UNIVERSITI KEBANGSAAN MALAYSIA
The National University of Malaysia
INSTITUT BIOLOGI SISTEM
INBIOSIS
INSTITUTE OF SYSTEMS BIOLOGY
eISSN 2710-6292

SYSTEMS BIOLOGY INSIDER

VOLUME 2(1) 2020

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INBIOSIS 15TH ANNIVERSARY

FOUNDING DIRECTOR

EMERITUS PROF. DR. NORMAH MOHD. NOOR

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Editorial

Greetings,

Happy 15th anniversary! INBIOSIS is 15 years old since its establishment in 2005. We would like to take this opportunity to congratulate and extend the appreciation to all INBIOSIS members for the hard work in leading the institute to a success.

In this issue, we share 2 success stories of INBIOSIS alumni, Dr. Khairunisa Khairudin and Ms. Shuhaila Sharif. We also highlighted one of our prominent high-end analytical instruments: Liquid Chromatography-Time of Flight-Mass Spectrometry (LC-TOF-MS) System.

Insights of this issue present "Systems Immunology: A Nascent Field" and "Contribution of Mass Spectrometry (MS) in the Understanding of COVID-19 Outbreak".

Lastly, if you would like to share any interesting articles, opinions and thoughts related to systems biology, you are welcome to email them to me. We will do the best to include them in the future Systems Biology Insider bulletin.

Many thanks

Dr. Low Chen Fei
Chief Editor
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PAVE THE WAY FOR BIG DATA BIOLOGY: The Establishment of INBIOSIS

Founding Director
Emeritus Prof. Dr. Normah Mohd. Noor

INSPIRATION

It started when we, the plant biotech group, felt that Plant Biotechnology Laboratory, Faculty of Science and Technology (FST), Universiti Kebangsaan Malaysia (UKM) was ready to be upgraded to the level of centre of excellence. Thus we put up a working paper and brought it up to the level of Board of Directors, UKM. The Board then recommended that we merge with another centre of excellence, the Centre for Gene Analysis and Technology (CGAT), to become an institute. Together with Emeritus Prof Dr Nor Muhammad Mahadi, we came out with the idea of **systems biology** as an approach in modern biotechnology that is using a systems perspective in seeking holistic understanding of biological complexity.

We felt that the establishment of our institute would be in line with the development and interest in the country for biotechnology as one of the key strategic drivers to propel the country's social and economic development in pursuit of the status of a developed nation. For the **Institute of Systems Biology (INBIOSIS)** to be functional and holistic, we added the Centre for Bioinformatics Research as the third research centre at INBIOSIS. Hence, the establishment of INBIOSIS consolidates and strengthens the university's established and successful modern biotechnology research programmes: the Centre for Gene Analysis and Technology (CGAT), the Centre for Plant Biotechnology (CPB), and the Centre for Bioinformatics Research (CBR).

CHALLENGES

Getting grants to build the infrastructure and for research was among the main challenges faced during the establishment of INBIOSIS. We were very fortunate to get support from the University to obtain the building and the basic equipments. We were grateful to the registrar's office for the support in hiring laboratory and office staff and research fellows in various fields needed for systems biology research.

I'm happy to see the developments and achievements of INBIOSIS so far. The number of research fellows in various relevant fields has increased and the number and quality of publications are very impressive.

FUTURE

I would like to see every member of INBIOSIS working together as a group to bring INBIOSIS to the next level, perhaps as a High Center of Excellence. With the mission 'Unraveling biological processes and networks leading towards exciting discoveries', INBIOSIS should be able to obtain large grants to pursue significant research with everyone's commitment and support. I hope that INBIOSIS will achieve its vision 'to be an outstanding institute pursuing innovative research in systems biology benefiting mankind'.

INSTITUT BIOLOGI SISTEM
INBIOSIS
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What our alumni say

INSTITUTE OF SYSTEMS BIOLOGY ALUMNUS
MS. SHUHAILA SHARIF
MASTERS IN SYSTEMS BIOLOGY, 2017

Currently I am working as an analytical chemist in R&D department of a newly set-up pharmaceutical company. My daily tasks involve analytical testing using High Performance Liquid Chromatography (HPLC), Fourier-Transform Infrared Spectroscopy (FTIR), Ultraviolet-Visible (UV-Vis) Spectroscopy etc. Other than that, I am also responsible for method development and validation.

Previously I've pursued my master's degree in Biomolecular Sciences at INBIOSIS. The focus of my research included metabolomics and fluxomics of *Lactococcus lactis*. I was given the opportunity to operate analytical instruments such as Gas Chromatography–Mass Spectrometry (GC-MS) and HPLC during my study at INBIOSIS, which has prepared me to become a skillful analytical chemist.

As an INBIOSIS alumni, I feel grateful and lucky as I was exposed to advanced analytical instruments during my study at INBIOSIS. The skills that I have acquired during my study at INBIOSIS have helped and prepared me for my current position. Besides, soft skills are also being taught at INBIOSIS. Those overwhelming presentations, reports and manuscripts are examples of valuable lessons that I have learnt and acquired.

Thus, as a student, do appreciate each single moment at INBIOSIS and always do the best in any work you do. INBIOSIS is not only a place for you to gain a scroll of certificate, but it is also a place for you to develop yourself.

I would like to congratulate all postgrad students for your bravery and courage to choose this path. Set your objective and be clear about it. Be flexible in your study as it will make you become creative. Stop making excuses. Do appreciate and enjoy each moment at INBIOSIS. Lastly, as a researcher you have to 'be curious and feed your curiosity'. As for career advice, be prepared for high expectations from employer and ready for a new career experience.

INSTITUTE OF SYSTEMS BIOLOGY ALUMNUS

DR. KHAIRUNISA KHAIRUDIN

MASTERS IN SYSTEMS BIOLOGY, 2014

My first degree provided a good grounding in scientific methodology and discipline which became a vital stepping stone to my postgraduate. I was motivated to take up Masters Research program in order to gain greater insight into scientific research and enhance my skills. I enrolled on the MSc Systems Biology (Biomolecular Sciences) at Institute of Systems Biology (INBIOSIS) in 2010. The program offered me the opportunity to explore an area of biology which gave me the experience I needed for my current position.

INBIOSIS provides an extraordinary curriculum that has benefited me both personally and professionally. It has a very good platform for the students to excel in their learning journey. Its strategic collaborations with local and international organizations to ensure smooth flow of knowledge and equip students with different aspects of skills especially interpersonal development. As for myself, I once was a shy person back then, always kept to myself and can hardly speak English. But having the opportunity to work with international collaborators and colleagues in INBIOSIS, I had to use English in my daily conversation. Besides, as a student, we were also encouraged to attend series of seminars and meetings where we had the opportunity to speak about our research and listen to different academics. Slowly I learned to be a better speaker and gained confidence in myself that I never really knew I had.

INBIOSIS research program focuses on practical skills and hands-on learning where you develop your skills and gather knowledge through your work. Embracing the education programs at INBIOSIS taught me to work smart. As a postgraduate, we are expected to be more independent to run our research and be able to do multiple tasks as we must juggle our time between reading, research and writing. Although it was a struggle in the beginning, I was grateful to have supportive team members who always provide guidance and help to create solutions for each problem.

I enjoyed the whole experience of being a postgraduate at INBIOSIS. I believe along the road, I've broadened my cultural horizons and learned to be more critical at my work. Thanks to the great experience I gained at INBIOSIS, my education did not stop at graduation. Towards the end of my Masters, an opportunity came as I was offered a scholarship by MARA to pursue PhD in the United Kingdom. I instantly grabbed the opportunity without thinking twice to challenge myself and Alhamdulillah all the hard work and determination paid off well. I'm currently employed as an R&D Scientist to work on a natural product research project at an institution in Singapore. My research is to explore anti-aging and antidiabetic properties of mushroom through chemical screening and synthetic biology.

My advice to prospective students is that, be certain with what you want to achieve, start meeting people, get involved with as many things as you possibly can and gain experiences. But don't forget to BE KIND to yourself. Reach out to someone if you feel lost along the way. It's okay to take a break then start fresh and always put yourself in the presence of God. You'll feel a lot more fulfilled and happier in the long term.

Systems Immunology: A Nascent Field

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The term "immune system" was coined in recognition to its complexity in protecting the host against diseases and infections. It consists of diversified immune cell subsets, defined by over 300 cluster of differentiation (CD) antigens, where these immune cell subsets could produce hundreds of signaling molecules (cytokines and chemokines) to activate and/or repress the transcription of thousands of genes. It requires a great deal of research to decipher and comprehend the intricate signaling pathways and interactions of the molecules within the immune system, what is more, the non-immune components. Systems biology approaches in immunology provide a powerful platform to understand the holistic principle of the immune system.

One of the main streams of systems immunology focuses on the cellular component, and its effector molecules used in cell-to-cell communication in response to pathogens and vaccines. This approach enlightens the field of vaccine development, guiding the vaccine design by immunological big data [1]. Understanding of the mechanistic immune protection conferred by vaccines could be achieved through high resolution genomics/transcriptomics and high throughput proteomics analysis, at once, reveal the underpinning molecular mechanisms of immune protection that is confers by vaccination. The immunological big data is providing insight into the efficacy of the vaccine candidates, and accelerates the vaccine development.

Vaccination is known to be the most effective prophylactic approach in disease prevention, which confer long-term immune protection through the establishment of immune memory. A vaccine often activates multiple components of the immune system that results in varied immune responses, enriching the immunological big data. The study of post-vaccination immune responses utilizing systems biology approaches has been specialized into "systems vaccinology" [2]. In this nascent field of systems immunology, the research largely focuses on the transcriptional responses upon exposure to pathogens or vaccines. Later, the breadth of immune responses is stretched out to incorporate the study of serum cytokines and chemokines, as well as other small/large protein molecules using high throughput proteomics platform. Besides, utilization of the high throughput proteomics platform in the study of cell surface proteome or the surfaceome is prominent in immune cell phenotyping. The surfaceome is defined as all plasma membrane proteins that have at least one amino acid residue exposed to the extracellular space [3]. This is crucial in identifying the immune cell signaling and communication that determine its cellular immune functions.

Similarly, vaccination program has also been widely practiced in veterinary across different classes of animals, from vertebrates to invertebrates. An interesting phenomenological evidence was recorded in invertebrates that are known to lack of the adaptive immunity (the immune component responsible for the establishment of immune memory upon vaccination, and the production of antibodies) to exhibit a form of 'alternative adaptive immune memory'. This phenomenon is now recognized as the innate immune memory or trained immunity. Epigenetic re-programming appears to play a central role in mediating innate immune memory by modulating the immune gene expression. In epigenetic, histone or DNA modification via methylation or acetylation could either activate or repress the transcription of genes involve in immune responses. Advancement of the high-resolution genome sequencing enables the sequencing of the epigenome to discover the mechanisms of epigenetic modulation in innate immune memory. In addition, high resolution genomic data allows the profiling and comparative genome analysis of the immune repertoires, such as the T and B cell receptors of the vertebrates, and the Down syndrome cell adhesion molecule (*Dscam*) of the invertebrates, which is a member of the immunoglobulin (Ig) superfamily [4]. T and B cell receptors are responsible for the recognition and binding of the specific epitope/antigenic determinant, subsequently elicit immune response for short/long-term immune protection. The availability of high resolution genomic data of immune repertoires facilitates immuno-bioinformaticians to predict epitopes from protein sequences, and the design of potential vaccine candidates [5,6].

The approach of systems biology generates vast biological big data of the genome, transcriptome, proteome, and metabolome of a biological system at a physiological state. Ideally, integration of these biological big data would provide a fundamental and comprehensive understanding of the given biological system. The accessible biological big data on the other hand offers unlimited opportunities for downstream applied research, such as the vaccine design in the field of systems vaccinology, and systems immunology.

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At present, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and its disease, Coronavirus disease 2019 (COVID-19) is considered a threat to global health security due to its highly infectious and fatality. COVID-19 has infected 2.5 million people and more than 348,000 fatalities recorded worldwide [1]. However, these numbers may be lower than actual data due to low mass testing and lag in test results [2]. Providing an early detection of severe COVID-19 patients remain a major challenge as comprehensive measures are required to produce reliable test results, as well to keep laboratory staff safe. Currently, real-time reverse transcription-PCR (RT-PCR) assays are the preferred testing method to detect SARS-CoV-2 infection [3]. The PCR-based test, however, indicates several drawbacks, including limited sensitivity, false negative results and can take days to obtain results. Therefore, fast and reliable complementary tests to identify individuals infected with SARS-CoV-2 are crucial and urgently needed. Over the years, mass spectrometry (MS) has undergoes tremendous technological improvements to enable the qualitative and quantitative analyses of enormously complex biological samples [4]. In comparison to PCR or immunoassays, mass spectrometry (MS) is considered a comprehensive technique for characterizing biological samples because it can deliver quick results with high mass accuracy, sensitivity, selectivity and specificity. These features make MS an ideal tool for rapid analyses of various biomolecules such as proteins, lipids and metabolites [5].

Contribution of mass spectrometry (MS) in the understanding of COVID-19 outbreak

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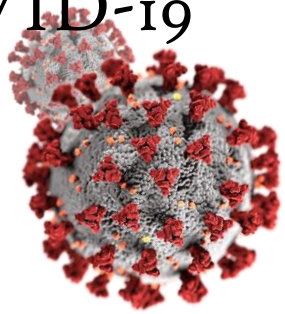
Universiti Kebangsaan Malaysia



The role of mass spectrometry

The application of MS as clinical diagnostics has been well received where MS is routinely used to identify microbial and viral infections, newborn screening (NBS), toxicology studies and drug development. For instance, endogenous metabolic profiling of human body fluids using MS technology has enabled the detection of disease biomarkers. Recently, studies indicating the use of mass spectrometry (MS) to analyze human body fluids of suspected COVID-19 cases have been reported. A study by Messner et al. successfully identified a series of differentially expressed proteins in the blood plasma of patients with different severity of COVID-19 symptoms using MS-based technique [6]. Simultaneously, Shen et al. reported that more than 100 metabolites were altered in COVID-19 patient sera using metabolomics based MS approach [7]. These findings highlight the usefulness of MS as a complementary diagnostic tool during global public health crisis. Meanwhile, a targeted MS analysis to detect SARS-CoV-2 protein in gargle solution samples of COVID-19 patients has been developed and verified with PCR analyses [1]. The findings indicate that MS-based methods can be applied as routine diagnostic that complement PCR based methods. Notably, a COVID-19 MS coalition (www.covid19-msc.org) involving mass spectrometry experts from around the worlds was formed recently [8]. The coalition aims to share optimized methods for sample collection, processing protocols and related COVID-19 data for maximal information gain. Collectively, the coalition hopes to provide prognostic biomarkers to understand and treat COVID-19 patients.

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Spotlight

Liquid Chromatography-Time of Flight-Mass Spectrometry (LC-TOF-MS) System

Our Liquid Chromatography-Time of Flight-Mass Spectrometry (LC-TOF-MS) system consists of **Bruker micrOTOF-Q III** coupled with the **Thermo Scientific Dionex Ultimate 3000 UHPLC system and RSLC nano**. The coupled chromatography - MS systems are popular in chemical analysis because the individual capabilities of each technique are enhanced synergistically. While liquid chromatography separates mixtures with multiple components, mass spectrometry provides structural identity of the individual components with high molecular specificity and detection sensitivity.

Our instrument consists of:

- MicroTOF QIII Bruker Daltonic
- Thermo Scientific Dionex UltiMate 3000 UHPLC system
  - Thermo Scientific C18 column
- Thermo Scientific Dionex Ultimate 3000 RSLCnano
  - Thermo Scientific C18 column (Acclaim™ RepMap RSLC, 75µm x 15cm, 2µm, 100A)

List of Publications

1. S.F. Mamat, K.A. Azizan, S.N. Baharum, N.M. Noor, W.M. Aizat. 2020. GC-MS and LC-MS analyses reveal the distribution of primary and secondary metabolites in mangosteen (*Garcinia mangostana Linn.*) fruit during ripening, Sci. Hortic. (Amsterdam). 262, 109004.
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3 S.N.F.B. Ismail, S.N. Baharum, S. Fazry, C.F. Low. 2019. Comparative genome analysis reveals a distinct influence of nucleotide composition on virus--host species-specific interaction of prawn-infecting nodavirus, J. Fish Dis. 42, 1761–1772.

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STATISTICS

No. of Publication, Jan – July 2020

Research Grants Awarded in 2020

RM 445,800.00
National

RM 200,000.00
International

Total active research grants
RM 3,774,311.00

Class of 2020 – Number of postgraduate student

28 PhD

22 MSc

Congratulations

to the grant recipients; Dana Impak Perdana, MRUN-LRGS, and IDRC Canada. We would also like to extend our congratulations to Dr. Maizom Hassan, who was granted with Geran Universiti Penyelidikan, GUP, for her research project entitled: Characterization and Functional Analysis of Juvenile Hormone Genes from Oil Palm Pest, Metisa Plana Walker for Potential Insecicide Discovery (RM 65,000.00 of research funding).

Assoc. Prof. Dr. Goh Hoe Han

Reference Database for Functional Genomic Analysis of Mangosteen.

RM 100,000.00

DANA IMPAK PERDANA, DIP

Dr. Hamidun Bunawan

Functional Analysis of P4 Protein as RNA Silencing Suppressor in Rice Tungro Bacilliform Virus.

RM 100,000.00

DANA IMPAK PERDANA, DIP

Dr. Maizom Hassan

Omics Guided Insecticide Development for Use in Precision Agriculture.

RM180,800.00

MRUN-LRGS

Dr. Low Chen Fei

Integrated Quorum Quenching Strategies to Reduce Antimicrobial Resistance in Shrimp Aquaculture (i-QAS).

RM 200,000.00

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE (IDRC), CANADA

Hall of Fame

Congratulations

to Assoc. Prof. Dr. Syarul Nataqain Baharum, Mrs. Rafidah, and Mr. Syahmi. The team won the Best Poster Award in Hyper-Interdiciplinary Conference 2020.

to all lecturers of RBRB6012 for winning the 2nd prize of MOOC course on 6 Feb 2020 during K-NOVASI: "Pertandingan Reka Bentuk MOOC UKM 2018-2019 - Kategori Terbuka" organized by Pengajaran-UKM.

Congratulations to INBIOSIS postgraduates for their publications in high impact journals ranking Q1/Q2 in the year of 2020

Nur Athirah Binti Abd Hamid

Diverse and dynamic roles of F-box proteins in plant biology

***Planta*, 2020**

(Q1, Impact factor: 3.390)

Siti Noor Fatimah Binti Ismail

Codon deoptimization of the viral capsid protein-encoding gene attenuates *Macrobrachium rosenbergii* nodavirus

***Aquaculture*, 2020**

(Q1, Impact factor: 3.224)

Reeki Bin Emrizal

Phylogenetic comparison between Type IX Secretion System (T9SS) protein components suggests evidence of horizontal gene transfer

***PeerJ*, 2020**

(Q2, Impact factor: 2.380)

Nazmi Bin Harith Fadzilah

Physical and physiological monitoring on red palm weevil-infested oil palms

***Insects*, 2020**

(Q1, Impact factor: 2.220)

INBIOSIS
15TH ANNIVERSARY

2005

The establishment of INBIOSIS was inspired by the idea of using a systems perspective in seeking holistic understanding of biological complexity, aims to unravel biological processes and networks leading towards exciting discoveries.

2010

The first international conference organized by INBIOSIS. Asian Regional Conference of Systems Biology, ARCSB is one of the main scientific event organize by INBIOSIS every two years.

2013

INBIOSIS equipped with its first PC2 Greenhouse (RTPC2) facility which enables research on genetically modified plants to be carried out within a secure and controlled environment.

2016

INBIOSIS was awarded the MS ISO/IEC 17025:2005 certificate through the Skim Akreditasi Makmal Malaysia (SAMM) for Work Procedure and Method of Sample Testing of the GC-MS.

2017

CODA
CENTRE OF OMICS DATA ANALYSIS

A new centre that provide one-stop solution for omics data analysis, a computational services in processing biological big data from high throughput experiments including transcriptomics, metabolomics, proteomics and bioinformatics analysis.

2018

Scientific event organized by INBIOSIS postgraduate association: INBIOSIS Biotechnology Aspiration Carnival (iBAC), INBIOSIS Open Day, and INBIOSIS Graduate Symposium. The event was participated by students from 5 secondary schools, communities, and postgraduates of local and international universities.

2020

Earlier this year, we have successfully organized ARCSB 2020 held at Langkawi island, Malaysia from 2nd to 4th March 2020. The event gathered international renown speakers from Australia, Japan, and Thailand, to share research findings and scientific knowledge.

Assoc. Prof. Dr.
Zeti Azura Mohamed Hussein
Director 2019 - current

Prof. Dr.
Ismanizan Ismail
Director 2014 – 2019

Emeritus Prof. Dr.
Normah Mohd. Noor
Director 2005 - 2014

CELEBRATING INBIOSIS 15TH ANNIVERSARY

INB 15 tahun SIS
2005-2020