# INTERNATIONAL COMMITTEE ON FOOD MICROBIOLOGY AND HYGIENE since 1953

## 3nd symposium
## "Food microbiology education in practice"
## at 26th Food Micro 2018 in Berlin
## 3. September 2018 from 8-17h

# Organised by

INTERNATIONAL COMMITTEE ON FOOD MICROBIOLOGY AND HYGIENE (ICFMH)
WPAEFM Chair
http://www.icfmh.org

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Prof. Dr. Peter Raspor, Dr.h.c.mult., Uni. dipl. eng.

link to the meeting
http://www.foodmicro2018.com/about-foodmicro-2018/

Session: **8,30 - 9,00**

## Introduction to the 3rd symposia

"Food microbiology education in practice"

**By the WPAEFM Chair**

**Education and training in food microbiology; current challenges and constrains** Peter **Raspor** (Slovenia)

Session: **9,00 - 10,20**

## 1 State of the art in food microbiology education:

Chair: Weihuan Fang and Peter Raspor

1. Keshab Chandra MONDAL
   **Present scenario and realistic constrains of food microbiology education in India; INDIA**
2. Mady CISSE
   **The training system in food and sanitary safety in the Senegalese institutions, SENEGAL**
3. Lidia STOYANOVA
   **Teaching food microbiology at Moscow State University, RUSSIA**
   Alonzo A.GABRIEL
4. **Improving Food Safety Management For Small And Medium Enterprises In A Developing Country: Transferring Knowledge And Best Practices Through Food Microbiology Education, PHILIPPINES**

Session: **10,45 - 12,05**

## 2 System concepts in food microbiology education:

Chair: Luca Cocolin and Peter Raspor

Dilek HEPERKAN

5. **From Basic Individual Experiments To Designing Integrated Laboratory Analyses For A Better Understanding Of Microbial Activity In Practice,** TURKEY
   Obadina Adewale OLUSEGUN
6. **Molecular Microbiology Facilities: Impact On Microbiology Training In Sub Saharan Africa Countries**, NIGERIA
   Dragoslava RADIN
7. **Newly Introduced Food Microbiology Module At University Of Belgrade – Faculty Of Agriculture, SERBIA**
   Fouad M. F. ELSHAGHABEE
8. **Biosafety Challenges In Students' Dairy Microbiology Laboratories, EGYPT**

## Session: **13,00 - 14,20**

## 3 Good food microbiology education practices and their realisation

Chair: Sonja Smole Možina and Peter Raspor

Ľubomír VALÍK,

9. **The Update Concepts In Food Microbiology Education: An Introduction Of Knowledge And Skills For Predictive Microbiology And Microbiological Risk Assessment In Foods,** SLOVAKIA

Uelinton Manoel PINTO

10. **Food Microbiology Training In Brazil – Experiences With Educational Practices For Undergraduate Students From Different Majors,** BRAZIL

Prue BRAMWELL

11. **The Role Of The Laboratory In Undergraduate Food Microbiology Education Today,** AUSTRALIA

Shigenobu KOSEKI

12. **Good Education Practice: Use Of Web-Based Database For Haccp Planning,** JAPAN

## Session: **14,35 - 15,55**

## 4 Food microbiology and future

Chair: Uelinton Manoel PINTO and Peter Raspor

Iwona GIENTKA

13. **Teaching Food Microbiology In The Non-University Education,** POLAND

George-John NYCHAS

14. **Food Microbiology Education At University Level In The Future,** GREECE

## Session: **16,00-17,00**

Chair: Peter Raspor

Establishment of network of food microbiology educators

# PRESENT SCENARIO AND REALISTIC CONSTRAINS OF FOOD MICROBIOLOGY EDUCATION IN INDIA

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The economic growth rate of India is very fast, but, one in every three malnourished children in the world lives in this country and this is due to lowest per capita daily supply of calories, protein and fat, according to the Organisation for Economic Co-operation and Development (OECD). The average Indian had access to 2,455 kcal per day and it is far lower than the at least 3,000 kcal per day availability for OECD nations. In this context, functional foods represent novel scientific paradigms that can surely improve the traditional nutrition deficiency. Apart from ex-situ food fortification techniques, fermented food is one of the age-old food culture of Indian people that enriched with diverse type neutraceuticals and improve the food digestibility. But due to civilization input, people are moving far away from this healthy traditional practice. The concept of probiotics, prebiotics, synbiotics are now emerging in the food industry. In these aspects, food microbiology education is in very nascent stage. Only 23 educational institute are now offering Food Science & Technology related Master degree level course. Microbiology in graduate and post-graduate level is offering by around 500 of college and university in this big and populated country. There are many institute also offering Biotechnology, Nutrition, Dietetics, Bioprocess & engineering and other related course at UG and PG level. It is noteworthy to mention that most of the course offered by the non-government organization, therefore, they support those courses which have market demand. Food microbiology is a minor part in these course curricula by giving emphasis on lactic acid bacteria, food spoilage, probiotics, and relevant aspect. But most of the curricula are devoid of microbial food processing, value added food for human and veterinary animals, food virology, ethnic fermented foods, food hygiene, quality control norms, like contents. Besides very little emphasis has also given on hands-on study or skill development on this subject. No one institute is offering food microbiology as independent course at any level. In related to this, very few microbial food products are also marketed except few dairy products and probiotic supplements for aquaculture and veterinary area. The poor market demand and industrial production are the major constrains behind the flourishing of food microbiology related courses in India. But, hope this darkness will be unlighted in recent future by depending upon effective education.

**Key words : India, food status, offered courses, food microbiology**

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After completing M.Sc. and Ph.D. in Physiology from the Vidyasagar University (West Bengal, India), Dr. K. C. Mondal, in 1997, joined as Lecturer, in the Department of Physiology, Raja N L Khan Women's College and later on in 2004, in the Department of Microbiology, Vidyasagar University and became Associate Professor in 2009. His research efforts have been focused on understanding the diversity of bacteria in intestine and foods, their enzymes and potential applications probiotics. He has published over 120 scientific papers, four review and six book chapters with citation of 2457, h-index 25 and i10 index 77. He handled 10 sponsored research projects. He is the recipient of Indo-Hungarian fellowship in 2014 and Tempus Public Foundation (TPF) fellowship, Hungary for the year 2015-16. He is a member of the Asian Federation of Biotechnology (AFB), Indian Science Congress Association (ISCA), Biotech Research Society of India (BRSI), Indian National Academy of Stress Sciences (INASS), Association of Microbiologists of India (AMI), and Physiological Society of India (PSI). He has been conferred with Gold Medal for scoring first rank in M. Sc. exam. He is a reviewer for manuscripts of several Indian and International journals. He has over 20 years of research and teaching experience. He has produced 16 Ph. D. students and presently 3 students are pursuing Ph. D under his guidance.

# THE TRAINING SYSTEM IN FOOD AND SANITARY SAFETY IN THE SENEGALESE INSTITUTIONS

**Mady CISSE[1], Nicolas Cyrille Mensah AYESSOU[1]**

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In recent years, Senegal has sought to strengthen the governance capacity of higher education institutions in the area of food and sanitary safety systems (SSS). Indeed, food safety is a public health priority in Senegal, which justifies the actions carried out in the country. For example, international health regulations are well reflected in national policies and programs. In addition, there are efforts to support standards, codes of practice and guidelines issued by the Codex Alimentarius Commission (CAC). In sum, the country is implementing multiple initiatives to strengthen the SSS system and there are controls to ensure food safety and protect the health of consumers. In this context, higher education institutions have set up several training courses in this area of food, nutritional and health security. These are the Cheikh Anta Diop University of Dakar (UCAD), the Gaston Berger University of Saint-Louis, the Inter-State School of Sciences and Veterinary Medicine (EISMV). At UCAD, several establishments carry training in food, nutritional and health security. These are the Polytechnic school (ESP), the Faculty of Science and Technology (FST) and the Faculty of Medicine and Ondtostomatology (FMPO). These courses cover several aspects including animal, plant and forest products; processing of agricultural products; food safety, quality in food; regulations, health and ethical standards; agricultural policies; entrepreneurship and management. These courses are of type: senior technician, license, master, engineer and doctorate.All of these courses aim to provide learners with knowledge and skills for mastering the technologies and tools needed to ensure food, nutritional and health security. In addition, a apply research and community service program accompanies the training component. Several laboratories and research teams are specializing in food, nutrition and health security. The analysis and testing laboratory plays an important role in the control of foodstuffs sold in Senegal. The Ministry of trade of Senegal through its laboratory deals with the inspection and control of imported food. The Food Technology Institute of Dakar is specializing in the control of aflatoxin in cereals.The training system in food and sanitary safety in the Senegalese institutions is developed. Coordination of all training and research activities carried out in the different institutions is necessary. Also, the search for complementarity is essential for a high efficiency and an efficient use of the means and the resources of the Senegal state.

**Keywords: Training, research, food and sanitary safety, nutritional, Senegal**

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Dr. Mady CISSE was graduated from ENSIA engineering school in France as an engineer in Food Industries. He has completed his PhD in Food Science in 2007 from Cheikh Anta Diop University, High Polytechnic School in Senegal. In 2010, he completed a second PhD in Food Food Processing Engineering at Montpellier SupAgro. Since 2004, he worked as a lecturer/researcher in High Polytechnic School at Cheikh Anta Diop University in Senegal. He teaches Microbiology and Food Microbiology, HACCP for undergraduate and Industrial Microbiology for engineering student. His research activities are in safety and quality of food, processing and preservation of fruits and vegetables, valorization of African raw materials, sensory and consumers tests. Chairman of the Scientific and Technical Committee of the Senegalese food innovation network since 2014, he is expert of the National Codex Alimentarius Committee of Senegal and expert consultant in Food security and safety. Currently he is also the deputy director of the High Polytechnic School in charge of studies and research.

# TEACHING FOOD MICROBIOLOGY AT MOSCOW STATE UNIVERSITY

**Lidia Stoyanova**
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Food safety is a task that humanity has been trying to solve for a long time. In the IV century BC Hippocrates in the Diet wrote: "Our food should be a medicine, and the medicine must be food". However, cooking, preserving food with the help of microorganisms and damaging it are two sides of one process. In 1857, L.Pasteur opened a new era in food microbiology, scientifically proving that it is microorganisms that cause food spoilage and indirect infectious diseases of humans and animals. The Department of Microbiology of MSU was founded in 1953 by V.Shaposhnikov - the founder of technical microbiology, which includes all aspects of industrial use of microbes. Microbiology is a fundamental discipline in university programs aimed at training specialists - microbiologists of a wide profile. The main objective of any of these programs is to find an appropriate balance between the basic concepts of microbiology and the practical skills necessary for the work of specialists, including professionals in the food industry. The training also includes laboratory practice, the requirements for the organization of a laboratory for microbiological work with food, the control of the quality of food and raw materials in accordance with regulatory standards for sampling methods, the use of traditional and express methods of detection, identification and quantification of dangerous microbes, special attention is paid to methods for controlling the presence of antibiotic content in products which cause multidrug resistance of infectious agents, as indicators of food safety, ways of reducing microbiological hazard in food products. Students, masters, as well as professionals to improve their qualifications through the International Center for Biotechnology at the MSU take part in the training. Educational and methodical manuals on methods of microbiological work, detection of dangerous infections, colonizing products, permissible levels of their presence in the product, state quality standards have been published. Over the past decade, most of the microbiology courses in food have evolved to provide, in addition to basic knowledge of the microbiology of food, skills in critical thinking and solving problems in creating biopreservatives and food additives that enhance the biological, nutritional value and their health benefits human, perfection of quality control methods. Teaching training courses in microbiology in the field of food safety should provide the graduate with a set of knowledge necessary for professional work in modern conditions.

**Key words: methods for controlling, food safety, training of professionals.**

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Dr. Stoyanova graduated the Biological Faculty of M.V. Lomonosov Moscow State University (MSU). Stoyanova earned Ph.D degree in Microbiology Science after post-graduate education. She had carried out investigations directed to isolation and construction of bacteriocine producing lactic acid bacteria with probiotics properties. The circle of interests is the quality and safety of products, the development of manufacturers of bacteriocins as biopreservatives, probiotics, prebiotics (food additives) to increase the shelf life of products and increase their biological and nutritional value, as well as extensive experience in food safety and food industry, with more than 30 years of teaching experience. She lectured in India: University of Delhi, the Institute of Antibiotics in Pune, Institute of Biochemistry and Microbiology in Chandigarh, lectures on bacteriocins produced by the lactobacillus bacterium in China, Kazakhstan. She directed 32 undergraduates and specialists from Russia, Iran, Bangladesh, Ethiopia, China. She also acted as an internal or external examiner for several doctoral dissertations. As an expert on food safety, she participates in independent audits with a certification authority. She published 156 sci papers, 6 books, 11 patents. She is a full member of the Russian Academy of Food Security, a member of the Microbiological Society. She headed the laboratory of microbiology "Certification Center Prodex" for food products.

# IMPROVING FOOD SAFETY MANAGEMENT FOR SMALL AND MEDIUM ENTERPRISES IN A DEVELOPING COUNTRY: TRANSFERRING KNOWLEDGE AND BEST PRACTICES THROUGH FOOD MICROBIOLOGY EDUCATION

**Alonzo A. Gabriel**

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A former Chancellor of the University of the Philippines (UP) once emphasized that "If UP is to fulfill its noble purpose as the national university then it must be the preeminent graduate and research university of the country as well as its leading public service university all at the same time." This statement therefore, has become the framework that we at the Laboratory of Food Microbiology and Hygiene (LFMH), use as guide in performing our mandate as a constituent of the only National University in the country. We understand that members of the faculty are tasked not only to transmit knowledge to students, but also to generate new knowledge through research and development activities; and to conduct community extension works that deliver information to sectors that do not have access to university education. The interfaces of this tripartite role of teaching, research and development, and public service are being explored to address the challenge of foodborne illnesses in the Philippines. The LFMH looks at this tripartite role as an opportunity to transfer food safety knowledge to micro-, small- and medium scale enterprises in a country where majority of food industry stakeholders are at these scales. In this presentation, we shall enumerate efforts of the LFMH in transferring knowledge to stakeholders from the food industry, academia, government units, and non-government organizations. We shall also share some of our experiences in merging teaching of university students and community extension activities to inculcate the values of service and grassroots empowerment. Learning and challenges we encountered in doing these activities shall also be discussed.

**Keywords: Food Microbiology Education, Developing Country, Food Safety Management**

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Dr Alonzo A. Gabriel also a Registered Microbiologist and a Diplomate of the Philippine Academy of Microbiology. He teaches undergraduate and graduate courses in Microbiology, Food Microbiology, and Sterilization Processes. His research interests include predictive model building for food quality and safety, hurdle technology, and microbial stress adaptation and its implication to food safety and quality. Dr. Gabriel is also busy with food safety education and information dissemination. His works on 'Precision Food Processing,' which involves the integration of predictive models that simultaneously estimate microbial inactivation and nutritional, color, and sensory quality deterioration in heat-treated fruit juices for were previously recognized in the Philippines and abroad. He is currently exploring the interfaces of food science and nutrition through functional food product development, and investigations on human microbiome as influenced by diet and nutrition and health status. Dr. Gabriel is a recipient of the International Union of Food Science and Technology Young Scientist Excellence Award (2013) and the Japan International Award for Young Agricultural Researchers (2016).

# FROM BASIC INDIVIDUAL EXPERIMENTS TO DESIGNING INTEGRATED LABORATORY ANALYSES FOR A BETTER UNDERSTANDİNG OF MICROBIAL ACTIVITY IN PRACTICE

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Microorganisms play an important role in changing the bio material (plant origin and animal origin) into simple or more complex products, so called fermentation process, when food is concerned. The characteristics of the end product is determined mainly by the type of microorganisms and the material. The intrinsic and extrinsic factors are also important for the microbal activity. During cheese production, for example, the raw material milk, looses its original characteristics and a new product cheese is manufactured at the end of the process. What we teach during a food microbiology course is the kind of microorganisms that can be used to produce cheese as well as which pathogens can be present in both milk and cheese and also the factors affecting the growth of the desired microorganisms. Students learn cheese manufacturing processes on the other hand, in technology lectures. They do not have the opportunity to combine the knowledge of microbiology and technology unless they have an advanced lecture in the programme. Food microbiology and food technology courses are mainly covered in the 5th and 6th semesters. They have design courses in the final semester. The content of the design courses is not enough for the students to understand the key points in food manufacturing. Since microbiology is the key difference between food engineering and other basic engineering diciplines such as civil, electric/electronic or mechanical engineering, an applied (theory and laboratory) course integrating these aspects is essential. The structure, content and the algorithm of such a course will be discussed in this presentation.

**Key words: microbiology, education, interdisciplinary, design, engineering**

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Dr. Z. Dilek Heperkan was graduated from Ankara University, Faculty of Agriculture, Department of Food Engineering. She has completed her PhD in 1986 from Egean University, Department of Food Engineering in Turkey. She worked as a researcher for 10 years in TUBITAK, National Scientific and Research Institute. She participated as a member of World Working Party of Mycotoxin between 2002 and 2007. She worked as a visiting scientist in countries such as Belgium, Germany, Netherland and United Kingdom. She worked for sabbatical in the USA in 2001. She also visited Universite de Vigo, Spain and gave lectures by Erasmus Programme in 2007. She was studied in USDA as a visiting scientist in 2015. She organized a number of national and internatiol meetings. Recently, she organized 23rd International FoodMicro 2012 Congress together with ICFMH; 14th Mediterranean Phytopathology Congress. After she worked for 27 years in Istanbul Technicl University she was started to work in a Foundation University. She is currently working as a full time Professor in Istanbul Aydın University, Food Engineering Department. She has been teaching Microbiology and Food Microbiology for undergraduate and Advanced Food Microbiology for graduate students. She has been giving service courses on general Microbiology for undergraduates in different departments such as Chemial Engineering, Environmental Engineering, Bioengineering and Food Engineering.

# MOLECULAR MICROBIOLOGY FACILITIES: IMPACT ON MICROBIOLOGY TRAINING IN SUB SAHARAN AFRICA COUNTRIES

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Microbiology laboratories play an important role in food safety and food spoilage studies. Within microbiology laboratories, molecular microbiology techniques have revolutionized the identification and surveillance of pathogens and spoilage microorganisms. The combination of excellent sensitivity, specificity, low contamination levels and speed has made molecular techniques appealing methods for the diagnosis of many food borne and spoilage microorganisms.
In a well-equipped microbiology laboratory, the facility designated for molecular techniques remains indiscrete. However, in most Sub Saharan African countries, poor infrastructure and laboratory mismanagement have precipitated hazardous consequences. The establishment of a molecular microbiology facility within a microbiology laboratory remains fragmented.
A high-quality laboratory is expected to include both conventional microbiology methods and molecular microbiology techniques for exceptional performance. Furthermore, it should include appropriate laboratory administration, a well-designed facility, laboratory procedure standardization, a waste management system, a code of practice, equipment installation and laboratory personnel training.
This presentation highlights fundamental issues that need to be addressed when establishing a molecular microbiology laboratory in Sub Saharan African countries.

**Keywords: Molecular Microbiology, Sub Sharan Africa, Food Pathogens, Food Spoilage**

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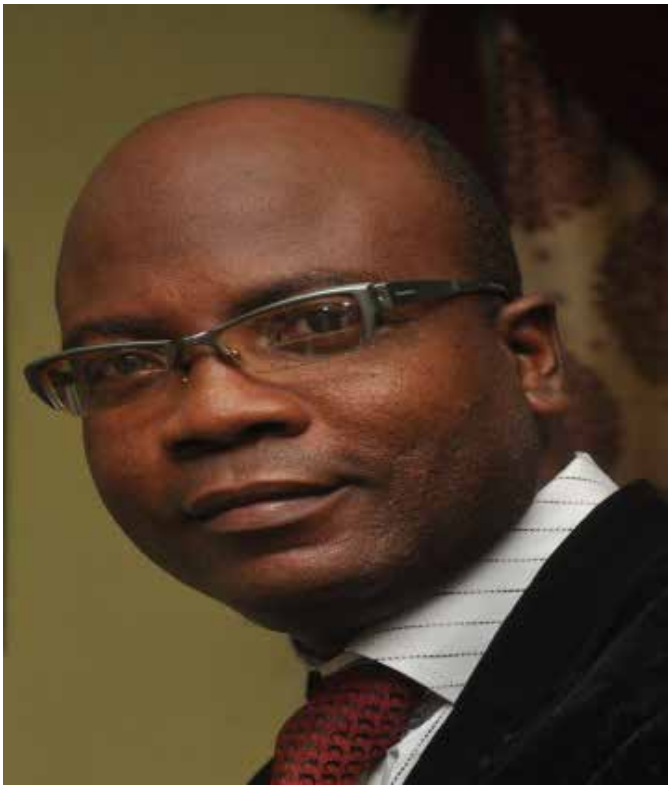

Dr. Adewale Olusegun OBADINA is the Director of Biotechnology Centre and lecturer in the Department of Food Science and Technology, Federal University of Agriculture, Abeokuta, Nigeria. He is a grantee and Research Associateship Fellow of The World Academy of Sciences (TWAS) with research interest in Food Safety and Quality. He was a visiting scholar at Katholie University, Gent, Belgium; Dublin Institute of Technology, Ireland; University of Johannesburg, South Africa and University of Maryland, USA. Also, a Project Scholar Supervisor at Michigan State University under the MSU-USAID Nigerian Agricultural Project Policy. He has been involved in projects sponsored by international donors such as DFID, EU, World Bank, Africa-Brazil Innovative Marketplace, M-BoSs and TWAS. He is a member of the Global Food Safety Partnership (GFSP) on Curricula to be executed by International Union of Food Science and Technology (IUFoST); member of the Food Science Advisory Council, Human Health Organization (HHO); member of the International Academy of Food Science and Technology – Early Career Scientist Section (IAFoST-ECSS). He is also a member of the IUFoST Mycotoxin Working Group; member of the Global Harmonization Initiative (GHI) Education and Training Working Group.

# NEWLY INTRODUCED FOOD MICROBIOLOGY MODULE AT UNIVERSITY OF BELGRADE – FACULTY OF AGRICULTURE

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Perceiving the need for well-trained professionals in the field of food microbiology, the Faculty of Agriculture (www.agrif.bg.ac.rs) has set up a whole new module "Food Microbiology" within basic academic studies (240 ECTS) integrated in the Department of Food Technology and Biochemistry. Within the module the following is studied: the basics of microbiology of food, industrial microorganisms in food of animal and plant origin, genetics of industrial microorganisms, microbiological food spoilage, food plant sanitation, probiotics and prebiotics, food infections and intoxications, microbiological methods of food analysis, etc. All lectures are followed by laboratory work. Most of the courses are present on e-learning platform moodle and accessible by students. Following good educational practices (GEP) we take care of regular up-date of the courses content and simultaneously promote and implement techniques of active learning. In order to achieve this goal, majority of lecturers have undergone various trainings to improve and develop new teaching skills. New accreditation of the Food Microbiology module have been opportunity to introduce some emerging topics, as e.g. foodborne viruses, increasing and serious concern in public health, or novelties in hygienic engineering and design, etc.

As a sequel, new module "Food and environmental microbiology" at the Master level of education (60 ECTS) was integrated in the curriculum of Food Technology. The new Master module consists of 3 compulsory subjects and 1 elective block from which 2 subjects are selected. Among others, the module includes subjects concerning introduction to scientific research, advanced methods in food microbiology, biotechnology in environmental protection, pathogens in food and environment, functional food, bioactive substances of microbiological origin, microbiological wastewater treatment, bioconversion of agro-industrial waste, etc.

It is expected that well trained students – future specialists will be integrated in all part of the food chain production, contributing significantly to the safety of food products and consumers.

**Key words: food microbiology, curriculum, active learning**

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Dr.Dragoslava Radin graduated (Food Technology) and MS (Microbiology) at the Faculty of Agriculture – University of Belgrade; PhD (Virology-bacteriophages) at University of Novi Sad, Serbia (1999). From 2001 she has been a teacher of Food Microbiology and related subjects at Department of Food Microbiology (Faculty of Agriculture, University of Belgrade) and participates and serves as student advisor in the MS program Food Microbiology and Environmental Protection as well as in PhD program Food Microbiology. She introduced Food Virology to Food microbiology and Food Safety and Management Control students. She is a mentor/committee member for thesis evaluation (Ph.D., specialization, master and B.S.) The main research area of Dr. Radin is food microbiology/virology, food borne pathogens (predominantly viruses), molecular detection methods and food safety issues. She is author or co-author of more than hundred scientific, review publications and book chapters. She was FAO fellowship; USDA Faculty Exchange Program and Fulbright Scholar. She has devoted significant time to promoting the teaching and application of the principles of active learning through different educational projects: LEA/RN™ at Iowa State University; TEMPUS Project Active Learning in Biological Science at University of Belgrade; FP7 ESConet European Science Communication Network at Centre for Advanced Academic Studies in Dubrovnik; Optimizing Teaching and Learning: Strategies to Carry Out and Use Pedagogical Research, at Georgia Southern University; ERASMUS+ Project INNOVIROLOGY: Innovation in teaching, training and dissemination of virology (2014-17). Dr. Radin was Ambassador of American Society for Microbiology for Serbia (2011-17) and General Secretary of Serbian Society for Microbiology (2008-ongoing).

# BIOSAFETY CHALLENGES IN STUDENTS' DAIRY MICROBIOLOGY LABORATORIES

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Generally, the environment of any microbiological work must be in safe mode including laboratory coats, gloves, area of analyses and safety glasses which represents the minimal personal protective for students and their teachers. Also, Good microbiology techniques (GMTs) represent an important prerequisite for bio-safety of different dairy microbiology laboratories in research and teaching. In analyses of milk and its products by students, check the purity of microbial cultures or any microbiological test, the analyses should be in bio-safety cabinet or using flame sterilization method for aseptic area. Teachers of food microbiology and their technical assistants should have enough knowledge and practice in using of different protective equipment and infection control measures in teaching laboratories in order to eliminate the spread of microbial hazards. The students' laboratories should provide with institutional bio-safety manual. Implementation of Good laboratory practice (GLP) could be a good solution for reducing or eliminating the microbial contamination especially pathogens e.g. *Staphylococcus aureus* and *Listeria monocytogenes* from students' laboratories.

**Key Words: Good microbiology technique, bio-safety, pathogens, microbial hazards, GLP**

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Dr. Fouad M. F. Elshaghabee is an assistant professor at Cairo University, Egypt. In 2014, he finished his Ph.D. at Max Rubner Institute, Kiel University, Kiel, Germany. He specialized in nutrition and house-hold economics. His research interest is food safety, functional foods, probiotics and nutrition. He has more than ten years of experience in the field of research and higher education.

# THE UPDATE CONCEPTS IN FOOD MICROBIOLOGY EDUCATION: AN INTRODUCTION OF KNOWLEDGE AND SKILLS FOR PREDICTIVE MICROBIOLOGY AND MICROBIOLOGICAL RISK ASSESSMENT IN FOODS

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Predictive microbiology deals with mathematical description of microbial behaviour in foods. Using mathematical equations and models describing the behaviour of microorganisms, it can predict the fate of microorganisms in food, making it an essential knowledge base for microbiological risk assessment. This contribution presents the concept and structure of education in food microbiology at Faculty of Chemical and Food Technology of the Slovak University of Technology in Bratislava, Slovakia.
Since 2015 subject of Predictive microbiology and microbiological risk assessment including computational exercises is being lectured for last-year students of the Nutrition and Food Quality Assessment specialisations. Experiences from this period up until today will be shared as a means of encouragement to emphasize the role of science in the art of microbiological studies.

**Key words: Predictive food microbiology, teaching with understanding**

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Dr. Ľubomír Valík is head of the Department of Nutrition and Food Quality Assessment, lecturer of Food Microbiology, Food Quality and Hygiene, Predictive Microbiology and Risk Assessment, active in training of professionals in Slovakia and abroad (Kyrgyzstan, Latvia, Lithuania and Myanmar) and supervisor of 14 postgraduate students. His advisory services were requested by Slovakian food industry, certification bodies and Ministry of Agriculture and Rural Development of the Slovak Republic. Recent and on-going research activity is focused on quantitative and predictive food microbiology, microbiological risk assessment aimed at current topics of food quality and safety, e.g. Slovakian traditional artisan cheeses manufactured from raw milk. Associate editor of the Journal of Food and Nutrition Research; delegate of Slovakia in the Network on Microbiological Risk Assessment by European Food Safety Authority (EFSA); the leader of four domestic scientific projects and expert in 5 international research and consulting projects. He has more than 100 referee articles, 6 books and 5 book chapters.

# FOOD MICROBIOLOGY TRAINING IN BRAZIL – EXPERIENCES WITH EDUCATIONAL PRACTICES FOR UNDERGRADUATE STUDENTS FROM DIFFERENT MAJORS

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Food Microbiology is a topic included in the curriculum of many majors such as Food Engineering, Food Science and Technology, Nutrition, Veterinary Medicine, Gastronomy, Pharmacy and Biochemistry, among others. These curricula focus different aspects of the role of microorganisms in foods, according to the career. One of the main challenges is to present the appropriate content to such a heterogeneous group. Food safety and hygiene are taught in most of these careers, but other subjects are also taught, such as technological applications of microbes. In a Symposium during the Brazilian Congress of Microbiology in 2017, some professors have expressed difficulties in getting the content along, especially in those majors where food microbiology does not seem to be directly related to the profession. The use of personal devices such as cell phones and tablets during classes, which deviate the attention of the audience, requires new teaching strategies. For instance, some professors have incorporated extension work in the course in an attempt to immerse the students in the reality of many small businesses. In this experience, students were able to create new foods from wasted by-products and they have implemented good manufacturing plans in some industries. Other experiences include the development of research projects along the semester and the generation of articles that are often published in local journals. A few professors have tried active learning methodologies adapting ideas from methods such as team based and problem-based learning in the hopes to improve learning outcomes and increase students' interests by bringing real life problems to the classroom. In these settings, smartphones, tablets and laptop computers have been used successfully. Large outbreaks, news about recalls or national and international scandals, such as those related to meat products known in Brazil as "Weak Flesh Operation", have generated interesting discussions. We have noted an improved interest, participation, and critical thinking upon implementation of these methodologies. However, most professors throughout the country still use traditional teaching methods and their reluctance to change is related to lack of training and time. iIt is crucial that awareness concerning the basic curriculum considering different careers and the challenges and dilemmas facing education for the new generations be brought upon and dealt with by using creativity and effective teaching approaches.

**Key words: Education, food microbiology, teaching, smartphones**

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# THE ROLE OF THE LABORATORY IN UNDERGRADUATE FOOD MICROBIOLOGY EDUCATION TODAY

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There are many aspects of food microbiology that can be taught in an undergraduate food microbiology laboratory class. Laboratory classes can be designed for a range of important food microbiology topics including microbial fermentation, microbial spoilage, foodborne pathogens and rapid advanced analytical techniques. However, understanding how to identify spoilage microbes, determine the cause of foodborne disease, make a fermented product, or use the latest diagnostic instruments is complicated and requires advanced knowledge and technical expertise. Designing practical classes using problem solving to develop learning skills in the above situations can be difficult, especially as universities often have strict regulations around contact hours. Practical classes often have a large number of students, and staff may need training to prepare meaningful food samples for analysis. There may also be limitations on the use of the latest rapid advanced identification techniques. Instruments are often expensive and their use in associated research laboratories may preclude inexperienced students from using complicated sensitive instruments. In light of the above considerations, we should ask ourselves whether large traditional practical classes with limited time is still achievable for the study of practical food microbiology. What are the most important practical outcomes from an undergraduate food microbiology subject in a wider biotechnology or food science degree? A combination of the traditional and the virtual laboratory helps students obtain a broad and practical education in food microbiology. The use of a central consul linked to students' computer screens in large classes has assisted teachers at RMIT University to communicate and explain techniques, especially when combined with virtual laboratory demonstrations. This has enhanced the student experience and improved students' exposure to advanced techniques using online resources which can be integrated into traditional practical classes.

**Keywords: Food microbiology, Undergraduate, Laboratory practicals, Virtual laboratories, Online resources**

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# GOOD EDUCATION PRACTICE: USE OF WEB-BASED DATABASE FOR HACCP PLANNING

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Information and/or data regarding microbial responses in foods are indispensable for constructing a plan for Hazard Analysis and Critical Control Point (HACCP). To facilitate planning a HACCP, web-based database and predictive tools such as ComBase (https://www.combase.cc) plays a key role. ComBase is a large database of microbial responses to food environments and has attracted the attention of many researchers and food processors. Although ComBase contains a vast amount of data, it is not easy to obtain desired information from the retrieved data. In the present study,we developed a new ComBase-derived database (Microbial Responses Viewer, MRV: http://mrviewer.info) consisting of microbial growth/no growth data. The growth/no growth data of nineteen different microorganisms were extracted from all the data in ComBase comprising 29 kinds of microorganism. The growth/no growth boundary was illustrated as a logistic regression model. The users easily enable to find out the critical limit for controlling targeted bacteria. Furthermore, the specific growth rate of each microorganism was modelled as a function of temperature, pH, and water activity (aw) using a generalized linear model. The specific growth rate was illustrated using a two-dimensional contour plot with growth/no growth data. MRV provides information concerning growth/no growth boundary conditions and the specific growth rates of queried microorganisms. Using MRV, food processors and HACCP trainee easily find the appropriate food design and processing conditions. This database will contribute to the efficient and safe production and distribution of processed foods and also efficient education and training for HACCP planning.

**Keywords: ComBase, Microbial Responses Viewer, HACCP, Critical limit**

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Dr. Shige Koseki is an associate professor for agricultural and food process engineering in Hokkaido University. He is currently teaching on food engineering, food science, HACCP, and predictive microbiology. Previously, he had been working as a senior researcher in National Food Research Institute, Japan for 10 years. He obtained Ph.D. in food and agricultural engineering from Hokkaido University in 2002. He has mainly conducted studies on non-thermal inactivation including sanitization of cut vegetables using electrolyzed water, high pressure processing and predictive modelling of bacterial growth on vegetables, microbial inactivation by high pressure processing. Furthermore, he has acted as a member of ComBase associates, which is the largest web database for microbial responses in foods. He collaborated internationally with UK Institute of Food Research, USDA ARS eastern regional research center, and University of Tasmania. In addition, he developed a novel database MRV (Microbial responses Viewer: http://mrviewer.info) derived from ComBase that allows users to identify conditions at the growth/no growth boundary visually as well as quantitatively. He has published more than 60 peer reviewed research papers and 6 book chapters. He has been currently serving as a board member of Journal of Food Protection, International Journal of Food Microbiology, and Applied and Environmental Microbiology. In addition, he is serving as an expert committee member for Expert committee of microorganisms and virus of the Food Safety Commission of Japan.

# TEACHING FOOD MICROBIOLOGY IN THE NON-UNIVERSITY EDUCATION

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We can assume that the learn of food hygiene and preparing meals should start already at the family level. However food microbiology has to be taught in different levels of formal education. Understanding the basic concepts of subject is critical in the context of water and food-related risk. This is a challenge to provide children or teenagers with basic knowledge in the field of food microbiology rising the awareness of the role of microorganisms in food and encouraging the exploration of this fascinating field of science. For many years Faculty of Food Technology participates many educational projects targeting primary and secondary school children. We have introduces diverse forms of lessons. The projects exist under common names Science Festival and WULS-SGGW Days and Open Labs. There are the food microbiology laboratory lessons organized for children with or without the supervision of their school teacher. Little biological knowledge, lack of skills in working with microscope and biological material are real challenges for an academic teacher. On the other side there is a lot of interest, dozens of questions and the desire of each of the children to independently perform the experiment. In an era of disciplinary specialisation and methodological focus the process of explanation the depth and breadth of microbiological research scientists to children is not always easy. The verbal interaction children-researchers are foundation of understanding. Teaching style influence the children and teenagers perception. The youngers see practical work as more enjoyable and olders as more more useful, clarifying or expanding knowledge. Practical examples answering some questions and trouble solutions will be presented and discussed.

Key words: **Education, Good practices, primary school, secondary school, laboratory lessons**

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# THE FUTURE OF FOOD MICROBIOLOGY EDUCATION AT UNIVERSITY LEVEL

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It is well known that the central objective of the FAO, WHO and EU policy and legislative framework related to food is always the provision of safe, nutritious, high quality and affordable food to the world's citizens and consumers. Thus regardless the challenges of the food system, such as climate change and resource scarcity, technological developments or the global economic and trade framework, the future education curriculum on Food Microbiology should be focused on food safety and nutrition. In order to be able to ensure the supply of safe and nutritious food to the consumer, we should prepare the *next generation students* **(ngs**) for food microbiology jobs (e.g., *food scientists and microbiologists in academia and government, food technologists and quality assurance specialists in the industry, food inspectors, food safety specialists and food safety lawyers, food processors, risk managers, food legislators, enforcement officials*) who are required to have solid knowledge and skills in microbiology *to solve problems that we don't even know they are problems yet, using approaches, technologies and/or developments that haven't been yet invented.*
Since we are living in exponential times, Food microbiology education, apart from the elementary subjects, such as (i) overview of food hazards, (ii) knowledge on microbiological and toxicological risk analysis, (iii) better interpretation of the information overload about hazards in food, (iv) why zero hazard does not exist, (v) ways to reduce hazards in food, should encompass additional aspects of food production, food stability (shelf life), food poisoning (infection and intoxication) and introduction of food waste or waste from food production processes (minimise environmental impact). Particularly, specific attention should be given to: (i) Next Generation Sequencing **(NGS)** that will allow students to have a greater depth of understanding on foodborne pathogens, (ii) access to technical information, as well as to new disciplines (big data, data analytics, computational biology) for better official inspections, i.e., explore the viability of technology-driven applications including nano-packaging, labelling, food-omics or molecular biology advances (e.g. DNA microarrays) and culture-independent techniques, or other rapid screening systems/sensors, on a large scale with reduced cost and easier mode of operation, adapted to small scale or home producers.

**Key words: education food microbiology, Next Generation Sequencing, *next generation students***

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Dr. George-John Nychas is professor and director of the Laboratory of Microbiology and Biotechnology of Foods of the Agricultural University of Athens (AUA), Greece where he is teaching Food Microbiology and Food Safety since 1994. Currently the Dean of School of Food, Biotechnology and Development of AUA he has been actively involved with food safety and consumer protection issues serving as (i) President of the Greek Food Authority, (ii) member of the Biohazard group of the European Food Safety Authority (EFSA), being expert in Predictive modeling / Quantitative Risk Assessment (QRA), (iii) Member of the Advisory Forum of EFSA (iv) Member of the "Food Safety Panel –Prevention & Control of BSE/TSE & of other Biological Hazards" of the European Parliament (v) Chairman of the Professional Development Group (PDG) of Predictive Modeling; 2008-2010. He is member of the pool of scientific advisors on risk assessment for DG SANCO, while he has nominated Chairman of the Scientific Working Group in Food Safety of the European Technological Platform. He has been involved in a wide range of activities, whose actually their main aim was to foster international collaboration including transatlantic collaboration (EU-USA) in food safety. This is achieved through European Research programs in which he either coordinated or participated and acquired extensive experience on; a) the assessment of food safety and spoilage through microbiological analysis b) on responses of stress adapted pathogens grown planktonically or attached on stainless steel surfaces (biofilms), and c) on modeling the behavior of microbial populations throughout the food chain to assist reliable estimation of microbial food safety risk d) Implementation of *Process analytical technology (PAT)* in Food Industry. He has important scientific impact 236 publications, ca. 9730 citations, h factor 57.