INTERNATIONAL COMMITTEE ON FOOD MICROBIOLOGY AND HYGIENE
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2nd WPAEFM symposium
"Food microbiology education in practice"
at 25th ICFMH Conference "FoodMicro" 2016
Dublin,19th July 2016

PROGRAMME

Session: **08.30 – 09.00**
Convenor: Peter Raspor

Introduction:

08.35-08.55 **Education and training in food microbiology; challenges and constrains for educators and employers**. Peter **Raspor** (Slovenia)

Session: **09.00 – 10.20**

State of the art in food microbiology education:

Chair: **Martin Wagner**, Institute for Milk Hygiene, Milk Technology and Food Science, Veterinärmedizinische Universität Wien, Austria

09.00-09.20 **An education in food microbiology/food safety, where will it lead you? A USA perspective.** James A **Lindsay** (USDA-ARS, USA)

09.20-09.40 **Good Educational Practices applied in Food Microbiology teaching. A value added to the food chain.** Daniela **Borda**, Iulia Bleoanca, Anca Gata, Anca Ioana Nicolau (Dunarea de Jos University of Galaţi, Romania)

09.40-10.00 **Constrains of food microbiology education at graduate levels (MSc and PhD) in southern Africa.** Pieter **Gouws, (**Stellenbosch University, South Africa)

10.00-10.20 **Integration of students into project work via (inter)national networks, studies and exchange/research programs**. Sonja **Smole-Možina**, Meta Sterniša, Anja Klančnik, Peter Raspor (BF-University of Ljubljana, Slovenia).

BREAK 10.20-10.40

Session: **10.40 – 12.20**

System concepts in food microbiology education:

Chair: **Marcel Zwietering**, Laboratory of Food Microbiology, Wageningen University, The Netherlands.

10.40-11.00 **Industrial experience concerning food microbiology knowledge and skills of food professionals**. Nick **Andrews**, Jenni Whelan, (Dawn Farm Foods Ltd, Ireland)

11.00-11.20 **Needs of Veterinary Food Inspection officers in modern food supply management: a matter of first-day skills or life-long learning programs?** Martin **Wagner** (**Veterinärmedizinische** Universität Wien, Austria)

11.20-11.40 **Food microbiology challenges in education of primary school children.** Andrej **Ovca**, Mojca Jevšnik, Peter Raspor (FVZ-University of Ljubljana, Slovenia)

11.40-12.00 **Classical vs. modern teaching tools in food microbiology: antimicrobial resistance.** Bruno **Gonzalez Zorn** (Complutense University Madrid, Spain)

12.00-12.20 **Innovating food microbiology lab classes.** Wilma C**. Hazeleger,** Heidy M.W. den Besten, Martine W. Reij, Marcel H. Zwietering, Tjakko Abee, Ida Jongenburger. (Wageningen University, The Netherlands)

BREAK 12.20-13.10

Session: **13.10 – 14.50**

Good food microbiology education practices and their realisation

Chair: **Sonja Smole-Možina**, Biotechnical faculty, University of Ljubljana, SIovenia

13.10-13.30 **Case: Food Microbiology training in India – good educational practices for skill development.** Prathap Kumar **Shetty, (**Pondicherry University, India)

13.30-13.50 **Case: Good food microbiology education practices and their realisation implementation in Turkey.** Dilek **Heperkan**. (University of Istanbul, Turkey)

13.50-14.10 **Case: Education of elderly people in Brazil.** Mariza **Landgraf,** Bernadette D.G.M. Franco. (University of Sao Paulo, Brazil)

14.10-14.30 **Case: Inclusion of foodborne viruses in food microbiology education.** David **Rodríguez Lázaro**. (University of Burgos, Spain)

14.30-14.50 **Case: Wageningen on-line courses in food safety.** Marcel H. **Zwietering**, Heidy den Besten, Martine W. Reij, (University of Wageningen, the Netherlands).

BREAK 14.50-15.10

Session: **15.30 – 16.10**

Food microbiology in the future

Chair: **Daniela Borda**, Faculty of Food Science and Engineering, Dunarea de Jos" University of Galaţi, Romania

15.10-15.30 **What microbiological knowledge and skills will employers expect when recruiting professionals to work in the food industry?** Pier Sandro **Cocconcelli** (Università Cattolica del Sacro Cuore, Piacenza, Italy)

15.30-15.50 **How should food microbiology laboratory training in developing countries be organized?** Weihuan **Fang,** (Zhejiang University, China

15.50-16.10 **Examination challenges for teachers of food microbiology: methods vs. knowledge and skills gained.** Stephen **Forsythe**, (Nottingham Trent University, UK)

Session: **16.15 – 17.00**

General discussion

and tentative: **Establishment of network of food microbiology educators**

For all details please visit

http://www.icfmh.org/activities_wpaefm.php

ABSTRACTS

EDUCATION AND TRAINING IN FOOD MICROBIOLOGY: CHALLENGES AND CONSTRAINTS FOR EDUCATORS AND EMPLOYERS

Peter **RASPOR**

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It is clear that during the last 150 years microbiological research has enabled major advances to be made in food security and safety. The results of this research have been gradually implemented and eventually become daily practice. Thus food microbiology has attained the high professional and educational reputation it enjoys today. Knowledge and understanding have been transmitted to those who work at various points in the food chain, from farmer to consumer, farm to fork, mostly within the context of their particular specialisation. The aspects of food microbiology considered relevant to the future career of the students have usually been emphasised by the tutor, who was in turn strongly influenced by their personal educational background and experience (including practical research) in the food area. The educational and/or occupational backgrounds of teachers includes agriculture, biology, chemistry, food technology and medicine. In particular, veterinary graduates have had a strong influence in food microbiology during the last hundred years. Consequently, the final expertise in food microbiology acquired by students has been influenced by the professional background of their teacher and suffers from the many limitations in knowledge and awareness of the individual teacher. As a result, food industry workers, each reflecting their teacher's knowledge and priorities, are to be found at various points in the food supply chain, including those in the highest management positions. This phenomenon still operates. It is important to remember that the majority of Food Business Operators are still small or medium enterprises, where selection of employees is based on the personal preferences of the management and familiarity with individual workers' profiles. It is therefore imperative to profoundly change and synchronise food microbiology curricula so that food microbiology knowledge and skills are comparable and compatible between all the specialities along the food supply chain.

Key words: **Education, training, food microbiology, profession, teacher, food professional**

AN EDUCATION IN FOOD MICROBIOLOGY/FOOD SAFETY, WHERE WILL IT LEAD YOU? A USA PERSPECTIVE

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In the United States there is a wide range of food safety careers to choose from with an education specializing in food microbiology and its related fields; for example, pure and applied microbiology, which includes specialization in medical, agricultural, industrial, dairy environmental and ecological microbiology. Careers include for example, food scientists and microbiologists in academia (Professors) and government (Department of Agriculture and the Food and Drug Administration), food technologists and quality assurance specialists in industry, food inspectors, food safety specialists and food safety lawyers. A minimum of a bachelor's degree in food science, agriculture, microbiology, or a related field is required for many food safety jobs, combined with an internship (on-the-job training) or practical knowledge. However, in order to have a long-term career with potential for advancement, a graduate degree such as a Master's in Science and/or Public Health, Doctor of Veterinary Medicine, Doctor of Philosophy, or Juris Doctor (Law degree) is required or often essential. Persons with work experience in the field may also qualify for some positions, however, this route may take a longer time for advancement. This presentation will discuss some of the educational requirements, preparation needed, job opportunities available, and salaries for a career in the United States. Examples of former student's education and subsequent professional lives will be discussed to show how careers can progress.

Key words: education, bachelor's degree, food microbiology

GOOD EDUCATIONAL PRACTICES APPLIED IN FOOD MICROBIOLOGY TEACHING - A VALUE ADDED TO THE FOOD CHAIN

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Education in universities needs not only a very proficient, competitive and in depth knowledge in scientific subjects but also a wide and complex understanding of the environment in which science is applied.

Teaching Food Microbiology today is a very challenging task given the increased public awareness of food poisoning outbreaks, the new molecular biology based methods for detection and quantification of microorganisms in food and the high number of professionals (food processors, hygienists for food industry, safety officers, risk managers, food legislators, enforcement officials) that are required to have solid knowledge and skills in microbiology.
Considering the complexity of the food processing operations, the practices of the suppliers, the length of the transportation chain, the distribution methods and the diversity of cooking habits one can understand why food microbiology education impacts every link in the food chain. As most of the activities performed within the food chain are based on **good practices** (GAP, GVP, GHP, GMP, GTP and GDP) education will also need to rely on a code of good practice. Moreover the concept of ***LOCKS*** (**L**earning **O**bjectives. **C**ritical **K**nowledge and **S**kills) could also be a key tool for food microbiology educators.

As **good educational practices (GEP)**, we suggest: an annual up-date of the course content with the aim of stimulating students' active thinking, maintaining students' interest in the subject, applying alternative teaching methods wherever possible, improving existing skills and developing new teaching skills.
Applying GEP will help future specialists working in any part of the food chain to perform better and contribute to the safety of food products and consumers.

Key words: education, food microbiology, good practices, skills, knowledge

CONSTRAINTS OF FOOD MICROBIOLOGY EDUCATION AT POSTGRADUATE LEVEL (MSC AND PHD) IN SOUTHERN AFRICA

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Southern Africa, relative to the rest of Africa, has considerable strengths in science and knowledge production. The quality of postgraduate education in food microbiology takes a variety of approaches and is largely determined by the research experience of the supervisors as well as a multiplicity of constraints. However, the major determinants of the quality of postgraduate education within a university or similar institution include the manner in which supervisors understand their roles, the supervisory approaches employed, research funding and access to student support facilities, including student financial support services. These factors are intertwined, not only reflecting the nature of the interaction between students and supervisors but also rooted in the way the institution is administered. While workshops to improve supervision and scientific writing are of immense benefit, failure to provide financial support to the students who are admitted will hamper the time-to-degree and throughput and often result in students abandoning their studies to take up employment in order to survive. Further significant constraints on students are the fact that they are exposed to a diversity of cultures in the classroom, and that for many, the English language of instruction is not their first language. Postgraduate education in food microbiology is thus complex and has a tendency to vary both at institutional level and in specific individual relationships. Visions, goals, strategies, plans and people with the necessary knowledge, expertise, skills and appropriate values and attitudes have to be stitched and held together effectively to ensure progress and success.

Key words: Southern Africa, education, postgraduate level, food microbiology

NTEGRATION OF STUDENTS INTO PROJECT WORK VIA (INTER)NATIONAL NETWORKS, STUDIES AND EXCHANGE/RESEARCH PROGRAMS

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The main challenge of integrating food microbiology in current study programs is balancing theoretical and practical work, routine and research skills as well as interdisciplinary and international team working. Optimal transfer of knowledge, skills and attitudes can be achieved with integration of at least the top 10% of students into formal and informal networks. We present our experience from teaching food microbiology, food safety and molecular epidemiology of food-borne pathogens at BF-UL Ljubljana (BSc/MSc/PhD programs of Food Science and Technology, Nutrition, Microbiology, Biotechnology and other (inter)national study programs i.e. SIFC, CEEPUS, Erasmus+). We have introduced diverse forms of work with the students: a) interactive lectures with several regular and invited lecturers with materials principally given in advance; b) structured written and oral student seminars of selected cases from food safety presented in class via playing roles of stakeholders in food production and supply chain (primary producer, processor, retailer, inspector, consumer); c) laboratory exercises including planning, lab-work and evaluation of collected results individually and for the whole group; d) integration of the laboratory results with literature data into a final report, which is prepared by selected students after weekly consultations with a PhD student in the same field. The final report is reviewed by the teachers and utilised as professional material for students and public; e) individual student research projects usually integrated nationally into work with food companies or (inter)national networks, exchange and/or research programs. The main challenges for improvement of the teaching/learning process remain raising motivation, improving communication with/among students and teachers, precise definition of learning aims, objectives, outcomes and required competences at specific levels of study, as well as feed-back to students, encouragement of self-evaluation among students/teachers and involvement of employers to improve employability of students after graduation.

Key words: Interactive teaching/learning; basic/advanced; routine/research; knowledge/ skills/attitudes

INDUSTRIAL EXPERIENCE CONCERNING FOOD MICROBIOLOGY KNOWLEDGE AND SKILLS OF FOOD PROFESSIONALS

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The objective is to present a food manufacturer's view on how degree-level food microbiology courses meet the needs and expectations of the food industry. Food manufacturers are concerned with producing safe food products, with great taste, at affordable prices, and that meet their customer's needs. The production process has to be controlled to achieve these requirements, and microbiological knowledge and skills are employed in quality assurance and product design roles, as well as in laboratory settings for verification testing. Degree-level education equips graduates with the technical knowledge to fulfil these roles. In our experience, there are other topics which may not have been covered, and which are of equal importance in effective business management. Typically, there is little understanding of the regulatory framework surrounding food preparation, processing and service, and particularly of how this dictates testing requirements. Some graduates lack practical laboratory experience, and require further instruction when working in a laboratory environment. Much of the work of the industrial microbiologist follows on from adverse test results, which require investigation; case studies are important tools for teaching the skills required to investigate and resolve contamination events. Training should include: 1) how the design of products, factories, equipment and process flows can impact on food safety; 2) an understanding of how to work within laboratory management systems; 3) knowledge of the most up-to-date testing methods in use and how these are validated and approved to meet regulatory requirements; 4) interpreting the real meaning of results in the context of processing and serving foods – the gravity of an adverse test result; 5) the crucial importance of communication, confidentiality, and being able to give practical advice to those working in the process, and 6) being able to re-trace the chain of custody of samples to confirm the accuracy of results.

Keywords: Microbiology, Food Industry, Knowledge, Skills, Food Manufacturing

NEEDS OF VETERINARY FOOD INSPECTION OFFICERS IN MODERN FOOD SUPPLY MANAGEMENT: A MATTER OF FIRST-DAY SKILLS OR SUBJECT TO LIFE-LONG LEARNING PROGRAMS?

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Veterinarians play a crucial role regarding the quality assurance of animal foods in many countries in Europe. Main activities involve slaughter animal inspection and meat inspection, food hygiene and work at public health authorities (risk assessors; law makers). Food safety is part of what is usually called veterinary public health in many curricula established at veterinary universities. With regard to a recommendation laid down by the European Association of Establishments for Veterinary Education (EAEVE), about 10-12% of the time budget of a veterinary study (360 ECTS) should be reserved for training in the area of veterinary public health. The general educative goal is to train students to reach first-day skills. This refers to a level of abilities that are necessary to start professional life properly without any further need for re-qualification. How to prepare students best to become respected members of a competent authority is an intriguing question. The national food production system is changing with more and more food business operations (FBO) growing into bigger conglomerates acting as transnational providers to food supply. Data produced nowadays by self-control systems of FBOs are voluminous but conclusive data interpretation suffers. Also the reasons for food law infringement change: according to the national Food Safety Report, only 1.5% of detected food law violations deal with safety issues whereas 98.5% of all documented cases deal with issues such as improper labelling or food composition defects. The only way to cope with the changing situation in the field is to accumulate experience as early as possible during a professional life. It is clear that such a professional profile demands for more than educating students with the ambition to reach a first-day skills level. Professional Life-long learning (LLL) programs could fill the gap however those are up to now scarcely elaborated at veterinary universities.

Key words: Veterinary education, first-day skills, Life-long learning

FOOD MICROBIOLOGY CHALLENGES IN THE EDUCATION OF PRIMARY SCHOOL CHILDREN

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Understanding the basic concepts of food microbiology is critical especially in the context of food-related risks. Childhood is crucial for developing this kind of knowledge and awareness, which should later result in correct actions when dealing with food. Education and training are important factors contributing to the reduction of foodborne illnesses. However, it is of crucial importance that the message is specifically tailored and specific to the needs of the target group. Use of microscopes and other laboratory equipment is often neither possible nor appropriate when dealing with food microbiology topics in primary education. Different methods are more suitable, including demonstrations and practical experiments that demonstrate the functioning of microorganisms in relation to the everyday situation (e.g. food handling). Children find practical work more useful and enjoyable in comparison with other teaching activities. If new concepts are introduced during childhood, using not only theoretical but also practical lessons, the impact on behaviour increases. This is supported by the study presented and discussed. The main purpose of the study was to investigate the effectiveness of focused educational intervention on methods to control microbiological hazards in domestic kitchens. A cross-sectional pre-test / post-test survey with a control group was administered. The results show considerable change of respondents' understanding of microbiological food-related risk and demonstrate that principles learned during the workshop could be applied in the domestic environment. There are several significant improvements and most of them are of a long-term nature, showing that simplification of information and communication was on the level understood by the target group. The improvement is more significant if substantiated with an experiment or practical activity in comparison to the measures addressed only orally. Results show that this teaching style influences young people's understanding of food-related microbiological risk.

Keywords: Food safety, Food hygiene, Microbiological hazards, Formal education, Primary school, Food handling

INNOVATING FOOD MICROBIOLOGY LABORATORY CLASSES

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Due to increasing student numbers, courses in Basic and Advanced Food Microbiology at Wageningen University were facing challenges to achieve the learning outcomes of the courses, especially for the laboratory classes. Therefore, these courses were innovated in 2015/2016.
In the basic course, practical classes were reduced from three to two weeks, while five former experiments were replaced by digital assignments, enabling students to interpret a larger data set then those previously obtained in the practical classes. Furthermore, short video clips were recorded to reduce the efforts of teaching staff to explain lab procedures. Clips were made available via a (protected) YouTube channel during lab classes and digital assignments.
The advanced course contained an experiment, where the students had to design a protocol to preserve a fresh food product. In the past, many students faced difficulties in designing the experiments and obtaining approval for their experiments by staff was time consuming. To solve these issues we developed an e-learning case using the online LabBuddy™-tool. The students designed their preservation experiment in the experiment designer, and in the laboratory they were supported by another newly-developed online laboratory manual. The e-learning case has the following features:

- providing just-in-time feedback;
- assisting students to choose a relevant combination of food product, preservation technique; storage conditions and appropriate spoilage microorganisms to investigate;
- assisting students to order the correct type and amount of media;
- easy access to online protocols which also use the videos recorded for the basic course.

An improvement in the design of the experiment, the practical instructions, and the interpretation of the results is expected, enhancing quality of teaching and learning and reducing time. The new set-ups will be presented and the results of supervisor and student feedback after the runs in September 2015 and January 2016 will be discussed.

Keywords: Design tool, Web manual, Digital assignments, BSc/MSc courses, Lab skills videos

CASE: FOOD MICROBIOLOGY TRAINING IN INDIA – GOOD EDUCATIONAL PRACTICES FOR SKILL DEVELOPMENT

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India is one of the fast progressing nations with one of the largest proportions of young people in the work force.. On the other hand, human resources with employable skills are highly limited. The food industry in India, has grown rapidly in the last decade, moving away from traditional small-scale and cottage industriesto modern and cutting-edge companies.. This shift prompted increased demand for well trained people in the field of food science and technology. Traditionally there were only a fewinstitutions offered Bachelor and Masters degrees in Food Science and Technology. With increasing demand from students , the number of Institutions offering Food Science and Technology courses has increased many fold.
Demand for well trained food microbiologists in the food industry, research and development institutions as well as academic institutions hasalso increased tremendously. Students opting for Food Science and Technology as well as students choosing Food Microbiology as open elective. However, such sudden expansion can also come with disadvantages such as inadequate training and skill development.
In connection with this, we have developed a curriculum in such a way that the training is based on industry requirements and also, the training comprises real-time rather than module-based fragmented components. This approach to training has helped the students to understand the conceptsanalytically, and develop skills which can be applied in the industry.Understanding of the whole subject has also improved tremendously. This paper summaries the above approach.

Key words: Food Microbiology, Training, Skill development, India, Food industry

CASE: GOOD FOOD MICROBIOLOGY EDUCATION PRACTICES AND THEİR IMPLEMENTATION IN TURKEY

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Food Microbiology is a dynamic science, studying microorganisms and their behaviour in foods. It covers both applied and basic science to explain the interaction between microorganisms and foods as well as the environment. Although the basic subjects of microbiology are similar in nature, due to the diversity of its application in different countries and cultures, the course curriculum varies. In this context, the following topics have been considered and as a case study, Food Microbiology education at Istanbul Technical University has been discussed.

Fermented foods make up an important part in the eating habits of the population. A comprehensive knowledge of starter cultures and their utilization in fermented food is essential to food engineering professionals. Lactic acid bacteria are particularly important in the preparation of fermented products especially non-alcoholic beverages in Turkey. However, the use of starter cultures is not common practice. The manufacturers use a back slopping technique with indigenous strains. However, the quality and sensory characteristics are not stable; they may spoil quickly, contain pathogenic bacteria, and produce undesired fermentation products. In addition, exopolysaccharides synthesized by certain lactic acid bacteria effect the textural characteristics of a product. Thus, using starter or adjunct culture in the production of fermented foods, the characteristics of strains used for this purpose and their contribution to the quality, especially viscosity and sensory characteristics should be understood by the students.

Having an enhanced fermentation character is not enough during the selection of microorganisms to be used as a starter or adjunct culture in fermented food. Instead of considering the activities of the microorganism in food alone theoretically, its influence on the sensory, physical and chemical properties should also be studied through practical work in the laboratory.

On the other hand, various levels of contamination occur during the handling and processsing of food. Besides, most of the non-alcoholic fermented beverages is consumed without any treatment by all age-groups including children and elderly. Therefore pathogens and their sources have to be understood, since they cause health hazard problems. Preventive systems such as HACCP should also be covered in the course content.

Key words: food microbiology, curriculum, Lactic acid bacteria, HACCP, starter cultures, non-alcoholic fermented beverages

CASE: TEACHING FOOD SAFETY TO ELDERLY PEOPLE IN BRAZIL

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In 1990 Pontifícia Universidade Católica de Campinas, Sao Paulo, Brazil, was the first Brazilian university to start courses for the elderly. In 1993, the University of Sao Paulo (USP) followed the successful initiative, and currently, there are several other Brazilian universities engaged in this activity. At USP, this program is called "University Program for Senior Citizens", and the objective is to enable the elderly to "deepen knowledge in an area of interest and exchange information and experiences with young people". It is quite a challenge for professors to teach in these courses because of issues such as: a) How to approach the subject? b) How diverse is the basic knowledge of the audience on the subject? c) How to maintain the attention of these students during the classes? In the specific case of the Food Safety course, taught every year, after a less appealing approach on basic microbiology, the interest of the audience increases enormously when food microbiology comes up. Subjects such as intrinsic and extrinsic factors of foods, foodborne diseases, microbial ecology of specific foods, and food hygiene as well as preservation methods and some regulatory aspects are taught. As soon as the course starts, the students immediately want to clarify their doubts related to problems at home with specific foods. The accumulated experience has shown that 1. Food microbiology is a topic of great interest to this target audience because it concerns everyday life; 2. Time allocated to this course is usually insufficient; 3. Evaluation of what was learned is very difficult, and 4. More experience is required for a proper adjustment of the content/length of this course.

Keywords: elderly, senior citizen, food safety, teaching

ASE: INCLUSION OF FOODBORNE VIRUSES IN FOOD MICROBIOLOGY EDUCATION

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Foodborne viruses are an increasing and serious concern in public health. Recently, it has been estimated that this pathogenic group produces more than 5,5 M gastrointestinal illness episodes in the USA every year, while norovirus alone, accounts for more than 58% of the cases of known etiology, representing an annual estimated cost exceeding $2 billion (5,000 QALYs). As a result, it is imperative that microbiological quality control programs are increasingly applied throughout the food production chain in order to minimize the associated risk of infection for the consumer. However, there is an evident lack of knowledge and harmonisation on the methods for the detection, monitoring and control of foodborne viruses. This can seriously hinder specific control measures for these microbial risks. Standard methods are not currently available for detection of the main enteric viruses in food, methods of inactivation have not been fully validated for them, and quality control plans have not been traditionally considered these agents as potential hazards in foods. As result they are not fully considered in the HACCP programs implemented in most food sectors. This reflects in part the lack of information that it is transmitted to the future food professionals during their training, as well as the fragmentation and lack of harmonization in the international Microbial Food Safety community (corpus). While Food Microbiology courses are a pivotal aspect in Food Science degrees, and the students receive a substantial training in the design and implementation of HACCP plans, they are mainly focused on bacteriology aspects, which does not reflect the current food safety situation. In order to correct this scenario, a fundamental shift in food microbiology courses is required, in which viral hazards are correctly weighted. In addition, *ad hoc* courses for food virology and viral food safety should be made available.

Key words: Foodborne Viruses, Food Microbiology courses, HACCP programs

CASE: WAGENINGEN ONLINE COURSES IN FOOD SAFETY
Abstract 284 of 300 words

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In our modern society food safety is a growing concern for many consumers. People want their food to be safe and are worried by the numerous sometimes conflicting messages thrown at them. The Wageningen departments of Toxicology and Food Microbiology have teamed up in building an open course with the aim to make food safety education freely available worldwide. The course will run as a MOOC (massive online open course) on the edX platform from 1 June 2016 and will deal with:

- Overview of food hazards
- Elementary knowledge on microbiological and toxicological risk analysis
- How to better interpret the information overload about hazards in food
- Why zero hazard does not exist
- Ways to reduce hazards in food

Elements of this MOOC will also be used a refresher course for (prospective) students of Wageningen University as a SPOC (small private online course), enabling students to brush up their knowledge of food safety basics before entering MSc level education, especially if they do not have a background in food sciences. Apart from these open course materials, the Laboratory of Food Microbiology at Wageningen University has also built on-line course materials at BSc level that have been used successfully both in Singapore and in Wageningen during introductory courses in Food Microbiology.

Finally, a distance learning programme (www.dl-fsm.nl) has been developed on selected aspects of food safety management, targeting both at students and food professionals at BSc or MSc level around the world who are interested in strengthening their knowledge on e.g. sampling & monitoring, hygienic design or preservation. On-line course materials are useful tools both in curriculum education and for open access for small or large groups alike but the various target groups require their own approach.

Keywords: Open access, MOOC, Distance learning, SPOC, Refresher course.

WHAT MICROBIOLOGICAL KNOWLEDGE AND SKILLS WILL EMPLOYERS EXPECT WHEN RECRUITING PROFESSIONALS TO WORK IN THE FOOD INDUSTRY?

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Food microbiology is a fundamental discipline in all the university programmes aimed to educate experts for the food sector. The main challenge for any of these programmes is to find the appropriate balance between the basic concepts of microbiology and the practical skills needed to be ready for the labour market. To reach this goal, over the last decade, the majority of the food microbiology courses have evolved to provide, in addition to the core knowledge on food microbiology, skills in critical thinking and problem solving approaches.
However, recently the food sector has rapidly become more complex.. Thus, in addition to the traditional food microbiological competences (e.g. the knowledge about foodborne pathogenic bacteria, spoilage microorganisms and food fermentation microbiota) new and multidisciplinary skills are required. For instance, professional food microbiologists should be able to respond rapidly to food safety crises, to manage emerging microbiological risks and to use the most advanced and rapidly evolving technologies, such as omics diagnostic tools.
Taking in consideration these recent developments, a number of questions still need to be answered in defining the curriculum learning goals for food microbiology: i) what are the expected learning outcomes to train future experts ready for the labour market? ii) what competency does the employer expect for both young and experienced professionals iii) how to train experts in food microbiology with competence in the new omics technologies, but with a good basis of traditional culture-based microbiological techniques? iv) how can evidence-based instruction in food microbiology be developed? v) what is the relevance of international system of higher education in food microbiology? Practical examples, aimed at answering these questions, will be presented and discussed.

Key Words: food microbiological competences; skills employers, labour market

HOW SHOULD FOOD MICROBIOLOGY LABORATORY TRAINING IN DEVELOPING COUNTRIES BE ORGANIZED?

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Teaching and training on foodborne pathogens should be universal regardless of countries, developing or developed because microbial contamination of food is common everywhere, although some particular pathogens could be more common than the other in some countries where particular types of food is processed or particular technologies are used for similar types of food. Increased global trade of food also requires that the methods used or safety standards be universally acceptable. Although HACCP-type control programs for exported foods are in place in developing countries like China, end-product testing is still the major strategy of food safety control for domestic markets. In the classroom, students are mostly taught about individual pathogens, implicated foods, health risk, methods of detection and general control measures. Practical training is largely on preliminary identification, with less or even nothing on systemic approaches like holistic HACCP. In coping with such defects in developing countries, attempts should be made to ensure that the students are given an array of skills from onsite sampling (including sampling schemes), sample processing, enrichment, presumptive identification by traditional methods and rapid molecular techniques, storage of isolates for subsequent source-tracking by relevant authorities, as well as control strategies along the processing lines. This can be achieved by a week (or even 10-day) long integrated laboratory practical course for university students and for those working on product quality control in food companies or even official laboratories. The training should also include good laboratory practice, use of basic predictive microbiology software, and set-up of quality-control laboratory in the food industry.

Key words: education, HACCP, food microbiology, developing countries

EXAMINATION CHALLENGES FOR TEACHERS OF FOOD MICROBIOLOGY: METHODS VS. KNOWLEDGE AND SKILLS GAINED
Abstract 289 of 300 words

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Food microbiology encompasses three aspects of food production (dairy), food stability (shelf-life) and food poisoning (infection and intoxication). It is both laboratory-based and managerial with numerous in-house and legal requirements to be met. For the purposes of this presentation my focus will be on the teaching aspects of laboratory-based food poisoning control, and not HACCP etc. Advances in Next Generation Sequencing (NGS) have given a greater depth to understanding foodborne pathogens, and as with other aspects of our lives, access to technical information has drastically changed since many lecturers were students themselves. In addition, information/teaching resources (e.g. smart phones!) have changed. In fact, 'NGS' should stand for 'Next Generation Students'. Nevertheless, despite all these advances, we still have issues with the control of foodborne pathogens including *Salmonella*, *Campylobacter*, and *E. coli* pathovars. So as lecturers/mentors of the next generation in food safety, do we examine according to knowledge, or according to understanding? In our experience, problem-solving scenarios can be a useful approach for individual final year undergraduate projects, and we have also trialled a modified SCALE UP approach with teams of final year students. SCALE UP stands for 'Student-Centered Active Learning Environment for Undergraduate Programs' and 'Student-Centered Active Learning Environment with Upside-down Pedagogies'. Initially the students are given a 2-3 sentence description of an outbreak, from which they draw up a short list of plausible causative organisms. They then decide on the next step of their investigation which they submit to the lecturer for approval. They also are given a budget to work to. In this session, I will share my experiences with individual and modified SCALE UP group-oriented problem-solving teaching and its relevance to assessing students as well as preparing students for food microbiology in the real world.

URLs: https://en.wikipedia.org/wiki/SCALE-UP & http://scaleup.ncsu.edu/
Key words: Food microbiology teaching, Next Generation Students, lecturers, mentors