CHAPTER 24

FOOD QUALITY AND FOOD SAFETY

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Outline

• The origins and transmission of foodborne diseases
• The role of pesticides in foodborne illness
• The impact of foodborne diseases
• Safety guidelines for household food preparation
• Concerns surrounding global food safety, including street-vended foods and genetically modified crops
• FAO and WHO strategies to promote global food safety
• Food safety in developing countries

Objectives

At the completion of this chapter you should be able to:

• Summarize the Food Safety and Consumer Protection guideline of the Food and Agriculture Organization of the United Nations (FAO)
• Explain what is meant by the term foodborne diseases
• Describe the various types of foodborne illnesses and how they can be prevented
• Describe the causes and extent of foodborne illnesses
• Describe the most important ways to keep food safe and clean in a household
• Explain what safety concerns surround street-vended foods
• Summarize the FAO and World Health Organization (WHO) strategies to promote food safety
• Explain the Hazard Analysis Critical Control Points (HACCP) System
• Describe what actions are being taken in developing countries to deal with the problem of food safety.
1. INTRODUCTION

According to the Food and Agriculture Organization of the United Nations (FAO), food quality is “a complex characteristic of food that determines its value or acceptability to consumers” (FAO, undated). A food’s nutritional value contributes to its perceived quality, as do its organoleptic and functional properties. Another element of quality is a food’s safety. A safe food is one that is free of any substances that might compromise a person’s health (FAO, undated). In ancient times, the chain of responsibility for food safety was very short: it essentially consisted of hunter-gatherers and their families. As societies grew larger and more complex, however, and as trade networks expanded and food began to be shipped long distances, the responsibility for food safety became more diffuse (Gorris, 2005).

Today, food safety is a global concern. With the rapid growth in international trade of food products, consumers in many countries are exposed to a greater variety of food products. At the same time, such trade can introduce new or unfamiliar food safety risks, and the chain of responsibility has become longer and more complex. In order to keep pace with the lengthening food supply chain, food safety management systems continuously need to be improved, so as to ensure that people are provided with safe food products (Gorris, 2005; Unnevehr & Huirne, 2002). Examples of food safety management systems include the Hazard Analysis Critical Control Points (HACCP), Good Manufacturing Practice (GMP) and Hood Hygiene Practice (GHP). Such systems have been implemented in various countries in recent years (Gorris, 2005; Nguz, 2007). Despite all these measures, foodborne diseases are still widespread and an increasing public health problem, in all countries (WHO, 2008b).

Foodborne diseases most commonly produce gastro-intestinal symptoms, but such diseases can also cause neurological, gynaecological, immunological, and other symptoms and can result in multi-organ failure and even cancer. Foodborne diseases thus carry a significant disability, morbidity, and mortality burden (WHO, 2008b).

Following the 1996 World Food Summit (which is convened by the FAO), an intergovernmental working group was established to develop a set of voluntary guidelines to support the efforts of governments in order “to achieve the progressive realization of the right to adequate food in the context of national food security.” The FAO adopted these guidelines in 2004. Although the guidelines are voluntary, they provide an additional instrument in the fight against hunger and poverty and thus help to accelerate the attainment of the Millennium Development Goals (FAO, 2005a; FAO, 2005b). Guideline no. 9 (see Box 24.1) encourages the world’s nations to establish government controls designed to ensure food safety and to protect consumers.

Box 24.1: FAO Guideline No. 9: Food Safety and Consumer Protection

| 9.1 | States should take measures to ensure that all food, whether locally produced or imported, freely available or sold on markets, is safe and consistent with national food safety standards. |
| 9.2 | States should establish comprehensive and rational food-control systems that reduce risk of food-borne disease using risk analysis and supervisory mechanisms to ensure food safety in the entire food chain including animal feed. |
| 9.3 | States are encouraged to take action to streamline institutional procedures for food control and food safety at [a] national level and eliminate gaps and overlaps in inspection systems and in the legislative and regulatory framework for food. States are encouraged to adopt scientifically based food safety standards, including standards for additives, contaminants, residues of veterinary drugs and pesticides, and microbiological hazards, and to establish standards for the packaging, labelling, and advertising of food. These standards should take into consideration internationally accepted food standards (Codex Alimentarius) in accordance with the WTO Sanitary and Phytosanitary Agreement (SPS). States should take action to prevent contamination from industrial and other pollutants in the production, processing, storage, transport, distribution, handling, and sale of food. |
9.4. States may wish to establish a national coordinating committee for food to bring together both governmental and non-governmental actors involved in the food system and to act as liaison with the FAO/WHO Codex Alimentarius Commission. States should consider collaborating with private stakeholders in the food system, both by assisting them in exercising controls on their own production and handling practices, and by auditing those controls.

9.5. Where necessary, states should assist farmers and other primary producers to follow good agricultural practices, food processors to follow good manufacturing practices, and food handlers to follow good hygiene practices. States are encouraged to consider establishing food safety systems and supervisory mechanisms to ensure the provision of safe food to consumers.

9.6. States should ensure that education on safe practices is available for food business operators so that their activities neither lead to harmful residues in food nor cause harm to the environment. States should also take measures to educate consumers about the safe storage, handling, and utilization of food within the household. States should collect and disseminate information to the public regarding food-borne diseases and food safety matters, and should cooperate with regional and international organizations addressing food safety issues.

9.7. States should adopt measures to protect consumers from deception and misrepresentation in the packaging, labelling, advertising, and sale of food and facilitate consumers’ choice by ensuring appropriate information on marketed food, and provide recourse for any harm caused by unsafe or adulterated food, including food offered by street sellers. Such measures should not be used as unjustified barriers to trade; they should be in conformity with the WTO agreements.

9.8. Developed countries are encouraged to provide technical assistance to developing countries through advice, credits, donations, and grants for capacity building and training in food safety. When possible and appropriate, developing countries with more advanced capabilities in food safety-related areas are encouraged to lend assistance to less advanced developing countries.

9.9. States are encouraged to cooperate with all stakeholders, including regional and international consumer organizations, in addressing food safety issues, and to consider their participation in national and international fora where policies which impact on food production, processing, distribution, storage, and marketing are discussed.

Source: FAO, 2005b.

2. FOODBORNE DISEASES

Foodborne diseases are usually infectious or toxic and are caused by agents entering the body through the ingestion of food or water. All people can be at risk of foodborne diseases (WHO, 2007a).

One of the main responsibilities of any government is to ensure the safety of the food supply so as to prevent such diseases. Diarrhoeal diseases, carried by food and water, kill approximately 2.2 million people each year and are the leading causes of illness and death in less developed countries, especially in children (WHO, 2008b). The major foodborne diseases are summarized at the end of this chapter, in Appendix 1, while Appendix 2 lists the major types of food poisoning.

2.1 The Transmission of Foodborne Diseases

Figure 24.1 illustrates the manner in which foodborne diseases are transmitted. It is clear that poor hand-hygiene practices and viruses (not only bacteria) are also considered major risk factors for foodborne diseases (Rolando, 2011). In food contamination, bacteria growing on the food prior to its consumption can produce toxins that may cause illness (Payne-Palacio & Theis, 2004).
Food Quality and Food Safety

Figure 24.1: Transmission of a foodborne illness as a result of cross-contamination.
Source: Adapted from Payne-Palacio & Theis, 2004.

Food should therefore not contain any

- harmful micro-organisms (bacteria, viruses, amoebae, fungi, algae, yeasts, or gardia),
- parasites (e.g., worm eggs, larvae, or cysts),
- toxins or poisons, or
- harmful chemicals, such as pesticides.

2.2 The Role of Pesticides

The term pesticides refers to all chemicals used for killing or controlling pests. In agriculture these include herbicides (poisons to eliminate weeds), insecticides (insects), fungicides (fungi), nematocides (nematodes), and rodenticides (vertebrates). Pesticides have been widely used since the 1950s as a standard method for pest control, specifically where intensive monoculture is practised. Unfortunately, with the benefits of chemistry have also come disadvantages, some so serious that long-term survival of major ecosystems are threatened owing to the disruption of predator-prey relationships and loss of biodiversity, and there are significant human health consequences as well (FAO, 2003).

There is little doubt that pesticides create considerable health impacts all over the world, though the actual toll is difficult to determine given the wide variety of chemicals and types of exposure. Pesticides vary widely in their degree of risk, and their effects can be divided broadly into two categories: acute effects, which appear very soon after exposure; and chronic effects, which may manifest many years later and whose origins are often difficult to trace. The human health effects of pesticide contamination are mainly linked to the causation of various diseases (cancer, birth defects), endocrine disruption, neurotoxicity, and kidney and/or liver damage (Prüss-Ustün et al., 2011).

The main routes of ingestion of pesticides are by

- skin contact, through the handling of products contaminated by pesticides;
- inhalation, by breathing of pesticide dust or spray; and
- ingestion of contaminated food or water.

doi:10.15215/aupress/9781927356111.01
The global disease burden for industrial and agricultural chemicals and acute poisonings amounts to at least 1.2 million deaths per year. This contributes 2.0% of the total deaths and 1.7% of the total burden of disease globally (Prüss-Ustün et al., 2011).

2.3 The Impact of Foodborne Illness

Malnutrition and infections account for the great majority of mortality in children in developing countries. Furthermore, malnourished infants and children are more exposed to foodborne hazards and risk of diarrhoeal disease. The high prevalence of diarrhoeal disease in developing countries again underlines the importance of food safety issues (WHO, 2007a). Furthermore, severe infections, often associated with unhygienic facilities, also contribute to child mortality. Such infections in turn exacerbate malnutrition, thus resulting in a vicious circle of disease and mortality (Prüss-Ustün et al., 2011). The unacceptably high mortality and poor quality of life of children in many parts of the world constitute great challenges for the public health community, including nutritionists. The 2008 mortality rate for children aged less than 5 years was much higher in developing countries (72 per 1000 live births) than in developed countries (6 per 1000). The major causes of child mortality in developing countries remain pneumonia and diarrhoea, which are both preventable and treatable diseases (UNICEF, 2010). Diarrhoea is thus a major threat to public health. As discussed in Chapter 11, major causes of diarrhoea are the unavailability of potable water, ingestion of unsafe water, inadequate water for hygiene, lack of access to sanitation, overcrowded living conditions, consumption of contaminated foods or poor food storage, and consumption of unwashed fruit (Hénock & Dovie, 2007).

Although it is not well documented, developing countries are believed to show the biggest impact of the problem of foodborne disease, because of the presence of a wide range of foodborne diseases, including those caused by parasites (WHO, 2008b). The high prevalence of diarrhoeal diseases in many developing countries is thus an indication of major underlying food safety problems (WHO, 2007b). Globally, the coverage of safe drinking water increased from 77% in 1990 to 87% in 2008, with only 84% of the population in developing countries having access to improved water sources, compared to almost 100% in developed countries. However, in sub-Saharan Africa (SSA) only 60% of the population has access to clean, safe drinking water (UNICEF, 2010).

Amongst children aged less than 5 years, 70% of deaths are also associated with biologically contaminated food. These contaminations are more frequently caused by foodborne parasites; however, mycotoxin contaminations are more widespread.

2.4 Domestic Food Preparation

International studies have demonstrated that unsafe food-handling behaviour during domestic food preparation needs to be addressed. This is especially true in places where unsafe water is used for cleaning and processing of food, poor food-production and handling processes, and the absence of adequate food storage facilities (Prüss-Ustün et al., 2011). Furthermore, people frequently underestimate domestic food poisoning and the frequency of its serious consequences. This may prevent consumers from taking appropriate steps to reduce their exposure to food-related hazards (Redmond & Griffith, 2004). Foodborne illnesses are often undiagnosed as they may present as flu-like symptoms, and the time of onset can be days after ingestion of the offending food. In addition to the traditional foodborne diseases, new pathogens can be transferred from animals to humans, as seen in avian and swine flu outbreaks (Prüss-Ustün et al., 2011).

Table 24.1 provides tips for households on how to keep food safe and clean in order to promote food safety. When purchasing food, the danger signs indicated in Table 24.2 should be heeded as these indicate that food is contaminated by micro-organisms, dirt, or toxins.
Table 24.1: Keeping food safe and clean in the household

1. Buy fresh foods on the day of consumption when possible, or use before the expiry date (if indicated).
2. Do not buy foods with any of the danger signs shown in Table 24.2.
3. Frozen food should be thawed in a refrigerator, not put in warm water or left out to thaw.
4. Store foods at the right temperature and covered.
5. Eat meals as soon as possible after preparation.
6. Use clean covered containers for fetching water.
7. Use a safe water supply, or else boil all water before use.
8. Wash hands with soap and water before food preparation, before eating meals, and after touching animals, dirty areas, or soil or after visiting the bathroom.
10. Cook food thoroughly or to the correct internal temperature (see Table 24.3).
11. Wash all food preparation and eating utensils thoroughly with water and soap before use.
12. Wash all fruit and vegetables before peeling or eating.
13. Do not cough, spit, or touch the body during food preparation.
14. Keep rubbish bins closed at all times.
15. Keep animals away from food preparation areas.

Source: Adapted from King & Burgess, 1993.

Table 24.2: Danger signs of unsafe food

<table>
<thead>
<tr>
<th>Food type</th>
<th>Food items</th>
<th>Danger signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh foods</td>
<td>Fish, meat, dairy products, fruit and vegetables, roots</td>
<td>Bad smell, Visible signs of mould, Fish with dull eyes, loose scales, soft flesh, pale gills, Meat with a bad smell or greyish colour</td>
</tr>
<tr>
<td>Dry foods</td>
<td>Flour, grains, nuts, legumes, sugar</td>
<td>Damp, Mouldy</td>
</tr>
<tr>
<td>Oils and fats</td>
<td>Vegetable oils, butter, lard</td>
<td>Unusual taste, Rancidity</td>
</tr>
<tr>
<td>Tinned foods</td>
<td>Any</td>
<td>Swollen tin, Leaking tin, Badly dented tin, Food looks, smells, or tastes bad</td>
</tr>
</tbody>
</table>

Source: Adapted from King & Burgess, 1993.

3. ENSURING GLOBAL FOOD SAFETY

The food production chain is becoming more complex, providing greater opportunities for contamination and growth of pathogens. Many outbreaks of foodborne diseases that were once contained within a small community may now take on worldwide dimensions (WHO, 2007a). The globalization of trade in food, urbanization, changes in personal lifestyles, international travel, environmental pollution, and deliberate contamination, as well as natural and man-made disasters, all contribute to mounting concerns about food safety.

3.1 Street Vendors

Urbanization and changing lifestyles are increasing people’s demand for convenience foods prepared outside the home, such as food bought at restaurants and particularly from street vendors (Troedsson, 2009). Street-vended foods (SVFs) are thus a phenomenon of growing international concern. The term encompasses
“a wide range of ready-to-eat foods and beverages sold and sometimes prepared in public places, notably streets.” As in the case of fast foods, “the final preparation of street foods occurs when the customer orders the meal, which can be consumed where it is purchased or taken away” (Winarno & Allain, 1991). Also included in this definition are fruit and vegetables intended for immediate consumption that are sold outside authorized markets.

Although readily accessible and affordable, SVFs are often perceived to be unsafe owing to the environment in which the food is prepared and purchased. Street-vendor locations may compromise food safety as safety requirements are often not met (WHO, 2010). This may result in unprecedented incidences of severe foodborne diseases that make food safety a public health concern as well as a development issue with huge financial consequences (Troedsson, 2009). In view of the number of vendors and their often transitory nature, it is very difficult to regulate SVFs in densely-populated areas, such as major urban centres. A need exists to improve the safety of SVFs through training (WHO, 2010; Winarno & Allain, 1991). Focusing on food hygiene, training should cover the transmission of diarrhoeal pathogens, proper handling of equipment and cooked food, correct hand washing practices, and environmental hygiene (Mensah et al., 2002; Vollaard et al., 2004; WHO, 2010). Attention should also be given to the provision of basic water and waste management, as well as financial assistance through social services affiliations (Azanza et al., 2000). Furthermore, it is recommended that management strategies be implemented with regard to regular visits from health inspectors, and local authorities should also be encouraged to provide the necessary infrastructure to improve the safety of SVFs (Winarno & Allain, 1991).

3.2 Biotechnology and Food

Biotechnology has become a major public issue in most countries. The safety of food derived using biotechnology should be carefully considered. In order to provide a scientific basis for decisions regarding human health, there is a need for new methods and policies for such foods to be developed and agreed upon internationally. Health benefits, as well as possible negative health implications, should be included in any assessment. However, clear communication of the basis for safety assessment in this area is often lacking at both the national and international level.

Proper monitoring and assessment are essential as changes in animal husbandry practices, including feeding, may have serious implications for food safety. Likewise, the addition of low levels of antibiotics to animal feed, resulting in an increased growth rate, has raised concern about the possibility that human pathogens may become resistant to these antibiotics (WHO, 2007a).

Furthermore, modern intensive agricultural practices that contribute to increasing the availability of affordable food items, as well as the use of food additives, can improve the quality, quantity, and safety of the food supply, but appropriate controls are necessary to ensure their correct and safe use along the entire food chain. Pre-market review and approval followed by continuous monitoring are necessary to ensure the safe use of pesticides, veterinary drugs, and food additives/residues (WHO, 2007a).

An aspect of biotechnology of particular importance is the development of genetically modified organisms (GMOs), which are organisms whose genetic makeup has been changed by the insertion or removal of new genetic material in order to create or enhance desirable characteristics. This topic is discussed in more detail in chapter 27. The weighing of potential risks and benefits is an important aspect of assessment of foods made from GMOs.

3.3 FAO Strategies to Promote International Food Safety

The FAO stresses the importance of adequate food control programmes in all countries to ensure that the populations of the world are food secure in terms of quality, quantity, safety, and affordability. This is essential in order to promote public health. For this reason the Codex Alimentarius General Principles of Food Hygiene was implemented by the Codex Alimentarius Commission in 1995 to provide a firm foundation for food hygiene and to highlight the key control points at each stage in the food chain (Codex Alimentarius, 2012). It further recommends that a Hazard Analysis Critical Control Point (HACCP) system be implemented to improve food safety and suitability for human consumption internationally. The HACCP system works by identifying food hazards and Critical Control Points, that is, points at which measures can be taken “to
prevent or eliminate a food safety hazard or reduce it to an acceptable level” (FAO, 1997). The FAO (1997) established the following seven procedural principles that together constitute the HACCP approach:

Principle 1: Conduct a hazard analysis.
Principle 2: Determine the Critical Control Points (CCPs).
Principle 3: Establish critical limit(s).
Principle 4: Establish a system to monitor control of the CCP.
Principle 5: Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.
Principle 6: Establish procedures for verification to confirm that the HACCP system is working effectively.
Principle 7: Establish documentation concerning all procedures and records appropriate to these principles and their application.

The HACCP system can be applied throughout the commercial food chain, from the producer to the end user, and results in improved food safety, a more effective use of resources, and timely responses to food safety problems. For the system to be successful, a team approach is needed, as well as the commitment of management and the work force. The HACCP method is compatible with all the other quality management systems, such as the International Organization for Standardization’s ISO 9000 series (FAO, 1997).

3.4 WHO Strategies to Promote International Food Safety

Food safety authorities globally have acknowledged that ensuring food safety is not only a national concern but should be addressed through closer linkages among food safety authorities at the international level (WHO/FAO, 2011). In 2000, the 53rd World Health Assembly urged the WHO to implement a global strategy to reduce foodborne diseases and to improve food safety practices. In 2007, the Beijing Declaration on Food Safety, a high-level international forum, was adopted by fifty countries (Prüss-Ustün et al., 2011).

In 2006, the WHO Department of Food Safety and Zoonoses, in collaboration with multiple international partners, held an international meeting to launch an initiative, a multi-disciplinary Foodborne Burden Epidemiology Reference Group with the mandate to provide a strategic framework for estimating the global burden of foodborne diseases (Prüss-Ustün et al., 2011). Furthermore, the need was identified for the routine exchange of information on food safety issues and rapid access to information in the event of food safety emergencies. In order to help achieve this, WHO, together with FAO, launched a new International Food Safety Authorities Network (INFOSAN) in order to facilitate collaboration among food safety authorities at the national and international levels (WHO/FAO, 2011). INFOSAN includes a food safety emergency network.

The WHO Food Safety Programme, in collaboration with other WHO programmes and departments, includes the strengthening of food safety systems, promoting good manufacturing practices, and educating retailers and consumers about appropriate food handling. Education of consumers and training of food handlers in safe food handling is one of the most critical interventions in the prevention of foodborne illnesses. In order to promote health, WHO (2006) developed a global food hygiene message with five key steps for the consumer and the food industry – the “Five Keys to Safer Food”:

• Keep clean. (This refers to hands as well as all food preparation areas.)
• Separate raw and cooked food.
• Cook thoroughly. (This includes reheating.)
• Keep food at safe temperatures. (see Table 24.3).
• Use safe water and raw materials.
Table 24.3: Temperature guide for optimal food safety

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Boiling point of water</td>
</tr>
<tr>
<td>74–100</td>
<td>Cooking temperature of food at which bacteria are destroyed</td>
</tr>
<tr>
<td>65–80</td>
<td>Keep hot food above 65°C. These are warming and holding temperatures, at which bacterial growth is prevented, but some bacteria will survive. 70°C is the optimum temperature for pie warmers and hot closets. Salmonella and listeria are killed. 80°C is the optimum temperature for food served hot. However, this may be detrimental to quality.</td>
</tr>
<tr>
<td>52–65</td>
<td>Some bacterial growth may occur. Most bacteria will survive. South African legislation specifies 60°C as the cut-off point</td>
</tr>
<tr>
<td>16–52</td>
<td>DANGER ZONE for holding and storing perishable food. 37.2°C is average human body temperature and the most suitable temperature for bacterial growth.</td>
</tr>
<tr>
<td>6–16</td>
<td>Some growth of food poisoning bacteria may be possible.</td>
</tr>
<tr>
<td>5</td>
<td>Optimum temperature for all food served cold, e.g., sandwiches and salads. 10°C is the maximum temperature to serve cold food.</td>
</tr>
<tr>
<td>0–4</td>
<td>These are appropriate refrigeration temperatures. They will permit slow growth of some bacteria that cause spoilage. Lysteria breed in 46 hours at 0–2°C. Do not store raw meat for &gt;5 days. Do not store poultry, fish, or minced meat for &gt;2 days.</td>
</tr>
<tr>
<td>-18–0</td>
<td>These are appropriate freezer temperatures. All bacterial growth is stopped, but some bacteria may survive.</td>
</tr>
</tbody>
</table>

Source: Adapted from Payne-Palacio & Theis, 2004.

4. FOOD SAFETY IN DEVELOPING COUNTRIES

Poor food safety is a significant factor in the burden of disease in developing countries. Food systems are not always well organized and developed. Furthermore, adherence to international food safety standards and legislation may be lacking in many places, and the responsibility for food safety in developing countries is often spread among many institutions (WHO, 2007a). They are therefore faced with a number of challenges (FAO, undated; Henson, 2003; WHO, 2007a;), such as the following:

- Problems related to population growth
- Urbanization and change in food intake habits
- Poor sanitation (WHO, 2008a)
- Lack of resources to handle pre- and post-harvest food losses
- Lack of modern food processing infrastructure and technology as well as adequately trained inspectorate and staff members
- Insufficient involvement of scientific expertise and lack of adequate facilities for food safety analyses
- Lack of coherence among different governmental departments, and
- Environmental and food hygiene issues

All of the above factors negatively impact the quality and safety of food supplies. Appropriate food control measures that are based on well-established food regulations pertaining to quality and safety of food should
be the essence of food legislation throughout the world. Although food quality and safety is the responsibility of the food industry in all countries, governments should provide the supporting infrastructure and take on an advisory and regulatory role (FAO, undated). The responsibility for food safety is thus shared amongst government, the food industry/trade, and consumers (Henson, 2003). The roles of each of these stakeholders are depicted in Table 24.4.

### Table 24.4: The WHO vision of shared responsibility for food safety

<table>
<thead>
<tr>
<th>Food Safety</th>
<th>Government/Public service</th>
<th>Consumers/Clients</th>
<th>Industry/Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Food legislation and labelling</td>
<td>- Educated and well-informed public</td>
<td>- Good food handling practices by primary manufacturers and distributors</td>
<td></td>
</tr>
<tr>
<td>- Industry guidance</td>
<td>- Discerning and selective consumers</td>
<td>- Quality assurance and control of processed food</td>
<td></td>
</tr>
<tr>
<td>- Consumer education</td>
<td>- Safe food practices in the home</td>
<td>- Appropriate procedures and technology</td>
<td></td>
</tr>
<tr>
<td>- Acquiring information and research</td>
<td>- Community participation</td>
<td>- Trained human capital – management as well as food handlers</td>
<td></td>
</tr>
<tr>
<td>- Provision of health-related services</td>
<td>- Active consumer groups</td>
<td>- Informative labelling and consumer education</td>
<td></td>
</tr>
</tbody>
</table>

**Commitment to food safety**

*Source: Adapted from Henson, 2003.*

For developing countries to participate in the international food market, they need to have the capacity to meet the food import requirements of the recipient countries. For example, the Food and Drug Administration (FDA) in the United States has a set of food regulations to be met before granting permission for the import of food into that country. Likewise, the European Union also has its own requirements for the importing of food. Furthermore, the recognition of international food standards in the international food markets is an important factor of the World Trade Organization (WTO) agreements; for instance, the mandatory sanitary and phytosanitary certificate as well as the certificate of origin are part and parcel of import documentations. These conventions and regulations were designed to harmonize world food markets and provide a fair chance for developing countries to participate in world markets (FAO, undated; Henson, 2003).

FAO and WHO established the Codex Trust Fund 2004 to assist developing countries to improve food safety and quality in terms of training and facility support systems. This includes a training package for strengthening national food safety systems (WHO, 2004). The rules of the WTO also stipulate that developed countries should assist developing countries to achieve the requisite high level of food safety for international trade. This assistance can result in building or enhancing integrated national food safety systems covering the entire food chain (WHO, 2007a).

### 5. CONCLUSION

Building capacity for food safety is essential in most countries, especially developing countries. Both positive and negative experiences from countries with well-developed food safety systems could be used as a means to improve systems globally. Foodborne disease has a significant impact not only on health, but also on development. Moreover, globalization of food trade and development of international food standards have raised awareness of the interaction between food safety and export potential for developing countries (WHO, 2004).
**DISCUSSION QUESTIONS AND EXERCISES**

1. Human beings have the right to wholesome food that is safe for consumption. Who is responsible for food safety? Looking at (a) the household, (b) the community, and (c) the national government, identify those responsible, and discuss the part they play in ensuring food safety.

2. Discuss the challenges that developing countries face in providing safe food.

3. What is the role of the WHO and the FAO in global food safety? Discuss how the WHO and FAO strategies described in section 3 above can benefit developing countries.

4. How can a Hazard Analysis Critical Control Point (HACCP) system be implemented in developing countries? Discuss the barriers, challenges, and possibilities.

5. What is the essence of the FAO Right to Food Guideline no. 9?

**REFERENCES**


doi:10.15215/upress/9781927356111.01


ADDITIONAL RESOURCES


# Appendix 1: Food infections (bacterial)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Disease organism</th>
<th>Signs and symptoms</th>
<th>Transmission</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacillus cereus</td>
<td><em>Bacillus cereus</em>, a saprophytic (bacteria that obtain food by absorbing dissolved organic material), spore-bearing organism widely found in nature</td>
<td>Severe vomiting 1 hour after ingestion, or diarrhoea later. Recovery is rapid.</td>
<td>The disease usually occurs in those who eat restaurant-prepared fried rice that is allowed to cool unsafely. The spore may survive normal cooking and produce vegetative forms during cooling.</td>
<td>Do not allow cooked rice to cool over a long period without refrigerating.</td>
</tr>
<tr>
<td>Brucellosis (Bang's disease, undulant fever, Malta fever)</td>
<td><em>Brucella abortus</em>, <em>Brucella melitensis</em>, <em>Brucella suis</em></td>
<td>A recurrent or undulating fever, which may rise to 40˚C to 41˚C in the evening, then drop to normal each morning. Sweating, fatigue, muscle ache, constipation. If untreated, symptoms may persist for months.</td>
<td>Consuming infected milk or milk products, or meat from infected animals</td>
<td>Pasteurize milk. Test animals, slaughter those that test positive.</td>
</tr>
<tr>
<td>Cholera</td>
<td><em>Vibrio comma</em>, a comma-shaped bacillus</td>
<td>Fever, severe diarrhoea, abdominal cramps, vomiting, intense thirst, followed by collapse. If untreated, a 50% death rate is common. Cholera is one of the most acute and violent infections known.</td>
<td>From infected persons and faecal-contaminated food and water</td>
<td>Isolate cholera patients. Destroy by fire material passed by patient. Eat well-cooked food and chlorinate water. Vaccinate. Treatment consists in replacing body fluids and electrolytes.</td>
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<td><strong>Clostridium perfringens</strong></td>
<td><strong>Escherichia coli (E. coli)</strong> infection resulting from food contamination</td>
<td><strong>Leptospirosis</strong></td>
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<td><em>Clostridium perfringens</em> (also known as <em>Clostridium welchii</em> or “the gangrene organism”), a spore-forming anaerobe widely distributed in soil, sewage, and unsanitary food-processing plants</td>
<td><em>Escherichia coli</em> (E. coli)</td>
<td><em>Leptospira</em>, so named because it is the smallest and most delicately formed of the spirochetes (spiral-shaped bacteria)</td>
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<td>Diarrhoea, which is often accompanied by abdominal pain and headache. Vomiting and fever are uncommon. The incubation period of the disease is 8 to 24 hours. Most patients recover in 24 hours or at the most within a few days. Rarely fatal.</td>
<td>Acute gastroenteritis in infants, and “traveller’s disease,” characterized by severe watery diarrhoea</td>
<td>High fever and intense, haemorrhagic jaundice and hepatitis.</td>
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<td>Infected foods, especially meats and gravies that have been allowed to cool slowly for several hours after cooking. The spores are resistant to heat and will survive boiling for as long as 5 hours.</td>
<td><em>E. coli</em> are one of the predominate bacterial flora of the gut, and are excreted in human faeces (and urine to some extent). Infection is spread to foods and food utensils by flies and human hands. Baby formulas prepared under unsanitary conditions are a common route of infection.</td>
<td>By polluted water, from drinking it or swimming in it, or through cuts or scratches on the skin. From exposure to animals or people with leptospirosis. By consuming food or water that has been polluted, usually by rats.</td>
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<td>Cook meats adequately. Do not allow foods, especially meats and gravies, to cool slowly after cooking; refrigerate them promptly.</td>
<td>Avoid contaminated food and water. Avoid overindulgence in consuming food and alcohol.</td>
<td>Avoid polluted food or water. Control rodents.</td>
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<td>Salmonellosis</td>
<td><em>Salmonella typhimurium</em> is the organism most commonly responsible. However, more than 1600 species within the genus <em>Salmonella</em> exist.</td>
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<td>Diarrhoea, abdominal cramps, and vomiting, which usually lasts for 2 to 3 days. The incubation period is 12 to 36 hours. Salmonellosis is rarely fatal except in elderly people and infants.</td>
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<td><em>Salmonella</em> bacteria grow rapidly in such cooked foods as meats, eggs, custards, and salads that have been left unrefrigerated for several hours. It may also be transmitted by sewage-polluted water. The organisms may be eliminated 2 to 3 days after the symptoms subside, thereby providing a continuing source of contamination for others.</td>
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<td>Refrigerate foods below 4°C. Food handlers must practise hand washing, scrupulously clean food processing equipment, and avoid use of cracked eggs unless thoroughly cooked. Salmonella in food is destroyed by a temperature of 60°C lasting for 20 minutes or 65°C for 3 minutes.</td>
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</tbody>
</table>

| Shigellosis (bacillary dysentery) | *Shigella* bacteria |
| Fever, loss of appetite, vomiting, severe abdominal cramps, and massive diarrhoea. Young children and frail adults may become dehydrated; care must therefore be taken to maintain their balance of mineral salts. |
| Spread by faecal contamination of food, water, clothing, and household objects by infected individuals. House flies are also an active agent in its spread. |
| Practise good public sanitation and personal hygiene. Control flies. Boil food and water. Pasteurize milk. Wash hands before handling food or eating. Isolate patients and carriers, especially if they are handling foods. |

| Tuberculosis (TB) | *Mycobacterium bovis* (tubercle bacillus) |
| Chronic coughing, usually fever and night sweats, extreme fatigue, loss of appetite, and, eventually, coughing up blood. Enlargement of the cervical and mesenteric lymph nodes. |
| The bacteria are spread by particles of dust or droplets expelled by a tubercular patient, especially when coughing or sneezing, or introduced into the digestive tract by contaminated foods or objects, such as milk from infected cows or objects placed in the mouth. |
| Avoid contact with infected people and foods. Pasteurize milk. Eat an adequate and nutritious diet. Have comfortable living quarters and sufficient daily rest. |
Tularemia (rabbit fever)  

_Francisella tularensis_  

An ulcer-like sore at the point where the germs enter the skin, followed by headache, aching muscles and joints, weakness, chills, and fever  

About 90% of reported cases can be traced to handling infected wild rabbits, but the disease has been found in almost every type of small wild animal. Cats and sheep have also been known to be infected.  

Wear protective rubber gloves when handling game. Thoroughly cook meat from game.

Vibrio Parahaemolyticus (food infection)  

_Vibrio parahaemolyticus_, an organism related to the cholera vibrio, which grows in sea water  

Profuse diarrhoea and dehydration  

Consumption of raw or undercooked sea foods  

Avoid contaminated foods. Cook foods well.

Source: Ensminger et al., 1994.

### Appendix 2: Food poisoning (bacterial toxins)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Disease organism</th>
<th>Signs and symptoms</th>
<th>Transmission</th>
<th>Prevention and treatment</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botulism</td>
<td>Clostidium botulinum, a bacteria that is widespread and found in soils. It forms heat-resistant spores, which if not destroyed by heat in cooking, vegetative forms may grow anaerobically and produce one of the most powerful toxins known.</td>
<td>Weakness of the eye muscles and difficulty in swallowing, followed by paralysis of muscles related to respiration, and death. Symptoms usually begin 18 to 36 hours after contaminated food is eaten.</td>
<td>Primarily by eating inadequately cooked meat and non-acidic vegetables such as beans, asparagus, corn, and peas.</td>
<td>Practise adequate cooking. The toxin is inactivated in 10 minutes by heat at 80°C, but the spores are not destroyed. Do not use food that shows gas production or change in colour or consistency. Discard canned food that shows bulging in one end of the can.</td>
<td>The toxin blocks transmission of the neuromuscular junctions. Botulinus-infected foods do not necessarily taste or smell spoiled.</td>
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</tbody>
</table>
Staphylococcal food poisoning

Staphylococcus aureus, primarily

Vomiting and diarrhoea, which may be severe and accompanied by collapse due to dehydration. Ingestion of contaminated food may be followed by symptoms within minutes to 6 hours. The illness usually lasts 1 to 3 days. Mortality is low.

Ingestion of food or water containing the enterotoxin. Many healthy people are carriers of staphylococcal infections, specifically Staphylococcus aureus. Foods are readily contaminated by carriers and may, under suitable conditions, provide a good culture medium for growth of the organism. A wide variety of foods have been implicated, but the most common ones are ham, poultry, cream, and custard-filled baked products.

Prevent carriers from contaminating food. Refrigerate foods promptly at 4 °C or below. Eliminate flies. Staphylococcus can be killed by heating to boiling temperature, but toxins may not be destroyed by boiling.

This is by far the most common form of food poisoning. Some strains of Staphylococcus produce a powerful enterotoxin that is resistant to heat.

Source: Ensminger et al., 1994.

ACKNOWLEDGEMENTS

This chapter is based in part on a chapter in an earlier book:


We acknowledge the contribution of Lenore Fuller, who was an author of the previous version of this chapter.