

Food Quality and Safety: Traceability and Labeling

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This article discusses food systems in general, their development over the past 120 years, and realities and problems faced by a world population of over 6 billion people. Various food and feed problems are mentioned, and the concept of “traceability” is discussed in the context of the broader and more useful approach of using “good practices” at all levels of the food chain.

Keywords Codex, food labeling, food legislation, good practices, traceability

INTRODUCTION

Presently in Europe and in the International FAO/WHO Codex Alimentarius Commission there are new regulations on “traceability” and labeling. These activities have been initiated for several reasons, including events related to weak European control of problems with foods, animal feed, and animal diseases. Also in Europe and other countries is a desire to restrict the production or use of foods or feed ingredients that are derived from biotechnology; there is also a requirement that the labeling of these products contains ingredients and foods derived from biotechnology, except animal products from animals that have been soy and soy protein from genetically modified soy beans.

As a means of production of higher cost, local products that may not be otherwise competitive in open markets, require labeling to contain a statement of the country of origin or specific production area. This has been introduced the European Union.

It is clear that every country needs an adequate supply of good quality and safe foods. This food supply must be available throughout the year and contain a variety of fresh or processed foods that can assure good nutrition for all. Adequate facilities for the storage, processing and preservation of harvest surpluses are critical to providing good quality and safe foods at all times, even during growing and harvest seasons or in cold or dry periods, when food production is reduced.

No country is self-sufficient in the production of all foods needed or demanded by consumers. At the same time, all countries should be self-reliant and have the ability to produce imported foods needed to assure an adequate food supply. Countries also need opportunities and systems that enable the export of surplus food production or cash crops grown mainly for export in raw, semi-processed, or processed forms. Ensuring an adequate national and global supply of good quality and safe foods

we must take into account current realities concerning food trade and consumer concerns about food quality and safety.

Over the past 50 years, world population has more than doubled, to the current level of more than 6 billion people. Continued global population growth is expected, mainly in developing countries, and will increase world population to 8–10 billion people by the year 2050.

Global population growth and economic realities have accelerated the movement of rural populations to urban areas and the rapid growth on cities in all countries. This growth has also brought about significant growth and changes in national and international food trade. The growth in global food supplies has kept pace with an increasing world population. However, more than 800 million people, mostly in developing countries, continue to have problems accessing food, resulting in under-nutrition, micronutrient deficiency diseases, increased rates of infant, child, and maternal death and illness, problems of growth and learning ability in children, and inability of adults to work efficiently.

FOOD INDUSTRY GROWTH AND CHANGES AND RESULTING FOOD LAWS AND REGULATIONS

Over the past 125 years, there have been dramatic changes in food and agriculture to meet new urban food demands and to improve the quality, safety, and availability of the overall food supply, and its quality and safety. Agricultural research, newer methods of food production, research into food composition, food science and technology, nutritional needs, and food processing and preservation all played a role in changing food supply from local and rural oriented systems to much larger production, storage, processing, and distributions systems that provide foods to markets over thousands of kilometers.

In the early 1800s, principles and systems for heating and preserving foods in sealed containers were developed, and by

the late 1800s, food canning was widely used to preserve food surpluses for consumption throughout the year. Prior to the canning of foods, drying, salting, smoking, and fermentation were used as food preservation or preparation processes. More durable products, such as grains, were stored in dried form after harvest for use in baking and in other grain based foods, including rice.

In the last 120 year, there has been extensive research and development activities in chemistry, microbiology, plant and animal breeding, food science and technology, refrigeration, freezing, and distribution, and in the marketing of foods. These activities have led to the current systems used to supply foods to urban and rural populations in all countries. Systems may vary in different countries based on geography, production and processing resources, levels of development, environment, and food habits and culture, but all systems should be adequate to protect the quality and safety of foods throughout the entire food chain.

The development and rapid growth of food processing industries for fruits, vegetables, and animal products in Europe, North America, and other regions of the world, from the 1880s onward, caused concern about the quality and safety of foods among consumers and legislators. Around 1900, several countries adopted new laws on assuring the quality of foods to protect consumers from fraudulent practices and low quality foods. Many of these laws also covered drug products, and in some cases, other consumer products and marketing practices.

Experience in the early 1900s showed that enforcing laws devoted only to preventing fraudulent practices was difficult, and that food safety concerns could not be addressed. Control of the use of food additives, food colors, and agricultural chemicals, including pesticides and pesticide residues, was difficult or impossible on the basis of the control principles contained in the early 1900s food laws. Similar problems were encountered in the control of the contents and labeling of various drug preparations. There were no regulatory provisions allowing government agencies to carry out a pre-market clearance procedure for proposed new products. In the United States in 1937, a pharmaceutical company marketed a sulfa drug syrup called "Elixir of Sulfanilimide," with the sulfa drug dissolved in ethylene glycol, which is a toxic chemical used mainly as automotive anti-freeze. Over 100 people, mostly infants, died from the toxicity of the propylene glycol, leading to considerable U.S. Congress concern, and the passage of the 1938 FD Food, Drug, and Cosmetic Act (FD and C Act).

The U.S. FD and C Act contained authority of the U.S. Food and Drug Administration to require pre-market approval of new drug products to assure safety in use, but did not provide authority for the pre-market clearance of drug effectiveness. The 1938 Act also provided authority to the Government to establish standards for foods and other food regulations for better control of the quality of foods. Further problems and developments in the food and drug industries led to amendments of the FD and C Act in the 1950s and 1960s to provide government authority for the pre-market clearance of food additives, pesticide formulations and residues, veterinary drug residues, and the safety and efficacy of new drug products.

The laws governing the quality and safety of foods and pre-market clearance of food additives, food colors, and pesticide or veterinary drug residues in foods, along with rules to control food contamination, food hygiene, and food labeling are administered by the government. However, the law and regulations place responsibility for compliance on all persons involved in food production, storage, processing, and marketing to meet all requirements of all applicable laws and regulations. Failure to meet legal requirements can lead to seizure or recall of food products, prosecution of individuals and companies placing illegal products on the market, and injunctions against further operations in violation of legislation. Marketing products that do not meet regulatory requirements can also have severe civil law implications and lead to costly civil suits against companies responsible for the marketing of fraudulent or unsafe products.

In order to assure the quality and safety of foods and food products, all entities involved in the production, storage, processing, and marketing of foods should have in place systems to control the quality and safety of all food ingredients in each food, of processing systems, and of post production storage and marketing facilities. This requires, at various levels of the food chain, knowledge and skills to prevent and control a wide range of food problems, such as spoilage or pathogenic microorganisms, natural or industrial contaminants, insect or rodent infestation and depredation, mold and toxic mold products, such as mycotoxins, etc. Controls are also needed to assure that food standards, limits on food and color additives, pesticide or veterinary drug residues, and food labeling rules are met.

Foods can be marketed to consumers as produced, such as fresh fruits, vegetables, and eggs. They can be marketed as lightly processed foods, such as meats or nuts, or they can be marketed on processed and packaged foods, containing a number of different ingredients. Food ingredients can be raw or unprocessed products, such as fruits and vegetables, grains, nuts, green coffee, raw milk, etc, or partially processed products that have been dried, salted, and separated into products such as animal or vegetable fats and oils; they can also be food additives or other chemical or microbiological products used in food processing.

Foods and food ingredients, including packaging and labeling, can be locally produced, or from sources that can be several thousand kilometers away from the point of food preparation or consumption. General food regulations for food labeling and good manufacturing practices have also been established. The concept and application of "good practice" to control possible food quality and safety problems is crucial to assuring compliance with food regulatory requirements. Farmers producing fruits, vegetables, grains, root crops, and animals and animal products must follow good agricultural practices. The proper preparation of soils, judicious and allowed use of fertilizers and crop protection chemicals, careful separation of products, adequate storage, and product transportation facilities are all essential for preventing food losses and assuring adequate levels of food quality and safety. Similar steps are needed to assure the quality and safety of fish and shellfish from open waters or from aquaculture.

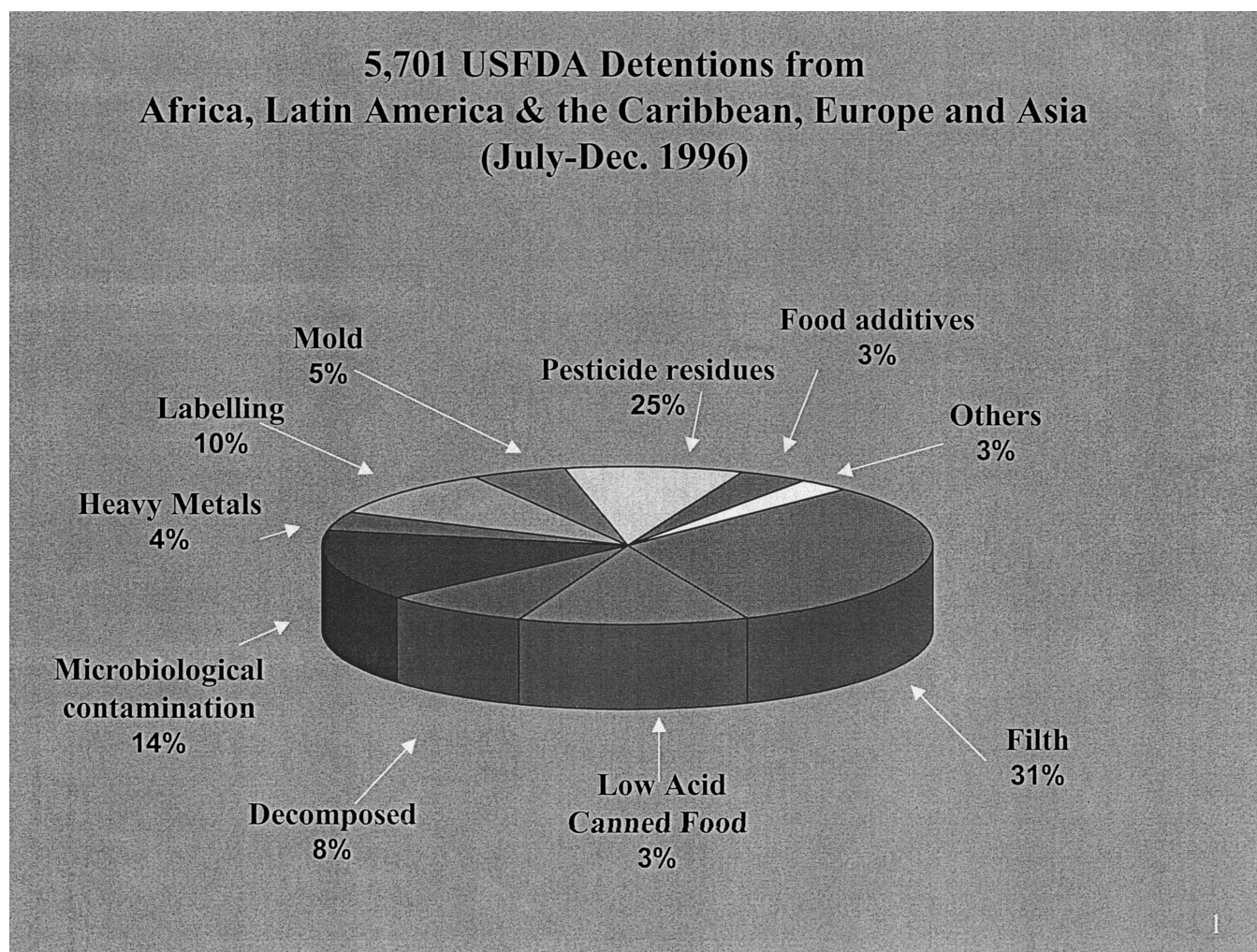


Figure 1

Foods can be stored in bulk or in packaged form, and problems of excessive moisture and mold growth, temperature control, insect, and rodent and bird contamination can all damage the quality and safety of stored foods. Good practices in food storage are clearly needed to preserve food quality and safety, protect consumers, and prevent food losses.

At the level of food processing and packaging, good manufacturing practices are critical. These practices require that food processors have sufficient knowledge of the quality and safety of all food ingredients and packaging materials to assure compliance with regulatory requirements. Food processing also requires scrupulous attention to food hygiene and the problems caused by improper food handling. With regard to food ingredients and packaging materials, food processing entities should have specific specifications in place that require suppliers to guarantee that materials provided meet specifications and regulatory provisions. This may require the training of staff of suppliers and food processors and adequate use of food inspection and analysis facilities for adequate food protection. Paper or electronic records should be kept relating to the origin and

use of each food ingredient and packaging material in the event that problems arise.

Processed and packaged foods also require adequate labeling. There are requirements in all countries that labels state the name of the food, a list of ingredients, net content, and name and address of the manufacturer or distributor. In many countries, additional information on nutrient content is either mandatory or voluntary, and in the European Union, rules exist about label declarations if a food contains ingredients derived from biotechnology. Good manufacturing practices can assure that all required label statements are accurate and can help to avoid problems related to mislabeling or misbranding, including false or misleading claims.

The wholesale and retail storage and marketing of foods also require that good practices be followed. Products that are temperature sensitive or subject to food spoilage and growth of or contamination with pathogenic microorganisms require adequate storage and marketing conditions and assurance of proper food handling practice by all staff. Records documenting the receipt, storage, and handling at these levels of the food chain are

important in demonstrating that adequate systems are in place to show the origin of food products and of proper storage and handling.

U.S., EUROPEAN, AND OTHER FOOD CONTROL SYSTEMS

Various countries and trading regions have different systems to control the quality and safety of foods. The European Union has a central system for formulating food regulations and related directives, with enforcement responsibility at the country or local level. Some E.U. member countries have nationwide enforcement systems, in addition to control at the province and local levels. Other EU member countries have central policy setting bodies, but rely on local authorities to enforce food regulations.

In the United States, there are national food regulatory systems operated by the U.S. Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA). State governments and local authorities also have food control systems, and efforts are coordinated with federal authorities. The FDA has highly trained investigators in offices throughout the U.S., so that one of these investigators can reach any point in the country within two hours of receiving an assignment or a report of a problem. FDA laboratories are fully equipped and staffed with trained chemists and microbiologists to carry out all necessary food analyses submitted by FDA investigators, whether from domestic or imported sources. The USDA has in-plant inspectors for the pre- and post-mortem inspection of meat, poultry, and other animal products, in addition to USDA laboratories to analyze samples.

Many countries have consumer organizations and government structures designed to assess consumer concerns about foods. These can have considerable impact, along with printed media, radio, and television, on consumer attitudes and practices, as well as on legislative bodies.

At the international level, efforts have been made to develop food standards, codes of hygienic and good agricultural practices, a general standard for food labeling, and to relate information and guidelines. Since 1962, the FAO/WHO Codex Alimentarius Commission has developed international standards for foods designed to protect the health of consumers and promote fair practices in the trade of foods. The work of the Codex Alimentarius Commission has recognition in the World Trade Organization agreements on sanitary and phytosanitary measures and on technical barriers to trade.

RECENT FOOD AND FEED PROBLEMS

A number of recent problems for foods, or related to animal feed and animal production demonstrate that prudent producers, processors, and distributors of foods should follow good practices at all levels of the food chain. They also demonstrate that problems can occur in developed countries, and that the

food industry has not always been vigilant in following good practices.

In Europe, adulterated olive oil was responsible for a number of deaths and illnesses in Spain, and subsequent investigations were not able to definitively show the origin of the problem oils.

In the United Kingdom, an epidemic of bovine spongiform encephalopathy (BSE), commonly called "mad cow disease," led to the destruction of many thousands of cows. BSE also spread to several other European countries, and recently one case in Canada and one in the US has occurred. Atypical cases of Kreutzfeld-Jacob diseases in the UK and other European countries caused the deaths of a number of people and was tentatively linked to the consumption of beef from BSE affected animals. Investigations of the causes of BSE showed that protein, fat, and other products from the rendering of sick or dead animals and animal slaughtering by-products were the probable cause of the spread of BSE in cattle. These rendering products were used as animal feed ingredients despite inadequate processing, and sales of these rendering products were continued from the UK to other countries after their use had been banned in the UK. It is suspected that this export of feed and the sale of infected animals played a role in the spread of BSE to other countries.

Also in the UK, suspected feeding of uncooked food waste was identified as the probable cause of an epidemic of foot and mouth disease that led to the slaughter and destruction of an additional large number of cattle and seriously damaged tourism in rural England for some time. UK regulations require the thorough cooking of food wastes before feeding cattle, but it appears that these rules were not adequately enforced or followed.

In Belgium, animal feeds containing high levels of dioxins, which are toxic and carcinogenic contaminants, caused the destruction of a huge amount of poultry, eggs, and pork products. In addition to Belgium, the contaminated feed was sold in parts of the Netherlands and France, and food products from all three countries were shipped to many other countries, leading to extensive food losses and consumer and governmental concern. It was reported that Belgian food authorities first tried to suppress information about this contamination when it was discovered, and subsequently were unable to clearly identify the source of the problem. It was suspected that an unscrupulous entity sold highly contaminated oil as a feed ingredient to feed producers, but that no control procedures were in place to identify the source or the condition or levels of contamination in the oil or other feed ingredients or finished feed.

In the U.S., problems with ground beef contaminated with hemorrhagic *E. coli* led to several deaths and illnesses. A number of recalls and destruction of contaminated beef were carried out. Investigations showed that significant changes had occurred in meat processing, with centralized production of ground beef taking the place of local and small-scale producers. While this enabled efficiency and lower production costs, improved control procedures for the changes made were not developed and enforced at the same time. Other problems of hemorrhagic *E. coli* contamination were also found in organic foods, such as apple juice and bean sprouts and reflected problems related to

poor control of raw materials, and improper food handling and production processes.

Also in the U.S., problems occurred or pathogenic *Listeria monocytogenes* bacteria in milk, local cheese and imported cheeses and caused illness, spontaneous abortions in pregnant women, and some deaths. Investigations into domestic problems showed that the food processors involved did not have adequate quality and safety systems in place, allowing the production and sale of contaminated products to consumers.

Problems with imports are also of concern. Fresh raspberries from Central America were contaminated with *Cyclospora* and caused illness in the U.S. The U.S. FDA routinely inspects and samples food shipments offered for import into the U.S. and stops the import of about 1000 shipments each month. About 33% of the shipments are rejected due to contamination with insects, rodent hairs, and other undesirable extraneous matter that indicates poor food hygiene and unacceptable production practices in the country of origin. Other imported food problems involve decomposed fish, heavy metal contamination in fish, illegal pesticide residues, contamination with pathogenic microorganisms, and improper labeling.

TRACEABILITY AND LABELING

Despite extensive food regulatory systems, it is clear that many quality and safety problems can occur with foods. Food entities can avoid or prevent most of these problems by developing and vigorously applying good practice systems that go far beyond the current E.U. concepts of "traceability." These good practice systems at all levels of the food chain will allow the identification (tracing) of all foods, food and feed ingredients and food products, and food inputs, such as animals, for food use. Given the possible civil and penal ramifications of producing, storing, processing, or distributing fraudulent or unsafe foods, it is obvious that all prudent entities should take all possible steps to assure that their food and feed products meet all regulatory requirements and are of good quality, safe, and properly labeled.

REFERENCES

- Belgium dioxins in food and feed; see Dioxins in the food chain, US Department of Agriculture Animal and Plant Health Inspection Service website, <http://www.aphis.usda.gov/us/cedh/ce/dioxins>, USDA, APHIS, Washington, DC, USA.
- Bovine spongiform encephalopathy; see www.cdc.gov/ncidod/diseases/cjd/cjd.htm, National Center for Infectious Diseases, CDC, Atlanta, Georgia, USA, 12 January 2004.
- Council Directive 2001/13/EC on food labeling, as amended by Council Directive 2003/89/EC, European Community, Brussels, Belgium, 2001, 2003.
- Council Directive 2001/18, on release of genetically modified organisms in to the environment, EC Regulation 1829/2003 and 1830/2003 on biotechnology, European Commission, Brussels, Belgium, 2001, 2003.
- EC Regulations 258/97 on novel foods and novel food ingredients, and Regulation 1139/98, amending Regulation 258/97, European Commission, Brussels, Belgium, 1997, 1998.
- EC Regulations 1830/2003 on traceability and labeling, and 641/2004, on implementation of Regulation 1830/2003, European Commission, Brussels, Belgium, 2003, 2004.
- Escherichia coli 0157:H7; US Centers for Disease Control and Prevention, Atlanta, Ga., USA, 27 January 2004.
- Food labeling regulations, 21 Code of Federal Regulations, parts 101.1 to 101.28, US Food and Drug Administration, Washington, DC, USA, 2004.
- Good manufacturing regulations for foods, 21 Code of Federal Regulations, parts 110.1 to 110.10, US Food and Drug Administration, Washington, DC, USA, 2004.
- Import Detentions by the US Food and Drug Administration, see FDA website www.fda.gov for monthly summaries of products detained, listed by country of origin, and reason for detention, US Food and Drug Administration, Washington, DC, USA.
- Listeriosis, US Centers for Disease Control and Prevention, Atlanta Ga. USA, 1 December, 2003, see www.cdc.gov/ncidod/dbmd/diseasesinfo/listeriosis-g.html
- Loi sur la Repression de Fraudes, Government of France, 1905.
- Regulation (EC) 49/2000, on compulsory labeling of certain foodstuffs produced from genetically modified organisms, European Commission, Brussels, Belgium, 2000.
- The Spanish Toxic Oil Syndrome, 20 years after its onset, a multidisciplinary review of scientific knowledge. Gelpi E. et al., Environmental Health Perspectives, vol. 110, no. 5, May 2002.
- U.S. Federal Food Drug and Cosmetic Act, as amended, US Department of Health and Human Services, Washington, DC, USA, 2004.
- U.S. Food and Drugs Act, U.S. Government, Washington, DC, USA, 1906.