



# Food and Agriculture Organization of the United Nations

## FAO Expert Meeting on microbiological risk assessment of *Clostridium* spp. in foods

FAO HQ, Rome, Italy, 17 – 21 February 2025

### Experts participating in the meeting

*Published in January 2025*

#### Background

The genus *Clostridium* encompasses several toxigenic species recognized as significant human pathogens, notably *C. botulinum*, *C. perfringens*, and *C. difficile*. These bacteria are commonly identified in various food sources. Foodborne botulism, induced by ingestion of as little as 50 ng of botulinum neurotoxin, results in severe and frequently fatal neuroparalytic intoxication. Foodborne illness due to *C. perfringens* ranks as one of the most frequent causes of foodborne illnesses in many countries, imposing a health and great economic burden. Recent data indicate an increasing proportion of community acquired *C. difficile* infections. The medical costs associated with *C. difficile* infections amount to billions of US dollars in some countries annually. Limited data are available regarding the control of *Clostridium* spp. in foods, and specific strategies to inhibit its growth and toxin production in food sources remain undetermined.

At least four Codex documents mentioned *Clostridium* spp.,<sup>1</sup> where practice on control measurements, hazard characteristics, and exposure along the food supply chain were not fully addressed. To provide a better understanding and control measurement of *Clostridium* spp. in foods, FAO is undertaking new work to collect recent research and surveillance findings about this group of pathogens as well as data representing the different food commodities and geographical regions associated with diseases caused by these organisms.

This call for experts seeks to identify scientists in their individual capacity and can contribute to the successful completion of this task. In addition, we are also seeking data on the control of *Clostridium* spp. in food. The purpose of the expert consultation is to review and discuss the available data and background documents, and to assess possible good practices on *Clostridium* spp. control in foods.

---

<sup>1</sup> CXC23-1979-1993 Code of Hygienic Practice for Low and Acidified Low Acid Canned Foods; CXC39-1993-1993 Code of Hygienic Practice for Precooked and Cooked Foods in Mass Catering; CXC40-1993-1993 Code of Hygienic Practice for Aseptically Processed and Packaged Low-Acid Foods; CXC 46-1999-1999 Code of Hygienic Practice for Refrigerated Packaged Foods with Extended Shelf Life

Information will provide a range of risk management options for a variety of products. Specifically, scientific advice is needed to provide the following:

- The global burden of disease caused by *Clostridium* spp. attributed to food, based on epidemiological data.
- Prevalence of contamination of foods with *Clostridium* spp. in different regions and consumption data of contaminated foodstuffs among diverse populations.
- Hazard identification and characterization of *Clostridium* spp., including information on genetic profiles and virulence factors and mechanisms, the dose-response and the susceptibility of the host, especially within vulnerable populations.
- Current monitoring, including the status of the currently available analytical methods (available and validated for regulatory purposes) for monitoring of *Clostridium* spp. in food and the production environment as basis for management and control.
- Strategies for the prevention and control of *Clostridium* spp. foodborne disease, especially as they may be deployed in low- and middle- income settings.

### List of experts

The following list of experts is proposed for this meeting. Please find below their bio-sketches. If you have any comments, please contact us at [kang.zhou@fao.org](mailto:kang.zhou@fao.org) no later than 9 February 2025.

#### **Declan Bolton**

Dr Declan Bolton is a Principal Research Officer in the Food Safety Department at the Teagasc Food Research Centre (Ashtown, Dublin, Ireland) and Adjunct Professor in the School of Veterinary Medicine, University College Dublin (Ireland). He served as a member of the European Food Safety Authority (EFSA) Biohazard Panel from 2012 to 2024. His research focuses on controlling bacterial pathogens along the food chain, microbial food spoilage/shelf-life, emerging microbial hazards associated with climate change and sustainable agriculture. He has coordinated 25 nationally and 2 internationally funded projects and participated in a further 3 national and 5 international projects with a total investment of €83.2m. To date Dr Bolton has over 650 scientific publications including 335 international peer reviewed papers. A significant part of his research has focused on *Clostridium* spp., including *Clostridioides difficile*, *Clostridium perfringens*, *Clostridium sporogenes* (as a surrogate for *Clostridium botulinum*), *Clostridium gasigenes*, *Clostridium estertheticum* and *Clostridium ruminantium*. He received a Clarivate Web of Science 'Highly Cited Researcher' award in 2020, with his research ranked in the top 1% globally in Agricultural Sciences.

#### **Roger Cook**

Dr Roger Cook is the Principal Adviser Strategic Science & Risk Assessment and Principal Microbiologist for New Zealand Food Safety (NZFS), a branch of New Zealand's Ministry for Primary Industries (MPI).

Dr Cook gained a PhD in Microbiology from New Zealand's University of Otago and following post-doctoral research in Toronto and Detroit, lead government-contracted research on meat hygiene including cold tolerant clostridial blown-pack spoilage at the Meat Industry Research Institute of New Zealand (MIRINZ).

In 1995, Dr Cook joined what is now NZFS advising on all matters of microbiological food safety and suitability including those relating to clostridia. His team carry out food risk assessments, develop and manage research projects, and design monitoring programmes to support food safety regulations and

specifications for both the export and domestic food sectors. He is an expert witness for prosecutions related to clostridial food-poisoning outbreaks.

Dr Cook is a member of the International Commission on Microbiological Standards for Foods, participated in the JEMRA STEC panel, is the head of the New Zealand delegation to the Codex Committee on Food Hygiene where he co-chaired development of guidelines for control of STECs in foods, and is a Past President of the International Association for Food Protection.

### **Kathleen Glass**

Dr Kathleen Glass, Distinguished Scientist, Emeritus, joined the Food Research Institute at the University of Wisconsin-Madison in 1985 and served as Associate Director from 2008 until her retirement in 2025. During her career, she worked with the food industry and regulatory agencies to evaluate microbial food safety risks and conduct microbial food challenge studies to identify critical control limits for production. Her research interests included developing practical approaches to improve the microbial safety of low acid refrigerated foods, ready-to-eat meats, and process cheese. In addition, Dr Glass oversaw student research and is a regular instructor at workshops on challenge studies and meat, dairy, and process cheese safety. Dr Glass earned her Doctorate in Food Microbiology and Safety at the University of Wisconsin-Madison. She is a Past-President of the International Association for Food Protection and recipient of the IAFP Fellow, Citation and Honorary Life Member Awards, National Cheese Institute Laureate Award, and the Food Safety Magazine's Distinguished Service Award. In addition, Dr Glass served as a co-chair of the National Advisory Committee for the Microbiological Criteria of Foods and is an academic advisor for the Food Microbiology Committee of the Institute for the Advancement of Food and Nutrition Sciences and other industry partnerships.

### **Tomasz Grenda**

In 2007, I graduated from the Faculty of Food Science and Biotechnology at the University of Life Science in Lublin. In the same year, I began doctoral studies at the National Veterinary Research Institute in Putawy. The subject of my doctoral thesis was "Detection of *Clostridium botulinum* in feed and food using molecular biology methods". In 2011, I obtained a PhD in veterinary sciences, specializing in veterinary microbiology, feed and food hygiene. Since 2011, I have been employed at the National Veterinary Research Institute, successively in the positions of: engineering and technical specialist, then research and technical specialist, and from 2014 as an assistant professor. In 2023, I obtained a postdoctoral degree (habilitation), based on a work constituting a series of publications, entitled: "Pathogenic Clostridia - occurrence and epidemiological significance in the food chain". My scientific work is mainly related to the improvement of methods for detecting *Clostridium* spp. in feed and food and other biological material, in particular those capable of producing botulinum toxins. I am a co-author of 57 scientific articles, including 35 from the JCR list, 45 reports for national and international conferences mainly concerning the problem of the occurrence and detection of *Clostridium* spp. In addition, I have participated in many research projects (as performer and lider) on the problems of detection and characterization of pathogenic Clostridia.

### **Caroline Le Marechal**

Caroline Le Maréchal is a researcher and deputy head of the Hygiene and Quality of Poultry and Pig products Unit at ANSES in France. She holds a PhD in Biochemistry, Molecular and Cellular Biology from the Agrocampus Ouest (Rennes, France) and an Engineer degree in agronomy from INP-ENSAT (Toulouse, France). Since 2012, she has been in charge of the French National Reference Laboratory for avian botulism at ANSES. Her research focuses in particular on the control of zoonotic clostridia in the poultry, swine and cattle sectors, through a multidisciplinary and inter-sectoral approach, including the food safety aspects. She has obtained several national and European grants to develop research

activities on botulism as well as on the study of *Clostridioides difficile* and *Clostridium perfringens* through a One Health approach. She is member of the expert committee on animal health and welfare at ANSES and of the scientific committee of several scientific congresses.

### **Chie Monma**

Dr Chie Monma is working with Jomonji University. Dr Chie Monma has over 30 years of experience at the Tokyo Metropolitan Institute of Public Health, specializing in microbiological examinations and pathogenicity analysis of foodborne pathogens, particularly *Clostridium perfringens* and *Clostridium botulinum*. Dr Monma has made significant contributions to understanding foodborne illnesses caused by a novel enterotoxin (CPiLE) produced by *Clostridium perfringens*. Furthermore, Dr Monma was the first in Japan to identify infant botulism caused by *Clostridium butyricum* producing type E botulinum toxin and botulism caused by *Clostridium baratii* producing type F botulinum toxin. Their research also encompasses the distribution, pathogenicity, and epidemiological assessment of *Clostridium* spp. in commercially available foods.

Currently, Dr Monma continues academic research at a university while contributing to microbiological risk assessment as a technical advisor to the Food Safety Commission Secretariat of the Cabinet Office, Government of Japan.

### **Thomas Riley**

Tom divides his time in Perth, Western Australia, between PathWest Laboratory Medicine, WA's public sector pathology service provider where he is a Senior Clinical Scientist, and The University of Western Australia where he is a Professor in the School of Biomedical Sciences, with Adjunct positions at Curtin, Murdoch and Edith Cowan universities. He has had a long-standing interest in diagnostic microbiology and healthcare-related infections, particularly the diagnosis, pathogenesis and epidemiology of *Clostridioides (Clostridium) difficile* infection (CDI). This has led to a One Health approach to the CDI problem resulting in a greater focus on *C. difficile* in animals, particularly food animals. The final element of One Health, the environment, has assumed greater importance with contamination of soil such as soil used to grow vegetables. He is a Fellow of the Royal College of Pathologists, the Australian Society for Microbiology, the American Academy of Microbiology, the Society for Healthcare Epidemiology of America and the Faculty of Science of the Royal College of Pathologists of Australasia and has published >450 book chapters and refereed journal articles, including >250 on *C. difficile*.

### **Maja Rupnik**

Professor Rupnik is microbiologist with long standing interest in *Clostridioides difficile*. Specific research focus of her group are variant *C. difficile* strains and distribution of *C. difficile* in diverse natural niches including food. Her group participated in national testing of *C. difficile* in food. She was also principal investigator of the study on *C. difficile* and potatoes across selected European countries.

She is currently the head of Department for microbiological research at the main national public health laboratory (National laboratory for health, environment and food, NLZOH) and lecturer at University of Maribor, Faculty of Medicine.

She is since 2024 the organizer of traditional *C. difficile* specialized meeting (ICDS; International *C. difficile* Symposium). Prof Rupnik is also Editor in Chief of Anaerobe journal.

### **Katja Selby**

PhD, DVM Katja Selby is a microbial food safety researcher with extensive experience in academia and research. Her PhD research, conducted in the group of Professor Hannu Korkeala, focused on the stress tolerance of *Clostridium botulinum*. Currently, as a University Researcher at the Faculty of Veterinary

Medicine, University of Helsinki, she focuses on the molecular biology of *C. botulinum* and the development of risk assessment and management tools for *C. botulinum* in the ready-to-eat food sector. She collaborates with stakeholders in the Finnish food industry. Her veterinary background, including practical experience in food production animal health, complements her academic expertise.

Dr Selby teaches key subjects in food hygiene, including microbial food hygiene, foodborne pathogens, and industrial food hygiene and safety. She emphasizes the importance of good hygiene practices and legislative frameworks in safe food processing. With a strong foundation in research and teaching, she is dedicated to advancing food safety education and practices from farm to fork. She is a member of the Finnish Veterinary Hygienists Association, HOH Helsinki One Health, as well as the Nordic Biosecurity Network.

### **Kristin Schill**

Kristin Schill is a Research Assistant Professor at the University of Wisconsin-Madison's Food Research Institute (FRI) and leads the Applied Food Safety Laboratory. In this capacity Kristin works directly with the food industry to design food challenge studies on a wide variety of food products and foodborne pathogens including *Clostridium botulinum* and *Clostridium perfringens*. Prior to joining FRI, Kristin served as a research microbiologist for the FDA and her research portfolio encompassed projects involving the genetic characterization of *Clostridium botulinum* and related surrogate organisms, development of botulinum neurotoxin detection methods, evaluation of thermal and nonthermal technologies for *C. botulinum* inactivation and whole genome, metagenomic and transcriptomic sequencing of foodborne pathogens. Kristin is a member of the International Association for Food Protection and co-teaches the IAFP Sponsored Microbial Challenge Testing for Foods Workshop. She also serves on the National Advisory Committee for the Microbiological Criteria for Foods (2023-2025). Kristin earned her Bachelor of Science degree (Microbiology) and Master of Science degree (Food Science) at Iowa State University and her PhD (Food Science) at the University of Wisconsin-Madison.

### **Martin Webb**

Martin Webb is a Consultant Microbiologist for QIB Extra, which conducts bespoke research for food, health and allied industries, with 25 years' experience of working with the important foodborne pathogen *Clostridium botulinum*.

After completing a PhD at the University of Liverpool studying bioremediation of chlorinated phenols, He undertook a post-doctoral position at Westlakes Scientific Consulting in Cumbria, conducting contract research to industry, regulators, stakeholders and government in the areas of Environmental Science and Biotechnology, before joining the Institute of Food Research in Norwich.

His research at the Institute of Food Research (which later morphed into Quadram Institute Bioscience) focused on germination and outgrowth from individual spores of *C. botulinum* to gain greater understanding of the physiology and variability surrounding these events; and using physiological and comparative genomic techniques to examine variability between Group II (nonproteolytic) *C. botulinum* strains.

In the last ten years he has predominantly focused on food industry-relevant projects investigating the survival and growth of spore-forming bacteria such as *C. botulinum* and *Bacillus cereus* in foods, particularly during refrigerated storage. In these projects he has worked closely with multinational food companies, both large and small, with regards to food safety.

### **Xuefang Xu**

Dr Xu completed her MSc and PhD in veterinary science in Roslin Institute and Edinburgh University in UK. She then went back to China and joined National Institute for Communicable Diseases Control and

Prevention (ICDC), China CDC till now. She took up the task of botulism work as the need of disease control and prevention. She started with the laboratory work with *Clostridium botulinum* (*C. botulinum*) strain isolation and toxin & toxin gene detection first. After 10 years' laboratory experience, she is familiar with *C. botulinum*, *Clostridium butyricum* (*C. butyricum*), *Clostridium baratii* (*C. baratii*) isolation and established a series of methods for detection.

She identified about 200 botulism accidents including infant and foodborne botulism in the past 10 years. She traced the foodborne botulism and infant botulism cases in China. She also analyzed the isolated strains from foodborne botulism and infant botulism, local environment and food in genomic level. So she developed a good understanding of the risk of botulism caused by food or in infants.

Despite the academic experience in Edinburgh University in UK and ICDC in China, she is also interested and open for international communication and participated in international meetings in the past few years.

### **Disclaimer**

*In order to enhance their management of Conflicts of Interest as well as strengthen public trust and transparency in connection with FAO meetings involving the provision of technical/normative advice, the names and brief biographies of individuals ("Published Information") being considered for participation in such meetings are disclosed for public notice and comment.*

*The Published Information is provided by the experts themselves and is the sole responsibility of the individuals concerned. FAO is not responsible for the accuracy, veracity and completeness of the Published Information provided. Furthermore, in no event will FAO be responsible or liable for damages in relation to the use of, and reliance upon, the Published Information.*

*The comments received by FAO through the public notice and comment process are treated confidentially and their receipt will be acknowledged through a generic email notification to the sender. Comments and perceptions brought to the knowledge of FAO through this process are an integral component of FAO's conflict of interest assessment policy and are carefully reviewed. FAO reserves the right to discuss information received through this process with the relevant expert with no attribution to the provider of such information. Upon review and assessment of the information received through this process, FAO, in its sole discretion, may take appropriate management action in accordance with their policies.*

*The participation of an expert in a FAO meeting does not imply that they are endorsed or recommended by the FAO nor does it create a binding relationship between the expert and FAO.*

*The list of participating experts, a summary of relevant interests disclosed by such experts, and any appropriate mitigation measures taken by FAO relating to the management of conflicts of interests, will be reported publicly in accordance with FAO practice.*