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## Challenges in food safety as part of food security: lessons learnt on food safety in a globalized world

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### Abstract

Food safety should accomplish food and nutrition security. A key challenge to scale up food safety globally is to better leverage existing capacity and research working towards evidence-based decisions. At Ghent University since 2009 an annual 3-months international Intensive Training Program on Food Safety, Quality Assurance and Risk Analysis has been organized ([www.itpfoodsafety.UGent.be](http://www.itpfoodsafety.UGent.be)). The trainees were asked to express their opinion on food safety concerns in their country and to select a case study to work on throughout the course. Main food safety issues had to do with bacterial pathogens, pesticide residues and mycotoxins which were challenged by lack of food safety knowledge and appropriate legislation and enforcement by government. They welcomed education and training on these topics in particular to elaborate on control measures including good hygienic practices, implementation of certified food safety management systems and setting of appropriate criteria. A number of topics are highlighted here in particular as these topics were shown to have a common ground of interest by several participants in several countries and throughout the years. These topics include among others safety of street foods, safe milk and cheese production, and risk assessment to control *Salmonella* and pathogenic *E. coli* in meat (and other foods). Although some recurring food safety issues could be identified, other topics are of particular concern in selected countries because of specific cultural appropriate eating habits. The world is changing fast. Problems change and the information stream is very intense. Leaders in food security should be aware about food safety as well, and will have to develop an attitude of continuous learning, critical thinking and be given the right tools (“know how”) to develop local solutions to address the emerging societal and environmental challenges to provide sufficient, safe, healthy, nutritious and sustainable produced food to the world’s population.

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**Keywords:** Food safety; management; risk assessment; international; training

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## 1. Introduction

This year World Health Day 2015 focused on Food Safety and it is highlighted that food safety should accomplish food and nutrition security. Food safety assesses and encompasses all points of the food production system where food borne illness risks can be controlled. Food availability (food security) is the reliable access to a sufficient amount of food that is safe, wholesome, and nutritious. Both are essential goals that need to be met to protect and improve human health and nutrition. Access to safe and nutritious food is considered a basic individual right. Food safety is recognized as part of the enabling environment for reducing hunger and malnutrition in the 2014 Framework for Action adopted at the Second International Conference on Nutrition. Consensus has emerged that the best way to address food safety is through the supply chain in a farm-to-table approach that focuses on cost-effective prevention and risk based management.

A key challenge to scale up nutrition, public health and food security/food safety globally is to better leverage existing capacity and research working towards evidence-based decisions. Food safety deals with safeguarding the own national food supply chain from the introduction, growth or survival of hazardous microbial and chemical agents. But within a larger international context, borders are fading and surely this is the case for foodstuffs which are an important globally traded commodity. There is great divergence in the degree of organisation, infrastructure, teaching capacity across countries and food protection (food quality, food preservation, food safety) needs to be tackled globally.

## 2. Methodology

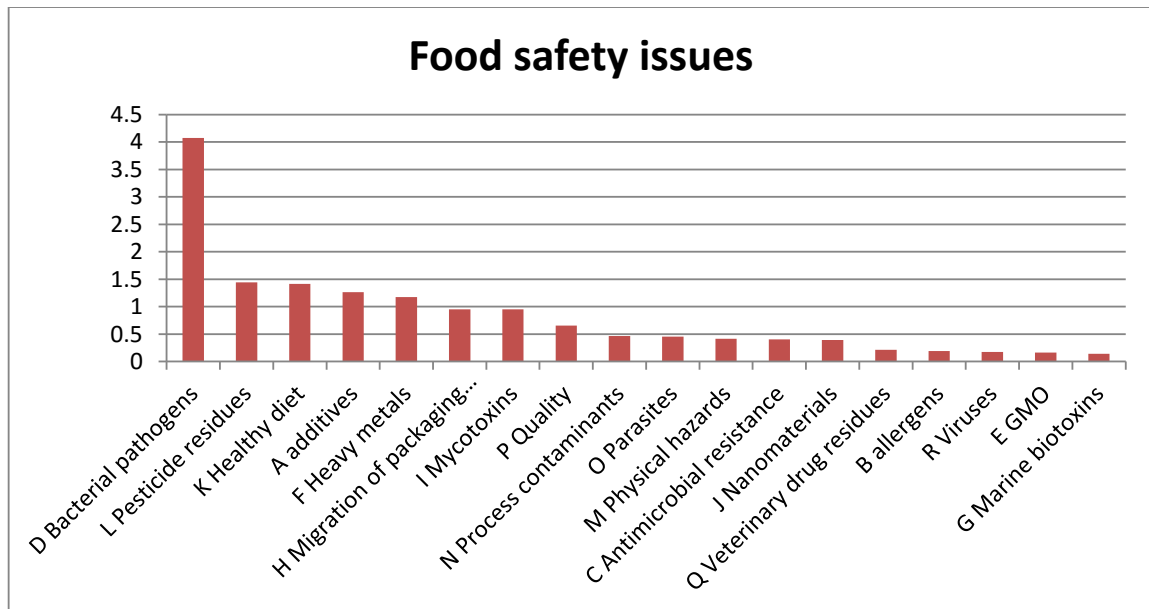
The experience gained from the concerns in food safety issues that were expressed by the trainees participating in the Belgian VLIR UOS funded ITP Food Safety course at Ghent University was the basis of this opinion paper. Upon their arrival in Ghent trainees were asked to express their opinion on food safety in their country and to select a case study to work on throughout the course. To facilitate a common starting point for discussion on food safety, the ITP Food Safety Trainees were provided with alphabetically ordered short lists of i) food safety issues of potential concern, ii) contextual factors affecting the safety of the food supply chain and iii) control measures for assurance of food safety as described by Van Boxtael et al.<sup>1</sup> Each of these lists and topics on the list were shortly introduced by a Ghent University collaborator. Next, the following questions were asked to each trainee *'Please using the shortlist rank the 5 most important i) food safety issues; ii) contextual factors; iii) control measures according to your opinion (for your country of origin) with 1 = most important, 2=second most important, etc'*. These rankings were collected from all trainees, and subsequently an overall ranking of the items based on equal weighting of the opinions of each participant was calculated. In summary, a weighting factor (WF) equal to 5, 4, 3, 2, 1 was assigned to the items that were selected for the positions 1, 2, 3, 4, 5 respectively in the top 5's. Items that did not occur in any Top 5, received a WF=0. Next, for each item, a score was calculated as the total sum of WFs. The resulting sum for each item was divided by five, which resulted in an average importance score between 0 (least important item) and 5 (most important item). In addition, a list of the case studies of food safety issues elaborated on in detail by the trainees with regard to hazard identification and food safety management or risk assessment over the years 2009-2015 was composed to look for a common ground of food safety issues of concern over the years. Participants were coming from in total 29 countries across the world including Bangladesh, Belgium, Benin, Bolivia, Brazil, Cameroon, Colombia, Cuba, Ethiopia, Ghana, India, Indonesia, Italy, Jordan, Kenya, Nepal, Nigeria, Palestine, Philippines, Rwanda, South-Africa, Sri-Lanka, Sudan, Tanzania, Thailand, Togo, Uganda, Vietnam and Zimbabwe.

## 3. Results, Discussion, Conclusions and Recommendations

Since several years, and with support of VLIR UOS and thus funded by the Belgian Development cooperation, an Intensive Training Program (ITP) in Food Safety, Quality Assurance and Risk Analysis has been organized at Ghent

University to provide training at an advanced level to leaders from food safety agencies, bureau of standards, extension workers, academic researchers in public health and food safety, etc in the South. The training aims to produce locally adapted solutions and research and policies that are capable to address the emerging food safety challenges in the participants' countries. Throughout the years we have welcomed almost one hundred participants from South-East Asia, Africa and Latin America as well as some from European countries each working on their specific case studies. As an example, when the ITP Food Safety participants in the period 2009-2014 were asked to communicate their main concerns in food safety and the challenges and threats for safeguarding the food supply chain, their main food safety issues were dealing with mainly bacterial pathogens, followed by pesticide residues and healthy diet (Fig. 1.(a)). Furthermore, it became clear from the survey that overall the contextual factors mainly impacting on lack of food safety or needing to drive food safety were perceived to be lack of food safety knowledge and need of health, food safety and agricultural policy and appropriate legislation and enforcement by government (Fig. 1.(b)). They welcomed education and training on these topics in particular to elaborate on control measures including good hygienic handling and agricultural practices, elaboration of certified food safety management systems and setting of appropriate criteria (results not shown).

Several case studies were tackled by the ITP Food Safety trainees during the 3-months training in Ghent with regard to hazard identification, potential control measures including elaboration of food safety management systems or risk assessments feeding into evidence-based decision making on intervention strategies or monitoring plans being worked out as a case study by participants of the ITP Food Safety. The full list of topics is provided in Table 1.



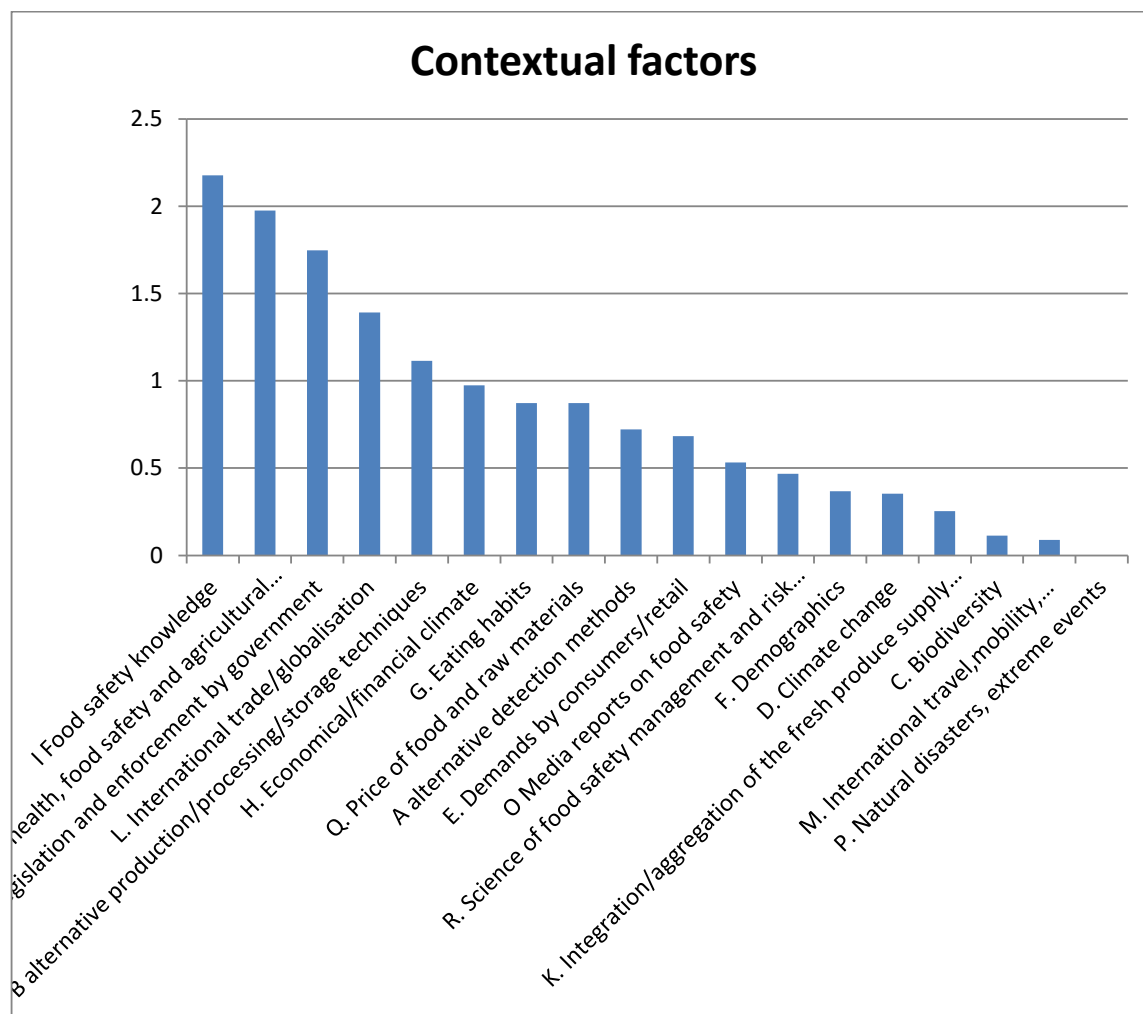


Fig. 1. (a) Main food safety issues of concern and Fig. 1. (b) Main contextual factors perceived to impact food safety (consultation of ITP Food safety Trainees at Ghent University, 2011-2015, n = 79 participants)

Table 1. Case studies on food safety identified by international participants (29 countries) to the UGent VLIR-UOS funded Intensive Training Program of food safety, quality assurance and risk assessment (2009-2015)

Food safety topics : Chemical hazards (n = 38)	
Pesticides' use and pesticide residues on banana & plantain production , cocoa or coffee beans or at small holder vegetable farmers & markets	10
Pesticides monitoring plans in fresh produce	1
Pesticides residues, mycotoxins and prohibited food colorants in spices	2
Mycotoxins (e.g. aflatoxin) in nuts, seeds, coffee, corn, cereal flours or sun-dried fruit and vegetables	10
Veterinary drugs (antibiotic) residues in fish, shrimps & fishery products	2
Heavy metals in fresh fish & in fruits and vegetables & animal products due to use of (contaminated) river water	3
Nitrofurans, formalin, heavy metals, antibiotic residues in fish shrimps	2
Chloropropanols, polycyclic aromatic hydrocarbons and heterocyclic amines in processed foods	1
Cyclopropenoic Fatty Acid (CFPA) in baobab oil	1

Etephon use and residues there-off in pineapple	1
The plasticizer DEHP (di-(2-ethylhexyl)phthalate) in food stuffs	1
Tetrodotoxin (TTX) due to Japanese Fugu fish (puffer fish)	1
Non-permitted food additives in fresh wheat noodles	1
Sudan IV Dye Adulteration of Palm Oil	1
Impact of harmful algal blooms and toxins on fish and fishery products	1
<b>Food safety topics : Microbial hazards (n = 38)</b>	
Microbiological quality of milk and milk products, the issue of <i>Salmonella</i> , <i>Listeria monocytogenes</i> and coagulase positive <i>Staphylococcus aureus</i> during cheese production	11
Microbial hazards (including histamine production) in fish and fishery products, traditional smoked fish	7
	7
<b>Slaughterhouse hygiene, sanitary quality of red meat and poultry processing and issues related to <i>Salmonella</i> and human pathogenic <i>E. coli</i></b>	
Microbiological quality of street foods	7
<i>Clostridium botulinum</i> and botulinum toxin in home canned food	2
Bacterial load of vegetables irrigated with wastewater	1
Antibiotic resistance of <i>E. coli</i> isolates from poultry	1
Sporeforming bacteria and bacterial toxin production in cooked chilled foods	1
Parasitic infections (e.g. cysticercosis) in meat	1
<b>Food safety topics : general issues (n = 9)</b>	
National food control systems and elaboration of a HACCP based approach in small and medium processing companies	5
Food safety problems associated with food donations to avoid food waste	1
Food safety concerns in fried potato products	1
Food safety issues on functional foods	1
Food safety concerns in energy drinks	1

A number of topics are highlighted here in particular as these topics were shown to have a common ground of interest by several participants in several countries and throughout the years. These topics include among others safety of street foods, microbiological safe milk and cheese production, the use of water and safety of fresh produce, the use of pesticides in a non-EU context, dealing with EU food safety requirements such as maximum residue limits on pesticide residues for produce for export versus local market, risk-based monitoring and risk assessment to control *Salmonella* and pathogenic *E. coli* in meat (and other foods), bottlenecks for setting up food safety management systems in small slaughterhouses and small food processing companies, mycotoxin production during production and storage of cereal flours, nuts, etc.

Some examples are shortly described below.

- Safety of street foods: Street food vending is found around the world, but has variations within both regions and cultures as with all food preparation activities, also for street foods basic food hygiene rules must be applied. It is believed that creating a favorable enabling environment, providing infrastructure, providing training and capacity building to transfer the “best available knowledge” is a key issue for local development in the field of food safety of street foods. In addition, good hazard identification will help to focus on relevant microbial or chemical agents of concern thus ensuring food produced and consumed is safe. Ensuring a swift response to hazardous food safety situations have very positive impacts on food security
- Microbiological safe milk and cheese production: Within food industry, the dairy sector is one of the most important sectors for the national economy. Milk and dairy production is extremely important for thousands of peasant families and smallholders in many countries. It has become part of a strategy of diversification of agricultural activities, risk management and security search. Considering the fact that milk is an excellent environment for the growth of different kinds of microorganisms, microbial hazards are the most important concern within the dairy industry. Prerequisite Programs (PRPs) are procedures that control the conditions of food processing and are key elements for an adequate safety control system. Still in the case of rural milk production and dairy manufacturing some bottlenecks are identified on the implementations of “best practices” and difficulties are highlighted in implementing food safety regulations by small companies.

- *Salmonella* a widely occurring microorganism in food stuffs: We know that *Salmonella* occurs commonly in livestock, in particular pigs and poultry, sometimes fish and derived animal products. During post-slaughter processing, *Salmonella* may also be spread by cross-contamination to other types of food during food handling. Public health authorities, regulators and food businesses have a vested interest in interventions to mitigate *Salmonella* contamination. There is thus a large interest in setting-up risk based monitoring plans, the selection of appropriate sampling and testing methodologies and using appropriate tools such as predictive modelling to identify critical time/temperature combinations throughout transportation, storage and food preparation. Although both foods of animal and non-animal origin are a frequent vehicle of food borne *Salmonella* infections in humans, it is difficult to quantify the true proportion of all salmonellosis cases that are associated with a particular type of food, whether directly or indirectly via cross-contamination. However, it is precisely this kind of information that is needed to understand the true risk to public health and to determine the effectiveness of intervention strategies. Ultimately, the efficacy of regulatory activities should be assessed on the basis of risk outcomes.

These are just three examples of microbiological topics for which a common ground is found being a food safety issue of concern for many countries around the world. However, some topics are rather of particular concern in selected countries because of specific cultural appropriate eating habits for example controlling *Clostridium botulinum* and *botulinum* toxin in home canned bamboo shoots in Thailand, food safety risks for traditional fish smoking in Ghana, etc.

The world is changing fast. Problems change and the information stream are very intense. We cannot train people anymore only in knowledge that is lasting and build-up technical competences (“know what”) but we should rather aim to provide participants with conceptual thinking, the capacity to analyse and evaluate a situation and provide the right answer based on best available evidence. Leaders in nutrition security and food safety will have to develop an attitude of continuous learning, critical thinking and be given the right tools (“know how”) to develop local solutions to address the emerging societal and environmental challenges effectively.

Although having elaborated appropriate control measures for ensuring safe food, it has to be acknowledged that microbial and chemical hazards are hard to exclude from the food supply chain and new ones are emerging all the time in particular in times of increasingly sensitive detection methodologies revealing new or lower concentrations of hazards. Even in a well-functioning regulatory and management system one cannot ensure zero risk and the term “zero tolerance” should not be used without knowledge of the scientific and technical factors surrounding it. In particular in the case of fresh (raw) ready-to-eat foods, it is not possible to exclude micro-organisms completely, some of which may be pathogenic. Food business operators are obliged to ensure food safety throughout the shelf-life, under reasonably foreseeable conditions of distribution, storage and use. Inspections, audits and monitoring plans by competent authorities, or as part of self-checking systems of companies, are risk-based to optimize the use of limited available resources. Risk assessment provides a meaningful approach and should be utilized throughout the food chain to help define risk-based decisions in food safety operation and control. In times of increasing concern on food and nutrition security, a debate on stringency of food safety regulation is expected, as strict food safety legislation is sometimes blamed as one of the causes contributing to food waste. This debate is part of the interface of risks assessment, risk management and risk communication and gains increased attention in the framework of risk analysis and accountability. The International Conference organized in Sri Lanka on Challenges beyond food security in November 2015 is an ideal meeting to discuss with many experts from various disciplines and backgrounds on food safety challenges, nutrition security, environmental impacts and socio-economic benefits in order to achieve a common understanding. This may support the elaboration of a roadmap to comprehensive food protection and achieving set public health goals both ensuring food security and food safety for all.

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