INSPECTION, QUARANTINE, AND QUALITY CONTROL ORGANIZATIONS

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Keywords: SPS, TBT, Codex Alimentarius (CA), EOQ, food control, food controller, food inspection, import/export inspection, IPPC, product recall, quality control, quarantine, SPS Agreement, TBT Agreement, withdrawal period, OIE, WTO

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Summary

An effective food control infrastructure must provide for sampling foods and inspecting the premises where they are prepared, packed, stored, or held for sale. Different types of food control organizations exist in every country: (1) official, national-level governmental systems, (2) quality control organizations of manufacturers, (3) private control laboratories, and (4) consumer associations. Governmental inspection is realized by governmental agencies, authorized to regularly inspect manufacturers, to take samples, and, in the system of governmental laboratories, to analyze the products concerning fulfillment of requirements included in regulations and standards. When

adulteration or any other defect of food is detected, adequate action is taken by the state. There is a general tendency to shift responsibility of the implementation of food law to manufacturers. This means that the manufacturer has prime responsibility to assure the production of safe food. As a consequence, the majority of manufacturers have established integrated food control systems.

The globalization of food trade and growing international problems of food safety have resulted in the establishment of such international organizations as the International Plant Protection Convention and the World Organization for Animal Health (which plays an important role in the prevention of the introduction and spread of pests or animal diseases). Agreement on the Application of Sanitary and Phytosanitary Measures, initiated by the World Trade Organization (WTO), and national quarantine regulations also are important tools of food inspection.

1. Introduction

An effective system for the implementation of food laws and food related regulations provides for an appropriate infrastructure. Such infrastructure should be suitable to fulfill basic functions such as administration, inspection and sampling, and analysis of food samples.

The administration ensures effective supervision and control, and takes follow-up action as may be required by inspectors and laboratory staff. The duty of the inspection group is to inspect and sample foods and to initiate appropriate action. Finally, the laboratory analyzes the food samples, evaluates them as is required, and initiates action. According to the recommendations of FAO/WHO guidelines, the local administration may be responsible for:

- supervision of day-to-day operations,
- follow-up action on the work of inspectors and analysts,
- coordination, consultation, and cooperation with all who have responsibility related to food control at this level, and
- budget preparation to provide for costs of the service, including equipment and supplies needed by inspectors, analysts, clerical staff, and so on.

Concerning the central administration, the main responsibilities should be: initiating, developing, and reviewing of regulations and enforcement policies, coordinating all activities related to food control, and contacting foreign governments and international organizations.

Because of wide differences in national and local systems of government, in legal philosophies, and in the training and education of officers, organizational forms and the division of responsibilities are different from country to country. In the following, this administrative part of food control infrastructure will not be discussed; the author will concentrate on problems connected with inspection. From an organizational point of view, different food control systems have been established in individual countries, but, generally, four types of food quality control organizations exist in every country: (1) an official, national level, governmental system; (2) quality control organizations within

factories or companies, (3) private control laboratories, and (4) consumer associations. In the following, the activity of these organizations will be briefly reviewed.

2. Inspection

2.1 Historical

Sporadic standardization activities took place in ancient cultures and in the Middle Ages (see *History of Food Quality Standards*), but during the nineteenth century legislation and other means to control the composition of various foods began to appear. In 1858 a municipal service was set up in Amsterdam for the control of foodstuffs and beverages. Some years later an Act for "Preventing the Adulteration of Food and Drink" was enacted. In Eastern Europe the first municipal service for control of drinking water was set up in Budapest in 1867. Later an institute for control of foods was founded.

The actions mentioned above were the consequences of the Industrial Revolution in the nineteenth century. Changes from a mostly rural to a more urbanized society, and from a domestic to a factory production system, with a concentration of population, resulted in new problems concerning food production and distribution. An important change brought about by the Industrial Revolution was that many people who became town dwellers could no longer produce their own food and began to rely exclusively on food produced and sold by others. The food shortage, and the great demand for food in these urban areas, created fertile ground on which adulteration could, and did, flourish.

Despite positive progress with the production of laws following this period, suitable backup services, so essential for effective control, failed to keep pace. Nevertheless the laws appearing in this period, being primarily directed toward the prevention of fraud, had some success despite difficulties in proving adulterations. The English Act of 1860, which was voluntary, was replaced by a new Act in 1875 that was mandatory and placed absolute liability on the food traders covered by the Act. Germany, in addition to creating the Food Act of 1879, created Food Inspection Bureaus, the first of which was established in 1884. In many of the laws, provision was made for the appointment of analytical chemists "to determine with accuracy, the extent of adulteration." This was another important advance in the continuing war against adulteration.

During this time, similar types of laws appeared in Belgium, Italy, Austria, Hungary, the Scandinavian countries, and in America. This was also a period of the foundation of institutions serving food inspection and food quality control. To give an idea of the volume of activity of such institutions even in that earlier period, it is informative to note a report of the Food and Drug Inspection Department of the State Board of Health of Massachusetts. It stated that more than 176 000 food samples were controlled, and that more than 11 000 were found to be adulterated, between 1882 (when a food inspection law was passed) and 1907. A major issue of the times was the recognition of the need and value of the food analyst. With the food law and a public analyst, the two main requirements in any food control service had become available. As a result of further progress, the third requirement, a system of inspection and sampling procedures, was also developed.

2.2 Food Inspection by Government

2.2.1 Organizations

The governmental organizations responsible for food supervision have many objectives. They protect the public health; prevent fraud and adulteration; promote local, interstate, and foreign trade; assist in assuring the protection of the environment; and so on. Concerning the organizations included in food inspection, there are big differences among countries, depending on the traditions, dimensions, population, and so on, of individual countries. Several specialists are of the opinion that a unified administration at a national level can operate most efficiently and economically. It can better carry out programs for education, development, and improved control.

Naturally, many day-to-day operations should be conducted at the local (county, municipality, city) level because local government bodies know the local situation better, have closer contact with local manufacturers, traders, and consumers, and play an important role in enforcement. The main objective is the periodic inspection of all producers of food for sale or barter, to ensure that foods are safe and wholesome, and that conditions in general comply with statutory requirements. In some countries a central service controls and coordinates local services. These central service organizations are responsible for the inspection of all types of foods produced in the country. As another example, in the US, federal agencies (Public Health Service, Food and Drug Administration, Department of Agriculture, Department of Commerce, Customs Service, and so on), and state agencies and municipal agencies are involved in food inspection. Food safety is the responsibility of the Food and Drug Administration (FDA) and some agencies of the US Department of Agriculture (USDA). The FDA makes decisions on the safety of food additives, enforces safe limits of pesticide residues in food, and regulates drugs and feeds that are for human-food-producing animals. The Agricultural Marketing Service (AMS) of the USDA has the responsibility for fruit and vegetable product standards. In addition, the Animal and Plant Health Inspection Service (APHIS) is responsible for maintaining phytosanitary and sanitary standards. However, to make things more complex, the Food Safety Inspection Service (FSIS) is responsible for the food safety of meat products. Most environmental standards are the field of activity of the environmental Protection Agency (EPA). Only the FDA is responsible for the enforcement of laws, and only the FDA can prevent certain manufacturing procedures or remove food from the market. The FSIS has the authority for condemnation without any regulatory authority. (The Sandwich system works like this: the FDA sets tolerance, the FSIS monitors, the FDA takes to court).

The FDA is divided into regions that are headed by regional offices. Within these regions, 22 regional district offices perform all FDA operations, including analytical activities for food supervision. These offices run the field laboratories that are responsible for FDA food control. Thus, the FDA runs about 20 laboratories. The laboratories are specialized; a given laboratory does not cover the whole variety of foodstuffs and analytical methods. For example, in the whole FDA organization, only the two field laboratories—in Denver and Baltimore—analyze samples for residues of drugs used in veterinary medicine.

In the UK governmental activity is divided between central and local government. Policy and lawmaking, and the large amount of research necessary to support these two activities, are undertaken by central government, which also undertakes some enforcement, for example, in relation to wine. The general run of law enforcement, in relation to labeling, weights and measures, hygiene, composition, additives, and contaminants, is undertaken by local government, mostly County Councils and Metropolitan Boroughs. These are defined in the Food Safety Act of 1990 as Food Authorities, and each one is obliged by the Act to appoint a public analyst. The scientific support for enforcement is provided by about 100 public analysts in 40 laboratories. In each laboratory there are teams of analytical chemists and other scientists, notably microbiologists. The total number employed in this service is about 1500 people to 2000 people.

Danish food control is the responsibility of three ministries. The Ministry of Health takes care of the general administration of food legislation. The most important general law is the Danish Food Act. The Ministry of Agriculture and the Ministry of Fisheries are responsible for special laws for fish, milk, and meat. According to the Danish Food Act, all manufacturers of food or food additives must be authorized before they start any production of food. The Danish Veterinary Service can give authorization to manufacturers of food. The National Food Agency handles the authorization of manufacturers of food additives. General food control is placed decentrally with 275 municipalities. The municipalities cooperate on the administration of 38 municipal environment and food control units.

The National Food Agency works with such subjects as food additives, material and articles in contact with food, chemical contamination of food, toxicological evaluation, dietary supplements, and human dietetics.

2.2.2 Staff and its Responsibility

For an effective food control system that protects consumers from injury to health and from deception, specialists from different scientific branches are required, including specialists in food chemistry, food technology, nutrition sciences, microbiology, and food law. These requirements are connected with the guidelines of the European Community (EC) for the accomplishment of official food control, which consists of:

- inspection,
- sampling and analysis,
- inspection of staff hygiene,
- examination of written and documentary material,
- examination of any verification systems set up by the undertaking, and of results obtained.

Because the super expert does not exist, a tight, confident, and equally entitled cooperation of experts of the different branches is essential for effective control. Thereby a principle generally applied is that, for the individual fields of food control, the expert with the greatest experience in a respective field is used. It is recommended to concentrate, when possible, administration, inspection, and sampling in one integrated institution.

An effective food control infrastructure must provide for sampling and inspecting the premises where they are prepared, packed, stored, or held for sale. The inspector occupies a key position in the food control system. He is the eyes and ears of his agency, and must be able to recognize, collect, and transmit evidence when a violation has occurred. He collects the samples for routine or special analysis. He cooperates with other food officers at the local level. To give an idea about the complexity of the work of FDA inspection, a part of the "Food Plant Inspection Checklist" is cited as follows:

- Raw materials
  - Receiving, handling, and storage
  - Decomposition, parasites, filth such as rat hair, ants, metals, and stones
  - Sampling for pesticides; bacterial, food, and color additives; and other analyses
- Plant construction and design
  - General conditions in relation to type of food processing
  - Floors, ceilings, walls, doors, windows, ease of cleaning and maintenance
  - Different operations partitioned to avoid cross-contamination
  - Location of lighting
  - Location for washing equipment and utensils
  - Ventilation to prevent airborne contamination
  - Mechanical exclusion of dogs, cats, birds, insects, rodents, vermin, by means such as windows, doors, pipings, and other outside connections
- Personnel
  - Rules about health problems such as colds, wounds, and boils
  - Appearance and cleanliness
  - Special clothing gear, such as hairnets and gloves
  - Rules about hand washing and sanitizing
- The controls and processing of food
  - Raw materials: type, condition, handling, storage, containers
  - Processing equipment and their ease of cleaning
  - Legal use of food and color additives
  - Packaging and analysis procedures
  - Product coding and recordkeeping
- Methods to avoid contamination of food by biological, chemical, and foreign particles, and deterioration of food
- Controls and operations, such as temperature, pressure, humidity, flow rate, time, freezing, sterilization, dehydration, and refrigeration

When making a decision as to which factory to inspect, the type of food produced, the area of product distribution, and the activity of other government bodies are taken into consideration. Some plants have a history of high quality products from good quality control. They are self-regulatory. Some factories are known to pay little attention to quality control. These are the ones most frequently inspected.

Keeping in mind the complex duties of food inspectors, it is understandable that high level education and training is needed for such specialists. For their practical activities as inspectors, they especially require knowledge in the fields of administrative law, penal law, food law, trade regulations, trade standards, price regulations, gauge regulations, knowledge of the food market, and food and factory hygiene.

Sampling and the analysis of samples is one important aspect of food control not only as a tool in the evaluation of the quality and safety of food sold to consumers, but also as a source of additional, useful information for a country's food and nutrition policies. These data, together with data from different surveys and monitoring programs, may give information about the common concerns of the population with residues and contaminants ingested with food, or about nutrition in general—the composition and quality of available and consumed foods. Because of this, some experts are of the opinion that it is not useful to investigate only one parameter of the samples taken, but that a number of aspects should be considered. These aspects include sensory value; the quality with reference to the content of nutrients, vitamins, and trace elements; the microbial state; the use of additives; the amount of residues of pesticides and veterinary drugs; environmental contaminants that attach to foodstuffs via water, soil and air; the interaction between food and its packaging; and finally, aspects of labeling, marking, and generic names.

2.2.3 Analytical Services

Adequate laboratory facilities staffed with analytical chemists, microbiologists, technicians, and support personnel are essential to an efficient food control service. Frequently, violations suspected by an inspector can be verified only through laboratory examination of food samples. As a consequence of growing requirements concerning food quality and food safety, the number of parameters to be controlled in the laboratory is growing dramatically. To give an idea about the difficulties and complexity of chemical control, it may be mentioned that several hundred additives are permitted for use in food production. Because of the huge number of possible substances in a food product, and because of the fact that, generally, every possible substance needs a different test method, it is usually practical to test for what is presumed to be in the product. This means that the product is unlikely to be tested for unsuspected, possibly unpermitted substances or contaminants not yet encountered in practice. Some years ago a wine contaminated with antifreeze was tested and passed by public analysts. To understand how that was possible, it should be known that EEC wine manufacturers are permitted to use up to twenty different chemicals in wine processing. Because of the huge number of possible substances, the wine was tested only for potentially occurring ones. Antifreeze, not an expected additive, was not tested for. A more recent example was the contamination of chicken meat with dioxins. In this case also, no one in the control laboratories expected that such a contaminant would be added (whether intentionally or not) to chicken meat feed and thus transmitted to chicken products.

Another problem in food testing is that many tests are totally destructive to the product itself. Thus the investigated unit cannot be sold. This means that the number of samples is limited. By the use of statistically controlled sampling plans, the possibility of passing unsatisfactory food units is minimized.

In every case, the institutes for chemical analysis require highly skilled technical equipment, if warranted, so that all analytical problems that occur, including unexpected ones, will be solved. The mutual recognition of examination results, which is a prerequisite of free trade in country members of free markets such as the EEC, assumes that they were obtained by methods that give comparable results. This applies only to

official methods of analysis, by standardization of test methods at the international level (see *International System of Food Quality Standards*, and *Basic Principles of Food Standards*). These are methods that were tested in ring tests and are usable by anyone in a standardized way. The analytical service may develop a laboratory procedure manual. This contains specific directions on how samples are to be handled to ensure their identity and integrity, and other procedures to be followed in the laboratory. When methods of analysis are not specified elsewhere, the methods are included in the manual.

A laboratory for food analysis with high capacity generally establishes a laboratory information and management system. It is recommended that this system perform, among other related tasks, sample planning, registration of samples, control of the lapse in analysis, control of autosamplers and analytical devices, storage of raw data, calculation and storage of the analytical results, quality control according to good laboratory practice (GLP), and transmission of results to data banks.
High-level food control also needs a system for controlling the laboratories analyzing foods. Such a system ensures the possibility of assessing both the competence of the laboratory and the quality of the analytical results of all methods of analysis used in the laboratory.

2.3 Inspection by Food Manufacturers

According to the views of many specialists such as the FDA, the manufacturer has the prime responsibility for assuring the safety of its products. Similar views are expressed in the directives of the EEC. The fact that the responsibility for product manufacture has been shifted back to the place of production has resulted in a need for new strategies in food control. As a consequence, a shift from classical product control to strategic quality management at all levels of the production chain, from field to table, may be observed. New concepts have been established such as controlled farming, integrated pest management, hazard analysis and critical control points system, good manufacturing practice, and integrated quality assurance. These terms are already pointing toward a new philosophy in the field of food production. The characteristics of a product are now being predetermined via an integrated system of preventive measures rather than via random checks.

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Biographical Sketch

Dr. Pál J. Molnár is Scientific Advisor and Director of the Food Quality Center in the Central Food Research Institute in Budapest. He studied Food Technology and Biochemistry at Humboldt University of Berlin 1962–1966. He received his Ph.D. from the same University in 1972, and his D.Sc. from the Hungarian Academy of Sciences in 1996. His main activities are related to food quality, sensory analysis of food, and several fields of food quality management, including food standardization and product development. He is President of the Hungarian National Committee of the European Organization for Quality (EOQ) and co-chairman of the Codex Alimentarius Commission on Methods of Analysis and Sampling (CCMAS), and has several other national and international positions. He is Editor of the Hungarian scientific periodical *Élelmiszervizsgálati Közlemények* (Food Investigations).

Dr. Molnár has published three scientific books and more than 300 papers in Hungarian and international periodicals. In addition, he has edited more than ten conference proceedings in the field of quality development.

He has been awarded several Hungarian and German recognitions.