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New technologies for ensuring the quality, safety and availability of food[1]

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AGRICULTURAL PRODUCTION is becoming increasingly knowledge-based and science-intensive. New strategic research areas have emerged and been developed, with profound effects on the capacity to produce food and manage natural resources and the environment.

As sustainable agriculture is developed, four key research areas are rapidly expanding. These are closely related to sustainable development and are:

- biological control, or integrated pest management;
- research into the management of genetic resources;
- natural fertilization;
- agro-ecology.

In the area of biotechnology, there is very rapid development of the application of molecular biology to a range of agricultural production problems and issues of sustainability (see Box 1).

Biotechnology has made possible the selective breeding and hybridization of crops. This process allows for the transfer of one or a few desirable genes, thereby permitting scientists to develop crops with specific beneficial traits and without undesirable traits. Current technology allows scientists to alter one plant characteristic at a time, rather than spending years trying to develop the best-tasting and hardiest plants in the traditional manner.

Benefits can also be seen in the environment, where insect-protected biotechnology crops reduce the need for pesticide use. Insect-protected crops reduce the potential exposure of farmers and groundwater to chemical residues, while providing farmers with control throughout the season. In addition, reducing the need for pest control also reduces the time, effort and resources spent on the land, thereby preserving the topsoil.

The achievements of "organic agriculture" have to be recognized, but its limits should also be shown. The growing methods recommended by organic movements basically aim for sustainability in terms of ecology. Organic agriculture

1 This article is largely inspired by CIAA. 1996. *The food and drink industry, a constant need, a constant challenge.* Brussels, Confederation of the Food and Drink Industries (CIAA) and Grocery Manufacturers of America (GMA), in honour of FAO's 50th anniversary.

may lead to reduced yields, thus it will not be possible to satisfy the needs of a growing world population. Given that expenditures for basic food requirements in developing countries are still high, organic agriculture may prove to be socially unsustainable. In developed countries, it is more competitive but still needs substantial financial subsidies. Although "organic production" by itself cannot be considered as a sustainable production system that would satisfy future food requirements, certain achievements and the knowledge gained through following such growing methods can be used in integrated, sustainable production.

Last but not least, information and communication technology is having a very significant impact in both research and production by empowering the innovation capacity at the farm level.

Applying technology to food processing

The different classes of food and drink products currently on the market, as well as the processes used for their manufacture, have been extensively reviewed. The primary object of this report is to look beyond these products and processes as a whole. One of the main contributions of the twentieth century has been to give the whole processing industry a solid scientific basis, leading to new approaches to technology. A better understanding of the complexity of foods and drinks has had profound implications for process and product quality.

Any food product follows a chain, which starts with the production and storage of raw materials and continues, through processing, packaging, distribution and preparation in the household, to the table of the consumer. Once eaten, a food product becomes nutrition, as it goes on to fuel the metabolic cycles of the life process.

Quality

The discussion on food quality is often limited to one of legal standards for the upper safe limits of microbial contamination or the lower limits of vitamins, minerals and trace elements in a product as it leaves the factory. This approach is too restrictive, since it does not take negative qualities into account. Instead, the food processor asks objective questions about quality along the food chain.

Quality for the consumer is subjective, seen partly in terms of visible features, such as the "pleasure" attributes of the product, and partly in terms of an awareness of invisible qualities, such as microbial and toxicological safety and nutritional value. The role of the food processor is to meet consumer expectations of quality, whether visible or invisible, through appropriate quality control and quality management methods.

A major issue in quality assessment involves analysing the impact of the production process and its residues on the environment – i.e. on the quality of soil, water and air. Research into environmental impact

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Key topics in plant biotechnology

Topic	Areas of research
Genetics and breeding	**Genome research**
	Genetic markers in breeding
Plant development	**Structure (height, branching, leaves, roots)**
	Flowers (structure, colour, timing of flowering)
	Hybrid production (self incompatibility; male sterility)
Altering inputs and yields	**Herbicide resistance in food and non-food crops**
	Insect resistance in food and non-food crops
	Resistance to bacterial, fungal and viral diseases
Products and applications	**Sugar, starch (different composition or higher content)**
	Oils (different composition or higher content)
	Flavours and fragrances (in food or as extracts)
	Speciality organic compounds (colours)
	Storage proteins
	Fruit (ripening and quality)
Environment	**Tolerance to drought, salt and heat**
	Flood tolerance
	Cold adaptation (extending growing limits)
	Frost resistance (specifically against freezing)

Source: European Food Information Council.

involves developing a range of ecologically balanced approaches, with the aim of avoiding the recycling of contaminants within the food chain. To ensure quality products at the end of the chain, quality needs to be addressed throughout the food chain, from the farmer to the consumer, by taking account of the following factors:

- Threats to food safety can be chemical in nature, such as the naturally occurring aflatoxins, or microbial, in the form of pathogenic microorganisms such as *Listeria monocytogenes* or *Salmonella* spp. Whatever the nature of the potential threat, food safety assurance involves a series of preventive measures all along the food chain which fall under the umbrella of the good manufacturing practice (GMP) code.
- Food legislation defines acceptable maximum levels of toxins or contaminants in food products. When these are exceeded, safety problems may occur. However, food safety from a personal point of view is an emotional subject that transcends the legal and scientific standards of quality.
- In assuring food safety, it is imperative to sort out the real from the emotional issues, in order to concentrate efforts in process and product safety in the most relevant areas, and to be ready to act when real problems arise. The food and drink industry has an ongoing objective, which is to develop and apply the most reliable control methods that ensure products and processes meet or exceed all given safety and quality standards and respond to consumer expectations.

Food preservation technology

Consumers demand convenient, innovative, fresh foods, including new "minimally processed" products. To meet consumers' expectations in the twenty-first century, the food industry will utilize novel technologies whose purpose will be twofold: 1) to provide the new quality attributes demanded by consumers; and 2) to ensure the all-important and often expected assurance of food safety.

Beyond the traditional food preservation methods of thermal processing, freezing, salting and drying, new methods of

BOX 2

Innovations in food technology

Ultra-high pressure hydrostatic processing

At pressures of 50 000 to 120 000 PSI, vegetative cells of spoilage organisms and pathogens can be destroyed with very little heating of the product. It is speculated that the mechanism of vegetative cell inactivation is through rupture of the cell wall during pressure release. With the addition of mild heating plus high pressure, some more fragile bacterial spores can also be inactivated. The ultra-high pressure process was first commercialized in Japan where fruit products, such as jellies and jams, are being treated to extend product shelf-life. This process can also be extended to heat-sensitive fruits and vegetables. Future applications are likely to include liquid and semi-solid food products, for which rigid texture is a less important attribute and little or no heat for processing is desirable.

Ohmic processing

Electric current applied directly to a conductive food allows for rapid heating of the food product. The heat generated destroys microorganisms in a manner similar to classical thermal processing. Ohmic processing has found applications in Europe, as well as in the United States. Future applications, such as for aseptic food products, are likely to take advantage of the unique characteristic of a process that involves both the uniform heating of particles and the suspension of fluid, together with the lack of a traditional heat transfer surface. In the future, formulated foods could be heat-treated by having liquids and suspended solids heated in different process streams and combined later. Different processing technologies may be used to optimize quality properties of the final product.

High-intensity light pulses

Very intense white light (20 000 times the strength of sunlight on earth) can be pulsed with a duration of between 10^{-6} and 10^{-1} cycles per second, which results in the decontamination of food surfaces. Higher levels of energy have been shown to inactivate bacterial spores as well as vegetative cells. Pulsed light may destroy microbes through both rapid surface heating, with no real cooking of the product, and a photochemical mechanism. Future surface treatment of foods and package material decontamination applications are anticipated using pulsed light technology.

High electric field pulses

Electrical pulses with a field strength of 10 to 20 kV per centimetre have been shown to disrupt and rupture cell membranes. The pulsing creates an uneven distribution of the electrical charge across the cell's membrane, which leads to microbial inactivation. Although the process generates little heat, it is likely that it may find commercial applications in conjunction with mild heating. Future applications may include pasteurizing fruit products and alcoholic beverage products.

Radio-frequency (RF) heating

Food material is placed in an electrical field consisting of pulses of radio waves. This generates heat throughout by a rapid reversal of the polarity of molecules. RF has both current and future applications for bakery products as well as for comminuted meat

processing and packaging continue to emerge. These can extend the shelf-life and freshness of perishable foods.

A brief description and some possible future applications for each of these technologies are given in Box 2.

Food analysis and testing for food pathogens

Over the past decade, food-borne illnesses caused by bacterial pathogens have raised concern about the safety of food. As a result, testing for biological hazards in foods is advancing significantly as awareness of food-borne diseases from microbial pathogens and their toxins gains more public visibility and a higher regulatory profile. In addition, with Hazard Analysis and Critical Control Point (HACCP) systems becoming mandatory for the whole food chain, effective testing methods for the surveillance of harmful microbes will become increasingly important.

Developing methods and procedures for the rapid detection of pathogens in foods is an ongoing challenge and a high priority for everyone who is involved in food and the food industry. Once technical feasibility is proven, new testing methods need to be standardized and verified through collaborative studies, prior to adoption by industry and authorities. Testing methods under development focus on increasing sensitivity, improving accuracy, decreasing time and reducing cost. Quick detection of harmful bacteria in foods can help avoid, or respond to, potentially disastrous food safety situations.

A variety of methods are used to detect pathogens in foods and food ingredients. During the past ten years, developments in pathogen detection have progressed from standard analysis done at the laboratory level towards on-line testing giving instant or nearly instant results. This trend towards instant testing has been driven by the need to provide information that is useful during the food production operation and by efforts to overcome the shortcomings of conventional methods, where results cannot be used to change the process.

The demand for new, rapid methods that are automated has led to the commercial introduction of several new approaches to food microbiological testing. This trend is expected to continue with the aim of

products. Other potential applications include reduction of Salmonella in eggs and destroying harmful bacteria in fresh fruit juices.

Irradiation

The destruction of bacterial cells and spores by radiation has been recognized for years. Governmental interest in the process is emerging for many reasons, largely related to persistently high food losses from infestation, contamination and spoilage; mounting concerns over food-borne diseases; and growing international trade in food products that must meet strict import standards of quality and quarantine – all areas in which food irradiation has demonstrated practical benefits when integrated within an established system for the safe handling and distribution of food.

FAO has estimated that, worldwide, about 25 percent of all food production is lost after harvesting to insects, bacteria and rodents. The use of irradiation alone as a preservation technique will not solve all the problems of post-harvest food losses, but it can play an important role in cutting losses and reducing the dependence on chemical pesticides. Many countries lose huge amounts of grain because of insect infestation, moulds and premature germination. For roots and tubers, sprouting is the major cause of losses. Radiation processing offers an alternative to fumigation and some other treatments.

Microwave processing

A well-accepted technology for heating and thawing for the past 20 years, microwave processing has yet to have wide commercial application. The lack of uniformity of heating has been a significant technical hurdle. However, because of its properties, the process has significant potential as a technology and may be used in combination with other methods. Its use in many food processing steps, such as blanching, baking and pasteurization, is projected for the future.

Thermo-sonication

The combination of ultrasound and heat at moderate temperatures can cause enhanced inactivation of microorganisms. This may be particularly useful for pasteurization of certain beverages where a reduced temperature is desirable. Ultrasound has potential application for emulsified foods, especially where a product's rheological qualities can be improved by ultrasound treatment.

Modified atmosphere packaging (MAP) and active packaging

Controlled atmosphere storage and preservation of packaged food products is a widely utilized technology for fresh foods, prepared foods and baked products. The utilization of inert gases, reactive gases or vacuum can allow for unique applications that control microorganisms as well as maintaining product colour and freshness. Extensive continued use of MAP in food preservation is anticipated for the future.

Packaging material can have functions other than its traditional barrier properties for oxygen control, moisture control and light restriction and against insect infestation. For example, active packaging material not only acts as a barrier to oxygen, but can also function as an oxygen absorber and scavenger. This active role reduces destructive chemical reactions in oxygen-sensitive products and can also help restrict the growth of oxygen-requiring microbes. The shelf-life of many different product types could be increased under reduced-oxygen conditions.

Source: J.T. Barach and R.S. Applebaum. *Food technology in the 21st century.*

generating instant or near instant results accurately and inexpensively. With automation, genotyping has evolved from a tedious and slow process into a practical method that can be applied to everyday microbiological testing. The use of speedy biochemical and serological techniques will play a much greater role in both rapid food pathogen testing and instant testing approaches.

Food safety systems

During the 1990s priority was given to the safety status of the food supply. Recently, there has been a continued effort to evaluate and adopt risk-based food safety systems, such as HACCP, into a regulatory framework.

HACCP systems focus on controlling hazards to ensure the production of safe and wholesome food by using a preventive system with monitoring and process controls. Safety is designed into the process rather than being reactionary, in response to an accident, for example. The HACCP approach has been adopted by both the food processing industry and governments as a key element in the modernization process.

Over the past 30 years, the food industry has time-tested the attributes of HACCP, and it was anticipated that the regulatory agencies would, eventually, introduce a system that worked well for the industry and would replace or supplement the traditional visual and organoleptic inspections. As industry and the regulatory agencies gain more experience with this new food safety system, HACCP continues to evolve into an increasingly successful food safety system for the twenty-first century.

The potential applications of HACCP are often described as extending from "farm to fork", although much work still needs to be done beyond the food processing industry to adapt and implement HACCP in other parts of the food chain to the betterment of the food industry.

Although the industry, regulators and consumers would favour a totally risk-free food supply, zero-risk is neither practical nor achievable. Considerable steps are being taken by the food industry towards understanding and managing risks that exist or are anticipated, and the development of methods and models for identifying health hazards and predicting food safety is a high priority.

Impact and challenges of new technologies

A number of technologies have been developed over the past century in the areas of molecular biology, nutritional science and food science, among others. If further change is to occur in the traditionally conservative food industry, a strong compelling reason to alter or adjust the way foods are processed, produced or tested is needed. The drive from industry and food regulators will come in the form of closer monitoring of food safety issues as the global food supply shifts towards fresh and minimally processed products, which may be imported more frequently and in larger quantities. Industry will continue to seek new rapid methods of testing foods and new technologies to identify and control possible food hazards. Likewise, consumers will push for new technologies in processing and packaging that use innovative approaches to yield foods with a "less processed" quality.

Regulation that calls for food safety systems based on anticipating hazards and managing risks will continue to reshape the role of regulatory overseeing and will have a significant impact on the food safety systems of the twenty-first century. New tools in risk assessment and new advances in HACCP training, system management and implementation will assist the industry in dealing with current and emerging food-borne hazards.

Innovation and acceptance of new technologies

Human beings seem to be inherently suspicious of novelty when it comes to food. Throughout history, migrating populations have carried traditional food habits over one or many generations, and new foods or processes have often been received with reservation.

The same kind of fears are manifested today regarding currently emerging food technologies. For the future, the widespread acceptance of technologies will depend very much on public information and education. In addition to international organizations, government health authorities, responsible elements in the media and informed consumer organizations, the food and drink industry as a whole must play a greater role in creating and diffusing educational material.

In any age, there are two fundamental issues in the relationship between humans and their food: the need as individuals to eat and drink, and the challenge to produce and preserve enough food and drink to meet the needs of entire populations. Just as past technical innovations in the nineteenth and twentieth centuries have served the food industry, so will the technological advances of the twenty-first century. Technical innovations and sound science will lead to the production of safer foods that have new flavours, textures and tastes, are more nutritious, are more convenient to prepare and have a longer shelf-life. Furthermore, new processes, packaging materials, equipment, testing procedures and safety systems will lead to advances in the overall systems for food handling and delivery.

The twenty-first century promises technological improvements in food production, variety, handling and delivery on a global basis. Tracing the food industry to its roots helps bring the debate on the consumer and food back into the context of biology and nature. The twentieth-century lifestyle of town and city dwelling has led to a lack of consumer awareness about nature, and this has had consequences on people's approach to food. The idea that industrially processed foods are not natural, or that they are

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synthetic, is a good example of this mechanism. In fact, the food processing industry does not "manufacture" foods as such. What it does is develop and use an ever increasing array of technologies to transform and preserve natural raw materials in the form of food ingredients or finished products, packaged and ready for use. Especially in view of the inevitable increase in industrial activity in the coming decades, keeping nature in focus is important for at least two reasons: the desire at the level of the consumer for "more natural products", and the need to see the food and drink industry as an integral part of a sustainable world.

Worldwide, there are thousands of ingredients, and hundreds of thousands of products that can be created from them. However, there are still only about 40 essential nutrients that foods and drinks must provide. Throughout the twentieth century, the food and beverage processing industry performed well in meeting the challenge to provide an ever increasing array of nutritious, safe products at affordable prices, that give pleasure as well as sustenance to an ever growing number of consumers. Investment in research and development, in both the private and the public sectors, to develop and exploit new technologies, backed by an effort to communicate to the consumer the benefits of these technologies, guarantees that this trend will continue into the twenty-first century.

Conclusions and recommendations

Training and education

There is still an essential need to develop new technologies and best practices. Research activities should therefore be supported further in order to contribute to innovation and the wealth of society. International organizations, supported by all existing expertise in the private and public sectors, should provide technical assistance to fill the knowledge gap and contribute to the availability of safe and nutritious foods at the global level.

Governments, industry, farmers and consumers should be involved in developing appropriate training packages for the safe production and handling of food, particularly involving the application of HACCP or similar systems. International organizations and governments, in close contact with industry and consumer associations, should develop education and training programmes that explain the importance of the safe application of new technologies. Such education and training programmes will lead to a better understanding of food processing and facilitate consumer acceptance.

The industry, regulators and consumers would favour a risk-free food supply, but zero-risk is neither practical nor achievable

Food safety regulation

Food safety regulation should be based on risk analysis. Codex Alimentarius should develop further guidelines for the correct application of the internationally agreed principles by member countries.

Risk assessment should be based on sound science. At the international level, the credibility of international scientific committees should be reinforced. FAO, WHO and their Member Governments should facilitate the creation of appropriate international, intergovernmental forums to address safety assessments of the new technologies and of the food products obtained with them. Risk management should be based on proper risk assessment. Food safety measures should be proportionate to the food safety problem to be limited or eliminated. Risk management decisions should be taken in a transparent manner involving all stakeholders, including industry. It is essential that all factors taken into account in the decision-making process are identified and debated in a transparent and objective manner in order to ensure a predictable environment to support innovation.

Food safety is a shared responsibility. Each link of the food chain has its specific role in the production, distribution and marketing of safe foods; an integrated approach, from "farm to fork", is therefore paramount. The application of good agricultural practice (GAP), such as integrated crop/pest management, and good manufacturing practice (GMP) should be recommended and promoted by international organizations as a way of producing safe foods.

The national and international food regulatory framework should acknowledge the prime responsibility of the whole food chain for the production of safe food by setting objectives, leaving the operators to determine the most appropriate means for achieving these objectives. Codex Alimentarius should continue to work along such lines and promote the application of all HACCP principles as laid down in the Codex General Principles of Food Hygiene. The principles should be applied to all foodstuffs, throughout the whole food chain, from "farm to fork", and include feedstuffs.

Risk communication. In order to benefit from the new technologies of the information era, risk communication is an important responsibility that should be shared by stakeholders. Clear and effective strategies need to be developed involving all stakeholders. Risk communication is a constant need and should take place at all stages of the risk analysis process, even before a decision is taken.

Labelling. Information about the use of new food technologies is essential to ensure consumer confidence and acceptance. Labelling is only one information tool, and its role should not be overestimated. Labelling should not be misused. Too much information on a label can be confusing. Labelling should remain functional. Other means should be developed in order to provide additional information to consumers.

summary | résumé | resumen

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New technologies for ensuring the quality, safety and availability of food

Agricultural production is becoming increasingly knowledge-based and science-intensive. Rapidly expanding research in biological control, management of genetic resources, natural fertilization and agro-ecology will profoundly affect the capacity to produce food.

Consumers demand convenient, innovative, fresh foods, including new "minimally processed" products. The food industry will utilize novel technologies to provide the new quality attributes demanded by consumers and to ensure the all-important and expected assurance of food safety. New methods of processing and packaging can extend the shelf-life and freshness of perishable foods. Brief descriptions and possible future applications for these technologies are given in the article.

Over the past decade, food-borne illnesses have raised concern about the safety of food. Considerable steps are being taken by the food industry towards understanding and managing risks that exist, or that are anticipated, and the development of methods and models for identifying health hazards and predicting food safety is a high priority. Hazard Analysis and Critical Control Point (HACCP) systems focus on controlling hazards to ensure the production of safe and wholesome food by using a preventive system with monitoring and process controls. Safety is designed into the process instead of being a response to accidents. The HACCP approach has been adopted by both the food processing industry and governments as a key element in the modernization process. Food safety is a shared responsibility: all links of the food chain have their specific roles to ensure the production, distribution and marketing of safe foods; an integrated approach from "farm to fork" is therefore paramount.

Nouvelles technologies visant à assurer la qualité, l'innocuité et la disponibilité des aliments

La production agricole fait de plus en plus appel au savoir et à la science. La recherche sur la lutte biologique qui se développe rapidement, la gestion des ressources génétiques, l'application d'engrais naturels et l'écologie agricole auront une forte incidence sur la capacité de production vivrière.

Les consommateurs demandent des aliments frais faciles à préparer, novateurs, y compris de nouveaux produits «ayant subi un traitement minimum». L'industrie alimentaire se servira de technologies novatrices pour fournir les nouvelles caractéristiques de qualité exigées par les consommateurs, ainsi que les garanties attendues et de la plus haute importance quant à l'innocuité des aliments. Les nouvelles méthodes de traitement et de conditionnement peuvent prolonger la fraîcheur et la durée de conservation à l'étalage de produits périssables. De brèves descriptions de ces technologies et leurs éventuelles applications futures sont présentées dans l'article.

Au cours des 10 dernières années, les maladies d'origine alimentaire ont suscité des préoccupations quant à l'innocuité des denrées alimentaires. D'importantes mesures sont prises par l'industrie alimentaire afin de comprendre et de gérer les risques existants, ou prévus, et la priorité a été accordée à l'élaboration de méthodes et de modèles permettant de cerner les risques pour la santé et d'annoncer que les aliments sont sans danger. La méthode du Système d'analyse des risques – points critiques pour leur maîtrise (HACCP) vise à maîtriser les risques afin de garantir la production d'aliments sans danger et sains, moyennant un système préventif lié à la surveillance et à des contrôles des opérations. L'innocuité est conçue comme faisant partie intégrante du processus et non pas comme parade à un accident. La méthode HACCP a été adoptée à la fois par les industries agroalimentaires et par les gouvernements, en tant qu'élément clé du processus de modernisation. L'innocuité des aliments est une responsabilité partagée: tous les maillons de la chaîne alimentaire ont une responsabilité spécifique dans la production, la distribution et la commercialisation d'aliments sans danger; une approche intégrée «de la ferme à l'assiette» est donc primordiale.

Nuevas tecnologías para garantizar la calidad, inocuidad y disponibilidad de los alimentos

La producción agrícola se basa cada vez más en los conocimientos técnicos y en una intensa actividad de investigación. La rápida expansión de los estudios sobre el control biológico, la gestión de los recursos genéticos, la fertilización natural y la ecología agrícola influirá profundamente en la capacidad para producir alimentos.

Los consumidores exigen alimentos convenientes, nuevos y frescos, que incluyen nuevos productos sometidos a una elaboración mínima. La industria alimentaria utilizará tecnologías recientes para proporcionar los atributos de calidad exigidos por los consumidores y asegurar la garantía de inocuidad de los alimentos, elemento fundamental que a menudo forma parte de sus expectativas. Los sistemas de elaboración y envasado actuales están en condiciones de prolongar la frescura y la duración en el almacenamiento de los alimentos perecederos; en este artículo se proporcionan breves descripciones de estas tecnologías y de sus posibles aplicaciones futuras.

A lo largo de la década pasada, las enfermedades transmitidas por los alimentos han despertado preocupación con respecto a la inocuidad de los mismos. La industria alimentaria ha avanzado considerablemente hacia la comprensión y el control de los riesgos existentes o previstos, y el desarrollo de métodos y modelos para identificar los peligros que amenazan la salud y predecir la inocuidad de los alimentos constituye una importante prioridad. El análisis de riesgos y puntos críticos de control (HACCP) se centra en el control de los peligros para garantizar la producción de alimentos inocuos y sanos, utilizando un sistema preventivo que incluye prácticas de vigilancia y controles de todo el proceso. La inocuidad no representa una respuesta a un accidente, sino que se incorpora al propio diseño del proceso. Tanto la industria de elaboración de alimentos como los gobiernos han adoptado el enfoque como elemento clave del proceso de modernización. La inocuidad de los alimentos es una responsabilidad compartida: todos los agentes de la cadena alimentaria tienen una responsabilidad específica en cuanto a garantizar la producción, distribución y comercialización de alimentos inocuos y por este motivo reviste fundamental importancia la adopción de un enfoque integrado, que vaya «del surco a la mesa».