

Local & Low
G.I.
Pg.14

**BACTERIA
ALERT!**

Pg.18

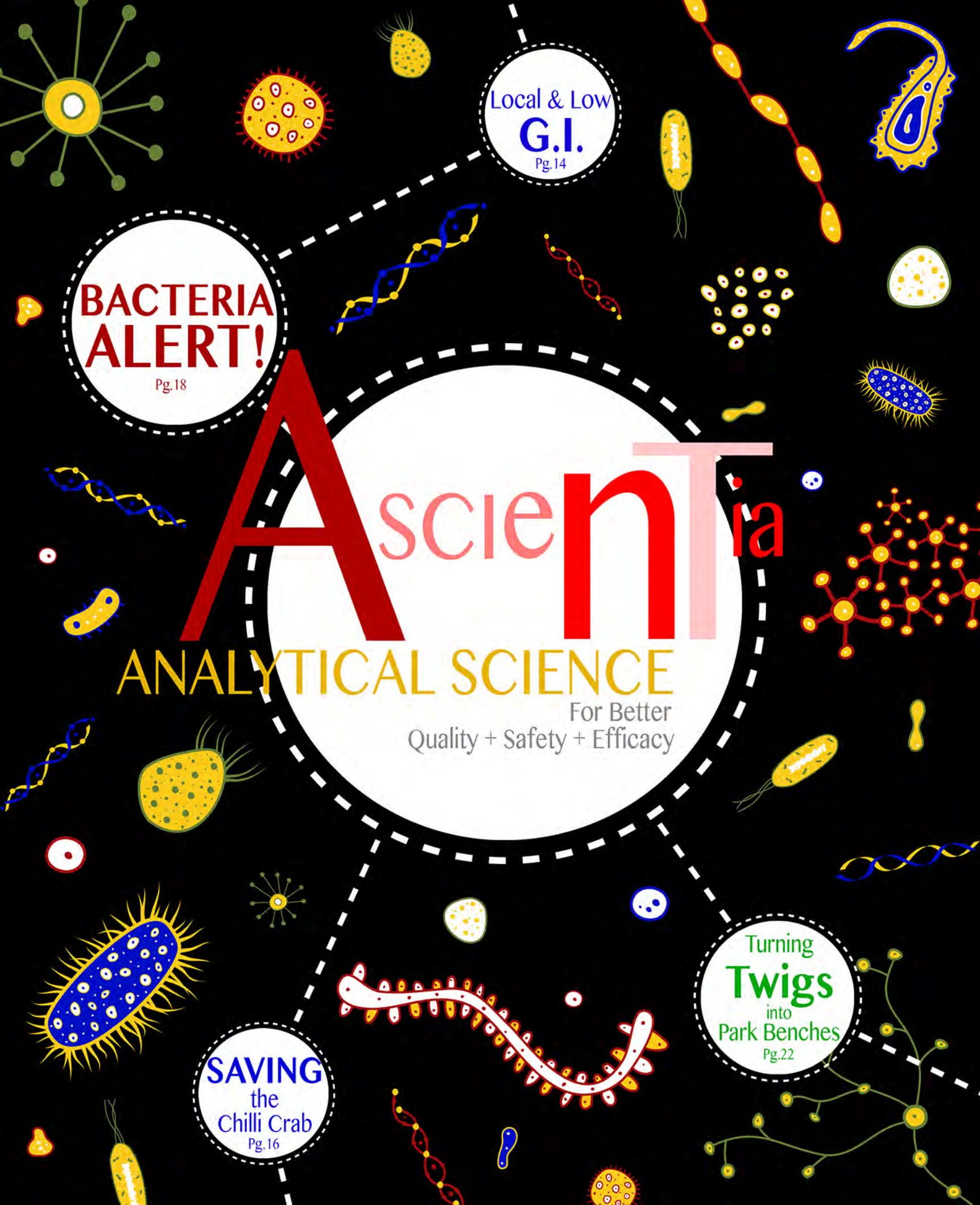
Ascentia

ANALYTICAL SCIENCE

For Better
Quality + Safety + Efficacy

**SAVING
the
Chilli Crab**
Pg.16

Turning
Twigs
into
Park Benches
Pg.22



BETTER

Quality + Safety + Efficacy
with Analytical Science



DEVELOPING THE
WORLD'S FIRST
Local Asian Food
GI Database

Contents

6 - 7

4 OUR CORE CAPABILITIES

CENTRE FOR
TRADITIONAL MEDICINE **8**

10 AQUACULTURE R & D
IN TEMASEK POLYTECHNIC

HALAL TESTING:
A MEATY ISSUE **12**

22

16 RESEARCH ON MUD CRABS
AWARDED MARINE LIFE FUND

MODELLING LIVER FIBROSIS
IN RATS **20**

Turning
Twigs
into
Park
Benches

26 PART TIME
DIPLOMA COURSES

DIRECTORY OF
SERVICES **29**

18

**BACTERIA
ALERT!**





Director's Message

Small and Medium Enterprises (SMEs) play an important role in Singapore's economy. Our SMEs currently account for over 99% of enterprises in Singapore, make up half of our GDP and employ two-thirds of the workforce. However, SMEs have limited resources in capability development, and many do not have the ability to access, analyse and evaluate scientific information. These limitations may impact negatively on their productivity, thus hampering their ability to achieve their business objectives.

One way SMEs can overcome these challenges is by partnering an institution like Temasek Polytechnic. And here at the School of Applied Science, we have a good track record of helping SMEs. In particular, our capabilities in Analytical Science have been applied to consultancy services in a wide range of industries such as traditional medicine, food, aquaculture, renewable resources, pharmaceutical as well as medical technology.

We provide high value, low volume testing services to SMEs. The technical assistance helps enterprises to reduce cost, gain access to capability development to enhance productivity, and build SMEs' competitiveness, allowing them to move up the value chain.

In short, by partnering us, SMEs gain an edge in economic competitiveness and technology innovation.

To further strengthen our leading position in Analytical Science, we have established a strategic alliance with Agilent Technologies, the world's leading measurement company. The new Agilent Partner Laboratory @ TP is the first Agilent Authorised Partner Laboratory in the Asia Pacific region. TP will leverage on the strategic partnership with Agilent to facilitate innovation for local enterprises, thus helping SMEs to attain their business goals.

Finally, I hope that the research projects highlighted in this publication will give you an insight into our core capabilities, and the kind of support we can give your company. We look forward to collaborating with you!

Lee Chee Wee (Dr)
Director
School of Applied Science

SCHOOL OF AP

Agri-Food Technology

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

Inno
Enab
State-Of
Anal
Capab

ANALYTICA

APPLIED SCIENCE

novation
led by
f-The-Art
ytical
ibilities

Medical Technology

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

Renewable Resources Technology

- Biofuels
- Green Materials
- Water Technology

AL SCIENCE

At a GLANCE

Our Core Capabilities

Agri-Food Technology

Key Accomplishments

- Establishment of two Centres of Excellence – the Centre for Applied Nutrition Services and the Centre for Traditional Medicine
- The first tertiary institution in Singapore to receive SAC accreditation for chemical and microbiological testing
- Publication of the first English-language book on HPLC fingerprinting of Chinese medicinal herbs
- The first facility in the world to achieve certification by an accreditation body for glycemic index testing
- Numerous research collaborations with MNCs, SMEs, hospitals, and government agencies

Target Industries

- Food & beverage
- Food production
- Sports & wellness
- Hospitals
- Food & ornamental fish farms
- Traditional medicine, health supplements, nutraceuticals, and cosmetics

Key Accomplishments

- Our Diagnostics team focuses on developing point-of-care testing platforms and nanotechnology-based biosensors with applications in aquaculture, medical care, and food- and environment-related industries.
- Our Proteomics & Protein Technology team is developing cost-efficient platform upstream and downstream processes for protein production, and utilises state-of-the-art proteomics techniques to authenticate animal medicinal ingredients.
- Our Animal Model team conducts animal studies for evaluation of nutraceutical products.
- Some of our collaborators include Singapore General Hospital, Changi General Hospital, Health Sciences Authority, Institute of Biotechnology and Nanotechnology, and Institute of Material Research and Engineering.

Target Industries

- Pharmaceutical, nutraceutical, and health supplement manufacturing
- Biomedical and life science

Renewable Resources

Key Accomplishments

- The team comprises scientists and engineers with core expertise in Water Technology, Green Materials, and Biofuel.
- Working with our industry partners, we have carried out projects ranging from design of wastewater treatment, optimisation of recirculating aquacultural systems (RAS), recycling of solid wastes into building materials, to bacterial strain development for enhanced biofuel production.

Target Industries

- Water & environment
- Aquaculture
- Solid waste
- Construction



Analytical Science Capability



Better **QUALITY** + **SAFETY** With **Analytical Science**

The School of Applied Science supports Small and Medium Enterprises (SMEs) in product development, product quality and innovation. Our Analytical Science capability forms the confluence of all in-house R&D as well as the workhorse for providing the industry with access to state-of-the-art testing facilities to drive commercial success.

Our capability in Analytical Science allows us to provide specialised high value services to industry. These include chemical profiling of functional food products, analytical method development and validation. We are a technology transfer partner supporting companies in the study of product safety, quality and efficacy.

Our laboratories are equipped with high end analytical instruments such as Q-TOF liquid chromatography mass spectrometers (LC/MS), QQQ LCMS, MALDI TOF/TOF mass spectrometer, flow cytometer, x-ray diffraction analyser, and inductively coupled plasma spectrometer.

OUR KEY SERVICES INCLUDE:

Traditional Medicine

- Authentication
- Elucidation and quantification of active ingredients
- Evidence-based product development
- QA/QC

Food and Nutrition

- Authentication & identification of active compounds
- Food safety and quality control
- Nutrition labeling

Aquaculture

- Analysis of water quality
- Analysis of feeds
- Analysis of nutritional value of products

Pharmaceutical

- Characterisation of drug candidates
- Safety and efficacy studies
- Stability studies
- Analysis of Pharmaceutical residuals
- Pharmacokinetic studies

Forensic science

- Crime/accident scene sample analysis
- Analytical reporting for litigation

Environment

- Trace compound quantification

Material science

- New material characterisation
- Materials QC
- Synthetic compounds and nanomaterials development

PROJECTS

Over the years, we have completed numerous consultancy projects with more than 50 companies. Some of our completed projects include:

- **H.W Traditional Medicine Pte Ltd**
Product QA/QC and product development
- **Tai Tong Ah Pte Ltd**
Product QA/QC and product development
- **Dawyn International Pte Ltd**
Product QA/QC and efficacy studies
- **Diabetics Specialities Pte Ltd**
Product development
- **Danone Centre for Specialised Nutrition, Singapore**
Product development
- **GSK**
Product pre-clinical and clinical studies
- **Nestle**
Product innovation
- **The Dow Chemical Company**
Development of functional food
- **Wyeth Nutrition**
Product QA/QC and nutrition labelling

Y + EFFICACY

OUR FACILITIES

- AVA licensed animal facility
- Culinary kitchens (Asian, Western, and Baking)
- Glycemic Index Research Unit
- Metabolomics research facility
- Plant biotechnology laboratory
- Proteomics research facility
- SINGLAS-accredited chemistry and microbiology laboratory

**Agilent Partner
Laboratory @ TP**



CENTRE FOR TRADITIONAL MEDICINE (CTM)

With an integrated approach to present TCM capabilities to industry, we are a one-stop centre offering a wide range of services from consultancy to training and research activities.

TCM CAPABILITY AREAS

TM PROFILING AND AUTHENTICATION

- Authentication, standardisation and quality control are vital steps in development and manufacturing of TM products.
- Our services in TM Profiling and Authentication use advanced techniques such as High Performance Liquid Chromatography (HPLC), Mass Spectrometry (MS) and DNA fingerprinting to identify and quantify the main chemical components in each herb or formulation as well as across different batches.

CHEMICAL AND MICROBIAL TESTING

In our SAC-SINGLAS Accredited Chemistry and Microbiology Laboratories, we provide the following chemical and microbial testing for the TM manufacturers:

- Residual Pesticides Contamination
- Toxic Heavy Metals
- Microbial Limits

FORMULATION DEVELOPMENT AND STUDY

There is a need for TM companies to expand its customer base as well as to meet consumers' demand for new products. Our multi-disciplinary team is able to help companies develop new products or re-formulate its existing products to target new market segments.

DEVELOPMENT OF FUNCTIONAL FOOD PRODUCTS

Catering to a burgeoning health-conscious society, our team of food scientists/technologists, nutritionists and chefs creates food products incorporating traditional herbs.

GOOD MANUFACTURING PRACTICES (GMP)

To effectively implement and meet regulatory requirements associated with the standards of GMP, CTM offers consulting services covering the following:

- Good Manufacturing Practice (GMP)
- Design and Implementation of Quality Systems
- Validation and Qualification
- Regulatory Agency Documentation
- Preparation for Audit of the Facility

RESEARCH & CONSULTANCY WORK

Our research and consultancy work focuses on the quality, safety and efficacy of TCM products, and include the following:

- HPLC/MS analysis: profiling/quantitation of active ingredients
- GC/MS analysis: profiling & quality audit
- Book publication in collaboration with Nanjing University of Chinese Medicine
- Efficacy studies using animal models
- Clinical studies using human subjects: herbal tea project with Changi General Hospital
- Proteomic & Metabolomic studies



Agri
Food
Technology



AQUACULTURE

R&D in Temasek Polytechnic

Reducing STRESS in Fish with HERBAL CONDITIONER

Aquaculture has huge potential for growth as it is one of the fastest growing sectors of the agriculture industry. Singapore's consumption of fish is estimated to be 100 000 tonnes per year of which about 5% is supplied by local foodfish aquaculture. Efficient, economical and productive aquaculture in Singapore would meet the growing demands of fish in the Singaporean diet, remove a huge burden on our natural wildlife resources, and also reduce our dependence on imports.

The School of Applied Science is supporting the aquaculture industry with research and development programmes to assist the industry in enhancing the productivity and quality of their produce. In addition, the School is also providing training programmes to provide the industry with a well-skilled workforce.



Our R&D programme focuses on the following areas:

- Breeding and propagation
- Sustainable culture systems
- Feeds, live feeds and supplements
- Fish health and disease monitoring, therapeutics and probiotics

One stop centre for Aquaculture R&D

- Breeding, rearing & production of ornamental & food fish
- Fish nutrition & fish health management
- Biosecurity and Analytical Science: Disease diagnosis
- Water technology: Re-circulatory Aquaculture System (RAS) and water treatment

Other on-going projects include:

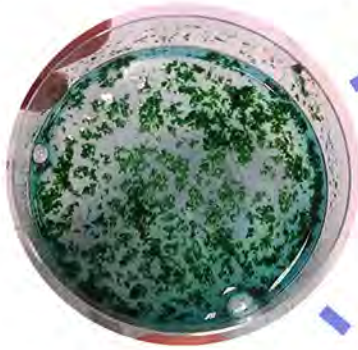
- Fatty Acid Profiles of D Magna Enriched with Different Concentration of Medium
- Analysis of Growth and Innate Immune Response in Grouper with Different Commercial Feeds
- Comparison of Different Types of Feed on The Growth of Grouper

Singapore is the world's largest freshwater ornamental fish importer and exporter capturing about 20% of the global export market. One of the common problems faced by local ornamental fish farms is the stress induced in fish when housed in high stocking density in tanks during quarantine and also likely the rough handling of fish when packed for export. As a result, the fish would become more susceptible to diseases especially when under stress. Presently, the choice of treatment for ornamental fishes ranges from simple salt water dips to broad spectrum antibiotics and sometimes malachite green. As an alternative to chemical treatment, a herbal water conditioner could be explored. The present study looks at the use of herbal water conditioner in enhancing protective immunity and reducing stress in fish under high stocking density and poor water quality conditions.

In the study, the water conditioner's efficiency was comparatively studied in four breeds of freshwater ornamental fishes that were put under stress induced by high stocking density and poor water quality conditions. Preliminary results showed higher lysozyme levels which indicated that there was anti-bacterial protective immunity developed in fish when subjected to the herbal water conditioner. We observed a reduction in the mortality among dwarf Gourami fish in the water conditioner treated group (7.8%) compared to the control group (59%). However, further evaluation of the efficacy of herbal water conditioner as an immunity enhancer would need to be explored at a later stage. Conditions such as varying water quality, stocking density, dosage and duration of its usage, fish breed and age of fish could be used in future studies.

Upon successful and reproducible outcome, the herbal water conditioner could be used to condition the water for packing fish for export and for quarantining at the farms as part of fish health management.

An ALGAE-BASED Circulatory System



for Treatment of Wastewater from Fish Farming

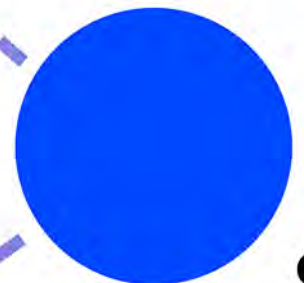
By Joshua Chan

The green movement prompted a team of researchers led by Dr. Wuang Shy Chyi to develop a complete aquaculture waste treatment system that aims to reduce the inorganic load of food fish wastewater through the presence of the cyanobacterium (also known as blue-green alga), *Spirulina platensis*, which is cultivated using the fish water in the tank. *Spirulina* microalgae are used to treat fish wastewater for recirculation as the algae can help to reduce the amount of ammonia and nitrite from the water. According to Dr. Wuang, such a system will greatly reduce water consumption in aquaculture and as a result minimise environmental load. This is because the recirculating system is able to reduce freshwater demand in fish farming without chemical use or excessive energy demand while providing complete water recirculation. She added that algae are not environmentally dangerous, and algae growth allows oxygen to be released, thus enhancing the auto-depuration potential of water.

As nitrate is not easily removed by conventional water treatment, biological nitrate removal using aerobic microalgae offers some advantage over anaerobic microbial denitrification since both ammonia and nitrate nitrogen are readily removed and the process is less complicated. *Spirulina platensis* is used because the algal cells can be harvested by simple filtration, are easy to mass culture, and are able to tolerate a wide salinity range. In addition, algae are a valuable by product which can be potentially used as biofuel source, food supplement, and fertiliser. In terms of cost, the algae-based circulatory system requires low capital, maintenance and operational costs.

"We expect our innovation which is both energy- and water-saving to benefit the fish farming industry and support sustainable intensive aquaculture", said Dr. Wuang.

The term "intensive" is used to describe a high level of control in production where more comprehensive capital and management are applied in controlled environments.



HALAL TESTING

By Dr Nurmawati M Hanafiah

A MEATY ISSUE

حلال

One project that the School of Applied Science is working on involves the use of metallic nanoparticle-based biosensors to detect porcine DNA.

In line with its focus on developing capabilities in analytical science, the School of Applied Science embarked on the area of analytical tests in Halal testing in 2012. TP's work on Halal testing also involves looking out for more reliable and accessible techniques.

One project that the School is working on involves the use of metallic nanoparticle-based biosensors to detect porcine DNA. This method that is being developed is potentially useful because of its low cost, efficiency and reliability. The method offers rapid screening of pork contamination using the naked eye without the need for expensive instruments.

As an institute of higher learning, the School recognises the importance of educating students in the area of Halal awareness. Since 2009, MUIS' representatives have been conducting workshops and educational talks for all our students to enhance their awareness of gracious living in a multi-religious society like Singapore.





NOW YOU SEE IT

VISUAL DETECTION OF PORCINE DNA IN FOOD USING DNA/GOLD NANOPARTICLE BIOSENSORS

The School has embarked on a project to develop a novel method to detect porcine DNA for Halal assurance. The method includes the extraction of DNA samples from meat sources, and the design of DNA/gold nanoparticle biosensors, as well as the verification processes of Halal food.

The nanoparticle biosensors can be directly used to detect the presence of pork in processed food products - a clear colour change from red to blue will be visible. This 'naked eye' method reduces the time and cost involved in the detection of meat adulteration.

"The method can be used for the detection of porcine DNA in a mixed meat sample, fast screening of food samples for Halal identification, and the development of on-site assay for animal DNA," said Dr Xue Xuejia, the researcher leading the project team.

DEVELOPING the WORLD'S FIRST

Local Asian Food GI Database

By Viji Vijaykumarr

Temasek Polytechnic's Glycemic Index Research Unit or GIRU has blazed a trail in developing a tool to assess the quality of carbohydrates in Asian food, a first in Asia and perhaps in the world. GIRU is the first accredited facility in Asia to conduct Glycemic Index testing and research and offer consultancy services. Its venture into devising a local GI database is welcoming news to the health scene in Singapore and the Small Medium Enterprises (SMEs) involved in food operations.

GIRU's consultancy service in this niche area is a boon to many SMEs in Singapore and in Asia. Currently, Glycemic Index research and testing is conducted in Australia, Canada, New Zealand, USA and Europe.

With funding from the Health Promotion Board (HPB), GIRU has spearheaded the GI testing of local food towards the collation of a local GI database.

This database will benefit people of all ages, gender, ethnicity and health status as a low meal GI plan helps people with weight problems, metabolic or insulin resistance syndrome, type 1 and 2 Diabetes, Pre-diabetes and Gestational Diabetes, High Triglyceride and High cholesterol levels and people who have increased physical or sporting activities.

GIRU comprises a team of staff led by Ms Kalpana Bhaskaran. According to Ms Bhaskaran, until recently, most local Asian food had not been assessed for Glycemic Index (GI) value. As a result, it had become a challenge to plan diets with low GI food. Local SMEs were not able to determine the GI value of their newly developed products due to high costs and other logistical issues of sending items for product testing abroad. Since GIRU's consultancy services would support these SMEs in determining the GI value of their new products, the GIRU unit is slated for bountiful growth in the next few years.

Glycemic Index (GI): a useful tool that helps to measure how quickly blood sugar levels rise after eating foods that contain carbohydrates. It helps us to choose the right type/quality of carbohydrates which will have a major impact on one's health as carbohydrates contribute to 50% of the total calorie intake.



TRY THESE HEALTHIER NOODLES

By Susila Krishnasamy



Obesity and a high incidence of Type 2 Diabetes have become a big concern amongst many Singaporeans. With the intent of reducing the rate of obesity, occurrence of diabetes and other chronic diseases and most importantly for promoting better health among consumers, the Food Research and Application team led by Dr Mabel Wang Rong has created healthier noodles.

Wheat noodles are widely consumed as staple food in many countries. Functional ingredients are incorporated into noodles to make them healthier. These improved versions will offer an interesting choice and variety for the discerning Singaporean palate.

Consuming healthier and functional noodles such as low GI wholegrain wheat-based noodles and rice-based noodles will help reduce the risk of diabetes, heart diseases and assist in weight management.

Also due to the busy and hectic lifestyle of many people, there is a demand for convenient food. So, ready-to-eat yellow noodles may provide consumers with a convenient choice. The noodles have to undergo a process of high heat and pressure treatment to ensure that the product is sterilised and can be stored at room temperature for ease of consumption.

"Development of Retort Stable Noodles", a student project, won the Champion prize for the Polytechnic Category in the Biennial Student Symposium 2013 which is organised by Singapore Institute of Food Science & Technology (SIFST).

The judges were mainly from the industry and they commented that our students had embarked on a challenging but novel product that provided convenience as a ready-to-eat meal to suit the busy and hectic lifestyles of Singaporeans.

Research on Mud Crabs

Awarded Marine Life Fund

By Hamida Zam Zam

The School of Applied Science has been awarded the Marine Life Fund (MLF) by Resorts World Sentosa's Marine Life Park for its project on mud crab research.

The project focuses on species conservation and research, aimed at improving the survival rate of hatchlings and larvae of the mud crab (Genus *Scylla*), better known to Singaporeans as the "Chili Crab". Production of the mud crabs is declining worldwide, and unchecked intensive harvesting will eventually put a strain on the species' population.

The research targets to create a system that can be used by local aquaculture farmers, reducing the need to harvest the crabs from nature. Hatchery techniques developed from the current project, if developed further for commercial purposes, could provide aqua culturists with a reliable supply of crablets (in Singapore and the region), and ultimately improve the existing production (to meet demand) as well as the conservation of the population in the wild.

The team will also work with conservationists to re-introduce juvenile mud crabs into natural habitats. In addition, the knowledge gained from the research can be adapted for other crab species that are currently being cared for in the Marine Life Park.





Medical
Technology

Rapid, Reliable, Low-Cost Method Can Prevent Contamination

By : Hamida Zam Zam

A single hamburger may contain meat from hundreds of animals. A single restaurant omelet may contain eggs from hundreds of chickens. A glass of raw milk may contain milk from hundreds of cows. These foods are particularly hazardous because a pathogen present in any one of the animals may contaminate the whole batch.

Indeed, we live in a world full of potentially dangerous microbes, and there are many opportunities for food to become contaminated as it is produced and prepared. Many food borne microbes are present in healthy animals (usually in their intestines) raised for food. Meat and poultry carcasses can become contaminated during slaughter by contact with small amounts of intestinal contents. Similarly, fresh fruits and vegetables can be contaminated if they are washed or irrigated with water that is contaminated with animal manure or human sewage.

"During food processing, other foodborne microbes can be introduced from infected humans who handle the food, or by cross contamination from some other raw agricultural product. In the kitchen, microbes can be transferred from one food to another food by using the same knife, cutting board or other utensils. Food that is not stored at the right temperature can also be contaminated by bacteria in the air such as staphylococcus," said Dr Kadamb Patel Haribhai who heads the team that is investigating a low-cost on-site method of detecting bacteria.

Food borne illnesses are an ever-present threat that can be prevented with proper contact and handling of food products. It is estimated that between 81 and 140 million cases of food borne diarrheal diseases occur each year worldwide, costing between \$12 billion and \$37 billion in medical contact and lost productivity.

One bacterium that reproduces by dividing itself every half hour can produce 17 million progeny in 12 hours. That explains why lightly contaminated food left out overnight can be highly infectious by the next day.

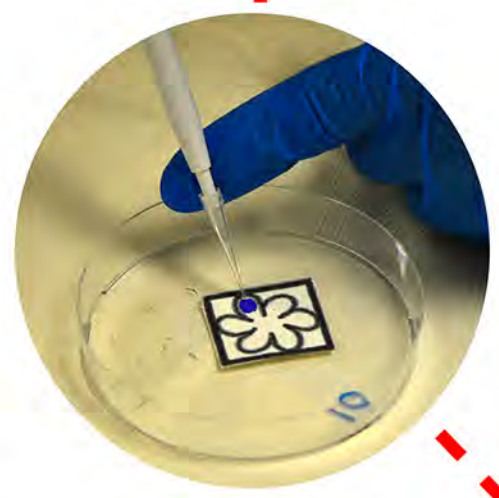
There is currently no commercially available portable point of contact testing for harmful bacteria which can help to ensure food safety and the absence of potentially harmful contamination, starting from manufacturer/processor, to distributors and end-users such as hawkers and restaurants. Current detection and identification of food borne pathogens continue to rely on conventional culturing techniques. Samples are incubated overnight to grow culture, until they form colonies large enough to be visible to the naked eye. These methods are very elaborate, time-consuming, and have to be completed in a microbiology laboratory and are therefore not suitable for on-site monitoring. The need for a more rapid, reliable, specific, and sensitive method of detecting a target analyte, at low cost, is the focus of this project.

"On-site detection of microorganisms without the need for sophisticated equipment or skilled personnel is the ultimate aim; this is extremely important in clinical settings and rapid response scenarios, as well as in resource-limited settings. We have developed a low cost device with a microbe sensitive colorant that undergoes a visibly detectable change in the presence of microbes," said Dr Haribhai.

This novel, rapid, cost-effective and user-friendly on-site testing device can play a major role in monitoring the food supply chain, starting from manufacturer/processor, to distributors, to end-users like hawkers and restaurants.

"Our proposed technology has the potential to speed up the detection of harmful bacteria which can be used for monitoring critical control points in food production. Hawkers and restaurants are the main users of raw food products. They have storage facilities for their daily or weekly supply, and any change in storage conditions can cause the proliferation of harmful bacteria," added Dr Haribhai.





DIAGNOSTIC

LOW-COST DIAGNOSTIC PLATFORM

The low cost paper ELISA devices can be easily adapted for:

1. Food industry
2. Aquaculture diagnostics
3. Veterinary sector
4. Microbiology
5. Home care industry
6. Point of care industry
7. Education kits

Typical tests conducted to diagnose disease and monitor the health of patients are expensive. Hence there is a widely acknowledged need to develop low-cost, simple-to-use, point-of-care (POC) diagnostic methods for diagnosis and monitoring the treatment of patients suffering from disease.

POCT is needed in developing nations because it can reduce the number of clinical visits, decrease costs to the patient and healthcare system, increase patient satisfaction, improve clinical outcomes, and provide clinical services for people in low resource settings.

Dr Haribhai is working on a project to develop a low-cost diagnostic platform. The paper-based device requires small volumes of test fluid with no external equipment. Dr Haribhai explained that paper was chosen because it is flexible, lightweight, and difficult to break or tear accidentally. These properties translate into ease of transport and storage. Paper is also flammable, so devices can be disposed of by incineration easily and safely after use, thus saving on biohazard disposal costs.

Modelling Liver Fibrosis IN RATS

By Susila Krishnasamy

Dr

Chooi Kum Fai, a Veterinarian with a passion for understanding disease mechanisms currently uses animal models to study the disease process. He has successfully obtained two Ministry Of Education Innovative Grants to study liver disease using the rat model. Following the induction of liver disease, clinical tests on the blood are carried out to monitor the disease progression.

He and his team members, Dinesh Babu, Gary Phang and Alden Toh have used established pathological scoring of Masson Trichome stained tissue sections and imaging software to quantify fibrosis in the rat liver. The combined approach provides a powerful platform to study the mechanisms of liver fibrosis. Simultaneously, the team is using this system to test novel compounds with prophylactic and therapeutic potential.

The team provides learning opportunities for students interested in how animal models are used in scientific research. Junior and Senior students have participated in various aspects of the study via the Differential Research Programme and Final Year Projects respectively. The team has presented this research at international and regional scientific conferences and was awarded prizes for presentations at the Singapore Association for Laboratory Animal Science Annual Regional Conferences in 2011 and 2012.



The haematology machine for analysis of blood parameters.



Renewable
sources
Technology

A large, leafy tree stands on the left side of the frame. In the foreground, a wooden picnic table with two benches is set on a gravelly ground. The background features a wide body of water, likely a lake or reservoir, with a city skyline and construction cranes visible in the distance under a clear sky.

Turning Twigs into Park Benches

Photo By : Kevin Lim

Recycling Wood from the Park Back to the Park



Can 500 tonnes of wood and horticultural waste be put to good use? With some innovation and a burning desire to create a greener planet, the answer is a resounding 'yes!'.

The next time you take a walk in the park, look for fallen branches and twigs. Now imagine 680 tonnes of these being collected everyday. Add another 940 tonnes of wood waste and picture this mountain of wooden bits and bobs being burned – everyday.


Some of this waste is recycled to produce charcoal or compost, but more than 500 tonnes of wood and horticultural wastes continue to be incinerated everyday. However, incineration and charcoal production are highly pollutive and require large kilns, while composting is slow and requires a huge footprint.

The researcher leading this project, Dr Wong Sook Fun, said that the driving force for her is the huge amount of waste Singapore is generating. She wanted specifically to work with waste that has a low recycling rate.

Approximately

343,800 tonnes of wood waste &

247,800 tonnes of horticultural waste
were generated in Singapore in 2012



Horticultural waste is gathered daily from parks, the roadside and gardens, while wood is collected from construction, demolition and renovation sites. "Historically, wood is an excellent raw building material, so it makes sense to turn the waste into innovative and value-added building products," said Dr Wong.

The successful implementation of this project will divert large amounts of the wastes from disposal at the landfill, and also from incineration which can be very pollutive and harmful to the environment and people. To date, there is no viable technology that could recycle wood and horticultural wastes into building materials. While there are competing technologies to recycle wood and horticultural wastes, e.g. incineration, charcoal production and composting, the disadvantages of such technologies, including negative environmental impacts and inefficiency of processes, are stumbling blocks to recycling. As a result, the recycling rate of such wastes remains low.

This project looks into the use of wood and horticultural wastes in cementitious building products for non-structural applications (such as tables, chairs, pavements) and structural applications (such as wall panels and floor slabs). A viable technique capable of processing and pre-treating these wastes has been developed to convert them into suitable and consistent forms, either as wood shavings for cement replacement, as wood chips for aggregate replacement and as wood fibres for reinforcement in cementitious composites.

The scope of work includes the development and testing of composites such as physical tests (e.g. slump test for mix consistency and workability, water absorption test for durability) and mechanical tests (e.g. flexural strength and toughness test, compressive strength test) as well as development of prototype.

BAYER YOUNG ENVIRONMENTAL ENVOY

Chemical Engineering students Kevin Lee and Adrian Kho who are working on this project with Dr Wong have been shortlisted for the Bayer Young Environmental Envoy award. If selected, they will join some 50 Young Environmental Envoys from around the world in Germany, where they will learn about trends and perspectives in the field of environmental protection and sustainability. Kevin and Adrian will spread their green message to the community through a series of exciting outreach activities for youths, and via Facebook.



Logon to www.facebook.com/greenhavensingapore. Hit the 'LIKE' button and **SHARE** the page!

THE PROCESS

Commercial Waste Collectors

Community Involvement Projects



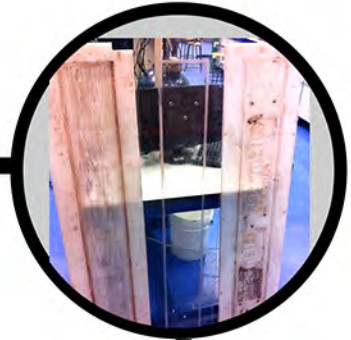
Pre-treatment



Mixing & Formulation



Casting



Commercial Park Bench



PART-TIME COURSES

We offer a range of part-time courses for adult learners.

Specialist Diploma in Biopharmaceutical Technology

The aim of the part-time Specialist Diploma in Biopharmaceutical Technology programme is to prepare or re-profile graduates for work in the pharmaceutical or biopharmaceutical and related industries. It also serves as a platform for individuals who are already working in a related industry to upgrade or update their skills and knowledge. On completion of the course, graduates will have theoretical and practical knowledge/skills to work in a manufacturing facility for the biopharmaceutical industry, and knowledge in Good Manufacturing Practice so that they are better prepared for work in the pharmaceutical industry.

This Specialist diploma is made up of 2 Post-Diploma Certificates in:

- Upstream Bioprocess Manufacturing
- Downstream Bioprocess Manufacturing

Specialist Diploma in Environment & Water Technology

The course provides participants with the theoretical and practical knowledge to operate environmental and utility installations for the Environment & Water Industry and Manufacturing Industry. Graduates of the course will be equipped with knowledge in environment management and environment legislation so that they are better prepared for work in the Environment & Water industry or Manufacturing industry.

This Specialist diploma is made up of 2 Post-Diploma Certificates in:

- Water Treatment Technology
- Air and Solid Waste Management

Diploma in Applied Science (Aquaculture)

The course provides participants with the knowledge and practical skills in aquaculture. It aims to promote continuing education and training among working adults in ornamental fish, foodfish industries and other related industries so that they can upgrade their skills and knowledge to meet the demand of the industry.

This diploma is made up of 5 Modular Certificates in:

- Aquaculture Fundamentals
- Aquatic Nutrition and Feeding
- Fish Health, Diseases and Prevention
- Fish Breeding
- Aquatic Systems, Practices and Management

Diploma in Applied Science (Chemical Technology)

This course provides participants with relevant knowledge and skills in process engineering, occupational safety and health, environmental technology, productivity and quality management to support the continued growth of the chemical, petrochemical and pharmaceutical industries. It aims to provide relevant, practical and applicable knowledge and skills by focusing on the process engineering principles and knowledge relevant to the operational requirements in the chemical and chemical-related industries.

This diploma is made up of 5 Modular Certificates in:

- Chemical Plant Unit Operations
- Chemical Plant Safety & Health
- Environmental & Waste Management
- Chemical Processes
- Chemical Plant Optimisation

Diploma in Applied Science (Forensics) For Home Team

Temasek Polytechnic and the Ministry of Home Affairs have jointly launched a part-time Diploma in Applied Science (Forensics) exclusively for the Home Team officers. This diploma offers officers involved in front-line criminal investigative work an opportunity to develop and update their knowledge and skills in the fundamental sciences.

This diploma is made up of 5 Modular Certificates in:

- Chemical Science
- Biological Science
- Analytical Science
- Forensic Science
- Investigative Science

For more information please visit our website:
www-as.tp.edu.sg



State-of-The-Art Facilities

Centres of Excellence

Centre for Applied Nutrition Services
Centre for Traditional Medicine

Learning Enterprises

Bistro Walk Training Café
Deli Delite Training Food Kiosk
KoolWerkz Learning Enterprise
TP Animal Clinic

R&D and Training Facilities

Temasek Applied Science Research Centre

Temasek Analytical Services Facility*
Food Product Development Facility
Nutrition Assessment Facility
Glycemic Index Research Unit**
Plant Tissue Culture Training Facility
Proteomics Research Facility

Culinary R&D Kitchen
TP Hydroponic Greenhouse
Environmental Technology Facility
Nanotechnology Research Facility
Pharmaceutical Technology Facility
Temasek Animal Facility

* Accredited by Singapore Accreditation Council

** Certified by Singapore Accreditation Council

DIRECTORY OF SERVICES

Analytical Capabilities

- High Performance Liquid Chromatography
- MALDI TOF/TOF Analyzer
- 2D-Nano Liquid Chromatography System
- Liquid Chromatography-Mass Spectrometer (LC/MS)
- Gas Chromatography-Mass Spectrometer (GC/MS)
- Quadrupole Time-of-Flight (Q-TOF) LC/MS
- 2D Gel Electrophoresis, Imaging, Gel Processing System
- Atomic Absorption Spectrometer
- Fourier Transform Infrared Spectrometer
- Inductively Coupled Plasma Spectrometer
- UV-Vis Spectrometer
- Flow Cytometer
- Microscopy
- TOC Analyzer
- Instron Material Testing System



Outsourcing of Testing Services

- Heavy Metals Chemistry
- Microbiological Testing
- Glycemic Index Testing
- Chemical Profiling
- Efficacy & Safety Studies Using Animal Models
- Clinical Studies Using Human Subjects

Research & Consultancy

- Method Development
- Analytical Support
- Applied & Translational Research

Continuing Education Training

- Part-time and Specialist Diplomas
- Short Courses

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For collaboration enquiries, please contact:

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