

AScientia

ANALYTICAL SCIENCE

Bridging Networks
Accelerating Innovation

Contents

Issue No. 11

AScientia is a combination of **ASC** (acronym for School of Applied Science) and **scientia** (Latin word for knowledge, science and skill)

Editor

Lee Poh Lian Jocelyn

Adviser

Krishnasamy Susila

Publisher

Temasek Polytechnic
School of Applied Science

01 Director's Message

03 Domains at ASC

14 Analytical Science at ASC

- Innovative Technology to Modernise Complementary Health Products Industry
- Simultaneous Determination and Analysis of Antibiotic Residues in Shrimp
- A Quick and Novel Approach to Certifying Products Containing Antioxidants
- Detection of Advanced Glycation End-Products (AGEs) in Local Foods

Appreciation is extended to all who contributed to the production of this magazine.





Besides maintaining our forte in analytical science, we are also making ASC into a more agile organisation by strengthening our capabilities and expertise through 12 domains viz., nine Technology Domains and three Non-Technology Domains.

These developments have been accelerating our innovative capabilities as we race to provide nothing but the latest in cutting-edge technology. With this, ASC has been providing advanced industry-responsive solutions to meet industry needs.

*Lee Chee Wee, PhD
Director
School of Applied Science*

Director's Message

2016 has been a year of exciting developments for our School of Applied Science (ASC). With the launch of two new centres, the Centre of Innovation for Complementary Health Products (COI-CHP) and the Centre for Aquaculture & Veterinary Science (CAVS), we are now well-poised to support the industry's analytical science, aquaculture, and veterinary science sectors.

Both centres, the first of their kind in Singapore, are slated to offer advanced testing services. These centres were jointly set up with our renowned partners Agilent Technologies and Apollo Aquaculture Group Pte Ltd. The COI-CHP is also supported by the government-backed enterprise enabler SPRING Singapore.

To take our analytical science capabilities up another notch, we have together with Agilent Technologies' support, organised the inaugural International Conference in Analytical Science aptly themed **Bridging Networks, Accelerating Innovation**. The Analytical Science conference serves to reach out to our industry partners and helps to bridge networks. Through this platform, we will showcase our innovative technology.

Our innovative technology would be instrumental in providing creative solutions to technical challenges faced by Small and Medium Enterprises working to enhance complementary health products such as traditional medicine, health supplements, and functional food products. We will also offer our expertise in areas such as product development, optimisation, and validation.

Besides maintaining our forte in analytical science, we are also making ASC into a more agile organisation by strengthening our capabilities and expertise through 12 domains viz., nine Technology Domains and three Non-Technology Domains.

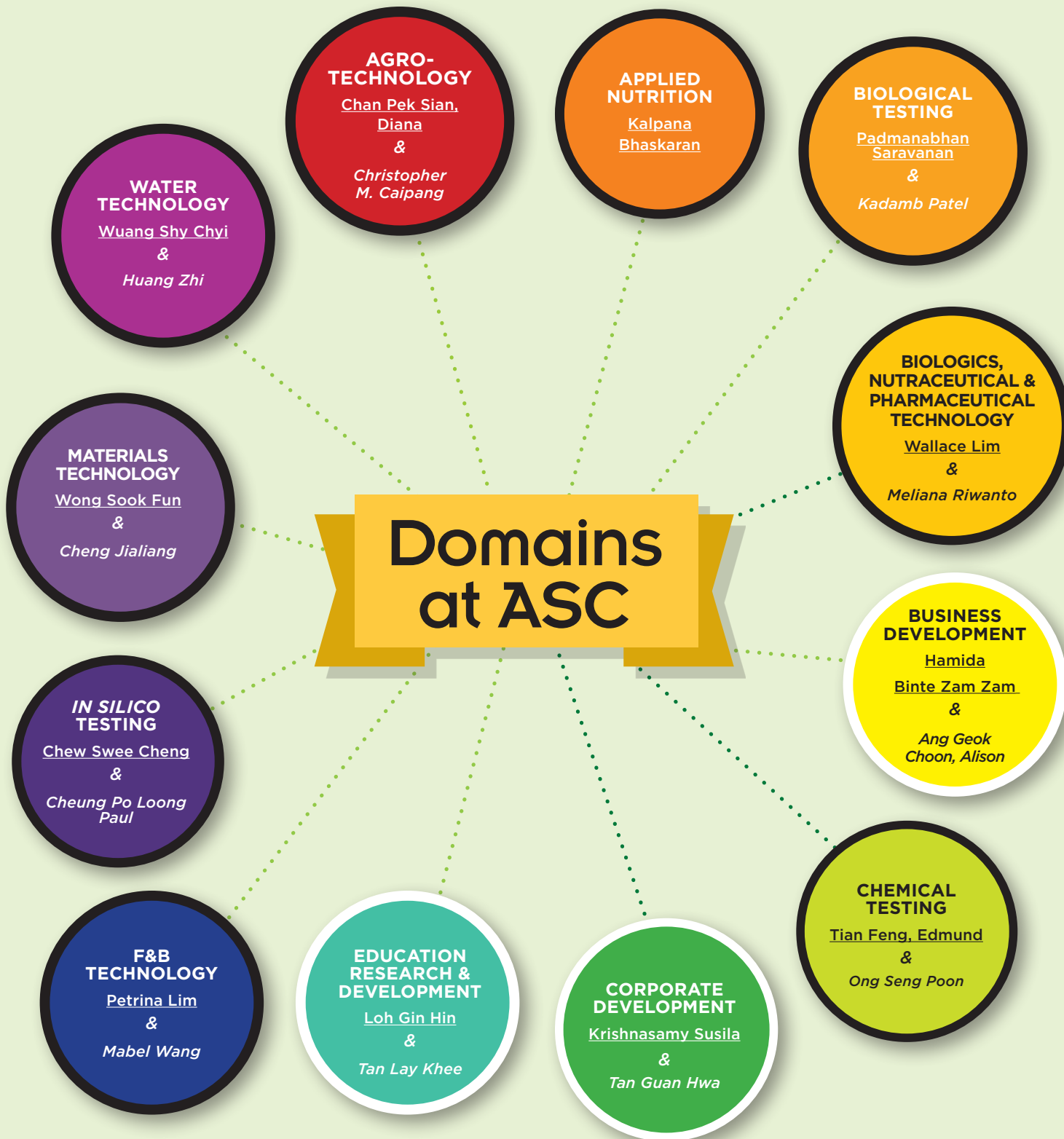
These developments have been accelerating our innovative capabilities as we race to provide nothing but the latest in cutting-edge technology. With this, ASC has been providing advanced industry-responsive solutions to meet industry needs.

We invite you to join the long list of partners who have already benefitted from our consultancy projects. Find out more about some of our research projects by leafing through this publication.

We look forward to partnering with you!

Lee Chee Wee, PhD

Domains at ASC



Non-Technology Domains



Technology Domains

Lead Domain Owner & *Co-Domain Owner*

Centre for Aquaculture & Veterinary Science (CAVS)

Focus for Sustainable Agrotechnology and Veterinary Care

Key Services for Horticulture & Floriculture Industries

- Hydroponics



- Aquaponics
- Aquatic & Non-Aquatic Plant Tissue Culture
- Algal Culture & Efficacy Studies on Growth Performance

- Composting

- Seedpod Germination & Seedling Propagation



- Efficacy Studies of Plant Extracts for Plant Growth Performance



- Pest Management Using Innovative Technologies



- Molecular Technologies e.g. CRISPR

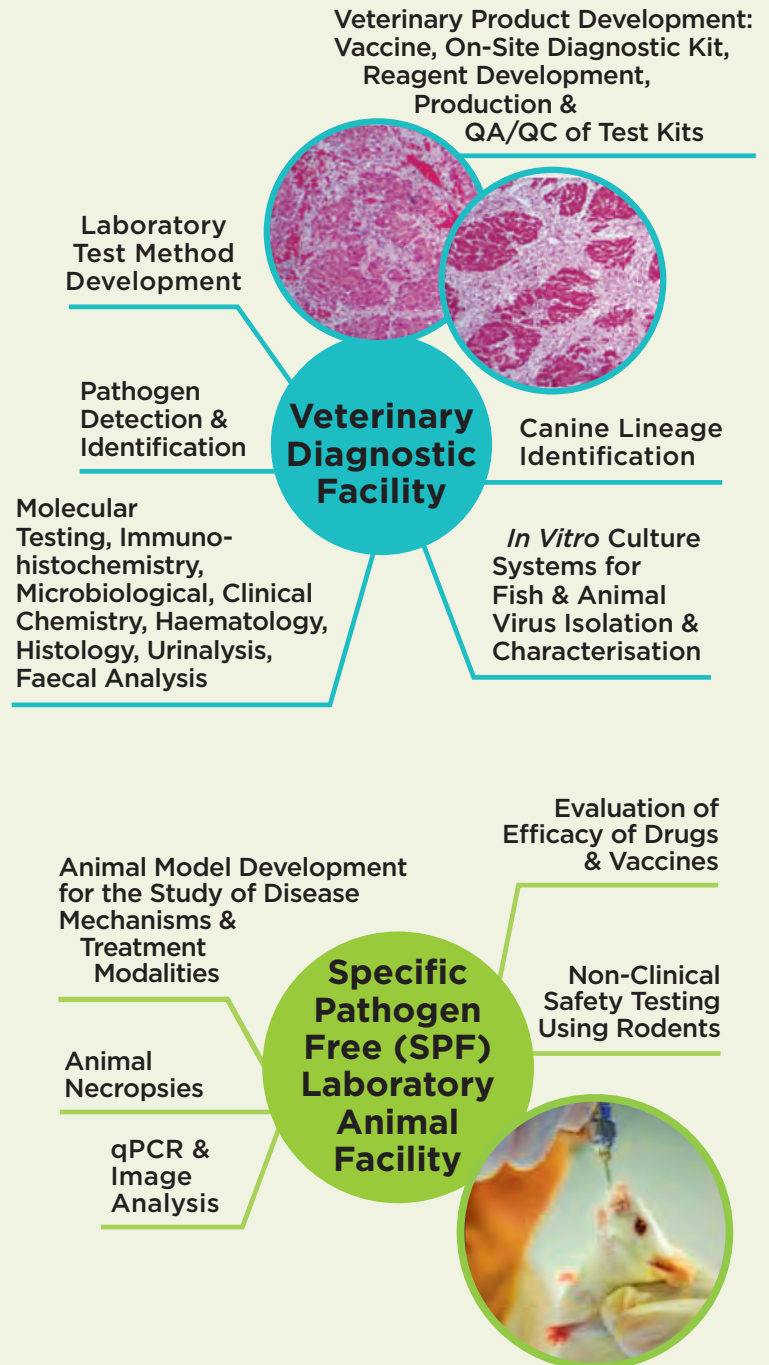


Pre-MT



Post-MT

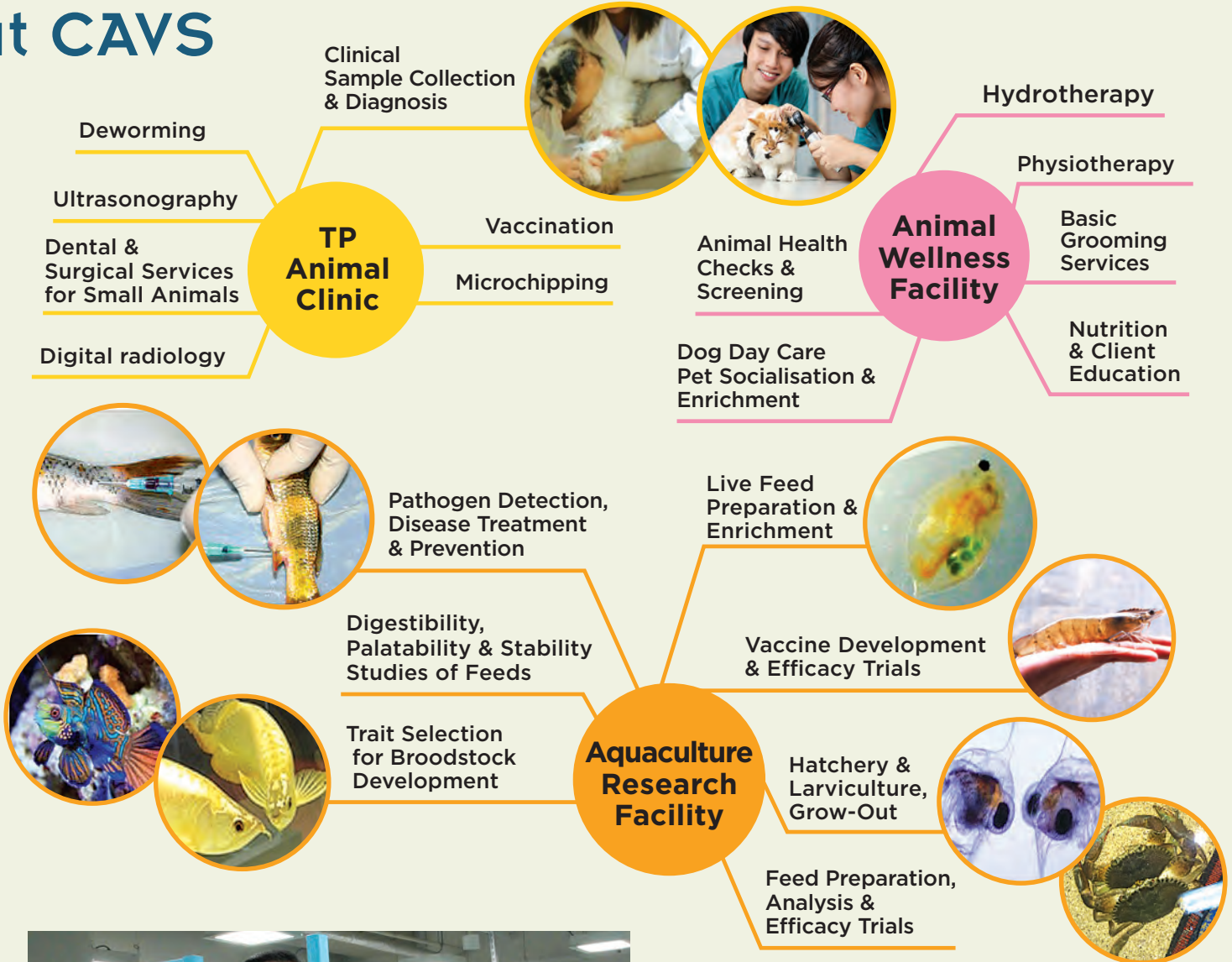
Key Services



Striving towards excellence in research and workforce training for the agrotechnology industry, particularly the aquaculture industry, CAVS will make full use of innovative technologies to support research endeavours and contract veterinary diagnostic services. With CAVS, the way is paved for closer working relationship with industry partners in capability building, applied research and development of innovative solutions.

Ongoing studies include aquaculture nutrition, diagnostics and disease prevention, genetic studies for enhanced growth performance, aquaponics and plant pest management. CAVS will not only be a training base for our own diploma students but also a provider of customised training for industry.

at CAVS



Minister of State Dr Koh Poh Koon at the CAVS launch

For more information, please contact Domain Owners:

Dr Chan Pek Sian, Diana
 Assistant Director/
 Technology Development
 T: 6780 5338
 E: peksian@tp.edu.sg

Dr Christopher M. Caipang
 Research Scientist/
 Technology Development
 T: 6780 1827
 E: ccaipang@tp.edu.sg

Applied Nutrition Services for Food & Health-Related Industries

Our integrated team of experts provides support and offers consultancy services in areas of applied nutrition and functional food to the various food and health-related industries. We have the capability to manage moderately medium-to-large-scale projects spanning different enterprises. Our Glycemic Index Research Unit (GIRU) has been at the forefront of GI testing and research, offering credible and confidential testing services.

Glycemic Index Testing & Research (SAC Accredited Facility)



Community Outreach & Education

- ✓ Public Talks
- ✓ Focus Group Discussions
- ✓ Customised Training Programmes & Workshops

Consultancy Services

- Meal Planning
 - Pre- & Post-Exercise
- Efficacy Testing
- Exercise Physiology Measurements
 - Resting Metabolic Rate
 - Energy Expenditure, VO2max

- Nutrition Assessment
 - Anthropometry & Dietary
- Computerised Analysis
 - Nutrient/Diet
- Nutrition Intervention

- Meal Planning
 - for All Age Groups Based on RDA
- Nutrition Surveys
- Health & Wellness Programmes
- Nutrition Educational Resources



- Glycemic Index & Glycemic Load
- Glycemic Response
- Insulinemic Index
- *In Vitro* GI Testing (Lab-Based)
- Amylose/Amylopectin Analysis
- Mixed Meal GI analysis

- Protocol Design
- Ethics Approval Process
- Regulatory Requirements

- Therapeutic Meal Planning
- Diet Counselling
- Appetite Studies
- Efficacy Studies --Dose Response
- Bioavailability Studies

For more information, please contact Domain Owner:

Dr Kalpana Bhaskaran
 Manager/Nutrition Research
 T: 6780 4152 (GI Lab) / 6780 5355
 E: bkalpana@tp.edu.sg

Competitive Edge through F&B Technology Solutions

To create commercial viability with a competitive edge, F&B innovation must push for novel concepts. Any development or improvement in a food product, recipe or its processes, should have emphasis on safety, quality and productivity. At ASC, our F&B technical team provides business solutions for a range of food products to meet the needs of key industries.



Beginning with novel concepts ...

CONSIDER:

- Customer-driven high value food and recipe concept development
- Technology application for your food business
- Creative product packaging applications for extended shelf-life

Moving on to develop the prototype and production ...

CONSIDER:



TYPES OF PRODUCTS

- Ready-To-Eat Meals
- Bakery Products
- Ice Cream
- Confectionery
- Snacks
- Sauces & Soups
- Desserts
- Beverages



TARGET INDUSTRIES

- Food Manufacturers
- Food Ingredient Manufacturers
- Catering & Food Services
- Hotels, Restaurants & Cafés
- Bakeries
- Food Processing & Packaging Suppliers



TECHNICAL TEAM

- Food Technologists
- Sensory Scientists
- Nutritionists
- Executive Chefs specialised in Western & Asian Cuisines
- Executive Pastry Chefs



For more information, please contact Domain Owners:

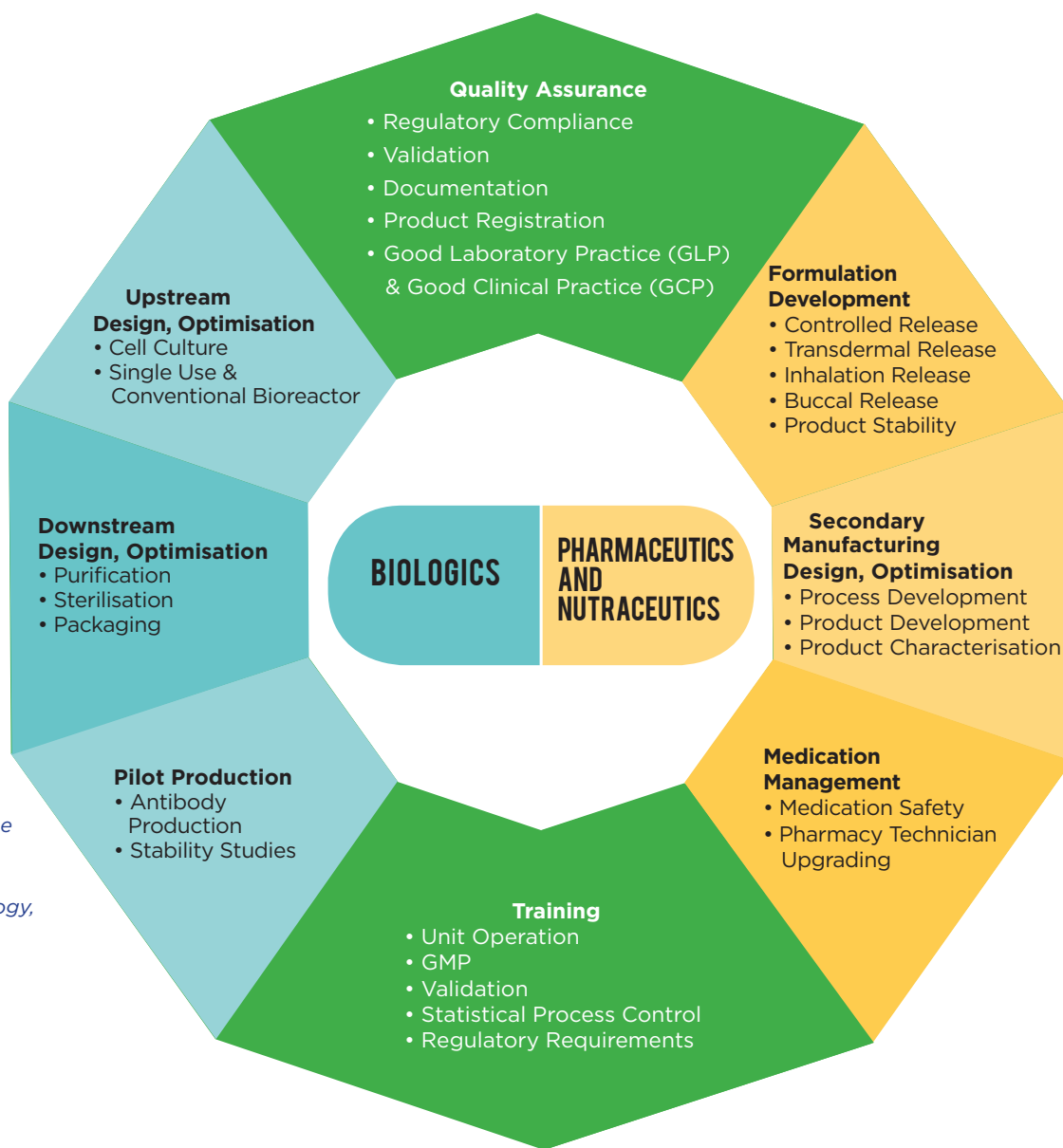
Ms Petrina Lim
Course Manager
Diploma in Baking & Culinary Science
T: 6780 6204
E: petrinal@tp.edu.sg

Dr Mabel Wang
Section Head
Food Research & Applications
T: 6780 5374
E: wangrong@tp.edu.sg

Comprehensive Suite of Services for Drug & Health Supplement Manufacturing Industry

In this domain, our Biologics, Nutraceutical & Pharmaceutical team aims to provide a comprehensive suite of services that covers production, engineering validation, quality control and quality assurance for the drug and health supplement manufacturing industry.

We have performed small-scale manufacture of proteins for research kits and conducted several pilot studies. Our team can provide current Good Manufacturing Practices (cGMP) training and consultancy services.

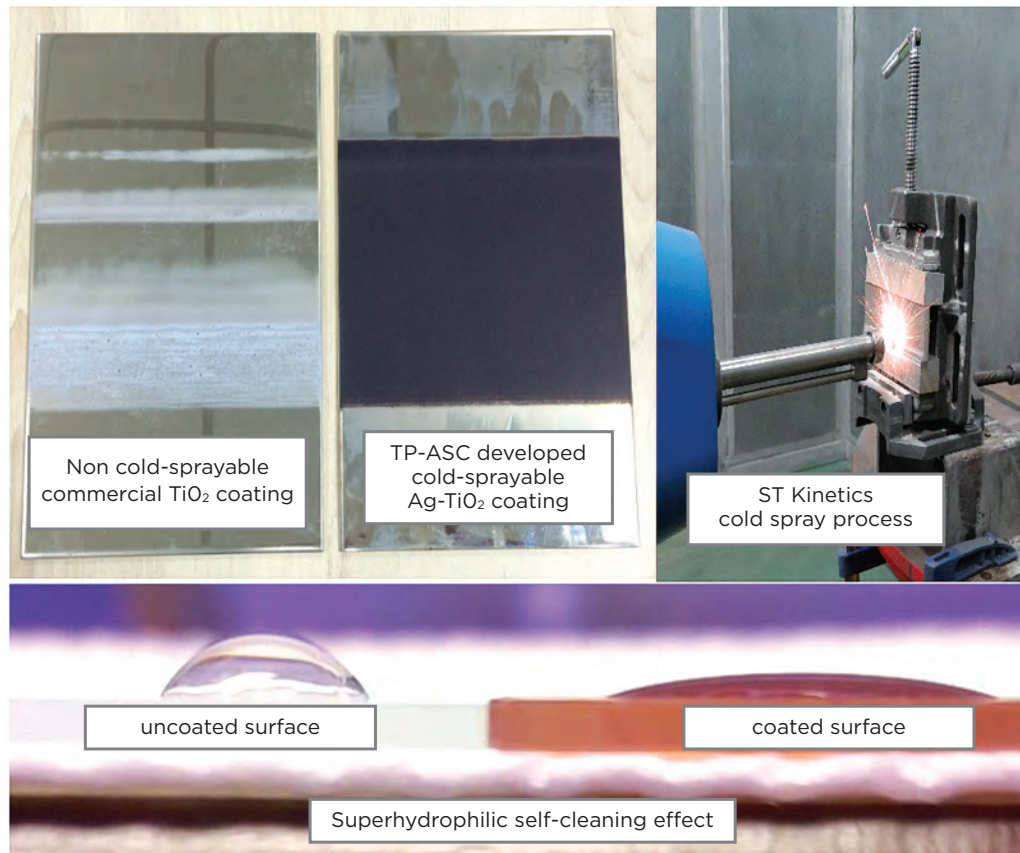


For more information, please contact Domain Owners:

Mr Lim Tse Loong Wallace
Section Head/Nanotechnology,
Technology Management
T: 6780 6215
E: wallacel@tp.edu.sg

Dr Meliana Riwanto
Lecturer/Diploma in
Pharmaceutical Science
T: 6780 6213
E: mriwanto@tp.edu.sg

Bi-Functional Cold-Sprayed TiO₂ Composites with Novel Properties



TiO₂ is a unique material with excellent photocatalytic effects contributing to bi-functional self-cleaning and antibacterial/anti-biofouling properties. For maximum photocatalytic application, the TiO₂ coating needs to remain in the anatase phase. Consequently, to achieve functional TiO₂ permanent coating, conventional spraying techniques such as thermal/plasma are not suitable as the high temperature during spraying causes an irreversible transformation of anatase into rutile phase which greatly decreases the photocatalytic activity, thus reducing the effectiveness of the coating. Cold spray, being a low-temperature process, is more suitable as it retains the anatase phase.

The challenges to kinetically cold-spraying hard ceramic materials such as TiO₂ on metallic substrates include shear instabilities after coating, causing the layers to flake off

easily. In view of the challenges and the market potential for permanent high photocatalytic TiO₂ coating, our industry partner, Singapore Technologies Kinetics Ltd (ST Kinetics) agreed with TP to co-develop novel synthetic methods to produce cold-sprayable TiO₂ composites with novel properties.

This collaboration project funded under the MOE TIF grant, allows both parties to tap on each other's expertise viz., materials development by TP and cold spray technology by ST Kinetics.

The implementation of the project will complement ST Kinetics' existing efforts to meet industry needs by developing next-generation high performance cold-sprayed materials for marine, aerospace and vehicular applications for ST Kinetics as well as commercial industries.

For more information, please contact DomainOwners:

Dr Wong Sook Fun
Programme Manager/Green Materials
Technology Management
T: 6780 6217
E: drsfwong@tp.edu.sg

Dr Cheng Jiali
Lecturer/Diploma in Chemical Engineering
T: 6780 1855
E: jlcheng@tp.edu.sg

PBR Technology for Sustainable Aquaculture

Tang Wanling, PhD
Lecturer/Diploma in Chemical Engineering

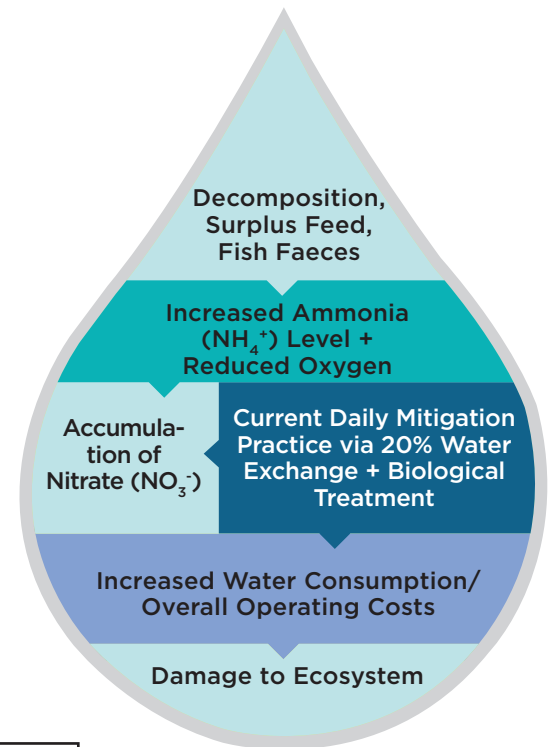
Phototrophic biofilm reactor (PBR) technology has not been adopted in Singapore, and its application in intensive aquaculture is not widely explored. However, due to the complementary requirements of both phototrophic biofilm growth and fish wastewater treatment, the application of PBR in freshwater fish farming is a possible actualisation. Such an integrated system using PBR technology is expected to greatly reduce the water consumption of freshwater aquaculture as well as the energy cost per unit of fish wastewater, thereby “greening” a sustainable aquaculture.

The current practice using conventional recirculating aquaculture system (RAS) for intensive freshwater aquaculture is

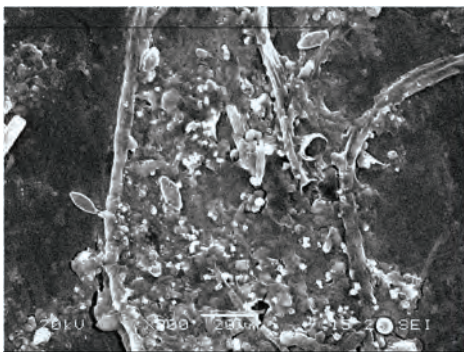
not only unsustainable, particularly when the area has limited water resources, but is clearly detrimental to the ecosystem.

Since land and water resources are limited in Singapore, our ASC research team is developing an innovative nitrogen-controlling technology in RAS which can be used for intensive freshwater fish farming. This work is currently supported by a research grant from the Tote Board (Social and Innovation Research Fund) for the development and application of PBR technology to treat fish farm wastewater.

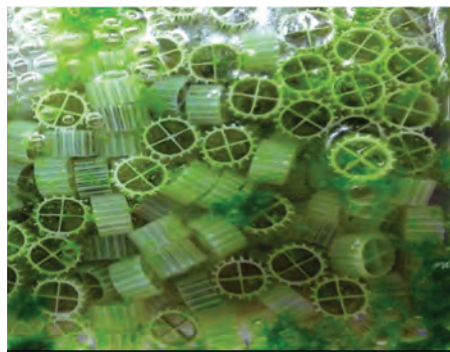
Conventional RAS in Intensive Freshwater Aquaculture



Phototrophic biofilm reactor (PBR) technology employs naturally available phototrophic biofilms and their ability to remove nitrogenous compounds from fish wastewater by assimilation, nitrification and denitrification.



Phototrophic biofilm observed under SEM (scanning electron microscopy)



Phototrophic biofilm formed on plastic carriers in PBR cultivation tank

For more information, please contact Domain Owners:

Dr Wang Shy Chyi
Section Head/Water Technology
Technology Management
T: 6780 6219
E: scwuang@tp.edu.sg

Dr Huang Zhi
Research Scientist
Technology Management
T: 6780 6425
E: huangzhi@tp.edu.sg

Cutting-Edge Chemical Analysis Technologies for Industry

Matthew Kong, PhD

Section Head/Analytical Science, Capability Development

The chemical testing domain of ASC aims to bring cutting-edge chemical analysis technologies and expertise closer to local industries. In particular, SMEs will benefit from TP's chemical testing expertise and can tap into TP's facilities and capabilities to conduct product testing, evaluation and staff training. This will help SMEs to move up the value chain through product innovation and capability building, and accelerate their growth in a more cost-effective way.

The key services we offer include:

- Food Safety Testing, i.e. Heavy Metals, Microbial, Multi-Residual Antibiotics and Pesticides in Food and Complementary Health Products (CHP)
- Chemical Profiling of CHP for QA/QC and Authentication
- Product Efficacy & Safety Studies
- Product Stability Studies
- Pharmacokinetic Studies
- Metabolomics Studies
- Proteomics Studies



Detecting metals using ICP-MS



Detecting contaminants such as banned substances using ELSD (Evaporative Light-Scattering Detector)

Our state-of-the-art technology development is carried out in facilities that include:

- SINGLAS-Accredited Chemical and Microbiological Laboratory
- Agilent Partner Laboratory @ TP
- Metabolomics Research Facility
- Proteomics Research Facility
- High Performance Liquid Chromatography (HPLC)
- Gas Chromatography-Mass Spectrometer (GC/MS)
- Triple Quadrupole Liquid Chromatography-Mass Spectrometer (LC/MS)
- Quadrupole Time-of-Flight (Q-TOF) LC/MS
- Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
- MALDI TOF/TOF Analyser



For more information, please contact Domain Owners:

Dr Tian Feng, Edmund
 Manager/Analytical Science
 Capability Development
 T: 6780 4165
 E: ftian@tp.edu.sg

Dr Ong Seng Poon
 Deputy Director/Capability Development
 T: 6780 6423
 E: sengpoon@tp.edu.sg

In Vitro and *In Vivo* Testing of Biological Materials and Devices

In Vitro Capabilities

- Custom Design and Testing Approaches for Industries
- Cell Based Biological and Non-Biological Chemical Reactivity Assays for Safety and Toxicity Testing of Raw Materials and Finished Products
- Focus on Health Care Products Testing and Validation
- Custom Development and Performance Validation of Diagnostic Tests



In Vivo Capabilities

- Development of Pathological Models for Studies on Disease Mechanisms and Treatment Modalities
- Pain and Behavioural Studies in Small Animals
- Systemic Toxicity (Acute) and Toxicity Tests (Acute to Sub-Chronic)
- Testing of Implantable Medical Devices
- Animal Models for Efficacy Studies on Health Supplements and Cosmetics
- Dermal/Ocular Toxicity Studies
- Allergenicity/Hypersensitivity Studies
- Design and Analysis of PK/PD



POC (Point-of-Care) Test Capabilities

- Custom Design and Development of Optical and Electrochemical Sensors
- Sample Preparation Methodologies for Small and Large Volume Analysis – Clinical, Food, and Environmental Sources
- Development of Hybridoma, Purification and Labeling of Antibodies
- Synthetic Antigen and Probes for Pathogens and Biotoxins



For more information, please contact Domain Owners:

Dr Padmanabhan Saravanan
Section Head/Medical Diagnostics
Technology Development
T: 6780 4235
E: psaravan@tp.edu.sg

Dr Kadamb Patel
Program Manager/Biosensors
T: 6780 6203
E: kadamb@tp.edu.sg

Exciting Emerging Time for Biostatistics, Bioinformatics & Biomodelling

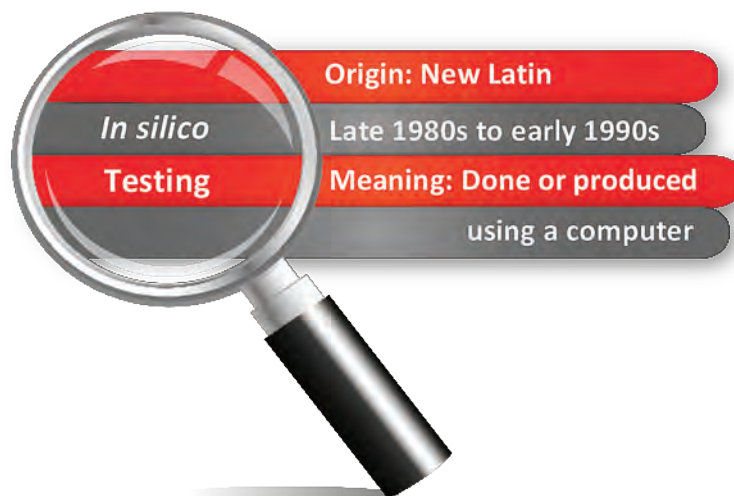
The phrase *in silico* literally means *in silicium* (the Latin word for *silicon*, alluding to a computer chip).

In silico testing is an exciting emerging field of using computer simulations and models to assist scientists in drug discovery or in understanding compounds, and in predicting how they will interact with proteins, for example.

At ASC, the *In Silico* testing domain has been in formal operations since 2015. This domain has three competency areas - Biostatistics, Bioinformatics and Biomodelling. To date, the domain offers courses in Biostatistics for Pre-Employment Training (PET) and Continuing Education & Training (CET) as well as a PET elective, *Scripting in Bioinformatics*.

Our team is also ready to offer services to scientists who require assistance in analysing their data statistically. We will be embarking on projects with external agencies in the areas of both Biostatistics and Bioinformatics, within the year.

Internally, ASC staff can also look forward to a series of workshops on Statistics, Statistical Analysis using Excel, SPSS, R, and Python.



For more information, please contact Lead Domain Owner:

Ms Chew Swee Cheng
 Manager/Mathematics & Statistics
 Manager/IDM Technology & E-Learning
 T: 6780 5350
 E: chewsc@tp.edu.sg

ANALYTICAL SCIENCE

At ASC, analytical science underpins our research work in areas such as Chemical, Biological, Functional and *In Silico* Testing. With our state-of-the-art analytical capabilities, analytical science has been the enabler of innovative solutions for our industry partners, as we carry out projects on ascertaining product quality, safety and efficacy.

Our teams are multidisciplinary, and our chemical and microbiological laboratories have been SAC-SINGLAS accredited since 2009 for food safety testing, alcohol testing, and porcine DNA testing. We constantly strive to scale up our analytical capabilities to deliver novel answers for enterprises seeking competitive advantages and sustainability.



Medical Technology

- Animal Model
- Diagnostics
- Proteomics & Protein Technology
- Trauma care



Agri-Food Technology

- Applied Nutrition & Food Technology
- Aquaculture
- Plant Biotech
- Traditional Medicine



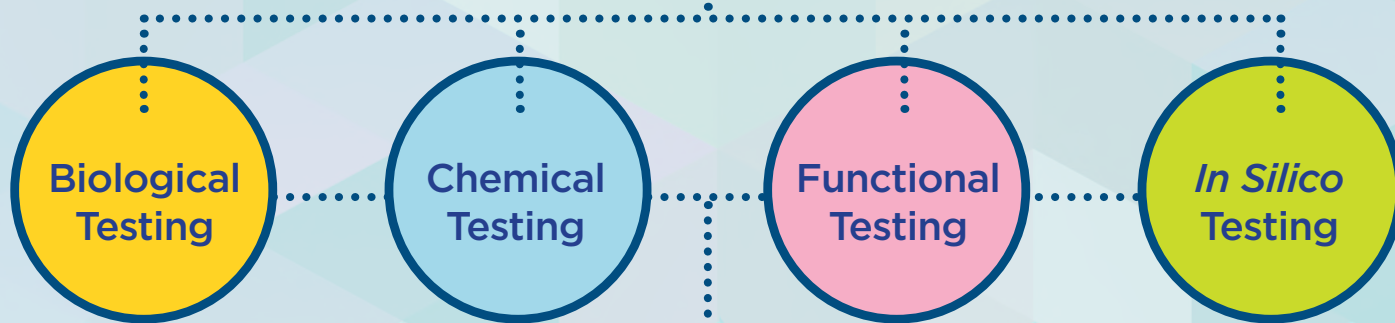
Renewable Resources Technology

- Biofuels
- Green Materials
- Water Technology

at ASC

Innovation Enabled by State-Of-The-Art Analytical Capabilities

Analytical Science Capabilities



Competencies

- *In Vitro* Bioassays/ Assays
- *In Vitro* Manipulation & Validation
- OMICS Technology
- Quantitative Analysis of CAM/Food Ingredients
- Analytical Method Development, Optimisation & Validation
- Metabolomics
- *Pre-clinical in vivo* Testing
- Clinical Testing
- Biostatistics
- Bioinformatics
- Biomodelling

Innovative Technology to Modernise Complementary Health Products Industry



Senior Minister of State Dr Amy Khor at the COI-CHP launch

Temasek Polytechnic, in collaboration with SPRING Singapore, established the Centre of Innovation for Complementary Health Products (COI-CHP) in 2016, the first of its kind in Singapore.

The complementary health products (CHP) industry is rapidly growing in many regions around the world, including North America, Europe and Asia Pacific. The sector is particularly vibrant in the Asia Pacific region, which is leading all the other regions around the world across the three main categories of complementary health products - traditional medicines, health supplements and functional foods.

The COI is a dedicated one-stop resource centre to support the modernisation of the CHP industry through the use of technology innovation to facilitate evidence-based CHP, focusing on product quality, safety and efficacy. Integrating a research-intensive, industry-centred environment, the Centre offers innovative and creative solutions for technical challenges faced by Small and Medium Enterprises (SMEs). SMEs can leverage on our scientific capability to increase their business opportunities in cost-effective ways and gain a competitive edge on a global scale.



For more information, please contact:

**Centre of Innovation
for Complementary Health Products**
T: 6780-4280
E: coi-chp@tp.edu.sg

Traditional Medicine (TM)

Authentication, standardisation and quality control are vital steps in the development and manufacturing of TM products. With our analytical science expertise, we can help to ascertain the quality, safety and efficacy of these products.

The COI's analytical capabilities go beyond routine testing and quality control or assurance. Assessing the authenticity and safety of novel and innovative products is a key part of our business. We use advanced techniques such as High Performance Liquid Chromatography (HPLC), Mass Spectrometry (MS) and DNA fingerprinting, to identify and quantify main chemical components in each herb or formulation.

In 2009, Temasek Polytechnic became the first tertiary institute to obtain SAC-SINGLAS laboratory accreditation in chemical and microbiological testing. The COI has since been accredited for more than 30 tests, such as alcohol and porcine DNA for *halal* testing.

Chemical and biological tests include:

- Alcohol Testing
- Quantification of Active Ingredients
- Chemical Profiling
- Porcine DNA Detection
- Antioxidant Testing

Measuring DNA concentration using state-of-the-art Nano Spectrophotometer



Extraction of compounds from TCM herbs



Isolating potential pathogens



Innoculating suspected pathogen



Loading DNA samples into PCR machine

Health Supplements

As consumers become more discerning, they are also increasingly selective about what they consume. Hence, over the last few years, health supplements, vitamins and dietary supplements have come under greater scrutiny. Toxicity and efficacy studies are therefore of paramount importance when new products are introduced in the market, or when existing products are reformulated. This would increase consumer confidence, allowing enterprises to remain competitive, tapping into new markets.

The COI has developed capabilities to conduct pre-clinical studies using animal models. Preclinical studies can be complemented by human clinical trials, in collaboration with Changi General Hospital Clinical Trials Research Unit (CTRU), to help verify a product's benefits or uncover any potential adverse events related to its use.

Safety and Efficacy Tests include:

- Toxicity Studies using Animal Models
- Heavy Metal Testing
- Stability Studies
- Residual Pesticide Analysis
- Microbial Testing
- Banned Substance Testing
- Efficacy Studies using Human Clinical Trials



Conducting microbial and molecular testing

Functional Food Testing & Research

Functional foods offer great potential to improve health and help prevent certain diseases, when taken as part of a balanced diet and healthy lifestyle. Innovative incorporation of functional ingredients into food products will offer added value to consumers viz., they not only help consumers to lead a healthy lifestyle but more importantly, they are critical for the prevention and management of diet-related chronic illnesses, such as diabetes, cardiovascular diseases and stroke.

Our integrated team of experts provide consultancy services in food, nutrition and culinary applications to the various food and health-related industries.

The COI houses the Glycemic Index Research Unit (GIRU), the first SAC-SINGLAS accredited facility in Asia to conduct GI testing and research. It is also the first GI testing facility in the world to analyse the GI values of Asian foods. To date, our team has tested over 400 foods for their GI values.



Black carrot cake



Roti prata



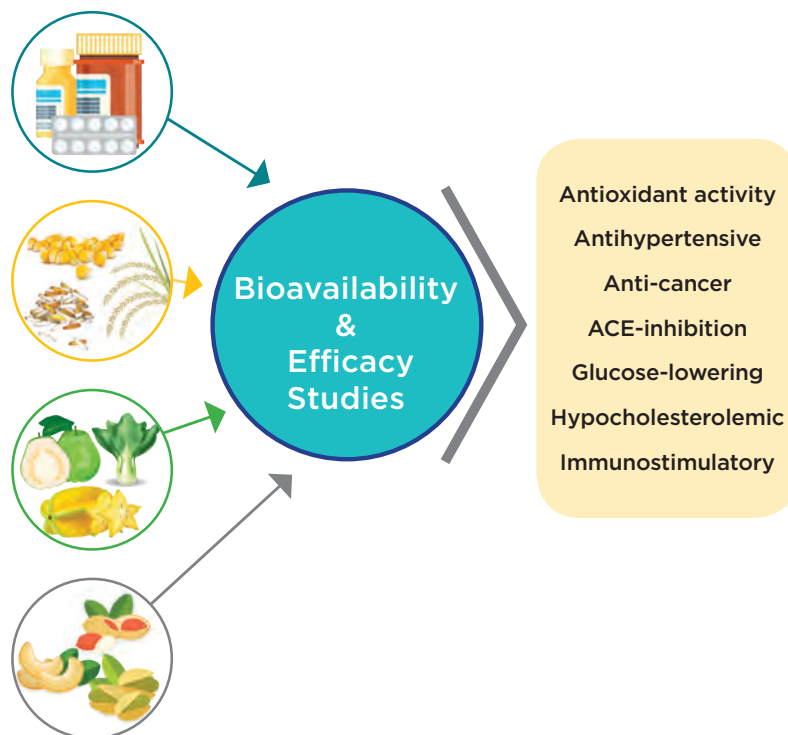
Chwee kueh



Capillary blood samples for GI Testing

Key services include:

- Applied Nutrition Research & Consultancy
 - Efficacy Studies - Dose Response
 - Bioavailability Studies
 - Nutrition Intervention
- Testing:
 - *In Vivo* & *In Vitro* Glycemic Index (GI)
 - Glycemic Response (GR)
 - Insulinemic Index and Insulinemic Response
 - Available Carbohydrate Analysis
 - Amylose/Amylopectin Analysis



Simultaneous Determination and Analysis of Antibiotic Residues in Shrimp

*Xue Xuejia, PhD, Lecturer/Capability Development
Attapol Pinsa, PhD, Lecturer/Chemistry Division*

The global surge in demand for shrimp has inevitably led to the pervasive use of antibiotics by shrimp farmers to improve the survivability and yield of farmed shrimp. However, this poses health risks for consumers, as consumption of tainted shrimp (and other similarly tainted seafood) may result in accumulation of antibiotics in the human body.

Noting this phenomenon, our researchers from the Analytical Science team at ASC have developed a rapid instrumental method for targeted detection of antibiotic residues in shrimp – a method that is based on state-of-the-art liquid chromatography and mass spectrometry (triple quadrupole) technology, allowing for accurate analyses with a relatively high throughput. This improved analytical method can

be used to analyse more than 40 antibiotics simultaneously, while maintaining sensitivity and efficiency of the analyses. Our study is an extension of previous research done elsewhere which only analysed between 10 and 15 antibiotics at the same time.

We will continue to advance this study by adding new antibiotic compounds to the database, as well as optimising the method to improve its sensitivity and throughput. Meanwhile, our findings can be used to educate local food importers and retailers about the potential antibiotic contamination of shrimp-based products. More importantly, they can be used to help reduce the health risks to consumers by raising their awareness of the dangers of inadvertently consuming antibiotic residues.

- Shrimp is a low-calorie, high-nutrient source of protein, increasingly preferred over red/white meats by health-conscious consumers.
- Global market for shrimp consumption is estimated to be worth over USD15 billion; farmed shrimp accounts for >50% of total world shrimp production.
- Demand for shrimp is rapidly rising in developed countries such as USA, Western Europe, and Japan.

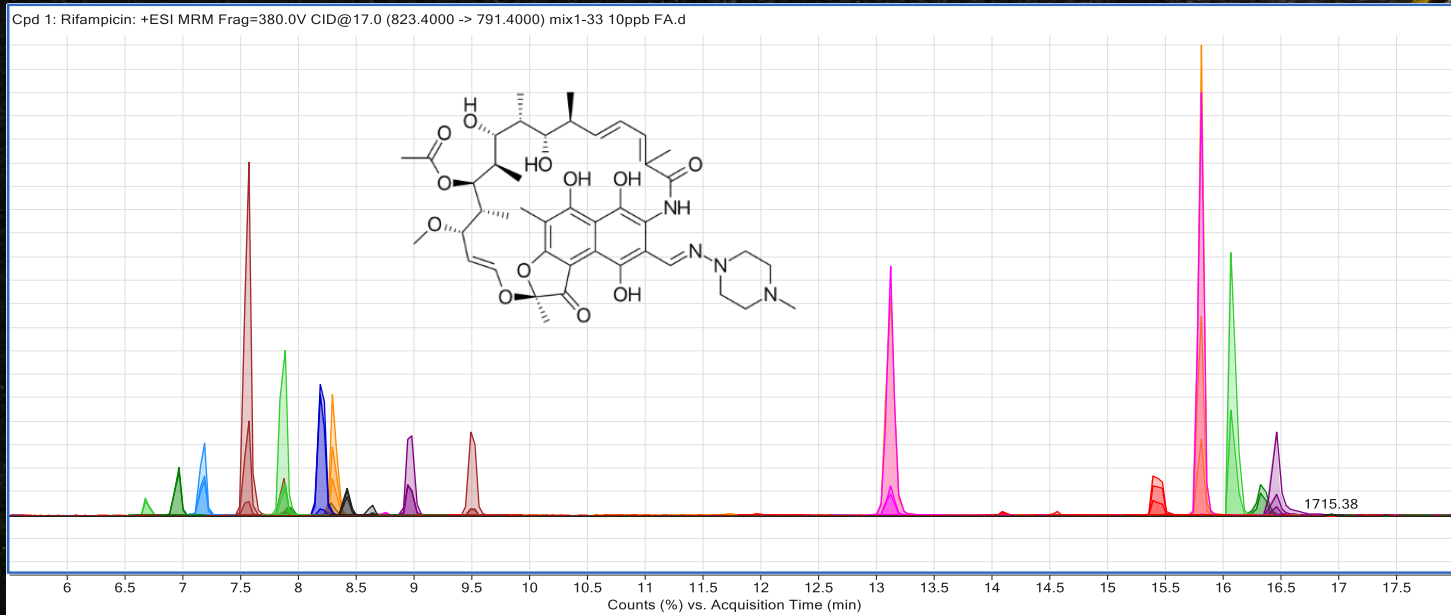
Our improved method has a large database of antibiotic residues, applicable to a wide range of shrimp-based products. Sophisticated liquid chromatography and mass spectrometry techniques allow efficient analyses with high throughput.



Setting up the LC/MS instrument



Rows of vials of samples for simultaneous analyses



A Quick and Novel Approach to Certifying Products Containing Antioxidants

*Yang Hong, PhD and Xue Xuejia PhD
Lecturers/Capability Development*



Antioxidants are a class of chemical compounds found in many types of fruits and vegetables. These compounds have attracted increased interest from the general population in recent years, due to wide publicity on their potential health benefits. Retailers of food products containing these compounds have also capitalised on this increased interest, readily marketing their products as “high in antioxidants” or “rich in antioxidants” in order to draw increasingly health-conscious consumers to their products.

Observing this trend, researchers at ASC have successfully secured funding for a project that is focused on developing an analytical method for determining the antioxidant levels in foods, health supplements, and herbal products. The development of

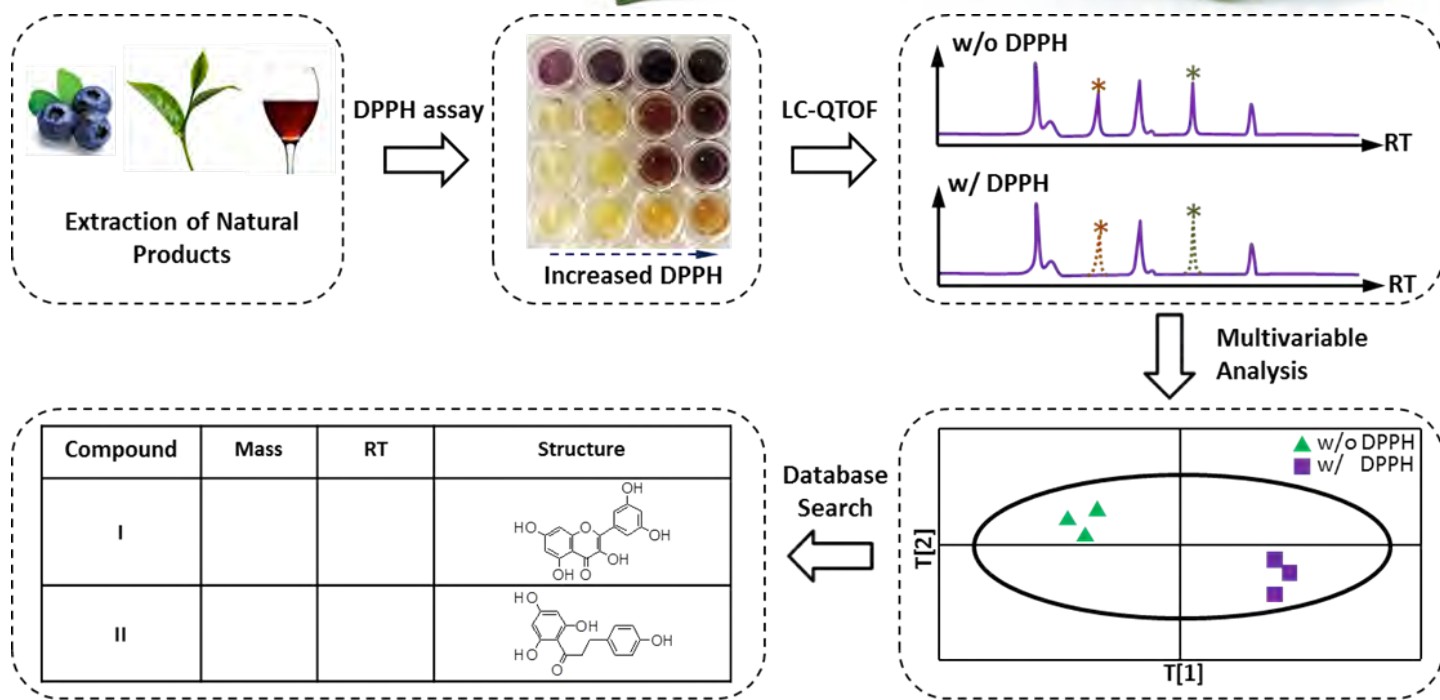
this analytical method will be followed by the development of a certification process as well as a logo, clearly showing that these food products do indeed contain compounds with high antioxidative capacities. This study is ongoing, and is funded by the Ministry of Education through the MOE-Translational and Innovation Fund (MOE-TIF). The results from this study could potentially allow local enterprises to differentiate their products from competitors, as their products will be reliably certified as “super antioxidative”.

As this research project progresses, a comprehensive study will be carried out to develop a large database of commonly occurring antioxidants in food products. A mathematical model capable of determining the relative antioxidative strengths among these compounds will also be established, allowing researchers to evaluate the overall antioxidative capacities of the food products tested. Such intricate analyses involving a large number of different chemical compounds can only be accomplished with state-of-the-art high-resolution analytical instruments

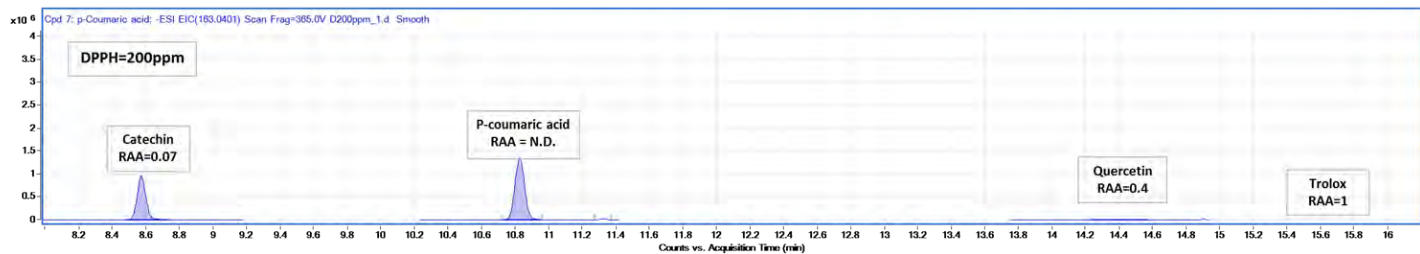
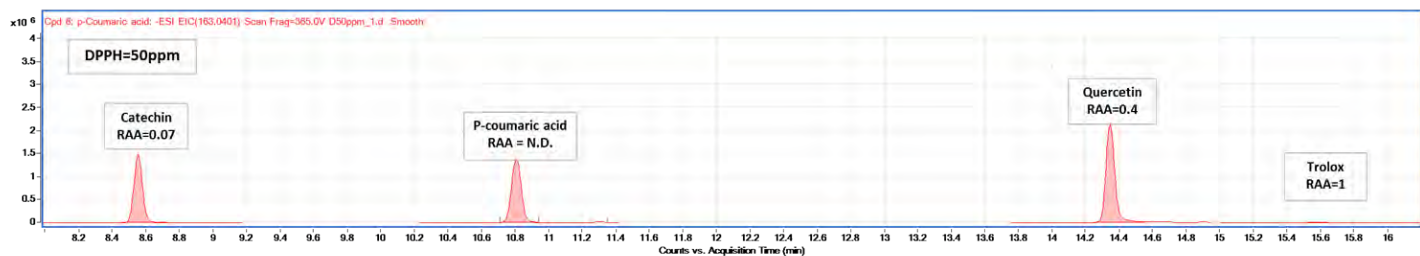
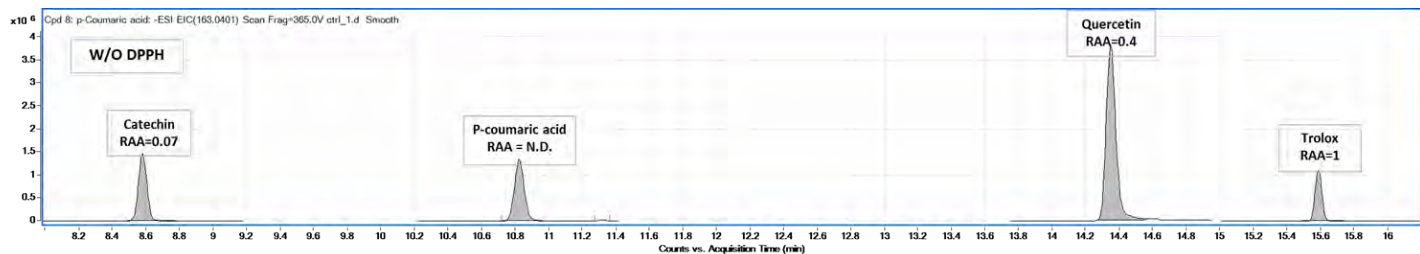
– namely, the Liquid Chromatography-Quadrupole Time-of-Flight (LC-QTOF) mass spectrometer in ASC’s Agilent Partner Laboratory.

Currently, more than 60 antioxidant compounds have been discovered, with over 20 successfully identified. Our Analytical Science research team will continue to add to these numbers, with the eventual goal of creating a database of information on a large number of compounds that display antioxidant properties. This work can be applied to traditional medicines, herbal remedies, and health supplements. It also presents an opportunity to give products in this space a competitive advantage. We are grateful to have received immense support for this project from companies such as H.W. Traditional Medicine Pte. Ltd and Thy Shan Medical Hall Pte. Ltd.

Collaborations such as these will go a long way towards value-adding to the local industry, as ASC continues its commitment in supporting their products through its developed capabilities.



Workflow for the discovery of antioxidant compounds by DPPH-LC-QTOF



Chromatograms of compounds demonstrating different antioxidant activities

Detection of Advanced Glycation End-Products (AGEs) in Local Foods



Tian Feng, Edmund, PhD
Manager/Analytical Science/Capability Development

Matthew Kong, PhD
Section Head/Analytical Science/Capability Development

The AGE database will include a wide range of food products including meats and pastries.

The food industry in Singapore has become increasingly developed and sophisticated in recent years. With an unprecedented rise in the number of cafes, restaurants, and other fine dining establishments, it is clear that food plays a major role in the lives of Singaporeans. However, a consequence of becoming an increasingly developed country is the corresponding increase in diet-related diseases such as obesity and diabetes. Many studies have shown that our dietary habits have contributed immensely to the spike in these diseases among Singaporeans.

As a result, it is important for scientists to continually develop improved methods and technologies that can detect and quantify chemical components in food that may contribute to the onset of these diseases. One class of these compounds are known as Advanced Glycation End-Products (AGEs). These compounds are present in many food products, in particular, foods that are deep-fried or barbecued. High temperatures used in these cooking methods result in foods having higher AGE content.

Deep-fried foods such as you tiao are known to contain significant amounts of AGEs.



Research has shown that consumption of these compounds can increase the risk of developing Type 2 Diabetes. This has led researchers at ASC to initiate a project involving the analysis of AGEs. Using state-of-the-art chromatographic and mass spectrometric techniques, this project will focus on the development of a fast screening method of AGEs in food matrices, with the aim of establishing a database of over 100 food products and their AGE content. This food database will even provide information on the AGE content in local favourites such as laksa, curry puffs, and roti prata. This information can then be used for health promotion

and disease prevention programmes to raise awareness among Singaporeans about the amount of AGEs that they are consuming, thereby empowering them to make better dietary choices.

The Singapore Government has recently declared a “War on Diabetes”, revealing that this disease costs the country over \$1 billion annually in healthcare. This declaration is in line with the project that our ASC researchers are working on, and we are confident that our work will contribute meaningfully in improving the health of Singaporeans.

State-of-the-art LC-MS technology enable development of a comprehensive database for AGE content of different foods





 **Temasek**
POLYTECHNIC | **School of Applied Science**

21 Tampines Avenue 1 Singapore 529757

Tel: (65) 6788 2000 | Fax: (65) 6782 5498 | Email: ASchotline@tp.edu.sg | www.tp.edu.sg

