New method may lead to better in vivo drug delivery

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At some point, every person is likely to experience an inflammatory condition. There are many causes of inflammation, and just as many treatments. Some types of inflammation disappear by themselves, while

others require medical treatment.

Medical treatment only works if the active substances in the medicine are transported via drug delivery to the right place. For example, if a patient needs to have medication directed to the liver, it is important that the medicine is designed so that it is not absorbed before it reaches the liver.

One of the major challenges in the field of drug delivery is to get the active molecules to the right organ, avoiding them to be absorbed elsewhere than the inflammated area. Now, chemist Jasmin Mecinovic from the Department of Physics, Chemistry and Pharmacy and his international colleagues report a new method of transporting these molecules.

Chemistry that acts as a crane arm

In a study that was recently published in *Nature Chemistry*, the researchers describe how small molecular 'slider' can act as an arm on a lifting crane, collecting small packages of molecules. It sits on a polymer strand, which mostly resembles boiled spaghetti in shape. There are many polymer strands in organic material, and the slider can therefore jump from one polymer to the next, all while carrying this molecular package with it.

Imagine that the molecular package is a therapeutic drug required by the kidneys, for example. The slider can transport the package through the body by jumping from polymer to polymer until it reaches the kidneys. This is what Mecinovic and his colleagues report in the new study.

The researchers developed a theory for using the slider as a vehicle. The chemical process utilizes a connection with negative and positive charges, which most people know from refrigerator magnets. The slider's

negative ions, i.e. the atoms with an excess electron, will bind to the positive ions on the surface of the polymer. The researchers have discovered that the laws of chemistry allow the slider to jump between several polymers.

Laboratory tests confirm the model

The researchers did not just show that it was possible in theory. They also verified the model by using computer simulations that artificially mimic reality. Here, they found that the transport could work in practice. This was subsequently confirmed when the research team tested it with gel in the laboratory in the Netherlands.

One thing is that it works in liquids where polymers float freely, but gel is a harder material that - in many aspects - resembles a human body from a chemically mechanical perspective.

This may lead to the use of Mecinovic and his colleagues' method of producing even more accurate drug delivery to be used in curing inflammatory diseases.

More information: Lifei Zheng et al, Catalytic transport of molecular cargo using diffusive binding along a polymer track, *Nature Chemistry* (2019). DOI: 10.1038/s41557-018-0204-7

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