OPPORTUNITIES FOR NATIONAL METROLOGY INSTITUTES AND REFERENCE MATERIAL PRODUCERS TO ENSURE GLOBAL FOOD SAFETY

A COMPANION REPORT

FINAL REPORT
APRIL 2020

from the
FOOD SAFETY WORKSHOP

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Opportunities for National Metrology Institutes and Reference Material Producers to Ensure Global Food Safety: A Companion Report

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U.S. Department of Commerce
Wilbur L. Ross, Jr., Secretary

National Institute of Standards and Technology
Walter Copan, NIST Director and Undersecretary of Commerce for Standards and Technology

The NIST Food Safety Workshop planning committee members included David M. Bunk, Carlos A. Gonzalez, Scott A. Jackson, Leah R. Kauffman, Katrice A. Lippa, Melissa M. Phillips, Catherine A. Rimmer, Stephen Semancik, Michael R. Winchester, and Laura J. Wood of the NIST Material Measurement Laboratory. This workshop report was prepared by Nexight Group (Silver Spring, MD) in conjunction with the workshop planning committee. The statements recorded here are those of the individual workshop participants and do not necessarily represent the views of all participants, their organizations, the planning committee, or NIST.

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EXECUTIVE SUMMARY

This companion report summarizes the discussion and subsequent actions from a supplementary one-day session following the NIST Food Safety Workshop held in October 2019. The supplementary session was open to National Metrology Institutes (NMIs) and Designated Institutes (DIs), commercial reference material and reference standard producers, and NIST staff engaged in developing measurement services and standards for food safety. The main goals of the session were to **synthesize the key takeaways** obtained from discussions during the 3-day Food Safety Workshop focused on four main food safety pillars (microbiological contaminants, chemical contaminants, food allergens, and authenticity); **disseminate the unique challenges**, **capabilities, and interests** for each institute and organization; and then **develop cooperative solutions** in five specific global food safety challenge areas, as delineated from the four pillars: microbiological contaminants, allergens and authenticity, inorganic contaminants, pesticides residues, and non-pesticide organic contaminants.

Participant demographics from the NIST Food Safety Workshop supplementary session.

NMI Measurement Service Portfolios

Many of the participating institutes and organizations described measurement services portfolios that contain common expertise and capacity for the development of food-related reference materials. Several institutes have worked independently or in small collaborations on measurement services for mycotoxins, developing excellent products but without realizing the full potential of the extensive NMI/DI network. Thus, a clear objective was identified to leverage the capabilities of joint institutes and organizations to cooperatively develop and contribute to the value assignment of new reference materials. This concept was further exemplified in an integrated plant protein reference material product under development by Canada, the US, and Brazil intended to support each of the participating economies. Many of the institutes and organizations have strong interest in developing services and standards related to the measurement of toxins, allergens, pesticides and drug residues, and toxic elements in various foodstuffs, the evaluation of safety (and efficacy) of *Cannabis* products, and building measurement infrastructure for microbiological contaminants and product authentication.

Cooperative Solutions for Measurement Challenges

Participants in the supplementary breakout sessions further discussed major measurement challenges for prioritized areas of food safety and brainstormed the potential solutions and stakeholder actions needed to address those challenges. Examples of short-term actions for cooperative, multilateral engagements that were identified from the five breakout sessions include:

Stakeholder Actions to Address Challenge Areas

Microbiological Contaminants: Build metrological infrastructure for the confident identification and traceable enumeration of *E. coli* in various food products

Allergens & Authenticity: Construct a network to collect authentic samples and improve product authentication measurements by handheld field devices

Inorganic Contaminants: Develop a new certified reference material to meet legislative mandates for toxic elements (e.g., cadmium) in cocoa raw materials from Central and South America

Pesticide Residues: Construct an international database of pesticide measurement data and regulatory requirements with a goal to harmonize global pesticide methods

Non-Pesticide Organic Contaminants: Build metrological infrastructure for the confident identification and traceable quantitation of perfluoroalkyl substances (PFAS) in water and foods

To ensure continued engagement of workshop participants toward global collaborative food safety measurement solutions, the NIST Food Safety Program has been established to encompass both internal NIST activities and external stakeholder engagement. NIST has implemented a Food Safety Forum[1] as an online hub to maintain the stakeholder connections and to facilitate future communication and information sharing among NMIs, DIs, and other interested parties. Through the Food Safety Forum and attendance at global food safety events, the number of stakeholders will grow and continue to represent the breadth of challenges and potential solutions.

In 2020, NIST will lay framework for a Food Safety Measurements Consortium (FSMC) to engage stakeholders for communication and promotion of the development, dissemination, and harmonization of measurement services, reference data and standards, and quality assurance (QA) and quality control (QC) practices in the safety testing of food products. The FSMC will support prioritization and development of collaborative research efforts to further measurement services and measurement science for advancement of food safety testing through engagement of global stakeholders representing food industry, testing laboratories, academia, and government perspectives. NIST will provide infrastructure, guidance, and leadership to the FSMC with the intention of developing capabilities of other stakeholders and empowering truly global collaborative solutions.

[1] https://groups.io/g/FoodSafetyForum

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LIST OF ACRONYMS

AFRIMET	Intra-Africa Metrology System
APMP	Asia Pacific Metrology Programme
CB&KT	Capacity Building & Knowledge Transfer
CRM	Certified Reference Material
DDT	Dichlorodiphenyltrichloroethane
DI	Designated Institute
FSMC	Food Safety Measurements Consortium
GMO	Genetically modified organism
ILC	Inter-laboratory comparison
LQ-MS	Liquid chromatography-mass spectrometry
MCPD	Monochloropropanediol
NIST	National Institute of Standards and Technology
NMI	National Metrology Institute
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated biphenyl
PE	Polyethylene
PFAS	Per- and polyfluoroalkyl substances
PP	Polypropylene
PT	Proficiency testing
QA	Quality assurance
QAP	Quality Assurance Program
QC	Quality control
RM	Reference material

BACKGROUND

The NIST Food Safety Workshop brought experts from the food industry, government, academia, and support organizations together to explore the measurement challenges facing government and industry stakeholders and brainstorm future measurement services as potential solutions to these challenges (report available at https://doi.org/10.6028/NIST.SP.1251). The one-day supplementary session following the workshop was organized to highlight National Metrology Institute (NMI) and Designated Institute (DI) representatives from various regional metrology organizations, including the Inter-American Metrology System (SIM), Intra-Africa Metrology System (AFRIMETs) and the Asia Pacific Metrology Programme (APMP), in addition to representatives from several commercial reference material and reference standard producers.

This archetype workshop was specifically designed to bring together these stakeholders from across the world to directly engage and problem solve with commercial reference standard producers with a goal of identifying practicable collaborative solutions for global food safety challenges. Invited participants in the workshop debrief session were expected to have the authority to forecast and/or make decisions about how their institutes may be able to contribute to future multilateral activities to ensure tangible outcomes would follow from the discussion. Given the extensive number and diversity of challenges facing food producers, regulators, and testing laboratories, collaborative solutions offer the greatest chance for success when built on existing strengths of various engaged organizations.

About the Food Safety Workshop

Date: October 28–30; a fourth day, October 31, was designated for reference material producers

Location: NIST Campus, 100 Bureau Drive, Gaithersburg, MD 20899

Participants: 170 experts from industry, regulatory bodies, RM producers, national metrology institutes, and academia from across the global food safety community; 75 NIST staff

Website: www.nist.gov/foodsafety

The primary intended deliverable of this supplementary session was to **connect stakeholders with similar interests** and **develop a concrete, achievable roadmap for future collaborations**.

KEYNOTE PRESENTATIONS

To begin the supplementary workshop session, Katrice Lippa, Michael Winchester, and Melissa Phillips of the NIST Material Measurement Laboratory welcomed attendees and reiterated the goal of the strategy session to prioritize future work and foster collaboration on creative solutions to the global food safety challenges as identified during the workshop of the previous days. Session participants were invited to consider five food safety areas (microbiological contaminants, allergens/authenticity, inorganic contaminants, pesticide residues, non-pesticide organic contaminants) and identify specific needs for his or her country, region, or organization to help ignite discussion during the later breakout sessions.

Following the introduction and welcome, two keynote presentations highlighted examples of ongoing approaches to collaborative solutions.

Global Initiatives in the Development of Mycotoxin Reference Materials — ***Melissa Phillips, Research Chemist, NIST*** summarized initiatives led by various NMIs to develop RMs for mycotoxins, including:

- NIST efforts to develop a Certified Reference Materials (CRMs) for mycotoxins in corn
- INMETRO (Brazil) efforts to develop a CRM for ochratoxin A in coffee
- NRC Canada efforts to develop calibration CRMs and rye flour matrix CRM for ochratoxin A
- NMISA (South Africa) efforts to develop proficiency testing for aflatoxins in peanuts
- BIPM and NIM China efforts to develop a capacity building and knowledge transfer program

She also discussed future plans to identify additional CRM development needs through collaborations and feedback with stakeholders.

Collaborative Development of a Multi-National CRM for Pea Protein — ***Michael Winchester, Research Chemist, NIST*** spoke on behalf of Zoltan Mester, NRC Canada, about a collaborative effort between INMETRO Brazil, NRC Canada, and NIST to develop a suite of plant-based protein CRMs, with NIST focusing on pea protein, INMETRO focusing on soybean protein, and NRC Canada focusing on canola protein. He noted that although the collaboration is only beginning, good progress has already been made. The next steps for this collaboration are to develop a timeline for blending and packaging of the materials and how to release the suite as a "CRM of the Americas."

LIGHTNING TALKS

Prior to discussion of food safety solutions, representatives from NMIs, DIs, and commercial reference material and reference standard producers were invited to give short, high-level presentations about their institutes and organizations. All representatives were asked to describe the top food safety challenges for their country and/or region. Participants were also asked to discuss the strengths of their measurement services portfolio for food safety, project future areas of involvement, and describe ongoing capacity development activities for food and natural product safety.

The common challenges expressed by the participants included maintaining adequate measurement services for the determination of chemical and microbiological contaminants in foods, ensuring authenticity of food products, and developing appropriate solutions to protect brand integrity for food manufacturers. Several institutes have ongoing efforts to organize proficiency testing (PT) and other testing services as well as fit-for-purpose reference materials to be utilized within their specific region. Most attendees revealed measurement services portfolios that contain common expertise and capacity for the development of food-related reference materials that cover organic, inorganic, and microbiological measurands for foodstuffs (e.g., milk-based products, cereal grains, vegetables, canned meats). Several institutes also maintain numerous Quality Assurance Programs (QAPs) and/or measurement and testing services for contaminants in foods (e.g., pesticide residues, preservatives, drug residues, toxic elements, microbiological pathogens), in addition to evaluation of residues in food contact materials.

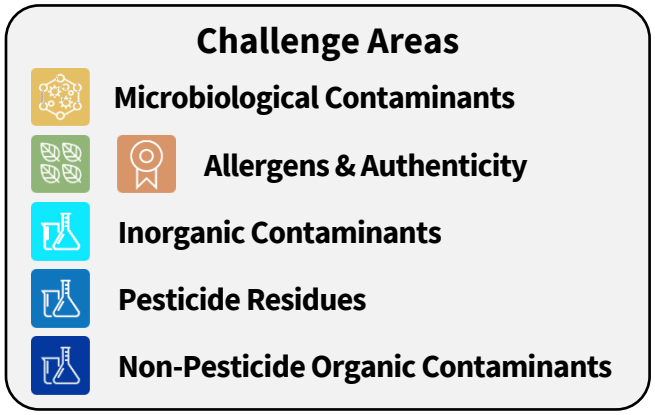
Many of the institutes and organizations have strong interest in maintaining and further developing services and standards related to the measurement of mycotoxins, toxic elements, pesticide residues, additives, and drug residues. Newer areas include developing capacity for alternative meat and plant-based protein materials, allergens, food and feed authenticity and adulteration, and the evaluation of

safety (and efficacy) of *Cannabis* products. Currently, only a few organizations deliver measurement services for microbial pathogen testing; however, numerous institutes expressed strong interest in development of this measurement infrastructure to address specific regional food safety challenges.

The full content of each lightning talk presented at the session, as well as those submitted after the session, are summarized in Appendix B in alphabetical order by country of the institute or organization. Commercial reference material and reference standard producers are detailed following the alphabetical list of NMIs and DIs.

FOCUSED BREAKOUT SESSIONS

Following the keynote presentations and lightning talks, session participants divided into groups (Appendix C) to discuss **challenges, solutions, and potential stakeholder contributions** for the challenge areas based on feedback during the main workshop as well as a pre-workshop poll. Challenges were prioritized based on feedback from all session attendees combined with interests of the breakout group members. Each group was tasked with identifying potential collaborative projects by first defining the problem, exploring possible solutions, and identifying stakeholders to provide materials, services, or other contributions to a possible solution. Each table below contains the outputs from all groups based on challenge areas.



MICROBIOLOGICAL CONTAMINANTS

Key examples: *Aspergillus* in *Cannabis*; *Salmonella* and *Listeria* in processed meats

Challenges	Solutions

• Lack of traceability in microbiological tests and measurements
  ○ Existing approaches are not traceable, not sufficiently sensitive, and/or not precise
  ○ Results are method specific
  ○ No approach exists for uncertainty analysis
• Lack of RMs specifically for
  ○ *Cannabis* (including hemp)
  ○ Processed foods
  ○ Meat and dairy products
• Existing methods are time consuming
• Bacteria in a food matrix are unstable over time
	• Develop a CRM that is useful for traditional methods as well as newer genomic approaches
	• Develop a variety of food-matrix CRMs certified for viable cells
	• Develop reproducible, fit-for-purpose reference methods for pathogen detection
	• Characterize existing commercial materials (e.g., Biomeriuex BioBalls) in terms of total cells and viable cells

Stakeholder Actions

- **BioMerieux, Microbiologics:** Collaborate to characterize existing materials in terms of total cells and viable cells
- **NIMT (Thailand), NIST (USA), CENAM (Mexico), NML (Philippines), LATU (Uruguay), Microbiologics (USA), NIM (China):**
  - Form a working group to develop CRMs
  - Collaborate to develop an RM for *E. coli* in a food matrix
  - Collaborate to develop methods to quantify viable cells

ALLERGENS AND AUTHENTICITY

Key examples: allergen proteins in food matrices; GMOs in soy; adulteration of edible oils, dietary supplement ingredients, meat, fish; phthalates in food contact materials[a]

Challenges	Solutions

• Allergens analytical community is fragmented and siloed: clinical diagnostics, test kit companies/users, and MS-based research
• Lack of available authentic materials
• No standard way to ensure materials are authentic
• Lack of performance validation standards for handheld field measurement devices
  ○ Many stakeholders with different levels of access
  ○ Requires matrix materials to challenge models
  ○ Requires data libraries that communicate across platforms and matrices
	• Incrementally improve allergen measurements through promotion of reference material use and encouraging communication
	• Develop a network to collect and verify authentic samples
	• Define needs for improving quality of measurements by handheld field devices

Stakeholder Actions

- **NIST (USA), LGC (UK), JRC (EU):** Evaluate the state of the science for food allergens and work collaboratively to improve traceability through reference materials, method, and interlaboratory comparisons
- **NIST (USA), LGC (UK), JRC (EU), IAEA:** Develop a network to collect and verify authentic samples by
  - ○ Developing consensus guidelines for sample collection, packaging, storage; data quality
  - ○ Forming consensus categories based on food types, availability, and impact on commerce and health, prioritized by matrix
  - ○ Compiling quality data to build or improve upon existing analytical databases
  - ○ Develop repositories for samples and data
  - ○ Begin with samples representing proteins (e.g., shrimp, fish), plants (e.g., turmeric, tea), and lipids (e.g., canola oil, olive oil)
- **NIST (USA), LGC (UK), JRC (EU), IAEA:** Define needs for improving quality of measurements by handheld field devices
  - ○ Determine performance criteria with comparison to higher-order methods on authentic samples
  - ○ Develop quality control materials and calibrants
  - ○ Establish criteria for statistical methods and models for data comparison
  - ○ Conduct proficiency testing and inter-laboratory studies

[a] Phthalates in food contact materials may not be considered an allergen or authenticity problem in the context of food safety; however, in the interest of transparency and to properly represent the discussion by stakeholders, this topic has been included in the report.

INORGANIC CONTAMINANTS

Key examples: heavy metals (e.g., Hg, Pb, Cr, Cd) in drinking water, industrial waste, rice, soil, fish, and cocoa; speciated Cr in supplements; nanoparticles in food packaging and additives; low Na in foods[a]; water content in olive oil[b]

Challenges	Solutions

• Determination of Cd and Pb in cacao bean raw material exports to meet EU regulations
  ○ Existing RMs are defatted powders and do not represent the analytical challenge
  ○ Existing methods used worldwide may not have adequate sensitivity
• Determination of Na in low sodium foods to meet numerous worldwide health-based regulations[a]
  ○ Existing methods used worldwide may introduce contamination and result in measurement biases
  ○ No RMs exist that target low sodium foods
	• Collaboratively develop an RM for naturally occurring Cd and Pb in raw and processed cocoa
	  ○ Evaluate laboratory performance through interlaboratory comparisons on commercial powders
	  ○ Evaluate method challenges in analysis of raw material
	  ○ Consider evaluation of elements related to sourcing (e.g., Ba, Sr, Mo) and process contamination (e.g., Cr, Fe)
	• Survey worldwide regulations to understand required analytical range for Na in low sodium foods[a]
	• Evaluate methods for Na in low sodium foods to assess potential for contamination and bias through interlaboratory comparison[a]

Stakeholder Actions

- **LACOMET (Costa Rica), INACAL (Peru), INM (Colombia):** Provide a cocoa powder material for interlaboratory comparison and/or RM development
- **NIS (Egypt), LACOMET (Costa Rica), NIST (USA), KEBS (Kenya), DRiCM (Bangladesh), Hong Kong Government Laboratory:** Conduct interlaboratory comparison for Cd and Pb in cocoa to evaluate laboratory performance and identify potential method biases, followed by educational workshop
- **LACOMET (Costa Rica), Hong Kong Government Laboratory, CENAMEP AIP (Panama), INACAL (Peru), NMISA (South Africa), INN (Chile):** Survey worldwide regulations and existing RMs to understand required analytical range for Na in low sodium foods[a]

[a] Low sodium in foods may not be considered an inorganic contamination problem in the context of food safety; however, in the interest of transparency and to properly represent the discussion by stakeholders, this topic has been included in the report.

[b] Water content in olive oil may not be considered an inorganic contamination problem in the context of food safety; however, in the interest of transparency and to properly represent the discussion by stakeholders, this topic has been included in the report.

PESTICIDE RESIDUES

Key examples: chlorpyrifos and fosetyl aluminum in fruits; DDT in grains, fruits, vegetables; pesticide residues in *Cannabis*, vegetables (e.g., avocado), fruits, grains, herbs, cheese; pesticide metabolites in foods

Challenges	Solutions

• Large variety of regulatory requirements that develop faster than measurement knowledge and expertise
• Large number of matrix and analyte combinations (plus potential metabolites) leads to extreme analytical complexity
• High cost and limited shelf life of calibration materials
• Difficulty accessing data and standards across borders
	• Define standardized categories of chemical compounds and matrices to facilitate demonstration of competence
	• Develop a user-friendly virtual space
	  ○ For sharing concerns, questions, and good practices
	  ○ With a database containing measurement data, information about methods, regulatory requirements
	• Work toward global harmonization of measurement methods

Stakeholder Actions

- **INM (Colombia), NML IDTI-DOST (Philippines), INN (Chile), Public Health Institute (ISP, Chile), INTI (Argentina), NIM (China), NIST (USA):** Conduct and participate in survey to determine highest priority needs for the data repository and propose pesticides and matrices that each can prepare for sharing
- **INM (Colombia), NML IDTI-DOST (Philippines), INN (Chile), INTI (Argentina), NIM (China), NIST (USA), MilliporeSigma, Phenomenex/Phenova, Restek:** Define standardized categories of chemical compounds and matrices to facilitate demonstration of competence
- **NIST (USA):** Host data repository and user-friendly virtual collaborative space

NON-PESTICIDE ORGANIC CONTAMINANTS

Key examples: domoic acid in shellfish; PFAS in popcorn and fish; PCBs, PBDEs, dioxins, cortisol, and zeranol in animal feed; MCPDs and glycidyl esters in processed foods; mycotoxins in oils, grains, spices, milk, coffee, and *Cannabis*; veterinary drug residues in poultry, milk, seafood, and feed; preservatives (e.g., chloroform) in milk and dairy; phthalates in food contact materials

Challenges	Solutions

• Accuracy of methods for perfluoroalkyl substances (PFAS) in water, foods:
  ○ Lack of calibrators of adequate quality and variety due to difficulty sourcing pure materials
  ○ Lack of matrix-based CRMs
• Lack of CRMs for veterinary drug metabolite residues in foods
  ○ Lack of understanding of metabolism in food animals
  ○ Lack of calibrators for metabolites
• Lack of RMs for contaminants (e.g., PCBs, dioxins, mycotoxins, MCPDs, glycidyl esters) in animal feed
	• Increase the number of available PFAS calibrators to support more accurate measurements, collaborating to build capacity in developing economies
	• Identify and prioritize RM needs for veterinary drug metabolite residues
	  ○ Consult clinical literature for understanding of metabolic processes
	  ○ Survey calibrator availability
	• Source one or more animal feed materials for interlaboratory comparison and potential RM development

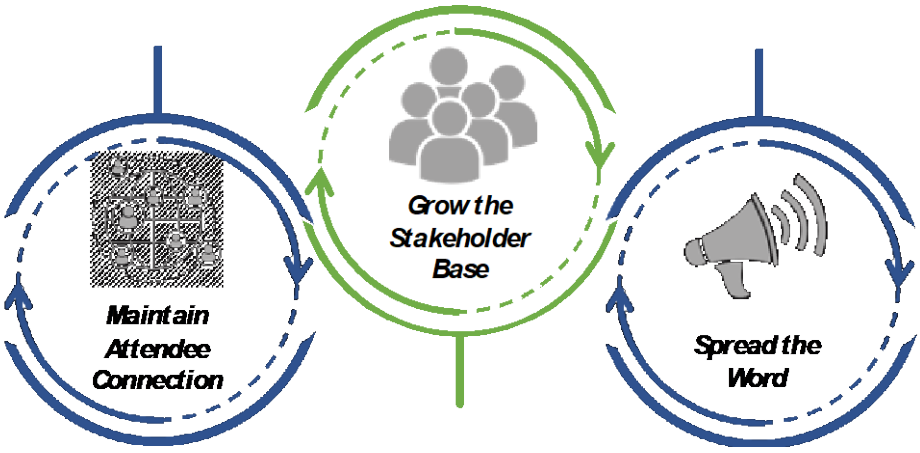
Stakeholder Actions

- **Merck, NMIJ (Japan):**
  - Source purification of technical PFAS mixtures and assign values using ^{19}F-qNMR
  - Isolate and/or synthesize calibrators and internal standards for veterinary drug metabolites
- **NIST (USA), NIM (China), NMISA (South Africa), INMETRO (Brazil), JRC (EU), NMIJ (Japan), TUBITAK UME (Turkey):** Collaboratively develop and value assign calibration CRMs for PFAS, and utilize experience for capacity building of other interested NMIs
- **BIPM (France):** Initiate next stage of Capacity Building and Knowledge Transfer (CBKT) program covering tetracycline calibrators preparation and characterization.
- **NMISA (South Africa), INMETRO (Brazil), INTI (Argentina), NIM (China), DRiCM (Bangladesh), KEBS (Kenya):** Continue development of in progress CRMs for veterinary drug residues in matrix
- **NMISA (South Africa):** Source, process, and package an animal feed raw material for collaborative evaluation
- **NIST (USA), NIM (China), NMISA (South Africa), INMETRO (Brazil), JRC (EU), INTI (Argentina), NIM (China), DRiCM (Bangladesh), KEBS (Kenya):** Collaborative value assign animal feed material for multiple toxin classes through interlaboratory comparisons

LOOKING FORWARD

Workshop participants concluded the supplementary session by discussing collaborative global solutions to address the challenges identified both in the session and in the larger workshop. The discussion built on the work in the breakout sessions where participants identified future stakeholder actions to address the challenges upon returning to their home institutes. While great progress was made in identifying paths forward, efforts toward solutions must not end at the conclusion of the workshop.

Maintaining the connections made between participants was identified as a key in continuing the collaborative work and ensuring that ideas discussed during the workshop come to fruition. Participants were encouraged to identify members within their organizations and networks to lead or contribute to these efforts and to share contact information to **expand the base of stakeholders** committed to food safety measurement solutions. Finally, attendees should **spread the word** about these collaborative efforts by widely distributing the workshop reports and attending other workshops and conferences to gather additional input and recruit new stakeholders.



Goals to build on the results of the Food Safety Workshop

Between the close of the workshop and the release of this report, NIST has already begun taking steps in development of a NIST Food Safety Program toward these goals. A **Food Safety Forum** has been implemented as an online hub for communication and information sharing among NMIs, DIs, and other interested stakeholders. NIST has also committed to working with other organizations to share materials and data, allowing each region to work with relevant specialized articles of commerce through the NIST Food Safety Program. NIST representatives will be attending workshops in 2020 to disseminate information about the Food Safety Forum and the NIST Food Safety Program, including the 2020 Government Chemist Conference, *Safe Food for Tomorrow's World*, in London and the 2020 *Africa Food Safety Workshop* in Johannesburg.

To maintain activity in these areas over the long term, NIST will lay a framework for a **Food Safety Measurements Consortium (FSMC)** to engage stakeholders to communicate and promote the development, dissemination, and harmonization of measurement services, reference data and standards,

and quality assurance (QA) and quality control (QC) practices in the safety testing of food products. Objectives will include:

- Identification, harmonization, and dissemination of QA/QC best practices for food safety testing.
- Prioritization and development of reference materials and data, sample and data repositories, interlaboratory comparisons, and other measurement services to support QA/QC efforts for food safety testing.
- Identification, prioritization, and development of collaborative research efforts to further measurement science for food safety.

The FSMC will be open to participation from global stakeholders representing food industry, testing laboratories, academic, and government perspectives. Leaders of the FSMC and related subgroups and tasks will be selected by the membership for finite terms of service, to promote global engagement. The membership will meet regularly via teleconference, and resources will be made available online for both members and non-members. Efforts within the Food Safety Forum and FSMC will be separate but complementary for the near term but may coalesce as the FSMC becomes operational. More information about the FSMC and how to join will be forthcoming in 2020.

APPENDIX A: LIST OF PARTICIPANTS

Ahmed Abou-Kandil
National Institute of Standards (NIS), Egypt

Marlon Aguinaldo
National Metrology Laboratory (NML) of the Philippines (ITDI-DOST)

Juliana Barrios Guio
Instituto Nacional de Metrología de Colombia (INM)

Bruce Benner
NIST Material Measurement Laboratory

Julian Braybrook
National Metrology Laboratory (NML) at LGC, UK

Ross Brindle
Nexight Group

Sally Bruce
NIST Standards Coordination Office

David Bunk
NIST Material Measurement Laboratory

Bryan Calderón-Jiménez
Laboratorio Costarricense de Metrología (LACOMET), Costa Rica

Steven Choquette
NIST Office of Reference Materials

Megan Cleveland
NIST Material Measurement Laboratory

Andrew Conn
NIST International and Academic Affairs Office

Aaron Dacuya
National Metrology Laboratory (NML) of the Philippines (ITDI-DOST)

Regina Easley
NIST Material Measurement Laboratory

Maria Fernandes-Whaley
National Metrology Institute of South Africa (NMISA)

Elizabeth Maria Ferreira
Laboratorio Tecnológico del Uruguay (LATU)

Sam Forry
NIST Material Measurement Laboratory

Francisco Javier Garcia Leoro
Instituto Nacional de Normalización (INN), Chile

Patricia Gatti
Instituto Nacional de Tecnología Industrial (INTI), Argentina

Lourdes González
Centro Nacional de Metrología de Panamá (CENAMEP AIP)

Ashley Beasley Green
NIST Material Measurement Laboratory

Grace Hahm
NIST Material Measurement Laboratory

Justyce Jedlicka
MilliporeSigma

Monique Johnson
NIST Material Measurement Laboratory

Sheila Kachila
Kenya Bureau of Standards (KEBS)

Leah Kauffman
NIST Material Measurement Laboratory

Simon Kelly
International Atomic Energy Agency (IAEA)

Mala Khan
Designated Reference Institute for Chemical Measurements (DRiCM), Bangladesh

Joseph Konschnik
RESTEK Corporation

Jason Kralj
NIST Material Measurement Laboratory

Scott Krepich
Phenomenex/Phenova

Adam Kuszak
National Institutes of Health – Office of Dietary Supplements (NIH-ODS)

Markus Lacorn
R-Biopharm

Rachel Lanspa
Nexight Group

Hongmei Li
National Institute of Metrology (NIM), China

Nancy Lin
NIST Material Measurement Laboratory

Katrice Lippa
NIST Material Measurement Laboratory

Caleb Luvonga
NIST Material Measurement Laboratory/Kenya Bureau of Standards (KEBS)

Nathan Mahynski
NIST Material Measurement Laboratory

Frank Mari
NIST Material Measurement Laboratory

Gustavo Martos Sevilla
International Bureau of Weights and Measures (BIPM)

Carrie Maune
Trilogy Labs

Nick Mitchell
Phenomenex

John Molloy
NIST Material Measurement Laboratory

Antonio Montoro Bustos
NIST Material Measurement Laboratory

Karen Murphy
NIST Material Measurement Laboratory

Jacolin Murray
NIST Material Measurement Laboratory

Matthias Nold
Merck KGaA

Melina Perez Urquiza
Centro Nacional de Metrologia (CENAM), Mexico

Melissa Phillips
NIST Material Measurement Laboratory

Guilherme Pinheiro
NIST Material Measurement Laboratory/INMETRO, Brazil

Paulina Piotrowski
NIST Material Measurement Laboratory

Benjamin Place
NIST Material Measurement Laboratory

Ka Fai Poon
Hong Kong Government Laboratory (GLHK)

Yanqi Qu
MilliporeSigma

Fernando Raco
NIST/Instituto Nacional de Tecnologia Industrial (INTI), Argentina

Kate Rimmer
NIST Material Measurement Laboratory

Steve Semancik
NIST Material Measurement Laboratory

Nicholas Sharp
NIST Material Measurement Laboratory

Valnei Smarcaro da Cunha
INMETRO, Brazil

Marcelo Soto
Public Health Institute of Chile (ISP)

Sasithon Temisak
National Institute of Metrology (Thailand) NIMT

Dileep Thatte
NIST Manufacturing Extension Partnership

Christian Uribe
INACAL (Instituto Nacional de Calidad), Peru

Thomas Vetter
NIST Material Measurement Laboratory

Michael Winchester
NIST Material Measurement Laboratory

Laura Wood
NIST Material Measurement Laboratory

Qinghe Zhang
National Institute of Metrology (NIM), China

APPENDIX B: LIGHTNING TALK SUMMARIES

Instituto Nacional de Tecnologia Industrial (INTI), Argentina

Mission

Strengthen industrial competitiveness throughout the country through technology transfer, compliance with metrological legislation and the promotion of technological development and innovation in all productive sectors

Country/Region Specific Challenges

Disseminate traceability to food industry through reference methods and reference materials

Ensuring accuracy of methods for determination of chemical and microbiological components in foods

Ensuring safety of food products according to national regulation

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Specific laboratories for milk products, cereals, vegetable oils, fruits, fish and meat products. • Extensive experience with food industry stakeholders • 16 reference materials • Integrated Management System (SIG)	• Food composition (major and minor nutritional components) • Chemical contaminants and residues • Microbiological contaminants	• Collaborations with NIST (SIM Engagement Opportunities Program) • Collaborations with BIPM (CB&KT Program) • Collaborations with PTB • Regional projects

Designated Reference Institute for Chemical Measurements (DRiCM), Bangladesh

Mission

Knowledge transfer through collaborative work is necessary to maximum utilization of the strength

Country/Region Specific Challenges

Knowledge transfer
Collecting CRMs
Ensuring accurate measurements
Organizing PT/ILC
Other testing labs using non validated methods, sometimes non-standard methods
Overprotection without valid scientific basis invite hazards
Misleading advertisement exploiting general public's ignorance
Protecting consumer from substandard and adulterated food

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• ≈1000 services (toxic elements, micro, pesticides, antibiotics, vet drug residues and physico-chemical parameters) • PT/ILC program • Training on analytical instrumentation, method validation & LC-MS (ISO-17025) • NIST-traceable pH buffer (4,7,10) for domestic lab use	• Chemical contaminants • Pesticides & drug residues • Microbial contaminants & MBM	• State-of-the-art laboratory • Trained & motivated manpower (80 approved to hire, 29 currently working) • Contributing in raising public awareness • Top management commitment

National Institute of Metrology (NIM), China

Mission

Realize global mutual recognition of national measurement standards maintained by NIM

Country/Region Specific Challenges

Ensuring accuracy of methods for determination of chemical contaminants in foods and agriculture products

Ensuring authenticity of food products in the market of China (e.g., wine, botanicals)

Ensuring safety of allergic consumers

Ensuring integrity of the food supply against nefarious intent

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Extensive experience with food testing laboratories • Over 400 CRMs • Quality assurance program on methods and RMs	• Chemical contaminants and residues • Nutrient content • Protein food allergens • Food authenticity • Microbiological contaminants	• Collaborations with BIPM, APMP • Collaborations with CFDA, CDC • Methods and CRM development • CRMs emerging contaminants • CRMs of pesticides • CRMs of mycotoxins • CRMs of veterinary drugs

Laboratorio Costarricense de Metrologia (LACOMET), Costa Rica

Mission

Disseminate and develop a national metrological structure, in agreement with the needs of Costa Rica

Country/Region Specific Challenges

Ensuring the development of metrological infrastructure to collaborate with national policies to prevent diseases due toxins and other chemicals in food

Ensuring metrological mechanisms (i.e., reference materials, aptitude tests, and measurements) to assess the adulteration and quality of agro-industrial and food products

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Proficiency testing (ISO 17043) • Calibration and Measurement Capabilities (CMCs-BIPM) • Calibration of chemical equipment	• Low sodium in foodstuff reference material (bread) • Chemical contaminants and residues (arsenic in rice and mercury in fish) • Pesticides in food (Bromacil) • Proximate analysis • Food authenticity	• Collaborations with NIST (Proximate, elemental analysis) • Collaboration with national bodies (e.g., CITA-UCR, INCIENSA, MINAE, CONARROZ) • Methods for toxic elements (total Hg and As) • Methods for proximate analysis • Methods for elements

National Institute of Standards (NIS), Egypt

Mission

NIS keeps, maintains and develops national standards and ensures traceability according to international regulations

Country/Region Specific Challenges

Ensuring accuracy of measurements for determination of chemical contaminants in food and other materials

Testing of contamination in food (organic and inorganic contaminants)

Production of reference materials for different industries

Helping laboratories improve their measurement capabilities through accreditation (ISO 17025)

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Heavy metal analysis related to food and water industries • Food packaging and food contact materials analysis	• Molecular weight distribution of poly olefins (PE and PP used in packaging) • Phthalate content in PE and PP • Chloroform and other contaminants in milk and dairy products • Water content in extra virgin olive oil	• Microbiological analysis • Collaborations with NIST and other institutes • Testing for pesticides

Government Laboratory, Hong Kong Special Administrative Region

Mission

Provide our community with quality analytical, forensic, and advisory services achieved through advancing measurement science and standards by a proud and committed work force

Country/Region Specific Challenges

Provide testing services to support the implementation of regular food surveillance program

Render urgent analytical support to the handling of various food incidents

New analytical methods for the Food Adulteration (Metallic Contamination) (Amendment) Regulation 2018

Method development in support of the Pesticide Residues in Food Regulation

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Wide range of scientific services • Quality system in line with ISO/IEC 17025:2017 • Reference Material Producer (ISO 17034:2016) • Proficiency Testing Provider (ISO/IEC 17043:2010)	• Food composition and labelling • Additives and contaminants • Pesticides and veterinary drug residues • Toxins (e.g. mycotoxins, shellfish toxins) • Species identification • GM food • Food allergens	• Collaborations with other NMIs/DIs • Coordinating key/supplementary comparisons and pilot studies • Organizing technical seminars • Organizing PT programs • CRM production

Kenya Bureau of Standards (KEBS)

Mission

To provide standards-based solutions that promote innovation, trade and quality life

Country/Region Specific Challenges

Ensuring food safety throughout the food value chain

Ensuring authenticity of food products

Development of food standards of strategic national interest

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Kenya Standards and standardization marks for food testing • Certification body • ISO certified • Quality awards	• Heavy metal contaminants • Organic contaminants and residues • Microbiological contaminants • Food and feed adulteration and authenticity	• Development of competence for mycotoxin metrology in collaboration with BIPM • Development of reference cultures for spoilage microorganisms. • Development of molecular techniques for food authentication using DNA fingerprinting of rice

*Provided after the session for inclusion in final slide distribution

Centro Nacional de Metrologia (CENAM), Mexico

Mission

Institution of the Mexican State leader in the science of measurements, with competent, committed and honest staff. It offers innovative services and solutions based on scientific knowledge and technological development and positively impacts trade, industrial competitiveness, the environment and the well-being of the population, with equity and transparency

Country/Region Specific Challenges

Ensuring accuracy of methods for determination of chemical and microbiological contaminants in foods

Ensuring authenticity of food products (e.g., coffee, tequila, cacao)

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Modest experience with food industry stakeholders • 20 reference materials for organic, inorganic and microbiology measurands • Quality assurance program (QAP)	• Chemical contaminants and residues • GMOs • Microbiological contaminants • Food authenticity • Cannabis	• Collaborations with NIST • Collaborations with the Ministry of Agriculture and Rural Development

National Metrology Laboratory (NML), Philippines

Mission

Providing international traceability to measurements in the country

Country/Region Specific Challenges

Establish, maintain, disseminate the national standard units of measurements to provide traceability for measurements done in the country

Conduct calibrations and measurements appropriate to the needs of the customer

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Development of reference materials and provision of proficiency tests • 10 PT schemes conducted (benzoic acid in mango juice, histamine in canned tuna, toxic elements in water)	• Additives (benzoic acid) • Pesticides (chlorpyrifos) • Veterinary residues (CAP, NF) • Toxic Elements (Pb, Cd, Hg, As) • Microbiological contaminants (*Salmonella* in milkfish)	• Technical capabilities (analytical methods and RM production) • Infrastructure (facilities and equipment • Personnel development (staff trainings)

National Metrology Institute of South Africa (NMISA)

Mission

To consistently deliver outstanding innovative and internationally comparable measurement solutions that support regional and international trade, people's quality of life and enable the protection of the environment.

Country/Region Specific Challenges

Be a unique product and service-oriented supplier; knowledgeable on exactly what our stakeholders require and efficiently optimize those requirements to provide fit-for-purpose Africa-relevant reference materials

Be accessible and affordable to support a sustainable Africa Food Safety Network of testing laboratories

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• ISO 17025:2017 • ISO 17034:2016 RM Producer • ISO 17043:2010 PT scheme provider for Food contaminants, nutrients and forensic blood alcohol	• Contaminants (Mycotoxins, POPs, heavy metals, melamine) • Residues (Pesticides, Antibiotics) • Food labelling (Protein, AAs, elements, alcohol, expanding into fats, vitamins, sugar)	• NMIJ – QNMR • BIPM CB&KT Mycotoxin Calibration solutions • NIM China – ZEN in maize RM • FAO/IEAE Africa Food Safety Network

National Institute of Metrology, Thailand (NIMT)

Mission

To ensure the uniformity of metrology in order to build confidence in reliability of measurements to help enhance economic performance and the quality of life.

Country/Region Specific Challenges

Ensuring accuracy of methods (chemical, microbiological) – including sensitivity, specificity

Ensuring the homogeneity of RMs

Comparing results with different methods (ppm/gene copies/units)

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Reference materials (pesticides; heavy metals in matrices like rice, prawn, and soil; aflatoxins in peanut butter) • Measuring services • Proficiency testing	• Food contaminants: veterinary drugs, pesticides, melamine, toxic elements • Food adulteration: meat adulteration, adulterated drugs in food supplementary • Microbiological contaminants • Cannabis	• Collaborations with NMI, Thai FDA, Department of Agriculture • Reference material producer • Proficiency testing • Training, workshops & seminars

National Measurement Laboratory at LGC, United Kingdom

Mission

Support the UK Industrial Strategy – Food Sector - Protecting consumers in a changing world, Supporting UK business & government, Maximizing UK measurement infrastructure to address future challenges, & Growing collaborative national skills initiatives

Country/Region Specific Challenges

Ensuring accuracy of methods for determination of chemical and molecular contaminants in food and feed

Ensuring authenticity of food and feed products consumed by UK population

Ensuring safety of food allergic consumers by international collaboration on reference methods and materials

Producing reference materials to address market gaps - where measurements are challenging or production hard

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Calibration services for chemical and molecular contaminants in food & feed (supporting CMCs) • 45 food & beverage Reference Materials (33% of portfolio) • 8 Proficiency Testing schemes related to food, 5 to beverages, 2 to food-related schemes (50% of portfolio)	• Food allergens (protein & DNA) • Food origin and authentication • Food integrity • Chemical and molecular contaminants & residues • Nanomaterials • Cannabis/CBD	• Collaboration with departments of the UK Government • Collaboration with UK & EU food reference institutes and networks • Collaboration with international NMIs & food allergy consortia • Novel meat alternatives • Novel food packaging/contact materials • Transportable POU technologies

National Institute of Standards & Technology (NIST), United States of America

Mission

Promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology

Country/Region Specific Challenges

Ensuring accuracy of methods for determination of chemical & microbiological contaminants in foods
Ensuring authenticity of food products coming into the US (e.g., botanicals, seafood)
Ensuring safety of allergic consumers in the absence of ingredient regulations
Ensuring integrity of the US food supply against nefarious intent

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Extensive experience with food industry stakeholders • 71 reference materials • Quality assurance program (QAP) • New QAP model for rapid RM development	• Chemical contaminants and residues • Protein food allergens • Food authenticity • Food defense • Cannabis • Microbiological contaminants	• Collaborations with INTI • Collaborations with U.S. FDA, USDA, DOD • Methods for pesticides, mycotoxins, process contaminants • New rapid response RM types

Laboratorio Tecnológico del Uruguay (LATU)

Mission

Promote the sustainable development of the country and its international insertion through innovation and transfer of value solutions in analytical services, conformity assessment, metrological, technological, promotion of scientific and entrepreneurial culture and the development of technological platforms

Country/Region Specific Challenges

Ensuring accuracy of methods for determination of chemical and microbiological contaminants used in the certification of exports and imports foods and services offered in general

Conducting risk analyses in the frame of Interinstitutional Scheme of Risk Analysis, managed by the Ministry of Livestock, Agriculture, and Fisheries (MGAP)

Foundation dedicated exclusively to Research, Development and Innovation, which works directly with the industry, particularly food industry

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• CRM/RM: Microbiological and contaminants in food • Proficiency test: Microbiological and contaminants in food • Service of accredited food analysis • Qualification services for thermal equipment • Food irradiation service	• Chemical contaminants and residues in foods • Microbiological contaminants • Food areas of interest: dairy, meat, cereals, honey, fruits and vegetables, yerba mate, fat and oils • Cannabis irradiation	• Extensive experience with food industry stakeholders that allows to work together • Collaborations with the Ministry as a scientific studies coordinator in the “Interinstitutional Scheme of Risk Analysis” • Customized CRM/RM production according to needs expressed by clients (state, industry, university) • Customized proficiency programs based on the needs of customers

International Bureau of Weights and Measures (BIPM)

Mission

To work with the NMIs, regional metrology organizations and strategic partners to advance the global comparability of measurements

Country/Region Specific Challenges

Achieve a global balance between the metrology capabilities in member states – Metrology for Safe Food and Feed

Provide knowledge transfer to visiting scientists

Enable NMIs to characterize pure substance materials, provide calibrants, matrix CRMs, PT materials

Enable NMIs to demonstrate comparability in international comparisons

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Purity value assignment by qNMR and mass balance methods (e.g., LC-hrMS, LC-UV, LC-CAD, TGA, KF) • Preparation and characterization of pure materials and calibrant CRMs	• Mycotoxins • Drug residues • Pesticides	• CBKT – mycotoxins program with 18 active participants • Open-access guides for purity evaluation and calibrant assessment • Coordination of primary calibrator comparisons relevant to food analysis

MilliporeSigma

Mission

Solving the toughest challenges in Food Safety Testing

Country/Region Specific Challenges

Providing compliant safety and quality testing solutions to address increasing consumer demand for safe, nutritional and healthy food

Helping protect manufacturers and testing labs protect brand integrity

Developing new and innovative food safety solutions (reference materials, rapid tests, microbiology)

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• 4 double accredited sites (ISO 17025, ISO 17034) – Buchs, Darmstadt, Laramie, Round Rock • More than 8,000 standards and reference materials • ISO 11133 compliant Media for microbiology • Milli-Q water systems • CRISPR, NGS and WGS Tools	• Reference Materials (e.g., Pesticides, Biotoxins, Heavy Metals, Microbiology, Allergens) • Food Quality and Safety Testing • Water and Beverage analysis • Cannabis • Mobile Analytical Tools • Pathogen Detection	• AOAC – TDRM, CASP • ACIL – FSS, CWG • NIST – Dx Protein CRM, toxin matrix materials, qNMR • Rapid Detection Tools – Chemical Analysis and Microbiology

Trilogy Analytical Laboratory

Mission

Providing Analytical Excellence for The Food and Feed Industry

Country/Region Specific Challenges

Procuring quality control or CRMs in matrices for use in drug residue testing

Procuring some PT rounds for some analytes

International differences in tolerances and absences of regulations for analytes

Increasing number of analytes found in unusual matrices or locales

Measurement Services Portfolio	Measurement Areas of Interest	Capacity Development
• Extensive experience with mycotoxins • Quality control materials and CRMs for mycotoxins – calibrators and agricultural matrix materials • Quality control materials for allergens • ISO 17025, ISO 17034; ISO 9001, ISO 17043	• Mycotoxins • Drug residues • Allergens • Biogenic amines	• Methods and method development for mycotoxins, drug residues by HPLC, LC-MS-MS • Development of custom quality control materials • Development of multi-analyte Reference Materials • Customized PT rounds

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APPENDIX C: BREAKOUT SESSION ASSIGNMENTS

Microbiological Contaminants	Allergens & Authenticity
Aguinaldo, Marlon	Beasley Green, Ashley
Cleveland, Megan	Braybrook, Julian
Ferreira, Elizabeth	Bruce, Sally
Forry, Sam	Bunk, David
Kralj, Jason	Choquette, Steven
Lee, G. Diane	Forbes, Tom
Lin, Nancy	Kelly, Simon
Patel, Ilabahen	Kraft, Rebecca
Perez Urquiza, Melina	Kuszak, Adam
Pinheiro, Guilherme	Lacorn, Markus
Temisak, Sasithon	Mahynski, Nathan
Thatte, Dileep	Mari, Frank
	Maune, Carrie
	Piotrowski, Paulina
	Qu, Yanqi
	Rimmer, Catherine

Inorganic Contaminants	Pesticide Residues	Non-Pesticide Organic Contaminants
Abou-Kandil, Ahmed	Barrios, Juliana	Fernandes-Whaley, Maria
Calderón, Bryan	Benner, Bruce	Khan, Mala
Easley, Regina	Dacuya, Aaron	Li, Hongmei
González, Lourdes	García, Francisco	Luvonga, Caleb
Johnson, Monique	Gatti, Patricia Alejandra	Martos, Gustavo
Kachila, Sheila	Jedlicka, Justyce	Nold, Matthias
Molloy, John	Konschnik, Joe	Phillips, Melissa
Montoro Bustos, Antonio Rafael	Krepich, Scott	Place, Benjamin
Murphy, Karen	Mitchell, Nick	Raco, Fernando
Poon, Ka Fai	Murray, Jacolin	Smarcaro da cunha, Valnei
Sharp, Nicholas	Soto, Marcelo	
Uribe, Christian	Zhang, Qinghe	
Wood, Laura		