ASIAN INNOVATION AWARDS

Membrane Could Speed Drug Discovery

Researchers at Singapore's IMRE Develop a Substitute for Live Cells to Use in Testing the Efficacy of Medicines

By Emily Veach

SINGAPORE—Researchers at Singapore's Institute of Materials Research and Engineering are working on a microscopic level to bring about large-scale medical advancement.

Madhavan Nallani and his team are developing artificial cell membranes to use in drug screening that mimic processes occurring in live cells. This invention, a finalist in the Asian Innovation Awards, is geared toward reducing the costs and time necessary to take drugs from the lab to patients.

Cell walls are known as membranes, and it's through the proteins found in them that cells communicate with one another, fending off diseases or succumbing to them. In drug discovery, researchers identify the drugs that interact with certain protein receptors in the cell walls.

"Our focus now is to use artificial cell membranes for testing drugs against, for example, Parkinson's disease. It can be applied for other diseases like diabetes and cancer," Dr. Nallani says.

He describes his synthetic membranes as bubble-like, made of polymer and customizable, and grouped into a liquid-based matrix. He says it takes four hours to produce proteins used in his membranes, while it takes four days to produce the same proteins in live cells. Further, a live-cell laboratory requires a large, sterile environment, while with artificial membranes tests can be conducted in a small room atop a standard table. And live cells are more complicated to work with because there is natural variability between individual cells.

Artificial cell membranes are easier and cheaper to manufacture, so much of the preliminary experimentation can be performed faster and cheaply. Plus, they're more uniform than real cells.

Inside his team's small lab in Singapore, Dr. Nallani shows how experiments are carried out. First, DNA is mixed in a tube with a small amount of the artificial membrane material and other reagents. They are incubated for 1½ hours. This produces a protein in the artificial membrane. Then he puts the tube in a centrifuge to remove unwanted materials, resulting in a liquid containing the purified artificial membranes.

"You break up the cells, take the soup of the cell. Then you add the DNA, then the soup cooks to produce a protein," he says.

A drug molecule is then added and left to bind to the protein in the artificial membranes. After unbound drug molecules are removed, the liquid is analyzed to see whether any of the drug molecules are still attached. If they are, it's a success.

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In theory, the same test will then be conducted and the results verified using live cells, potentially saving money and time. "By using our artificial cell membranes, you can enhance the drug-discovery process by cutting down the cost and the time required to test a drug," Dr. Nallani says.

To test whether a drug molecule or antibody is bound to the cell membrane, scientists use high-powered microscopes. The scale can be difficult to imagine: The membranes Dr. Nallani is working with have controllable thickness comparable to live-cell membranes' four nanometers. He explains that one nanometer is roughly 1/1,000th of the thickness of a strand of hair.

Targeting the drug-screening process and not direct human treatment helps Dr. Nallani avoid, for now, cumbersome regulatory hurdles that can take years.

But he thinks direct human treatment is in the cards. The near-term goal, he says, is to pitch the technology to pharmaceutical companies.

A U.K.-based technology-commercialization company called **2Bio** Ltd. has taken on IMRE as a client in 2010. Founder and Director Rhys Roberts says he first determined that Dr. Nallani's invention "was more than idea or idle curiosity." Satisfied, Mr. Roberts and 2Bio have provided advice on how to spin off the technology as a start-up company

"We are targeting major drug companies with gaps in their pipelines for future drug sales," Mr. Roberts said. "Artificial membranes...will benefit medicine through more effective and safer drugs, and the drug companies by repopulating their depleted drug lines."

Acceptance as an enhancement to using live cells in drug screening by established companies could be a step toward broader acceptance in applications such as drug delivery and personalized treatment. But even persuading pharmaceutical companies to shift could take a long time.

Premkumar Arumugam, associate director of biology at **GVK Biosciences Pvt.** Ltd., based in Hyderabad, India, said his lab is testing the artificial membranes in drug-binding studies.

"The first results are very, very promising," Dr. Arumugam said in August, adding that the membranes' efficiency still needs to be improved. "If they mimic the biological system it will revolutionize the whole discovery area."

IMRE is part of the government agency A*Star—Agency for Science, Technology & Research—which oversees 14 institutes devoted to the biomedical and physical sciences and engineering.

In the coming years, Dr. Nallani says, A*Star's Exploit Technologies marketing and commercialization arm will help the team create a business model, incubate the business and pitch the idea to large pharmaceutical companies.

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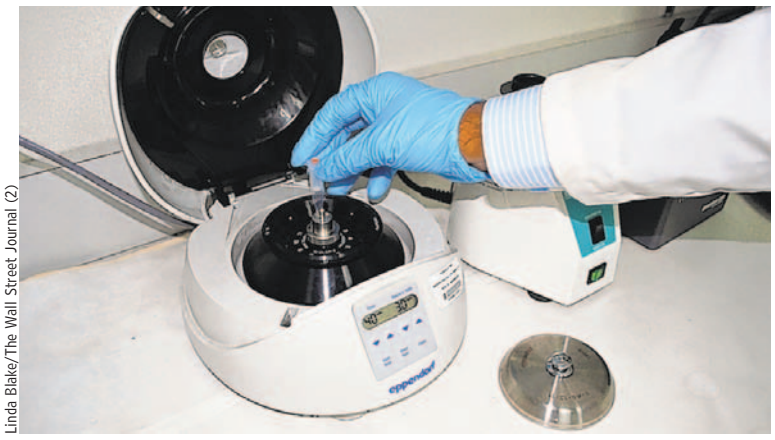
ONLINE TODAY: Watch Dr. Nallani explain how he makes artificial membranes and read about other finalists at **asia.WSJ.com/aia.**

Madhavan Nallani, senior research engineer at IMRE, prepares synthetic cell membranes that mimic biological processes and can be used in drug testing.



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