex situations inside our bodies, which can create a difficult environment for medications," Ji said.

Polydopamine also acts as a type of double-sided tape, Parquette said.

"You have these other sticking points, so we can bind things like antibodies or other things that might have the potential to target specific cancer cells to increase a medication's effectiveness," he said.

The researchers think that polydopamine could also be used as a thin layer to protect solar panels or other materials exposed to sunlight, which can break down bonds that hold materials together.

More information: Jon R. Parquette et al. Enhanced Stability of

Peptide Nanofibers Coated with a Conformal Layer of Polydopamine., *Chemistry – A European Journal* (2020). DOI: 10.1002/chem.202000403