

Singapore takes a lipidomics leap

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After proteomics and genomics, lipidomics promises to be the next emerging field of research in the bioscience industry. Its potential use in healthcare, including disease prediction and diagnosis, has led Singapore to step up its focus on the lipidomics research front. This South East Asian city-state is one-of-the-first countries to explore the potentials of lipidomics. It has entered into a number of collaborations with the industry at the global level in order to initiate research in the field to strengthen its knowledge base.

Lipidomics is an emerging field of biomedical research that includes analysis of all the lipids present in a biological system known as a lipidome. The study involves systems-level identification and networks of cellular lipids molecular species and their interactions with other lipids and proteins. Analysis of the lipid is indicated for application in the fields of pharmaceuticals, medicine and nutrition.

Singapore taps research potential

National University of Singapore, which is pioneering the research in lipidomics in Singapore, has tied up with Agilent Technologies to share expertise and knowledge in the area of analytical lipidomics for creating new classes of biomedical research tools and therapies. The two are collaborating on research projects, consultancies, customized training programs and workshops, to advance the level of knowledge in the field of lipidomics.

The city-state has also established a non-profit multi-center initiative, LipidProfiles, anchored within National University of Singapore. The set-up includes research and educational activities to develop novel tools that will provide deeper insights into the role of lipids. It connects national and international laboratories, research programs and industry, developing a base for sharing the rich knowledge and talent pool.

The Singapore Lipidomics Incubator (SLING) is another initiative that functions as a global magnet to draw collaborations in the field from both the academia and the industry. While delivering new technologies and intellectual capital in lipidomics, it also ensure high participation of Asian universities in the research and development programs.

Dr Markus Wenk, associate professor with the department of biochemistry and department of biological sciences at National University of Singapore, is spearheading novel approaches in lipid analysis for enabling its application in development of drugs and biomarkers with relevance to various disease areas. Under his mentorship, Singapore is leveraging research and educational initiatives in lipidomics to develop novel tools to explore the role of lipids. Prof Wenk and his team are focusing on

the practical applications of lipidomics, developing technologies and strategies for lipid analysis, and to introduce lipid-based biomarker and diagnostic tools for clinical applications.

Lipidomics as biomarkers

The application of lipidomics as a biomarker in ovarian cancer is one area that has captured the attention of Prof Wenk.

So far, diagnosis of ovarian cancer is done through physical examination, X-ray, and chemical and hematological studies that include protein and plasma testing on patients. Current diagnostic method of ovarian cancer is determined by the level of a protein called CA 125 that is produced by ovarian cancer cells. These proteins play the role of biomarker to detect ovarian cancer but they have their own set of limitations. The indication by this marker can go wrong as some ovarian cancer cells may not produce enough CA 125 to detect the growth of cells.

Since the existing diagnostic and prognostic tools are not adequate in predicting the onset of many diseases, advancements in biomarker are essential. It has better potential in tracking the growth of diseases and researchers are exploring the use of lysophosphatidic acid (LPA) - a class of lipid, as a biomarker for ovarian cancer. LPA has been shown to stimulate the proliferation of ovarian cancer cells and has been found in the blood of ovarian cancer patients. As a biomarker, it has shown to have a sensitivity of 100 percent in advanced stage and almost 90 percent in the early stages.

However, the utility of LPA as a biomarker has not been completely tapped for certain discrepancies. According to Prof Wenk, there is a need for a better method to detect and diagnose cancers, and lipidomics analysis could bring revolution in the diagnosis of ovarian cancer at an early stage.

Prof Wenk and his team at NUS have developed a mass spectrometry technology that provides classification between healthy cell and diseased cell and further classification of benign cell and malign cell. Prof Wenk says the technology is capable of distinguishing an early-stage cancer from a late-stage cancer and whether a sample is cancerous or normal. The invention employs conventional techniques of chemistry, molecular biology, microbiology, recombinant DNA and immunology. In the method, the team creates assay of concentration of sample derived from bodily fluids, such as blood, blood serum or extracts from tissue.

"Mass spectrometry technology performs generation process where a data set of lipid is characterized and analyzed. The objective of the study is not only to identify patients but also to separate the benign from the malignant. Currently, there is no available tool to identify the benign from the malignant unless the growth is surgically removed and sent for various pathological tests. Our research is able to do so and extrapolate the model to separate late from early stage of malignancy and the performance could be better than CA125," explains Prof Wenk.

"The strength of this method relies not only in using one set or class of biomarkers but a complete profile, and then use it as a diagnostic tool. The patient is relieved of the unwanted trauma of going through a surgery for such a small sample," he adds.

Application

Prof Wenk and his team are focusing on developing novel lipid-based biomarkers for the early detection of a wide range of diseases apart from ovarian cancer, such as gastric cancers, neurodegenerative diseases, Alzheimer's disease, stroke and schizophrenia, inflammatory disorders, infectious diseases such as tuberculosis and dengue fever.

"So far, the developments in the fields of genomics and proteomics have been far ahead as compared to the corresponding advancement of knowledge in the field of lipids. This is largely due to the complexity of lipids and the lack of powerful tools for their analysis. Novel analytical approaches would enable systems-level analysis of lipids and their applications, together termed as lipidomics," says Prof Wenk.

The team involved in lipidomics research believes that chromatography and mass spectrometry technologies are going to revolutionize the field of lipid research and it would be possible to detect, characterize and quantify lipids at high levels of sensitivity and resolution. Lipid analysis could be a milestone in early diagnosis of serious and killer diseases and a wide clinical application through devices and diagnostic kits.