IBN Creates Unlimited Source of Human Kidney Cells

ACN Newswire

Researchers at the Institute of Bioengineering and Nanotechnology (IBN) have successfully generated human kidney cells from human embryonic stem cells in vitro(1). Specifically, they produced the renal cells under artificial conditions in the lab without using animals or organs. This has not been possible until now.

According to IBN Executive Director, Professor Jackie Y. Ying, "This discovery has wide-reaching implications for in vitro toxicology, drug screening, disease models and regenerative medicine. In particular, we are interested in applying our technology to develop predictive in vitro drug testing and renal toxicity models as alternatives to animal testing."

IBN Team Leader and Principal Research Scientist Dr Daniele Zink elaborated, "The kidney is a major target organ for drug-induced toxic effects. Therefore, it is important for pharmaceutical companies to find out early in the development phase whether their drugs would cause nephrotoxicity in humans. However, animal models are of limited predictability, and there is currently no regulatory accepted in vitro assay based on renal cells to predict nephrotoxic effects. A major problem is the lack of suitable renal cells, which may now be resolved through our discovery."

At present, human kidney cells are extracted directly from human kidney samples. However, this method is not efficient because such samples are limited, and the extracted cells die after a few cell divisions in the petri dish. Also, cells obtained from different samples would display variable features, depending on age, gender, health status and other conditions of the donor. Therefore, cells that have been isolated from human samples are of limited suitability for research and applications in industry and translational medicine, which require large cell numbers.

An alternative approach is to use human renal cell lines that have been rendered immortal, i.e. they can be reproduced indefinitely in the lab. However, such cells may not be used in many applications due to safety issues, and their functional features have usually been changed so profoundly that they may no longer be useful toward predicting cell behavior in the human body.

IBN's technique, on the other hand, enables human embryonic stem cells to differentiate into renal proximal tubular-like cells. This particular kidney cell type plays an important role in kidney disease-related processes and drug clearance. Results showed that the renal proximal tubular-like cells generated by IBN were similar to the renal proximal tubular cells isolated from fresh human kidney samples. For example, they displayed very similar gene and protein expression patterns. Also, since human embryonic stem cells may grow indefinitely in cell culture, the IBN researchers have discovered a potentially unlimited source of

human kidney cells.

"We are currently adapting our approach to use induced pluripotent stem cells as the source," shared Dr Karthikeyan Narayanan, IBN Senior Research Scientist. "We are also planning to modify our protocol in order to generate other renal cell types from stem cells."

The IBN researchers have tested the renal cells they generated in in vitro nephrotoxicology models developed by the Institute, and have obtained very promising test results. They welcome industry partners to collaborate with IBN on commercializing this technology.

IBN has recently received a grant from A*STAR's Joint Council Office Development Program to further develop predictive in vitro models for liver- and kidney-specific toxicity. This project will be conducted in collaboration with the Experimental Therapeutics Centre, the Bioinformatics Institute and the National University Health System.

Reference

(1) K. Narayanan, K. M. Schumacher, F. Tasnim, K. Kandasamy, A. Schumacher, M. Ni. S. Gao, B. Gopalan, D. Zink and J. Y. Ying, "Human Embryonic Stem Cells Differentiate into Functional Renal Proximal Tubular-Like Cells," Kidney International, (2013) DOI: 10.1038/ki.2012.442.

About the Institute of Bioengineering and Nanotechnology

The Institute of Bioengineering and Nanotechnology (IBN) was established in 2003 and is spearheaded by its Executive Director, Professor Jackie Yi-Ru Ying. Professor Ying was a Professor of Chemical Engineering at the Massachusetts Institute of Technology (1992 - 2005). She was recognized as one of "One Hundred Engineers of the Modern Era" by the American Institute of Chemical Engineers in 2008 for her groundbreaking work on nanostructured systems, nanoporous materials and host matrices for quantum dots and wires.

Under her direction, IBN conducts research at the cutting-edge of bioengineering and nanotechnology. Its programs are geared towards linking multiple disciplines across engineering, science and medicine to produce research breakthroughs that will improve healthcare and our quality of life.

IBN's research activities are focused in the following areas:

- Nanomedicine, where functionalized polymers, hydrogels and biologics are developed as therapeutics and carriers for the controlled release and targeted delivery of therapeutics to diseased cells and organs.
- Cell and Tissue Engineering, where biomimicking materials, stem cell technology, microfluidic systems and bioimaging tools are combined to develop novel approaches to regenerative medicine and artificial organs.
- Biodevices and Diagnostics, which involve nanotechnology and microfabricated platforms for high-throughput biomarker and drug

screening, automated biologics synthesis, and rapid disease diagnosis.
- Green Chemistry and Energy, which encompass the green synthesis of chemicals and pharmaceuticals, catalytic conversion of biomass, utilization of carbon dioxide, and new nanocomposite materials for energy applications.

IBN's innovative research is aimed at creating new knowledge and intellectual properties in the emerging fields of bioengineering and nanotechnology to attract top-notch researchers and business partners to Singapore. Since 2003, IBN researchers have published over 820 papers in leading journals.

IBN also plays an active role in technology transfer and spinning off companies, linking the research institute and industrial partners to other global institutions. The Institute has a portfolio of over 581 patents/patent applications, and welcomes industrial and clinical partners to collaborate on and co-develop its technologies. IBN has successfully commercialized 46 patents/patent applications, and has established 6 spin-off companies.

IBN's current staff and students strength stands at over 150 scientists, engineers and medical doctors. With its multinational and multidisciplinary research staff, the institute is geared towards generating new biomaterials, devices, systems and processes to boost Singapore's economy in the medical technology, pharmaceuticals, chemicals, consumer products and clean technology sectors.

IBN is also committed to nurturing young talents. Besides the training of PhD students, IBN has a Youth Research Program (YRP) for students and teachers from secondary schools, junior colleges, polytechnics, and universities. Since its inception in October 2003, IBN's YRP has reached out to more than 59,860 students and teachers from 289 local and overseas schools and institutions. Over 1,670 students and teachers have completed research attachments at IBN for a minimum period of four weeks. For more information, visit www.ibn.a-star.edu.sg [1].

About A*STAR

The Agency for Science, Technology and Research (A*STAR) is the lead agency for fostering world-class scientific research and talent for a vibrant knowledge-based and innovation-driven Singapore. A*STAR oversees 14 biomedical sciences and physical sciences and engineering research institutes, and six consortia & centres, located in Biopolis and Fusionopolis as well as their immediate vicinity. A*STAR supports Singapore's key economic clusters by providing intellectual, human and industrial capital to its partners in industry. It also supports extramural research in the universities, and with other local and international partners. For more information about A*STAR, please visit www.a-star.edu.sg [2].

Source URL (retrieved on *08/31/2014 - 5:18am*):
http://www.mdtmag.com/news/2013/02/ibn-creates-unlimited-source-human-kidney-cells?qt-most_popular=0&qt-recent_content=0

Links:
[1] http://www.ibn.a-star.edu.sg
[2] http://www.a-star.edu.sg