HSA CheMetrology News

An e-newsletter brought to you by the Chemical Metrology Laboratory, Health Sciences Authority, Singapore

Issue 2024

Dear Reader,

Welcome to this year's edition of CheMetrology News. We are delighted to extend a warm welcome to you, and we are truly appreciative that you are here to delve into the latest updates and developments in the Chemical Metrology Laboratory (CML).

We are privileged to have this opportunity to share with you our ongoing activities and new metrological services. We are particularly excited to introduce our new Certified Reference Materials (CRMs) and Proficiency Testing (PT) programmes. We strive to provide you with insightful information on areas relevant to our work. This includes our efforts in the production of CRMs for alternative proteins, a cutting-edge endeavor that holds significance in the current landscape.

Finally, we are pleased to share our staff's "behind-the-scenes" experience in the organisation of HSA's External Quality Assessment Programmes (EQAPs), it underscores our dedication and is a testament of our ongoing commitment to delivering excellence in metrology.

Your input is invaluable in our journey forward. Your feedback on our e-newsletters, HSA CRMs, and PT programmes is crucial to our continuous enhancement. Please do not hesitate to reach out to us via email at **HSA_CML@hsa.gov.sg** or **scan the QR code**.

Thank you for taking time to read this e-newsletter. Let us stay connected!

Dr Teo Tang Lin
Division Director
Chemical Metrology Division
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TINY GIANTS: THE FUTURE OF SUSTAINABLE FOOD SYSTEMS

Written by
Ms Deborah Sim Lay Peng
Analytical Scientist
Dr Lu Ting
Senior Analytical Scientist
Ms Cheow Pui Sze
Consultant Analytical Scientist
Dr Richard Shin
Consultant Analytical Scientist

Singapore has been actively exploring alternative protein sources to strengthen its food security. Among these options, insects, with their impressive protein content, have emerged as a promising solution [1]. The Singapore Food Agency (SFA) has taken significant measures to facilitate this innovative approach and is reviewing 16 insect species, including crickets, silkworms and grasshoppers for human consumption [2,3].

Besides the 16 insect species that are being considered by SFA, there are other insect species that also contribute to food sustainability, such as black soldier fly larvae (BSFL). BSFL is rich in protein and easy to digest, it is widely used as fish and shrimp feed. Those intend to introduce BSFL as food will have to obtain SFA approval under its novel foods framework.

In this article, we will cover the stories of how Chemical Metrology Laboratory (CML) helps to ensure the safety of these insects prior to their incorporation into our food chain.

The Evolution of Cricket Flour from Farm to Certified Reference Material (CRMs)

With the potential of emerging alternative proteins like cricket flour, it is imperative to remain vigilant about the possible presence of harmful trace elements [4]. Elements like arsenic (As), cadmium (Cd), mercury (Hg), and lead (Pb) may contaminate cricket flour. These can come from various sources, such as the environment, feed, harvesting stage and processing techniques.

Food testing laboratories play a vital role in verifying the safety and quality of food products. In order to carry out this role, they require a suitable matrix CRMs to ensure the accuracy and traceability of their measurement results. Hence, CML has embarked on the development of matrix-matched CRMs for method validation and quality control to help in ensuring the safety of cricket-based food products.

As the concentration of most toxic elements are generally low in commercially available cricket flour, they may not be suitable for food testing laboratories to validate their routine test methods. Hence, our journey of scientific exploration to produce this cricket flour CRM started all the way from a local farm where resilient crickets were fed with elevated level of toxic elements in their feed before they were harvested. CML engaged Yong Crickets Trading to farm and harvest the crickets.

Farming: Crickets were bred and raised

These little crickets embarked on a 45-day journey before they were ready to be harvested.

A mixture of arsenic, cadmium, chromium, lead, mercury, and other potential contaminants were added into the feed (chicken broiler grain)

Harvesting: Once matured, crickets were harvested and processed

After the harvest, the crickets were dried in an oven at 100 °C for six to twelve hours to remove most of the moisture.

In order to produce around 1.5 kg of cricket flour, approximately 37,500 crickets were bred!

Grinding & Sieving: Removal of large particles to ensure a consistent texture

Before grinding and sieving

Grind using knife mill for grinding

Sieve shaker for sieving

Fine powder after processing

Homogenisation & Packaging: The fine cricket powder was then homogenised, packaged and disinfected by γ-irradiation

Mixed in a drum mixer

Stored in amber glass bottle

Disinfected by γ-irradiation

Finally, the cricket flour was subjected to homogeneity and stability tests as well as assignment of reference values in accordance with the requirements in the ISO 17034 and ISO Guide 35. The material had been proven to be homogeneous and stable for transport under ambient temperature. The analysis of toxic elements in cricket flour using high accuracy methods such as exact-matching isotope dilution mass spectrometry (IDMS) and standard addition are currently underway.

Exploring Organic Contaminant Residues in Insect Protein through BSFL

In Singapore, BSFL are mainly used to process food waste, because it can consume a huge amount of organic waste (up to four times of their body weight per day). This extraordinary ability enables BSFL to be a potential matrix-matched material for studying organic contaminant residues in insect protein matrix. Hence, we explored the production of a powdered BSFL material containing a series of organic contaminants [5-7] trough the following approach.

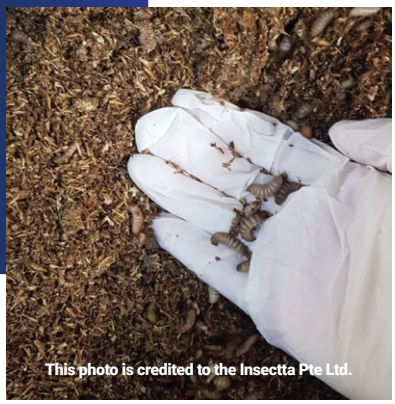
For the trial production, four batches of feed were spiked with either mycotoxins, polyaromatic hydrocarbons (PAHs), veterinary drugs, or pesticides. In the farm, four groups of BSFL were fed with either one batch of these customised feeds. The growth of the BSFL was then closely monitored. Other than the group that was fed the pesticide-contaminated feed, the other three groups of BSFL grew well and were harvested and sent to our laboratory for grinding and analysis. The preliminary analysis showed that low concentrations of the organic contaminants were found in the powdered BSFL material. The production of a larger batch of BSFL CRM containing mycotoxins, PAHs, and veterinary drugs is currently in progress.

Preparation of customised feed

One batch of the customised feed material was spiked with the organic contaminant.

In the farm: Larvae feeding and harvesting

The BSFL were fed with the customised feed in the farm.

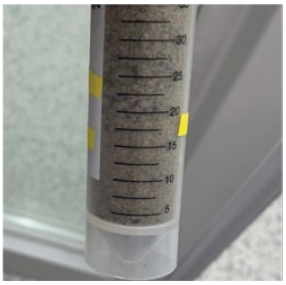


The BSFL was harvested in the farm.

After Harvesting: Grinding & Sieving

Frozen BSFL

Grinding ▶



Coarse Powder

Sieving ▶

Fine Powder

The BSFL were then ground and sieved in our laboratory prior to analysis.

The development of the first CRMs for novel food by CML marks a breakthrough that holds the potential to benefit commercial testing laboratories in the analyses of inorganic and organic contaminants in novel food matrices.

If you would like to enquire about the details of any CRM, request for its Certificate of Analysis or pricing, please email us at **HSA_CML@hsa.gov.sg** or **scan the QR code**.

https://go.gov.sg/hsa-crm-enquiry

Click or Scan QR

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1. Trends in Food Science & Technology 102 (2020) 155–168 • (https://doi.org/10.1016/j.tifs.2020.06.013)
2. Sale of Food Act (Chapter 283, Section 56(1)) Food Regulations. • https://sso.agc.gov.sg
3. Consultation on regulation of insect and insect products (imports and locally farmed/processed) • www.sfa.gov.sg › docs › default-source › default-document-library
4. Science of the Total Environment 885 (2023) 163716 • (https://doi.org/10.1016/j.scitotenv.2023.163716)
5. Commission Regulation (EC) No. 1881/2006 setting maximum levels for certain contaminants in foodstuffs • (https://leap.unep.org/countries/eu/national-legislation)
6. Regulation (EC) No. 1831/2003 of the European Parliament and of the Council on additives for use in animal nutrition. • (https://www.legislation.gov.uk/eur/2003/1831/contents)
7. Commission Recommendation 2006/576/EC: contains guideline values for deoxynivalenol, zaeralenone, ochratoxin A, fumosin B1 and B2, and T-2 and HT-2 toxin in feed material and compound feed • (https://feedlegislation.org/en/feedlegislations/europeanlegislation/undesirable-substances/recommendation-2006576ec/)

ARTIFICIAL SWEETENERS – WILL I KNOW HOW MUCH IS IN MY FOOD AND DRINKS?

Written by
Ms Gui Ee Mei
Analytical Scientist

People take artificial sweeteners as a sugar substitute in order to reduce their calorie intake and manage their weight. Artificial sweeteners are much lower in calories than sugar, and they do not raise blood sugar levels, making them a popular choice for people with diabetes or those who are trying to manage their blood sugar levels [1].

In July 2023, the International Agency for Research on Cancer (IARC) and the World Health Organisation (WHO) released a report classifying aspartame, an artificial sweetener commonly used in food and beverages, as a possible carcinogen to humans. However, it is still considered safe for consumption within the acceptable daily intake (ADI) of 0-40 mg/kg body weight established by the Food and Agriculture Organization (FAO) Joint Expert Committee on Food Additives (JECFA). The evaluations were based on scientific data from sources like peer-reviewed papers and government reports, etc. While IARC and WHO continue to monitor for new evidence, they encourage for further research on the potential link between the consumption of aspartame and human health risks [2].

On the other hand, manufacturers may substitute aspartame with other artificial sweeteners in their products. There are several other artificial sweeteners that are commonly used as sugar substitutes, including sucralose, saccharin and acesulfame potassium. Each artificial sweetener may have its own potential benefits and risks. Therefore, it is important for artificial sweeteners in food to be properly quantified on the product labels so that consumers can make informed decisions about what they are consuming. This is particularly significant for people trying to manage their sugar intake or who have health conditions like diabetes.

CML offers high purity artificial sweeteners, such as aspartame and sucralose, as CRMs. A soft drink-matrix CRM containing four of the commonly used artificial sweeteners is also available for sale. The pure substance CRMs can be used as calibrant standards while the matrix CRM can be used as a quality control material by food testing laboratories to determine and report the amount of artificial sweeteners present in their samples accurately and confidently.

CRM Code	Material
	Pure Substance
HRM-1009A	Sodium cyclamate
HRM-1010A	Saccharin
HRM-1012A	Acesulfame Potassium
HRM-1015A	Sucralose
HRM-1019A	Aspartame
	Matrix
HRM-1025A	Artificial Sweeteners in Soft Drink

Our CRMs are produced in accordance with the requirements of ISO/IEC 17025, ISO 17034, and ISO Guide 35. A comprehensive Certificate of Analysis is provided with each CRM. If you would like to enquire on the details of a CRM, request for its Certificate of Analysis or pricing, please email us at **HSA_CML@hsa.gov.sg** or **scan the QR code**.

https://go.gov.sg/hsa-crm-enquiry
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References:

[1] Everything You Need to Know About Aspartame – Food Insight

[2] Aspartame hazard and risk assessment results released (who.int)

HSA PROFICIENCY TESTING PROGRAMMES

Written by
Ms Gui Ee Mei
Analytical Scientist
Dr Fransiska Dewi
Senior Analytical Scientist

Overview

CML is the first PT provider in Singapore to be accredited by the Singapore Accreditation Council (SAC), in accordance with the requirements of ISO/IEC 17043. We offer accuracy-based PT programmes, whereby the performances of participating laboratories are evaluated against SI-traceable assigned value.

Food

Water

Fuel Oil

Pharmaceuticals

Cosmetics

Inorganic Elements in Infant Formula (2023)

We are pleased to provide the final update on the PT scheme on the Determination of Inorganic Elements in Infant Formula, covering toxic elements (arsenic, cadmium, lead and mercury) as well as essential elements (copper, potassium and iodine).

The latest schedule is as follows:

October – November 2023	**: Call for participation**
December 2023 – January 2024	**: Distribution of PT materials**
February – March 2024	**: Submission of results**

Organic Contaminants in Marine Fuel Oil (MFO) (2023)

To follow up on 2022 Issue of CheMetrology, we are pleased to update on the launch of the PT programme, which consists of two PT schemes:

(i) PT scheme I: Qualitative identification of common chlorinated organic compounds (COCs) and volatile phenols in MFO, and
(i) PT scheme II: Determination of 1,2-dichloroethane, tetrachloroethylene and chlorobenzene in MFO

The updated schedule is as follows:

December 2023	**: Call for participation**
March 2024	**: Distribution of PT materials**
May 2024	**: Submission of results**

Toxic Elements in Cosmetic Cream (2024)

We are in the process of coordinating a PT scheme on the Determination of Toxic Elements in Cosmetic Cream covering arsenic, cadmium, mercury and lead. The main objective of this PT scheme is to improve the accuracy and reliability of toxic element analysis in cosmetic products, which is of paramount importance in ensuring customer safety. This PT scheme would be launched in 2024 and offered to cosmetic testing laboratories nominated by the accreditation body in their economies [members of the Asia Pacific Accreditation Cooperation (APAC)] and members of the Asia Pacific Metrology Programme (APMP).

Pesticides in Water (2024/2025)

We will be collaborating with international metrology institutes to organise a proficiency testing (PT) scheme on pesticides in water. The scheme will focus on several analytes of interest, including polar pesticides such as glyphosate, as well as non-polar analytes like lindane and methoxychlor. This initiative aims to improve the accuracy and reliability of pesticide testing in water, which is crucial for ensuring the safety of our water supply.

The PT scheme will be open to members of APMP and APAC internationally and is tentatively scheduled to launch between 2024 and 2025. This will be an excellent opportunity for water testing laboratories to improve their measurement capabilities. For more information, please stay tuned to our next issue.

We would like to encourage testing laboratories who are interested in participating in any of these PT programmes to get in touch with us and we will provide you with more information. To register your interest, please email us at **HSA_CMLPT@hsa.gov.sg** or **scan the QR code**.

https://go.gov.sg/hsa-pt-enquiry

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POST-MEASUREMENT WORKSHOP – MAKING AN IMPACT ON WATER QUALITY FOR PUBLIC HEALTH & SAFETY

Written by Dr Fransiska Dewi, Senior Analytical Scientist & Dr Teo Tang Lin, Division Director

We are thrilled to share the remarkable outcomes of our recent project, the "Post-Measurement Workshop – Making an Impact on Water Quality for Public Health & Safety." In the conclusion of a project generously funded by the Asia-Pacific Economic Cooperation (APEC), we saw the collaboration from experts across the Asia-Pacific Metrology Programme (APMP), the Inter-American Metrology System (SIM), and the Asia Pacific Accreditation Cooperation (APAC). Nine distinguished experts from these organisations worked together to organise a Post-measurement Workshop with the valued support of APEC, APMP, SIM, APAC, and the Physikalisch-Technische Bundesanstalt (PTB).

Post-measurement workshop attendees (onsite and online).

Taking place at the Impiana KLCC Hotel in Kuala Lumpur, Malaysia, from 6 to 9 March 2023, this event was hosted by the Department of Chemistry, Malaysia (KIMIA). The workshop focused on:

1. **Technical Discussion:** Participants engaged in thorough discussions regarding the results of measurements from three studies: APEC PT on Trace Elements (Arsenic, Cadmium, Lead, and Antimony) in Natural Water, APMP.QM-P41, and SIM.QM-S12.

2. **Capability Enhancement:** A primary focus was on identifying capability and knowledge gaps through sharing of requirements and applications of relevant international standards to uplift our collective competence.

3. **Future Roadmap:** Together, we crafted action plans for future strategies aimed at enhancing laboratory practices, measurement capabilities, and quality infrastructure. The workshop featured a distinguished lineup of speakers drawn from metrology institutes, standards and conformance bodies, and a regulatory authority. These expert voices added depth and perspective to the discussions.

In essence, the Post-measurement Workshop facilitated fruitful dialogues and fostered networking opportunities among metrology institutes, accreditation bodies, and testing laboratories. These interactions significantly heightened awareness of the pivotal role of chemical metrology in our region. Learning from the successes achieved through this collaborative effort, we invite you to partake in safeguarding water quality for the well-being and safety of our communities through your participation in similar regional and international capability building efforts. If you are interested to be informed about future workshops or seminars related to water safety and quality, please don't hesitate to reach out to us via email at **HSA_CML@hsa.gov.sg** or **scan the QR code**.

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STAFF HIGHLIGHT

Interviewed and written by Ms Teo Hui Ling, Analytical Scientist

The Chemical Metrology Laboratory of HSA has been an accredited proficiency testing provider under ISO/IEC 17043 since 2013. Organising and executing proficiency tests is no easy feat but it definitely is a fulfilling and purposeful endeavour.

Ms Sharon Yong, one of the Coordinators for HSA HbA1c EQA Programme (EQAP), is here to share with us about her experience in organising such programme.

1. What do you and your colleagues need to do before organising an EQAP?

There is quite a lot of homework to be done! Firstly, we need to check on the relevance of a programme and the interest level through a couple of avenues, e.g., surveys or consultations with our Panel of Advisors. We also need to build our measurement capability and ensure that we have met the international benchmark. At times, we also need to conduct some form of feasibility study or carry out a pilot run to ensure there are no "surprises" during the actual programme.

2. What EQAPs does CML offer currently?

We run a national EQAP for HbA1c in fresh blood and a regular EQAP for other commonly tested clinical markers in frozen human urine and serum.

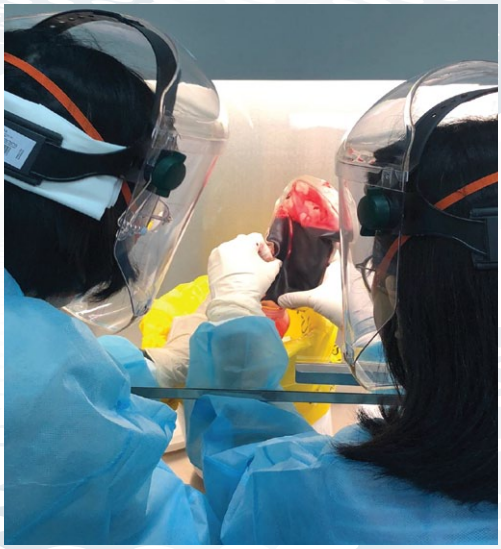
3. Is there any difference in planning for the various programmes?

Yes, the two programmes have different turn-around-times due to the different nature of the samples and our plans need to cater for this.

4. What is the most challenging aspect of organising the EQAP on HbA1c Testing?

Fresh blood has limited stability and, hence, the entire programme needs to be completed in roughly 2 weeks from the time the samples were drawn from a human donor. This alone is quite tricky as blood donors are hard to come by. The other challenges revolve around working with overseas suppliers from an opposite time zone and ensuring sufficient staff support during the active phase of the programme.

5. Can you share more on your experience in working with overseas suppliers?



Our laboratory regards the HbA1c EQAP with great importance as it is a national programme which impacts the licensing status of medical facilities. We strive to deliver the programme on schedule, but working with overseas biological product suppliers and courier agents in a different time zone proved to be very challenging.

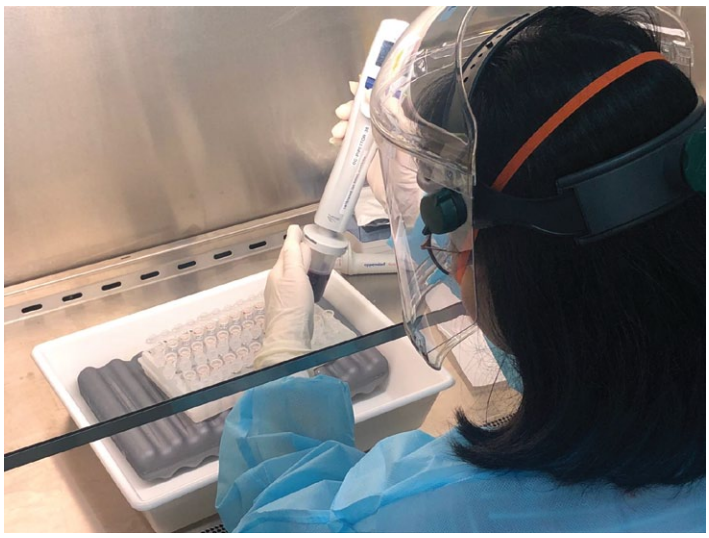
Back when we first started the HbA1c EQAP, we did not receive timely response from the suppliers and our staff had to stay up late to communicate and liaise with them at their local time. Over time, we identified what worked best and we tried to improvise to speed up communication as much as possible along the way.

6. How do you maintain the integrity of the fresh blood EQA samples?

Our samples are transported and handled under strict cold chain. We place temperature trackers together with the shipment for monitoring purpose. When the samples reach our facilities, they are inspected by our experienced staff and stored in a refrigerator with a temperature monitoring system and restricted access. Last but not least, we have experimental data to support the stability of the samples under these conditions for the duration of each programme.

7. What do you find most meaningful in organising EQAPs?

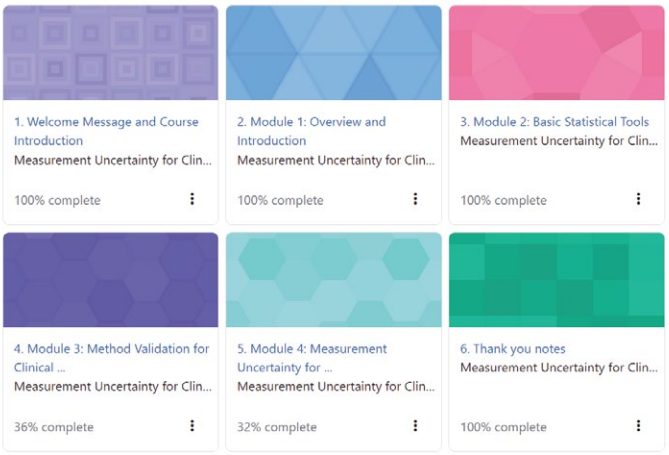
When a participating medical facility does not perform satisfactorily in our EQAP, we immediately provide an additional sample for their retesting. This additional service has allowed some medical facilities to promptly identify problems and troubleshoot them. I like to think that our EQAPs have raised the standard of testing in healthcare and effectively reduced the chance of releasing wrong test results.



ENHANCE YOUR STATISTICAL SKILLS WITH SELF-DIRECTED ONLINE LEARNING ON MEASUREMENT UNCERTAINTY

Written by Dr Ng Sin Yee, Analytical Scientist & Ms Cheow Pui Sze, Consultant Analytical Scientist

Are you interested in improving your statistical knowledge but struggle to find time to attend a course in-person? Our online self-learning course on measurement uncertainty for clinical laboratories provides a flexible and self-paced approach to statistical training that can benefit scientists seeking to enhance their professional development.



An overview of the courses available to registered participants in Moodle

Through our digital learning platform, Moodle, participants will have access to a range of course materials, including lecture notes, worked exercises and practice questions in the form of spreadsheets and online quizzes. Additionally, video presentations of the lecture narrated by the trainer are available for unlimited access during the course period. The participants have the flexibility to review the materials at their own pace, allowing a thorough understanding of the concepts covered. Both the trainer and participants can also monitor their progress throughout the course, ensuring that they are on track to meet their learning goals.

Overall, our online self-learning course offers a convenient and effective way for professionals to enhance their statistical knowledge, with the flexibility to learn at their own pace.

"Thank you for this great opportunity. I really appreciate it. I gain so much knowledge, and I'll be implementing it in my diagnostic laboratory."

- Feedback from past participant

Trainer's Biography

Ms Cheow Pui Sze

Ms Cheow obtained her MSc (Chemistry) degree from the National University of Singapore in 2008. She is a Consultant Analytical Scientist and Team Leader of the Organic Chemistry Section in the Chemical Metrology Laboratory (CML), Health Sciences Authority (HSA). Ms Cheow has over 10 years' experience in providing statistical training to analysts in HSA, as well as local and overseas laboratories.

She has also provided several consultancy services on statistics to testing laboratories. Ms Cheow serves as SAC-SINGLAS Technical Assessor and was also a member of a working group tasked to develop the SAC Technical Guide 4 – A Guide on Measurement Uncertainty in Medical Testing.

She is involved in the method validation and evaluation of measurement uncertainty in international and regional comparative studies participated by HSA CML and is also largely responsible for the implementation of statistical methods in proficiency testing programmes organised and certified reference materials produced by the laboratory. She represents Singapore Standards Council in ISO/CASCO Working Group (WG) 57 on Conformity Assessment – General Requirements for Proficiency Testing and ISO/TC 334 WG 16 on Reference Material Value Assignment.

Editors' Profiles

Dr Fransiska Dewi
Senior Analytical Scientist • Inorganic Chemistry Section
Unit Leader, PT/CRM Unit

Areas of interest: elemental analysis and chemical speciation on water, food, cosmetics, pharmaceuticals and biological samples; nanoparticle analysis

Ms Gui Ee Mei
Analytical Scientist • Organic Chemistry Section
Deputy Unit Leader, PT/CRM Unit

Areas of interest: quantification and analysis of organic contaminants in food, water and fuel oil

Ms Teo Hui Ling
Analytical Scientist • Organic Chemistry (Clinical) Section

Areas of interest: analysis of non-communicable chronic disease and endocrine biomarkers in human serum and blood; quantification of RNA copy number

ACKNOWLEDGEMENTS

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