Food Processing: Strategies for Quality Assessment, A Broad Perspective

Abdul Malik, Farhana Masood, and Saghir Ahmad

1 Introduction

Quality assessment of processed food has become an emerging issue in the present era. The quality factor has broadened and covers all the aspects which satisfy consumer expectations. Subject of quality covers different sections like quality analysis, sensory quality, quality safety quality assurance, and quality standards and regulations. Quality analysis is an approach assisting the functioning of industries, establishing the standards and bringing the manufacturing process for establishment and successful. Every industry, grades the raw materials and implements prevention of Prevention Food Adulteration (PFA) legislation. The analysis of food and food products requires proper sampling as the plant and animal tissues not only having variation in composition of different varieties/brands rather observe variations in individuals of same variety. Sometimes there is variation in various parts of same fruits/vegetables/animal tissues. Food analysis is divided in two groups, namely, proximate and ultimate analysis. The former gives the facts of nutritional/biochemical aspect, while the latter covers the information of particular element or organic compound. Proximate analysis covers the determination of percentage of moisture, ash, crude fiber acidity, proteins, lipid, sugars, and carbohydrate. The ultimate analysis provide information of a particular element like calcium, sodium, iron, magnesium and zinc, vitamins, pigments and antioxidant. Before analysis sampling is very important so as to get the accurate information of analysis. The samples should be taken in sufficient quantity to compensate the variability.

A. Malik • F. Masood (✉)
Faculty of Agricultural Sciences, Department of Agricultural Microbiology,
Aligarh Muslim University, Aligarh 202002, India
e-mail: farhanamasud4@gmail.com

S. Ahmad
Faculty of Agricultural Sciences, Department of Post Harvest Engineering and Technology,
Aligarh Muslim University, Aligarh, UP 202002, India

A. Malik et al. (eds.), *Food Processing: Strategies for Quality Assessment*,
Food Engineering Series, DOI 10.1007/978-1-4939-1378-7_1

A pioneer approach has been adopted by the Government of India to safeguard the health of consumers by establishing the food safety and standard act 2006. This act shall come into force on such time as the Central Government appoint official gazette, and different dates may be appointed for different provisions act at any reference in any such provision to the commencement of this Act shall be used as reference to the coming into force of that provision.

The provision safeguards the interest of consumer to protect them against adulteration.

2 Food Safety

Nowadays global food industry is in a highly competitive market place. There are numerous persons to bring the cost and to improve margin in order to survive. As a result food safety experts are struggling to maintain adequate control of their firm activities. To safeguard the interest of consumer and to prevent fraudulent practices, the food and beverages companies follow food legislation and regulations and their brand names reputation.

Food processor has to go through all steps of productions from grower to the consumer. Each step involves substantially different types of processes and unit operations which require monitoring for safety, compliance of FDA/HACCP, and also profit optimization. Mandate by FDA such as HACCP procedure and ISO-22000-based food safety management system are the basis quality program in the food and beverage industry. To maintain adequate service, a lot of expenses are incurred mostly by companies that maintain improperly trained employee.

2.1 Quality and Safety in Food: Benefits and Risks

The terms “food quality” and “food safety” mean different things to different people. Quality has a vast number of meanings and can encompass parameters as diverse as organoleptic characteristics, physical and functional properties, nutrient content, and consumer protection from fraud. Furthermore, it can cover political and social issues such as wages paid to farm workers, geographical issues such as controlled appellations, and religious issues such as halal and kosher. Safety is more straightforward, relating to the content of various chemical and microbiological elements in food. Clearly, food quality and safety issues need to be addressed along the entire food chain. FAO has adopted this approach, defined as recognition that the responsibility for the supply of food that is safe, healthy, and nutritious is shared by all involved from primary production to final preparation and consumption. Compositional changes, for better or for worse, can be introduced at each and every link in the food chain.

Adopting a food chain framework goes beyond ensuring the safety of food. It facilitates more generally an approach to quality in agriculture and food safety and quality systems that will comprise government, industry, and consumer involvement. This implies potential future shifts in the agricultural sectors in many countries. For example, plant breeders are using genetic resources to increase the nutrient contents of foods at source. Farmers are also exploring new farming and technology choices to meet demands for a safe and healthy diet in response to new regulations and standards, changing global consumption.

FAO recognizes the need to more fully incorporate a food chain approach in its food quality and safety and nutrition strategies and acknowledges that this revised strategic direction will require an integrated and preventive approach to the management of food safety meeting sustainability concerns and building on aspects of the implementation of international commitments such as Agenda 21 (United Nations Conference on Environment Development (UNCED), 1992/1997). While the developments may be largely beneficial, the composition of the foods needs to be monitored to ensure that no harm results to the consumers.

Since 1963, an international food code has been in place to ensure food safety worldwide. Codex Alimentarius, or food code, jointly administered by FAO and the World Health Organization, sets harmonized standards for food. These include specific food standards, guidelines, codes of practice, and recommendations on hygiene; food labeling; food safety risk assessment; contaminants in foods; sampling, analysis, inspection and certification procedures; maximum limits for pesticide residues; food additive provisions; and maximum limits for veterinary drugs in foods. It serves as the basis for many national food standards. Codex has established such well-known safeguards as the "Best if used before" food label and definitions for low-fat and light food. Codex considers independent scientific advice from such bodies as the Joint FAO/WHO Expert Committee on Food Additives (JECFA), the Joint FAO/WHO Expert Meetings on Microbiological Risk Assessment (JEMRA), the Joint FAO/WHO Meeting on Pesticide Residues (JMPR), the Joint FAO/WHO scientific expert consultations on Foods Derived from Biotechnology, and the expert consultations and technical workshops on human nutrition.

Food safety systems in both developed and developing countries face unprecedented challenges arising from demographic change, the globalization of food trade, shifts in food consumption patterns, more processed foods with increased amounts and numbers of additives, increased urbanization, and more intensified food production systems. To help countries respond to these challenges, FAO is redefining its own approach to food safety and quality issues. In a report to the organization's high-level COAG, a comprehensive new system is proposed that would share the responsibility for providing safe food among all players in the food and agricultural sector, from food producers and processors to retailers and consumer households. This "food chain approach" would be strengthened by development of Good Agricultural Practices (GAP) that would help farmers prevent threats to food safety at source.

Parallel with consumer pressure for safer food, economic globalization has raised significantly the risks and costs of food-borne diseases. The globalization of trade

means that it will become increasingly difficult to resolve food safety problems of any one country without collaborative international efforts. Once unsafe or contaminated food has entered the food chain, it is distributed more rapidly and to a greater number of consumers; hence the risks are higher (Burlingame and Pineiro 2007).

FAO's framework for development of a food chain approach to food safety is based on three key elements. First, it calls for universal adoption of a "risk-based" approach to the management of food safety hazards. Food control resources should be directed to hazards posing the most serious threats to public health and where the potential gains from risk reduction are greatest. "Establishing risk-based priorities requires sound scientific knowledge and effective systems for reporting the incidence of food-borne diseases," FAO (2003) says. There also needs to be a net distinction between risk assessment, based on independent scientific research, and risk management which "very often involves a political process—the political nature of government decisions on regulation and control of food safety may partially explain why it is essential that risk assessment and management are separate functions."

FAO also advises shifting the emphasis on regulation and control of end products to preventive measures to control the introduction of food hazards along the entire food chain. That requires adoption of GAP in primary production, postharvest treatment, processing, and handling to reduce the risk of microbiological and chemical contamination and to retain optimal quality. In-plant controls of food processing operations should be based on the Hazard Analysis and Critical Control Point (HACCP) system, which identifies, prevents, controls and then monitors the most vulnerable points in a food production system. In order for standards concerning the safety and quality of various types of additives to be developed and enforced at government level, there must be consistent methodology for authentication and validation.

Food safety regulatory agencies such as FDA in the USA and EFSA in the EU, and similar agencies in other countries, have been charged with ensuring the safety of the food supply (Chassy 2008, 2010). The situation is far different in developing countries where a significant portion of the population can suffer from undernutrition or malnutrition, and micronutrient deficiencies are common (FAO 2008, 2009); see also (http://www.gainhealth.org/about-malnutrition/nutrition-facts). Consumers in developing countries may be more concerned with obtaining adequate food supplies and ensuring food security than they are with food safety, although—paradoxically—their food is frequently contaminated with biological and chemical agents that have adverse effects on health (Wild and Gong 2009). Scarcity of food energy and micronutrients takes a staggering toll of the poor, particularly in underdeveloped countries (FAO 2008, 2009) to optimize the risk governance framework, SAFE FOODS proposes to expand conventional risk assessment by incorporating the evaluation of environmental, ethical, and socioeconomic impacts into assessment in terms of risks and benefits associated with food issues. Specifically, a framework for improved risk analysis of foods has been proposed, systematically incorporates risk–benefit assessment, stakeholder consultation, and public participation at appropriate stages in the risk analysis process. The framework includes risk–benefit assessments relating to non-health aspects of food safety. Two main types of

assessment are identified; those relating to the risk–benefit assessment of health and environmental impacts, and the assessment of economic, social, and ethical impacts (Koenig et al. 2010; Cope et al. 2010). The dominant model of risk analysis applied in the agrifood sector is that proposed by FAO/WHO. This model comprises three phases: food risk assessment, food risk management, and food risk communication. Risk assessment focuses on estimating the risk that a hazardous food safety incident will negatively affect human health (FAO/WHO 1998).

3 Approaches in Food Safety

New science-based approaches to food safety provide an effective way for governments to protect consumers against food-borne diseases and plan appropriate response measures when necessary. Risk analysis, in particular, allows data on hazards in food to be systematically linked to food-borne disease epidemiological data, making it easier to determine the risk to human health. Risk analysis has demonstrated its ability to improve food safety decision-making processes and produce improvements in public health. It offers governments a framework to effectively assess, manage, and communicate food safety risks in cooperation with the diverse stakeholders involved. By providing a process to establish realistic, science-based targets to reduce the incidence of food-borne disease, plan and implement tailored interventions, and monitor the outcomes (both successful and unsuccessful) of these interventions, risk analysis contributes to continuous improvements in food safety.

3.1 Traditional Food Safety Systems

Food safety is the responsibility of everyone involved with the food chain from regulators to producers to consumers. However, governments are responsible for providing an enabling institutional and regulatory environment for food control. Most developing countries already have some sort of food control system in place, usually based on hygiene and adulteration/fraud inspection. While these vary considerably, they usually incorporate food laws and regulations, food control management, inspection and laboratory services, and sometimes mechanisms for information, education and communication, and monitoring of the food supply.

The increasing globalization of the food trade, urbanization, changing consumption patterns, the intensification of agriculture, increasing travel and tourism, and new types of production and manufacturing systems are just some of the trends that are having a serious impact on food safety in many countries. At the same time, a number of existing and new food safety hazards are of increasing concern. New pathogens are also frequently emerging, and existing ones evolving or reappearing. For instance, the resistance of food-borne pathogens to antimicrobial agents is of increasing concern.

Although traditional food safety systems were somewhat effective in reducing food hazards in the past, they are unable to detect and resolve many current problems, and to effectively deal with the full range of complex, persistent pervasive, and evolving challenges confronting different parts of the food chain. A modern food safety system, with the new Risk Analysis approach has the ability to much sharper diagnose the problems and also to suggest focused interventions to properly deal with them.

3.2 A Science-Based Approach to Food Safety

A number of developing countries are already taking steps to improve and strengthen their systems for food safety management. Several are moving away from the traditional approach focused on end-product control toward a process and science-based approach. Indeed, food safety regulators in many countries are already implementing different types of science-based actions and decision making in their day-to-day work.

Examples of Science-Based Activities

1. Implementation of Hazard Analysis and Critical Control Point (HACCP) systems
2. Establishment of acceptable daily intakes for chemical additives and residues of pesticides and veterinary drugs in food
3. Establishment of tolerable in takes for chemical contaminants, including natural toxins
4. Use of science to develop labels to warn consumers about potential risks including food allergens
5. Use of risk assessment to support food safety regulations
6. Establishment of product safety standards, performance standards, and specifications for use in international trade
7. Resolution of trade disputes based on the Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement)
8. Establishment of dose-response relations for pathogenic microorganisms
9. Establishment of a Food Safety Objective to achieve an appropriate level of protection (ALOP)

A science-based approach strengthens the capacity of traditional food safety systems to meet current challenges and improve the availability of safe food for consumers. Scientific evidence can be used to minimize the occurrence of food-borne hazards, to reduce and manage risk, and to improve the outcomes of decision making. A science-based approach enhances the ability of food safety regulators to:

1. Identify hazards
2. Characterize the nature and extent of those hazards
3. Assess exposure to the identified hazards
4. Estimate the likelihood and magnitude of the resulting risks and impact on human health
5. Help set priorities between hazards

As a concept, a science-based approach to food safety is not completely new. It is related to processes such as GAP, good hygienic practices, good manufacturing practices, and Hazard Analysis and Critical Control Point system (HACCP), which are already used in many countries. Scientific assessment of chemicals in general has also a rather long "tradition." What is new is the use of risk analysis as a framework to view and respond to food safety problems in a systematic, structured, and scientific way in order to enhance the quality of decision making throughout the food chain.

A science-based risk analysis framework requires modern food safety and public health institutions and infrastructure, as well as an overall environment that values and supports the risk analysis paradigm. Risk analysis is just one part of an effective food safety system. It will also be essential to develop and improve components of food safety systems including food safety policies, food legislation (encompassing food law, regulations and standards), food inspection, laboratory analysis, epidemiological surveillance of food-borne diseases, monitoring systems for chemical and microbiological contamination in foods, and information, education, and communication.

Increasing public awareness of food safety hazards, concern over threats to health attributable to food hazards, and reduced confidence in the ability of current food supply systems to manage food safety risks are additional factors to be considered in the development of a food chain strategy. Information is rapidly disseminated and the media quickly spreads news of food safety emergencies. Consumer organizations concerned with food safety issues continue to increase their political influence and this trend is of great benefit to the consumer. However, food safety concerns and food scares that are not scientifically substantiated may create unnecessary obstacles and potentially hinder development of potentially useful new technology. Consumers are now equally concerned about the quality of their diet with relation to health and risk of chronic diseases. The need to address their concerns with regard to the nutritional quality of the diet can be easily and closely interwoven with food safety during the development of the food chain strategy. In summary, the use of a science-based approach will enable governments to develop and implement a range of general improvements and interventions tailored to specific high-risk areas, which will ultimately improve food safety and reduce the burden of food-borne disease.

References

Burlingame B, Pineiro M (2007) The essential balance: risks and benefits in food safety and quality. J Food Compos Anal 20:139–146

Chassy B (2008) Global regulations of transgenic crops. In: Kriz AL, Larkins BA (eds) Molecular genetic approaches to maize improvement. Springer, New York

Chassy BM (2010) Food safety risks and consumer health. New Biotechnol 27:534–544

Cope S, Frewer LJ, Renn O, Dreyer M (2010) Potential methods and approaches to assess social impacts associated with food safety issues. Food Control 21:1629–1637

FAO (2003) FAO's strategy for a food chain approach to food safety and quality: a framework document for the development of future strategic direction. Item 5 of the Provisional Agenda, Committee on Agriculture (COAG), 17th session. Rome, 31 March–4 April (Document COAG/2003/5/http://www.fao.org/DOCREP/MEETING/005/Y8274e.HTMS)

FAO (2008) The state of food insecurity in the world 2008. FAO available at http://www.fao.org/docrep/011/i0291e/i0291e00.htm

FAO (2009) The state of food insecurity in the world 2009. FAO available at ftp://ftp.fao.org/docrep/fao/012/i0876e/i0876e.pdf

FAO/WHO (1998) The application of risk communication to food standards and safety matters-report of an FAO/WHO Expert Consultation; FAO Food and Nutrition Paper No. 70. FAO, Rome http://www.fao.org/docrep/005/x1271e/x1271e00.htm

Koenig A, Kuiper HA, Marvin HJ, Boon PE, Busk L, Cnudde F et al (2010) The SAFE FOODS framework for improved risk analysis of foods. Food Control 21:1566–1587

United Nations Conference on Environment & Development (1992/1997). Agenda 21/http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htmS

Wild CP, Gong YY (2009) Mycotoxins and human disease: a largely ignored global health issue. Carcinogenesis. doi:10.1093/carcin/bgp264