Source : www.thehindu.com Date : 2019-06-24

IIT GUWAHATI USES WATER-REPELLING COTTON FOR SUSTAINED DRUG RELEASE

Relevant for: Science & Technology | Topic: Biotechnology, Genetics & Health related developments

Tuning in: We can tailor water repellency from 125 to 150 degrees so that the drug is released in a sustianed manner over several days, say (from right) Uttam Manna, Arpita Shome and Adil Rather.

Sustained release of drugs for as long as 110 days has now been achieved by researchers at the Indian Institute of Technology (IIT) Guwahati by immobilising the drugs on cotton that is extremely water repelling (superhydrophobic). A team led by Uttam Manna from the Department of Chemistry found that 30% of the drug was released within 48 hours and the remaining drug over a period of 110 days. Two drugs — aspirin and tetracycline — were tested for sustained drug release.

“We have extended this approach [use of superhydrophobic cotton coated with the drug for sustained release] to make bandages for wound healing,” says Dr. Manna. “Animal studies will be undertaken soon. The collaborative work with the Delhi-based International Centre for Genetic Engineering and Biotechnology (ICGEB) has already begun.”

The researchers found that the duration of drug release can be tuned by varying the degree of water repelling property of cotton. For instance, when water repellence was reduced from 155 degree to 125 degrees, the duration of drug release reduced sharply from 110 days to over 50 days. “When the cotton was moderately water-repelling (125 degrees), 64% of the drug was released over 48 hours and the remaining drug was released over 50 days in the case of both the drugs tested,” Arpita Shome from IIT Guwahati and first author of a paper published in the journal *ACS Sustainable Chemistry & Engineering.*

To make the supremely water-absorbing cotton to repel water the researchers coated the cotton with a naturally occurring protein — bovine serum albumin (BSA). The BSA protein is dissolved in water and when ethanol is added it forms nanoparticles, which get embedded on the cotton. The BSA nanoparticles are made to bind to each other to form a 3D coating on the cotton with the addition of a cross-linker (5ACl). “The residual acrylates of 5ACl are further exploited to react with amine-containing long-chain hydrocarbons. The long hydrocarbon chain of the alkyl amine renders hydrophobicity to cotton,” says Shome.

“Two essential criteria are needed for achieving extreme water repellence — topography which can trap a layer of air and low surface energy coating that makes the cotton inert so it does not react with water,” says Dr. Manna. In this case, the BSA nanoparticles provide the required topography and the long hydrocarbon chain of the alkyl amine makes the cotton inert.

“We can tailor water repellency to varying degrees — 125-150 degrees — by selecting an appropriate alkyl amine to react with the residual acrylates on the BSA nanoparticles,” Dr. Manna says.

The drug to be loaded onto the extremely water-repelling cotton is dissolved in ethanol and the cotton is soaked in the drug-containing ethanol. When the cotton is removed, the ethanol evaporates leaving behind the drug molecule on the cotton. Superhydrophobicity returns once ethanol evaporates.

When the cotton containing the drug comes in contact with water, the air that is trapped gets displaced. Water slowly starts penetrating the cotton and comes in contact with the drug molecule and dissolves it. The dissolved drug diffuses out of the cotton and thus the slow release of drug over a period of over three months is achieved.

When cotton is supremely water repelling, there is sustained release for about 110 days after the burst-release in the first 48 hours. When the cotton is moderately water-repelling, 64% of drug is released in 48 hours and the remaining over the next 50 days.

Both the drugs were released in a similar fashion and the bioactivity of the tetracycline released at one, three and seven days was examined. “The bioactivity was similar to the native drug at all three time periods. Tetracycline was able to prevent the proliferation of both *E. coli* and *Streptococcus aureus*,” says Dr. Manna.

The antibacterial study was done in collaboration with Prof. Biman Mandal’s group at IIT Guwahati.

END