NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

AVA Agri-Food & Veterinary Authority of Singapore

Food Safety Risk Assessment Public Seminar Meeting Report

5th November 2018

Jointly organised by

Agri-Food & Veterinary Authority of Singapore (AVA) and
Nanyang Technological University Food Technology Centre (NAFTEC)

Contents

Acknowledgments

Nanyang Technological University Food Technology Centre (NAFTEC) would like to express their gratitude to the Agri-Food and Veterinary Authority of Singapore, for their efforts in collaboratively planning and organizing the event. Many thanks also to all NAFTEC staff members assisting in the event coordination and drafting of the meeting report, especially Dr Natasha Yang, Dr Moon Tay Yue Feng, Dr Chengcheng Hu and Ms Kelyn Seow.

Acronyms

AVA	Agri-Food and Veterinary Authority of Singapore
ANSES	The French Agency for Food, Environmental and Occupational Health & Safety Agency
AFSSA	French Food Safety Agency
ANSET	French Agency for Environmental and Occupational Health Safety
BfR	The German Federal Institute for Risk Assessment
BMEL	Federal Ministry of Food and Agriculture (Germany)
BSE	Bovine Spongiform Encephalopathy
BVL	Federal Office of Consumer Protection and Food Safety (Germany)
CDC	Centers for Disease Control and Prevention
DTU	Technical University of Denmark
EFSA	European Food Safety Authority
ECDC	European Centre for Disease Prevention and Control
EU	European Union
EURL	European reference laboratory
GMI	Global Microbial Identifier
FAO	The Food and Agriculture Organization of the United Nations
FBO	foodborne outbreak
MLST	multilocus sequence typing
NAFTEC	Nanyang Technological University Food Technology Centre
NGS	next generation sequencing
NRL	national reference laboratory
PFGE	pulsed field gel electrophoresis
RA	risk assessment
SCELSE	Singapore Centre for Environmental Life Sciences Engineering
USFDA	US Food and Drug Administration
WGS	whole genome sequencing
WHO	World Health Organization

Executive Summary

Nanyang Technological University Food Technology Centre (NAFTEC) together with the Agri-Food and Veterinary Authority of Singapore hosted a half day seminar on risk assessment for food safety on 5th November 2018. The event was attended by 142 participants, with 52 from academia, 33 from industry and 57 from government regulatory sectors. The positive reception of the event reflects the interest of participants in advancing food safety and security which is of particular importance to Singapore – a major food importing nation.

The event commenced with opening remarks from NTU President, Professor Subra Suresh, and featured presentations from two of the largest risk assessment bodies in the European Union, namely The French Agency for Food, Environmental and Occupational Health & Safety (ANSES), and The German Federal Institute for Risk Assessment (BfR). ANSES and BfR provided a historical overview of their institution, both of which was developed as a successful response to the 1990s BSE crisis, as well as other European food scandals. The discussion also focused on the positive reception and many uses of novel systems in controlling and reducing foodborne risks i.e. the use of next generation sequencing.

Overall, the meeting highlighted the success of the new direction of food safety systems in a risk analysis framework ensuring segregation between the risk assessor (science) and risk manager (regulation). Risk assessment is typically performed by a collective group of experts active in the relevant field of research. Consequently, both risk assessment institutes (ANSES and BfR) are linked to University science, as are several other European Food Institutes. Furthermore, the use of whole genome sequencing (WGS) evidently has multiple uses in the food safety regulatory framework, including timely source attribution and response to foodborne outbreaks. The effective use of WGS technology will be enhanced through the development of regional or global databases. Nanyang Technological University will host a meeting on such databases on the 10th -14th June 2019 as part of the 12th Global Microbial Identifier Meeting.

Time	
12:00	Registration and lunch
13:00	Welcome introduction ***Subra Suresh, President, Nanyang Technological University, Singapore***
13:10	The legal and institutional background of food safety in Europe: The role of ANSES in France ***Roger Genet, Director General, ANSES, France***
13:30	The legal and institutional background of food safety in Europe: The role of BfR in Germany ***Reiner Wittkowski, Vice-President, BfR, Germany***
13:50	The construction of European Food Safety Authority (EFSA) expert committees and risk assessment challenges in EU systems ***Joergen Schlundt, Director, NAFTEC, Steering Committee Head, GMI, Singapore***
14:10	QA and Discussion
14:35	Intermission
14:50	The impact of globalisation on food safety: introduction to the Global Microbial Identifier and the use of NGS ***Joergen Schlundt, Director, NAFTEC, Steering Committee Head, GMI, Singapore***
15:10	A bird's eye view of genomic projects in the ANSES laboratory for food safety ***Michel-Yves Mistou, ANSES, France***
15:30	Genome-wide identification of host-segregating epidemiological markers for source attribution in Campylobacter jejuni ***Gilles Salvat, ANSES, France***
15:50	Application of whole genome sequencing for foodborne outbreak investigations and epidemiological studies in Germany ***Burkhard Malorny, BfR, Germany***
16:10	QA and Discussion
16:30	Tea break

Lecture Theatre 6
Block NS2, NS2-02-05
North Spine
LEVEL 2, NEAR CEE

The legal and institutional background of food safety in Europe – The role of the French Agency for Food, Environmental and Occupational Health & Safety Agency (ANSES) in France

Roger Genet, Director General, ANSES, France

The French Agency for Food, Environmental and Occupational Health & Safety Agency (ANSES) was incepted in 2010, following the mad cow disease outbreak and fusion of French Food Safety Agency (AFSSA) and French Agency for Environmental and Occupational Health Safety (ANSET). The agency is comprised of 1400 permanent staff members organized in 4 divisions: [1] General Affairs, [2] Regulated Products, [3] Science for Expertise, [4] Research & Reference. In accordance to their mission - ensuring human health and safety in the fields of food, environment and occupational health – the agency serves across five ministries: health, agriculture, ecology, consumer protection, labour. The basis and success of ANSES is through exercising the core values including independence/impartiality whereby the agency only receives public funding, and acts with transparency whereby the opinions including minority opinions are published. In regards to funding, ANSES receives an annual budget of 145 million euros and 8 million euros is directed to support calls for research projects. ANSES works closely with researchers to produce risk assessments for the risk manager. The Agency has approximately 800 external experts working in its various expert groups, chosen through a public call for applications and selected based on criteria of scientific competence and absence of potential conflicts of interest. The Agency also runs a network of 11 reference and research laboratories located throughout France that are internationally recognised in various fields or disciplines. Annually, more than 230 opinions are published and 4000 decisions/marketing authorisations are made.

The legal and institutional background of food safety in Europe – the role of The German Federal Institute for Risk Assessment (BfR) in Germany

Reiner Wittkowski, Vice-President, BfR, Germany

Similar to ANSES, The German Federal Institute for Risk Assessment (BfR) was founded as a response to improve food safety systems following on from the BSE crisis. BfR focuses on conducting risk assessment for food safety along the whole food chain and also has a dedicated department specific to risk communication. BfR risk assessments are not conducted by one person but by several active researchers and experts. The risk assessment is provided to the German Federal Office of Consumer Protection and Food Safety (BVL) that works closely with the German Federal Ministry of Food and Agriculture (BMEL) to execute legislation and food control. While in Germany there is a clear distinction between the risk assessor and risk manager, other systems following on the same principle may also be effective e.g. government working with universities. Since there is no international trade without an assessment of the safety of food there is a need for risk assessment to be globally harmonized. Some of many efforts in this area is the preparation of the EU almanac detailing how food safety is organized in Europe, “BfR to go” biyearly publications and organizing the yearly summer academy on risk assessment for food safety. It is anticipated that BfR will hold a workshop in Asia, likely to be in Japan, possibly Singapore.

The construction of European Food Safety Authority (EFSA) expert committees and risk assessment challenges in EU systems

Joergen Schlundt, Director, NAFTEC, Steering Committee Head, GMI, Singapore

This presentation discussed the problems of achieving realistic estimates of the burden of foodborne diseases as well as the problems in our previous food safety systems leading to the adoption of the risk analysis framework. A brief overview of risk analysis in food safety regulations and risk assessors in different international levels was also discussed. The construction of the European Food Safety Authority (EFSA) in 2002, together with its expert committees and its role as the risk assessor was described. The independent, transparent science-based risk assessment and new developments and challenges in the area were emphasized. Lastly, suggestions were given relative to improving food safety and risk prevention efforts in the EU.

Main messages

- The burden of foodborne diseases is considerable and estimated to be much more serious than the incidence of reported cases. Testing alone does not solve problems, with a probability of detection of the hazard which is in many cases very low.
- Risk Analysis Internationally and Nationally and its 3 components: Risk Assessment, Risk Management and Risk Communication. Independent Risk Assessors of the United Nations, EU systems and national level such as WHO/FAO, EFSA, National Food Institute in DTU, ANSES and BfR. Risk assessment and Risk management are functionally separated.
- The construction of European Food Safety Authority (EFSA) expert committees, its role as the risk assessor and the independent, transparent science-based Risk Assessment.
- The new and exciting developments in research will advance risk assessment dramatically in the years to come. There are also new challenges and threats in Risk Analysis, such as Multiple Chemicals, Acrylamide, Bisphenol A, Antimicrobial resistance (AMR).
- Foodborne disease should be prevented through more efficient food safety systems focusing on prevention as close to the source as possible
- Full burden of disease relative to safety and consumption (+nutrition) needs to be considered
- New agricultural products will most likely affect both nutrition and food safety in the future.
- There is strong need to prevent through sensible practices and good production methods, and these should be defined and/or assessed through relevant risk assessments.

The impact of globalisation on food safety: introduction to the Global Microbial Identifier and the use of NGS

Joergen Schlundt, Director, NAFTEC, Steering Committee Head, GMI, Singapore

This presentation provided an introduction to the Whole Genome Sequencing (WGS) and the Global Microbial Identifier Initiative (GMI). Then the GMI achievements and NGS potential in developing countries and the advantages of NGS-based microbiology diagnostic systems were summarised. Consequently, the impact of WGS on clinical, surveillance and food safety management, One Health and historical investigation were further discussed, and four revolutionary examples were presented. Lastly, it is emphasized how genomic data sharing is important as a public good in relation to health, food safety and economy, realizing that a number of (especially, but not solely political) concerns relative to open data sharing are still hampering progress.

Main messages

- Whole Genome Sequencing (WGS) has given us the perfect tool in microbiology. It is important to share DNA sequence data which provides a global advantage for all.
- GMI (Global Microbial Identifier): 1st global tool to identify all Microorganisms and Antimicrobial Resistance and its 3 lines of action.
- GMI achievements includes: Epidemiological metadata in NCBI using GMI/NCBI minimum epi data requirements (FDA GenomeTrakr and CDC use these fields); Three GMI Lab Proficiency Tests assessing DNA sequencing procedures and output (support from USFDA and WHO Coll. Centre (Tech Uni DK); Letter sent to 192 Governments (Ministries of Health and Agriculture), suggesting that these countries support international WGS discussions
- NGS leap-frog potential in developing countries and the advantages of NGS-based microbiology diagnostic systems.
- The impact of Whole Genome Sequencing (WGS) on Clinical, surveillance and food safety management, One Health and historical investigation.
- Four revolutionary examples: 1) Foodborne disease source attribution, 2) Historical analysis of spread of pathogens; 3) Metagenomic analysis and prediction of AMR; 4) Positive microbiology – Revelations from the gut microbiota
- Data sharing is important for a public good in relation to health, food safety and economy although there are several concerns.

A bird's eye view of genomic projects in the ANSES laboratory for food safety

Michel-Yves MISTOU, **Head of Department, Microbiological Contaminants in Food, Laboratory for Food Safety, ANSES, France**

WGS is well used in the Foodborne Pathogens Department that focuses on detection, typing and characterization of foodborne pathogens. There were many challenges to change from the conventional methods to the new unique technical platform in terms of expertise and staff training, financial resources, IT infrastructure, and regulatory issues, etc. The challenges were overcome through a "learning by doing" process while completing the genomic research projects. The department includes a GAMeR team who have set up a GNU/Linux based-environment, and built up the ARTwork pipeline. The department has also developed a local database for easy and secure access to genomic data and analysis. The department has many ongoing WGS projects including those on genetic diversity and associated-risk, source-attribution, quantitative risk assessment, and new typing methods development, etc.

WGS Case projects:

1. DerbyClone-Phylogenetic analysis of salmonella Derby Isolates.
   - S. Derby 1st serovar isolated in pork meat in Europe.
   - Sequencing and analysis of 140 animal and food strains representative of the production sectors and geographical origins.
   - Clarify the Salmonella Derby epidemiological situations by compaing 302 human clinical isolates with animal and food sector.

2. FBO investigation at the European Level: in July 2018, multi-country outbreak of *L. monocytogenes* ST6, with 47 human cases and 9 deaths.

3. Large-scale genomic analyses and toxinotyping of *Clostridium perfringens* implicated in foodborne outbreaks in France: No typing methods relevant for FPO investigation is available; then doing genome analysis of 141 isolates involved in 42 French FPOs.

Genome-wide identification of host-segregating epidemiological markers for source attribution in *Campylobacter jejuni*

Gilles Salvat, Managing Director General, Research & Reference Division, ANSES, France

This project aimed to assess the ability of three genotyping methods in source attribution to identify the origin of human campylobacteriosis in France. There are numerous potential sources of contamination, where chicken is the main source of human contamination. The main risk factors are consumption of undercooked broiler meat and cross contamination. Three methods were used and compared in this project including multilocus sequence typing (MLST), WGS, and comparative genomic fingerprinting CGF40 methods.

Key Findings:

- Differences in attribution between the 3 genotyping methods: MLST vs WGS Host-segregating (HS) markers: improvement of sensitivity using the HS markers; CGF40: not suitable to perfom source attribution study as it does not provide enough detailed genotyping information;
- Differences in the source attribution according to the year;
- Chicken is the most important source of human foodborne campylobacteriosis;
- Ruminant reservoir plays a significant role in foodborne campylobacteriosis in France, maybe because of cultural habit of consuming raw (minced) beef.

Application of whole genome sequencing for foodborne outbreak investigations and epidemiological studies in Germany

Burkhard Malorny, **Head of Unit, Molecular Microbiology and Genome Analysis, BfR, Germany**

This presentation described WGS applications for foodborne outbreaks in Germany. Almost 400 foodborne outbreaks occurred in Germany last year, and most outbreaks with high evidence were caused by raw milk. In 2018, a salmonellosis outbreak with 60 cases in 6 European countries is still ongoing, so far no source has been identified. There was a listeriosis outbreak in Germany caused by pork products. This outbreak had 78 cases from 2012 to 2016, which included 8 fatal cases and 4 of them were confirmed by listeriosis. Explorative interviews gave no clear reference to causative foods. Several PFGE profile matches with NRL and EURL-*Listeria* databases, but no match of isolates with outbreak strain using whole genome sequencing. Further epidemiological surveys pointed to pork products from supermarkets in southern Germany, altogether 543 isolates were typed. Smoked pork belly sampled by food inspectors was shown to be L.m. positive, 1.9 x 105 CFU/g, matching with the human outbreak strain: PFGE 13a/54, CT1248, as confirmed by WGS.

Key Messages:

- There is a transition in Europe to investigate outbreaks using WGS technologies;
- Many outbreaks cannot be determined all the way back to the source with PFGE genomic testing only, WGS represents a clear improvement;
- Efforts are under way to establish a common database system for improved investigation of European outbreaks (EFSA and ECDC);
- Nomenclature of WGS data needs to be harmonized to easier comparison of data (worldwide problem!);
- Global Microbial Identifier initiative should be supported to harmonize WGS analyses and to create WGS repositories on global level.

Participant feedback and concluding remarks

The following message is from the Agri-Food and Veterinary Authority of Singapore:

"We find the seminar to be a great success. Credits to the hard work that the NTU NAFTEC team has put in to make this possible. The smooth operation of the event is a good reflection on the hard work spent in the liaison with the speakers, curation of the programme and the long string of administrative/logistic arrangements. At the same time, SCELSE has also been helpful with accommodating our request for venue usage. We received feedback from the participants that they enjoyed the breadth of topics for the seminar, but lamented that the programme was not long enough to go into further depth. This, together with our sensing of the participants' behaviour during the session, is a strong indicator of their interest in the seminar.

This is also reflected in the feedback forms, which presented over 90% positive response for all survey questions. If we must focus on the negative, feedback on the areas for improvement presents a rather conflicting picture. There are requests for the presentations to be in more layman terms, while others suggest to have more in-depth topics and to increase the scientific content. There are also request for the presentations to be more focused on different angles, e.g. industry focus, sharing on improvement journey. We attribute this to the diverse background of the participants, which has always been a challenge for public seminars.

All in all, we find the collaboration with NTU to continue to be a very pleasant experience. Thank you for making this possible".