

Sanitation and Safety in Food Services

Dr. Anju Singh

Associate Professor. H.O.D. P.G. Dept. Of Home Science -Food Nutrition, T.M.B. University, Bhagalpur, Bihar, India

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ABSTRACT

The food safety issue faces increasing attention around the world, as it is established interdependence between food that is consumed and health. Regarding that today's trades and transportation of food have an international character, a question of food safety has become a common problem in both developed and developing countries. Governments of many countries have established new institutions, standards and methods for regulation of food safety and, also, increase investment in the control of potential hazards.

The biggest challenge in the food industry right now is the effort to: a) reduce economic losses caused by food spoilage, b) reduce the price of the food production process, c) reduce the possibility of pathogen transfer, and d) satisfy the growing consumer need for ready-to-use food that tastes fresh, has a high nutritional and vitamin value, and has been minimally processed and treated with preservatives. In this endeavor sanitation procedures play a key role. We can say that the definition of "food sanitation" is "protection from contamination". When designing a food hygiene and sanitation program, a total supply chain approach is crucial. The major areas to cover are: equipment, environment, air and water. A key thing to note about these areas is that they function not as a static entity, but as a constantly evolving system. Sanitation is a dynamic and ongoing function and cannot be sporadic or something that can be turned on once a day, once a week, etc. Therefore, another definition could be: "sanitation is a way of life". The procedures and methods of implementation of sanitation in the food industry are described in many documents of the Codex Alimentarius Commission, the Food and Agriculture Organization, World Health Organization, the Food and Drug Administration and European Union, as well as numerous professional literature. However, it is very important to know that sanitary procedures must be adapted to each specific technology and each concrete product. Sanitation programs, good manufacturing practices and fulfillment of hygienic conditions in work environment and processes, are considered necessary preconditions for the production of safe food. These programs are a prerequisite and basis for the HACCP and are essential components in the system of ensuring food safety in every company.

1. Introduction

Aside the fact that food safety has big attention around the world, but it is the system which established interdependence between food that is consumed and health. Having in mind that modern food trade and transportation have an international character, food safety question has become a common problem in both developed and developing countries. New institutions, standards and methods for regulation of food safety are established by many Governments around the world and, there is an increase in investments in the potential hazards control.

Biggest challenge in the food industry in this moment are efforts to: a) reduce economic losses caused by food spoilage, b) reduce the price of the food production process, c) reduce the possibility of pathogen transfer, and d) satisfy the growing consumer need for ready-to-use food that tastes fresh, has a high nutritional and vitamin value, and has been minimally processed and treated with preservatives. Key role in this endeavor are playing sanitation procedures. We can say that the definition of "food sanitation" is "protection from contamination". When designing a food hygiene and sanitation program, a total supply chain approach is crucial.

2. Food safety and food sanitation

How to secure sufficient supplies of safe food?

At the beginning of the new millennium, when science has received great recognition, having paved the way for increasingly effective technologies, along with the rising labor productivity, when conditions have been created for human creative power to be fully employed in order to enrich both the spiritual and material life, the contemporary man is experiencing all symptoms of diseases of civilization as both an inheritance and an extension, and is not optimistic about his future, but rather has many moral dilemmas and even fear for survival on the planet.

One of the most serious existential problems not only in underdeveloped countries but also on the global level is to secure sufficient supplies of safe food (Baras *et al.*, [1]). The United Nations (UN) 2002 official data show that about one-fourth of the human population in developing countries are facing serious problems related to food and water shortages. Moreover, interdependence of the food consumed and human health has been observed. As reported by the World Health Organization (WHO), more than one-third of the global population are currently suffering from health issues due

to biologically contaminated food and water, whereas cases of chemical contamination of food have been on the rise. Consequently, there has been an increase in the number of cases of diseases with fatal consequences. According to the same data, more than 100 million children die annually due to consumption of contaminated water. Also, analyses suggest that at least 150 million people in the future will suffer from hunger due to sudden food price increases, which might lead to serious social turmoil worldwide. Therefore, two basic questions arise and demand answers:

How to secure sufficient supplies of food and How to ensure food safety (Vesković and Đukić, [2])?

The food security problem was first seriously manifested as early as the 1960s at the time of increasing demographic expansion. To increase food production, the so-called "Green Revolution" was initiated in the agrarian complex of underdeveloped countries, while at the same time it had already taken hold in developed countries. Its main characteristic is the use of modern cultural practices to increase soil productivity. These practices (the production of high-yielding cultivars exhibiting increased resistance to unfavorable environmental factors, use of mineral, organic and microbiological fertilizers and chemical plant protection agents) increased crop yield, but decreased the nutritional value of food due to micro- and oligo nutrient deficiency in the soil). This deficiency was transferred to agricultural and animal products, thus leading to a considerable reduction in the nutritional quality of food products when compared to foods produced by conventional farming methods. These food products caused a new disease called "hidden hunger", which was common in both underdeveloped and developed regions of the world. Although not producing hunger, it led to increase of illnesses due to the inadequate nutritional value and reduced micro nutrient content of foods consumed. The deficiency of micronutrients (micro- and oligo elements) in foods is attributable to the overuse of mineral fertilizers which, as a rule, contain no micronutrients; moreover, due to the presence of toxic elements and radionuclides, poor quality fertilizers cause pollution and super mineralization of the soil, thus reducing its biological productivity (Baras *et al.*, [1]). Soil biological productivity is also significantly reduced by uncontrolled use of mineral fertilizers, pesticides, polluted waste waters, heavy agricultural machinery, exhausts, fuels, lubricants, acid rain, etc. (Đukić *et al.*, [3]). Obviously, the Green Revolution has transferred the food security problem to the food nutritional value issue, with soil pollution emphasizing the problem.

Food manufacturers have always been expected to process raw ingredients in a way to ensure that the food produced is:

- Safe and functional,
- Of high nutritional quality,
- Physiologically utilizable (digestible and absorbable),
- Of acceptable sensory quality and
- Commercially acceptable to producers and consumers.

All these expectations are still imperative to the food industry, in addition to new inevitable demands such as to reduce processing level in order to preserve the nutritional and functional value of food products, to reduce production costs

i.e. reduce the market price of products, to preserve and improve the nutritional and functional value of foods using solely natural supplements, to reduce environmental impact in the food production and utilization chain (Baras *et al.*, [1]).

3. Food spoilage - economic and health concerns

The food safety issue is receiving increasing attention worldwide, given the interdependence of the food consumed and health. Improving food safety is an essential element of improving health in situations when sufficient amounts of safe food are secured and when quality parameters are defined (Memiši *et al.*, [4]).

In view of the international character of today's food trade and transportation, food safety has become a shared concern among both developed and developing countries. Governments in many countries have established new food safety institutions, standards and methods, and have increased investments in the

control of potential hazards. To ensure food safety and proper quality, an efficient control of the food chain (production, transportation, distribution and storage in retail stores and home refrigerators) is of crucial importance. In other words, the food production chain must provide adequate evidence on the traceability of all inputs and production processes to the ultimate consumer (Vesković Moračanin *et al.*, [5]).

The farm-to-table principle in Italy, farm-to-fork in England and producer-to-consumer in Germany are synonyms underlying the new integrated food safety system in the European Union (Memiši *et al.*, [4]). This principle indicates that food safety begins at the primary production level, starting from production both on agricultural land and in the stable, and ends with food consumption by the ultimate consumer. The system determines the responsibility of all participants in the entire integrated food production, processing and distribution chain (Vesković Moračanin *et al.*, [5]).

Food spoilage is a process or a series of changes that make a food product undesirable or unacceptable for human consumption; it is the result of the biochemical activity of microorganisms present in the food and/or chemical processes occurring in the food, whose dominance is dependent on prevailing ecological determinants. Unsafe food contains hazardous agents or contaminants that can cause illness in people or increase their risk of chronic disease. Such contaminants can enter food in many different ways in the food production process, as the result of poor or inadequate production and hygiene practices. Hazardous agents that lead to unsafe food generally include microbial pathogens, parasites, mycotoxins, veterinary drug residues, and pesticide residues. In the last several decades, modern livestock production and veterinary practices have rested on the use of veterinary drugs. Immense advances in chemical synthesis and pharmacological research have led to the production of many pharmacologically active substances, which are used as veterinary drugs in the course of everyday veterinary practice. Along with good livestock practices and animal welfare, these substances have been legally approved for use and are responsible for preserving and/or improving the health and production characteristics of animals. However, uncontrolled use of veterinary drugs has side effects on consumer health (Vesković *et al.*, [6]).

All countries are facing similar problems regarding food safety. The relative importance of different risks varies with sanitation status of the soil (Đukić *et al.*, [7]), climate (Đukić *et al.*, [8]), diets, income levels i.e. state revenue, and public infrastructure. In general, the most common food safety risks and, hence, human health risks are greater in developing countries due to poor sanitation and inadequate drinking water quality than in developed countries. Modern technologies implemented in food processing and microbiological food safety standards have diminished, but not wholly eliminated, the likelihood of food-related illness and food spoilage in industrialized countries. The increasing consumption of fresh, thermally untreated or minimally treated foods and the importation of raw foods from developing countries are among the main causes of this situation. Despite the use of modern production technologies, good manufacturing practices, quality control and food safety systems, such as risk assessment concepts and HACCP, the registered number of episodes of food-borne diseases and alimentary toxin-infections have increased over the last decade.

The WHO estimates that about 70 percent of the approximately 1.5 billion cases of diarrhea have been caused by biologically contaminated food. The data show that, in

Europe, morbidity from food poisoning is second only to respiratory diseases, with estimates of 50,000 - 300,000 cases of acute gastroenteritis per million population every year (Luchansky, [9]). This trend was also presented in the 7th report (1993 - 1998) of the Food and Veterinary Office (FVO) for Europe, which has documented 5,517 episodes of food poisoning in Spain, with 69,553 people affected and 6,820 hospitalized (Schmidt and Tirado, [10]).

According to reports of the European Food Safety Authority for 2009 year (EFSA, [11]), food-related infections in the European Union are mostly caused by *Campylobacter*, *Salmonella*, *Listeria* and viruses. The EFSA estimates that over 380 thousand cases of diseases in the EU have been caused by these pathogens each year (EFSA, [12]), but the actual number is probably much higher (EFSA, 2012 [13]).

In the USA, acute gastroenteritis affects 250 to 350 million people annually, and more than 500 people die. An estimated 22% to 30% of these cases are thought to be caused by foods (including meat, poultry, eggs, seafood and dairy products) contaminated by pathogens (Mead *et al.*, [14]).

Figure 1 presents potential pathways of microbial pathogen contamination of animals, people and animal products.

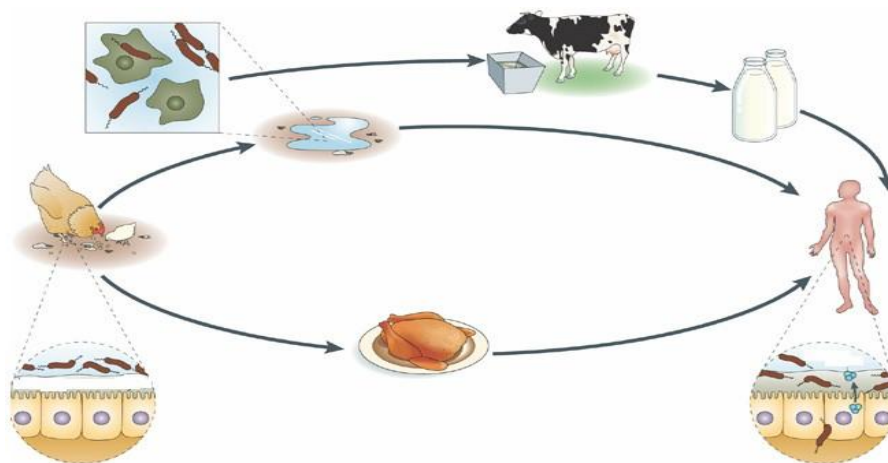


Figure 1. Pathways of microbial pathogen contamination of animals, people and animal products

Safe food is produced by adhering to Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), Good Laboratory Practice (GLP), Good Agricultural Practices (GAP) etc. and by implementing food safety risk management systems such as Hazard Analysis Critical Control Points (HACCP), but the level of safety that these food safety systems are expected to deliver has seldom been defined in quantitative terms.

Taking the new approach adopted by international organizations i.e. the FAO, WHO, Office International des Epizooties (OIE), and the International Organization for Standardization (ISO), and relying on the starting points

Codex Alimentarius and EU food, veterinary and phytol sanitary regulations, the integrated food safety system provides a basis, involving quality management principles and the HACCP system. Generally, prior to implementing HACCP in any sector of the food production chain, the sector in question should operate in accordance with the food hygiene principles laid out in the Codex Alimentarius, the related GMP codex and related food safety regulations (Commission EU, [15]).

In summary, the requirements for the modern food industry are based on the effort to: a) reduce economic losses caused by food spoilage, b) reduce the cost of the food production process, c) reduce the risk of pathogen transfer, and d) satisfy the growing consumer need for ready-to-use food that tastes fresh, has a high nutritional and vitamin value, and has been minimally processed and treated with preservatives.

4. Food sanitation - what is it?

Food sanitation is the practice of following certain rules and procedures to prevent the food contamination, keeping it safe to eat. Many jurisdictions around the world have specific food sanitation laws, along with lists of regulations created by public health agencies. The practice of food sanitation is recommended at every step of the supply chain within the food industry, from workers in crop fields to waiters at restaurants. The term "food sanitation" typically refers to rules and procedures within the food industry, whether during production, packaging, transporting or serving. At the

consumer level, such as in a home kitchen, practices designed to ensure that food is uncontaminated and safe to eat are often referred to using the term “food hygiene”.

Also, another definition of “food sanitation is “protection from contamination “. When designing a food hygiene and sanitation program, the total supply chain approach is crucial. The major areas to cover are: equipment, environment, air and water. A key thing to note about these areas is that they function not as a static entity, but as a constantly evolving system. Sanitation is a dynamic and ongoing function and cannot be sporadic or something that can be turned on once a day, once a week, etc. Therefore, another definition could be that “sanitation is a way of life “.

On the one hand, sanitation is a direct application of science towards the production of safe food which is: treated, prepared, displayed and sold in a clean hygienic environment by healthy food workers; on the other hand, sanitation includes operations intended to prevent food contamination via microorganisms that cause food-borne diseases, and any practices designed to retard the growth of food spoilage microorganisms. In other words, effective and efficient sanitation practices include all measures conducive to these goals (Škrinjar and Tešanović, [16], Memiši *et al.*, [4]).

Sanitation practices include a set of hygienic operations that contribute to a clean healthy environment for food production, processing and storage purposes, as well as to improving the quality and hygienic conditions in commercial stores, public facilities and private homes. Furthermore, sanitation practices can affect waste disposal, thus reducing pollution and establishing an environmental equilibrium. Therefore, when used efficiently, sanitation practices are beneficial to the entire environment.

Proper implementation of sanitation practices as a tool for reaching desired results requires knowledge of potential risks (biological, chemical and physical risks), methods for their control, and fundamentals of food microbiology, with particular reference to microorganisms that may adversely affect human health. Identification, assessment and control of these risks, along with efficient implementation of sanitation procedures are ways to ensure food safety (Marriott and Gravani, [17]).

Food hygiene is essential to both Good Manufacturing/Agricultural Practices and to the development of Hazard Analysis Critical Control Point, and is part of all benchmarked food safety standards. Government, industry and consumers play a role in safe sanitation and food hygiene practices. Studies have shown that an appreciable percentage of food-borne illness cases can be attributed to poor sanitation and food hygiene, including poor personal hygiene and contamination of equipment and/or environments.

According to the Codex Alimentarius Commission [18], food hygiene should cover all of these elements throughout the supply chain:

- Primary production (environmental hygiene, hygienic production, handling storage & transport, cleaning, maintenance and personnel hygiene).
- Establishment - design and facilities (location, premises and rooms, equipment, facilities).
- Control of operation (food hazards, hygiene control systems, incoming materials, packaging, water,

management & supervision, documentation & records, recall procedures).

- Establishment - maintenance and sanitation (maintenance & cleaning, cleaning programs, pest control systems, waste management, monitoring effectiveness).
- Establishment - personal hygiene (health status, illness and injuries, personal cleanliness, personal behavior, visitors).
- Transportation (general, requirements, use & maintenance).
- Product information and consumer awareness (lot identification, product information, food labeling, consumer education), and
- Training (awareness & responsibilities, training programs, instruction & supervision, refresher training).

Sources of contamination in the food industry and the necessity to implement sanitation practices

Due to their chemical composition, meat, milk and their products are susceptible to (microbial and physicochemical) degradation processes which may lead to changes in quality parameters as well as in safety risks. Other food products are also susceptible to degradation. As soon as the fruits are harvested, animals slaughtered or fish caught, a race against time begins. This is when degradation and spoilage processes start to pose a threat to the quality and stability of food products. At the same time, environment-related factors such as production hygiene and temperature pose a danger to food safety. Therefore, importance is given to ways food is being handled during the production, packaging or storage in the cold chain (Milijašević *et al.*, [19]). In other words, there are many different routes of food contamination along the food chain from production to consumption. Food can be contaminated at any point, at the production site (farm, crop field, sea), at the processing facility, during transportation, as well as in retail and wholesale stores and by consumers in their homes. Certain production lines, equipment, utensils, work surfaces and packaging in the food industry are often open or semi-open systems that are susceptible to contamination by microorganisms from the environment.

Given the wide range of processing technologies and food products, and increasing production volumes as part of the modern development of the food industry, ensuring appropriate timely implementation of sanitary practices is an essential factor in safe food production. It is in customers' interest to consume perfectly safe food products, while it is in producers' interest to achieve the longest possible shelf life of a product. To this end, maximum attention should be given to hygiene during the production process (Turubatović *et al.*, [20]).

Considering the presence of not only saprophytes but also microbial pathogens in micro populations of production lines and work environments in the food industry, it is necessary to continuously maintain a

high level of hygiene in the production plant, using appropriate cleaning and disinfection procedures (Mercade-Prieto *et al.*, [21]). Cleaning and disinfection should be taken as a joint operation of the hygiene package (Wilson, [22]). Appropriate cleaning procedure can remove 99.99% microorganisms, in addition to removing impurities, whereas

appropriate disinfection which comes afterwards can reduce microbial counts up to 99.999% (Marriott, [23]). As opposed to disinfection, sterilization involves a 100% reduction in microbial counts, but it is too specific to be often used in the food industry. Namely, applying sterilization to most surfaces of food production equipment and devices is technically infeasible, and its cost-effectiveness is questioned. Very high hygiene requirements often demand separation of the cleaning and disinfection steps. Most disinfectants can be inhibited by residues of products, proteins in particular, their efficiency thus becoming reduced (Christian and Fryer, [24]). In addition, microorganisms found underneath impurities or covered with a protective coating of impurities are not accessible to the disinfectant. It is only under certain circumstances that cleaning combined with disinfection - involving, for instance, a small amount of impurities on surfaces, a single use of a cleaning solution, good pre-rinsing etc. - can lead to satisfactory hygiene effects in a single step (Marriott, [23]).

Accordingly, sanitation as an applied science involves principles related to planning, development, implementation, maintenance, introduction or improvement of hygiene practices designed to ensure proper environmental conditions for food production. Moreover, sanitation is considered an applied science for its importance in protecting human health and its relationships with environmental factors that affect health (Obradović, [25]). In other words, sanitation is intended to control biological, chemical and physical hazards in the food production environment. Planning principles, in terms of hygiene, include a clear separation of zones in the production plant, personnel and material flow control to reduce hazards, prevention of water accumulation in the production plant, temperature and humidity control, air flow and quality control, location of the facility, outward appearance of the building, internal space chart, civil engineering structure, equipment and tools, and sanitation itself in accordance with the characteristics of the facility. These principles are also essential for establishing HACCP and are a vital component of the food safety system (Obradović, [25]). The sanitation program to be implemented must comply with regulations to protect the reputation of both the brand and the product, protect the safety and quality of the product, and prevent contamination. All stages of the food production and sanitation process at the production plant should be covered by the sanitation program to complement the equipment cleaning and sanitation procedure.

In most European countries, requirements for hygiene standards in the food production have become increasingly stringent (Wilson, [26]). However, despite the increasingly

strict hygiene standards, many cases of intoxication have been reported. This has led to health problems and, often, consequential human fatalities, as well as to high economic losses. For instance, in the USA, where the hygiene standards for food production are the strictest, 12.6 million cases of food intoxication have been registered annually, with an economic loss of 8.4 billion dollars. Therefore, cleaning and disinfection cannot be considered a luxury any more, but rather as a matter of necessity and obligation (Memiši *et al.*, [4]).

Management must also strive for continuous facility and equipment improvements. This initiative usually demonstrates commitment to sanitation conditions and food safety within the plant. Sanitation programs have a cost that can be impacted by the design and construction of the plant and equipment. Cleaning costs are recurring, and if the equipment is difficult to clean, it may take additional man-hours to even be effective. Still, sometimes the outcome is less than what it should be, resulting in costly product recalls and damage to the brand name (Prince, [27]).

5. Conclusions

Food sanitation is a basic, yet essential, element in all food manufacturing operations. There are several facets to an effective sanitation program for maintaining a clean food production facility that is evident to all workers or visitors. It is far more complex than investing in a broom and a mop bucket.

An effective sanitation program is part of the food-safety culture that involves all employees working together to achieve customer expectations. The employee sanitation culture begins in the parking lot and continues through the entrance and into the plant. The appearance of the entrance and locker rooms establish a mindset with each employee of the sanitation level management expects within that operation.

A bright, well-lit entrance and a locker room that is clean and neat certainly extend a positive message to employees as they start their day. Sometimes, it is amazing how even a fresh coat of paint can send a message that management cares about the facility and its employees. Employees with positive attitudes are part of the equation to achieving successful results for an operation.

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