ORIGINAL ARTICLE

Globalization, food safety issues & role of international standards

David R. Lineback[1], André Pirlet[2], Jan-Willem Van Der Kamp[3] & Roger Wood[4]

1 International Union of Food Science & Technology, Oakville, Ontario, Canada
2 European Committee for Standardization, CEN Research, Brussels, Belgium
3 TNO Quality of Life, Zeist, Netherlands
4 Food Standards Agency, Institute of Food Research, Norwich, England

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Correspondence
André Pirlet, European Committee for Standardization, CEN Research, Brussels, Begium
Email: andre.pirlet@cen.eu

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Abstract

Introduction The concept of food safety is influenced by many factors, scientific and non-scientific. *Results* Globalization plays an important role, including issues raised by the lengthening of the food supply chain. Various aspects of the impacts of globalization on food are explored. Increasing numbers of chemical and microbial contaminants contributing to food safety issues require analytical methodologies for rapid detection, identification, and quantification. *Conclusion* International standards and their harmonization are needed for these to be effective globally. Current legislation (regulation) and related activities aim at bringing a high degree of food safety at reasonable cost. *Objective* The value being added by the MoniQA NoE to efforts of standardization and harmonization are a focus of this paper.

Introduction

Factors influencing food safety include globalization, changes in food production and food processing practices, changes in microorganisms, demographics, and consumer demands, attitudes, knowledge, beliefs, and practices related to food handling and preparation.

In the past, foods were commonly produced near the point of consumption or at least in the same country/region. Globalization is resulting in a lengthening food chain, greatly increasing the complexity of the challenges for food safety. This requires a focus from production through consumers' tables (farm-to-fork). Recognition and identification of current, potential and emerging issues need to occur as rapidly as possible. The price of energy may be expected to have an impact on production and transport costs, and therefore on globalization.

The issues are no longer of 'food safety' alone (Miller, 1997). The concept of 'wholesomeness', i.e. impact of new foods and products on the well-being of society, is included. This involves integration of toxicology, nutrition, microbiology, food science, genetics, environmental science and other disciplines/fields. Superimposed on the fundamental problems involving science are complicating factors from international and domestic politics, economics, and social demands. As a result of globalization, many different drivers contribute to food safety. These include:

- Trade (food supply) – import and exports of raw materials and food ready to eat.
- Exposure to unfamiliar food-borne hazards through international travel.
- Inadvertent introduction of pathogens into new geographic areas.
- Increasing emphasis upon health and well-being.
- Consumer demands for convenience.
- Consumer demands for freshness and increased shelf–life.

Identification and safety assessment of new contaminants

Globalization may lead to reduced insight into the origin and (pre-) treatments of raw materials and products and materials to which products were exposed. This is resulting in growing risks of missing toxic components, when analysis will be focused on the past experiences and the 'usual suspects'. A recent example is the contamination of dairy products with melamine. In the area of food contact materials, legislation is emerging, placing more focus on unlisted substances (such as impurities, degradation products and reaction products migrating from the packaging material into the food) and their safety assessment. With the growing power of (usually mass spectrometry based) multi-methods, non-target multi-component analytical surveillance is becoming a more and more realistic option (Coulier *et al* 2008). The analytical strategy must be able to detect a wide range of different components within a broad dynamic range of concentrations as well as identify/classify relevant migrants and/or functional groups within a substance above a certain threshold. In case safety data of newly identified contaminants are unknown, the knowledge of functional groups and exposure data will allow a TTC (Threshold of Toxicological Concern) approach for safety assessment.

This combined analytical and toxicological approach can serve as a gatekeeper. After identification of new contaminants, less sophisticated methods can be selected for targeted analysis with standardized methods

Addressing microbiological risks and food processing

For many decades, mechanical engineers and designers of production plants have not been sufficiently aware of microbiological risks, whereas consumer interest in 'fresh' – i.e. not over-sterilized or -pasteurized–products without preservatives is growing.

The adoption of the Food Hygiene Directive 93/43/EC and the Machinery Directive 98/37/EC initiated a start for improving this situation. Because these directives themselves were too generic to initiate actions, the European Hygienic Engineering and Design Group (EHEDG) (http://www.ehedg.org) – a consortium of major food producers and equipment suppliers, took the initiative to develop guidelines for a broad range of specific plant design and operation issues. EHEGD efforts were greatly stimulated by the EC Framework 5 project HYFOMA European Network for Hygienic Manufacturing of Food (2001–2004). At present, the ~40 guidelines cover, for example, design of valves and pipe couplings, production and use of food grade lubricants, and prevention and control of *Legionella spp* in food factories. Methods for evaluation of the performance of equipment – e.g. leak-tightness for bacteria or in-place cleanability – are included in these guidelines.

The European Committee for Standardization (CEN), has also developed an impressive range of activities in CEN-TC (Technical Body) 153, on Machinery intended for use with foodstuffs and feed, by developing more than 50 Standards for Safety and Hygiene requirements for specific types of machines. With the EHEDG and CEN activities Europe has taken worldwide leadership in this area.

For assessment of the hygienic and microbial performance of machines and production plants, as well as for measuring bacterial contamination in foods, test methods are required for measuring/counting microorganisms. The 'genomics technology' revolution is creating opportunities for application of new types of tests with greater specificity and speed than the widely accepted classical plate count tests. It is a task for MoniQA to promote harmonization and standardization of such new, rapid and specific test methods

The role of laboratory quality standards

It is now internationally recognized that for a laboratory to produce consistently reliable data it must implement an appropriate programme of quality assurance measures; this is particularly the case when trace constituents, such as natural toxicants, trace elements, allergens and GMOs are to be determined. However, the same considerations apply to all analytical determinations. Among such measures is the need for the laboratory to demonstrate that the methods used are 'fit-for-purpose' and in statistical control, and to participate in proficiency testing schemes.

It is generally recognized that it is necessary for the quality measures to be implemented in the food and feed control laboratories. In the European Union (EU), as also in Codex Alimentarius, they are required to do so by legislative requirements. These are as a result of the implementation of the Official Feed and Food Control Regulation N° 882/2004 in January 2006. Essential requirements of the Regulation are as follows:

Laboratories

Laboratories should:

- use validated methods of analysis;
- use internal quality control procedures;
- participate in proficiency testing schemes; and
- become accredited to an International Standard, normally EN ISO/IEC 17025.

Methods of sampling and analysis

The methods used for official control should:

1. comply with relevant Community rules or,
2. if no such rules exist, with internationally recognized methods or protocols, for example those that the CEN has accepted or those agreed in national legislation; or,
3. in the absence of the above, with other methods fit for the intended purpose or developed in accordance with scientific protocols.
4. where methods from 1to3 above do not exist, then the validation of methods of analysis may take place within a single laboratory according to an internationally accepted protocol.

Characterization of methods of analysis

Wherever possible, methods of analysis shall be characterized by the appropriate criteria, and in particular:

(a) accuracy, (b) applicability (matrix and concentration range), (c) limit of detection, (d) limit of determination, (e) precision, (f) repeatability, (g) reproducibility, (h) recovery, (i) selectivity, (j) sensitivity, (k) linearity, (l) measurement uncertainty, and (m) other criteria that may be selected as required.

Contributions of CEN and MoniQA

A. CEN

In light of the above, experts working under the aegis of CEN (see http://www.cen.eu) are very active in developing methods of analysis in the food and feed sectors. This is illustrated by the number of CEN Technical Committees in these sectors, i.e.,

CEN TC 174: fruit juices

CEN TC 194: materials and articles in contact with food

CEN TC 275: horizontal methods and analysis (and this TC has 14 Working Groups on very disparate subjects, from intense sweeteners to trace elements to allergens).

CEN TC 302: oils and fats

CEN TC 307: milk and milk products

CEN TC 327: animal feeding stuffs

CEN/TC 338 : cereals and cereal products

All these CEN/TCs aim to prepare and publish methods of analysis which comply with the EU requirements given above. Other CEN/TCs, like TC 153 mentioned above, are of a different nature, but also quite relevant.

We should also mention the important input from ISO/TC 34 'food products' and ISO/TC 134 'fertilizers and soil conditioners'. Both CEN and ISO coordinate their activities for a mutual benefit, avoiding duplication of efforts.

B. MoniQA

But just a list of CEN or ISO methods is not sufficient. The MoniQA network appreciates that for the laboratory it is necessary to have available a comprehensive list of methods of analysis, together with their performance characteristics. The analysts will then know whether there is a method available which is, from his perspective, 'fit-for-purpose'.

The MoniQA Consortium is working towards developing such a database which will be of very real assistance to the analysis on the bench, and which is recognized as being required by analysts.

Role of risk analysis

Sourcing/import of food and ingredients from around the world has major potential impacts on food safety, income, price and food 'security', requiring a global perspective and response. To successfully address these issues will require the use of risk analysis (risk assessment, risk management, risk communication) to ensure that responses are in proportion to the risks involved. Underlying the acquisition of data required for quantitative risk assessment is the necessity for harmonization of the analytical methodologies involved, including determination of exposures, and the uncertainty in exposure modelling. This, in turn, requires a harmonization not only of analytical methodologies, but also of the processes for validation and standardization of the analytical procedures. The MoniQA Network (see http://www.moniqa.org) is being developed to address many of these issues.

The issues of food safety are now addressed in a more systematic way than previously. In particular, microbial pathogens and their toxins have been, are, and will continue to be a major concern in view of the regular occurrence of food-related disease outbreaks. Other agents involved in food safety include mycotoxins, allergens, pesticide residues, process-formed contaminants, environmental contaminants and migrants from food contact materials. However, in order to determine whether any of these are present in foods, reliable and validated methods are needed. A user-friendly database is being built up in the MoniQA Network of Excellence (NoE) to bring together such methods. This database will allow an easy search for analytical methods for specific analyses, including the extent of their validation and their availability. The information will allow a better judgement to be made as to whether any particular method meets specific legal performance criteria for that determination; it will also state what legal limits apply for the analyte being considered, and will therefore usefully complement the benefit offered by AOAC. With an increasing ability to detect and measure chemical compounds (toxicants, contaminants, etc) in foods, it is now necessary to make decisions about priorities with respect to food safety issues. This will involve the use of risk-based decisions and is reflected in the increasing importance of risk analysis (risk assessment, risk management, risk communication). Here, there is also a need for clear definition and characterization of food safety difficulties, issues and challenges, to still better identify the missing parts in the 'puzzle' leading to concrete solutions. This could involve new specific research activities, adjustment of legislation, in particular at international level (EU Directives, Codex, etc.) and wide scale harmonization of the procedures for good (laboratory) practice; this is helped by the development of standardized methods and other quality procedures (e.g. accreditation requirements, proficiency testing, etc.). In addition there is also a need to address other issues, such as qualification and certification of personnel, 'green' and reliable packaging, education of consumers, etc. This will also be aided by the development of a database for food safety hazards in the MoniQA NoE. This will help to prioritize food safety hazards and risks, and should lead researchers to develop new measurement techniques and curative tools.

Crucial in developing databases and systems that analyse risks is the dynamics of the world (market), the food production chain, and knowledge of risks and issues. This includes risks or hazards we have no knowledge or awareness of at this time. Central in the risk analysis process would be exposure assessment after hazard identification and then risk management, and basically that means awareness of the things that (might) happen. Risk management means prevention and preparing for the future. With global chains as daily business, risks are everywhere and reach us earlier than we sometimes expect. International standards fulfil their task in managing the most important (KNOWN) risks, but standards are reactive and take a long time to take effect.

In line with the EU General Food Law, food business operators should act proactively in taking responsibility for food safety and quality. Continuous awareness and vulnerability assessments are needed to remain updated at all times. There are numerous developments in applied research to support and assist companies with this. Techniques to identify emerging risks are being developed and several are already functioning. Tools to systematically address the food chain vulnerabilities in the food safety area as well as the quality area are also under development. These tools not only assess the position of a food business operator in its chain, web or network but also help to set the right priorities and allocate the limited resources. Through the MoniQA NoE these tools and developments become available for every party.

It is well-recognized that food safety is a global concern of great importance. With an increasing global population, this should include the creation and management of strategic stocks of essential long lasting food, also of 'ethnic' foods, kept for long-term under suitable storage conditions, and also more development and improvement of food delivery to the needed persons, frequently in hostile environments. Authorities should also contribute to ensure that food remains globally affordable! In that context, there is sometimes a trade-off between very stringent food safety requirements and legislation on the one hand, and relatively cheap food on the other hand! This could extend to the problem of large-scale development of genetically modified food organisms, but also lead to consider as contingency the need for agricultural changes in the face of global warming. Long drought periods, for example, would force to modify some crops and irrigation techniques. The impact of certification costs also needs to be addressed: if they remain proportionally too high for small areas of food production, in particular in developing countries, this would result in hampering food export to developed nations. Creativity is required to promote the most appropriate production schemes (regrouping of food production in larger areas, administrative support to small farms) to ensure efficiency and increase resilience in food supply.

Harmonization of requirements and testing methods, in particular through international standards, will enhance quality and provide economies of scale and help avoid commercial and legal uncertainties and trade disputes.

Conclusions

Thanks to the mandatory requirements and implementation steps introduced by the legislative bodies (EU and Codex) and the support provided by scientists and standardizers, the consumer can be assured that measures are in place which will allow the confirmation of the identity and compositional characteristics of food and feed moving in international trade. If these measures are well implemented and correctly used, then we all will have confidence in the free movement of food across the globe.

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