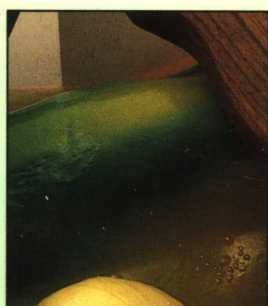


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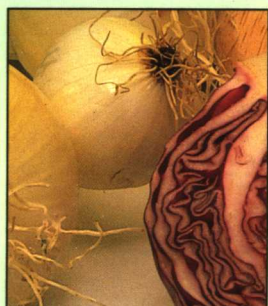
Safe food handling



A training guide for managers



of food service establishments



M. Jacob



World Health Organization
Geneva

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Safe food handling

A training guide for managers of food service establishments

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Other WHO publications on food safety

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Evaluation of programmes to ensure food safety: guiding principles. 1989 (47 pages)	9.-
Health surveillance and management procedures for food-handling personnel. Report of a WHO Consultation WHO Technical Report Series, No. 785, 1989 (47 pages)	6.-
Food irradiation: a technique for preserving and improving the safety of food. 1988 (84 pages)	16.-
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CHARLES, R. H. G. Mass catering WHO Regional Office for Europe, European Series, No. 15, 1983 (80 pages)	13.-

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Preface

Incidents of foodborne disease, especially those widely publicized in the media, highlight the problems that need to be overcome to achieve safe preparation, handling, storage and distribution of food. They also act as a constant reminder that foodborne disease occurs even where formal national or local government controls are in force. Routine inspections of food service establishments may help to ensure that food is prepared in a clean environment, but often cannot control other factors that contribute to foodborne disease. Carrying out daily inspections is neither practical nor effective.

The recent emergence, in some developed countries, of foodborne illness associated with foods not previously implicated, e.g., salmonellae in eggs and *Listeria* in chilled foods, indicates that contamination of raw products can be a problem. However, on a worldwide basis, most such illness is caused by foods that have been mishandled or mistreated during preparation. One of the most effective preventive measures to deal with foodborne illness is thus to educate food-handling personnel in safe practices.

This guide has been designed to help overcome the problems associated with educating food handlers. It is written for anyone involved in managing a food service establishment, or supervising food handlers, and is appropriate for use in hotel and catering management courses. Its emphasis is on bacterial foodborne diseases as these diseases can readily be prevented by the adoption of safe food handling techniques.

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The author is grateful to all those people who reviewed the early drafts of this guide, and whose comments and suggestions were most helpful in the preparation of the final version.

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How to use this guide

Parts I–III of this guide give details on how food contamination occurs and how to prevent it by employing a variety of measures including safe food handling. Part IV gives guidance to help managers organize this information into a training course for food handlers.

The guide has been written taking into consideration the wide range of educational backgrounds of managers and supervisors in food service establishments. The most crucial points from each chapter are collected in boxes labelled 'Important training points'. Managers with only a basic level of education should concentrate on understanding and remembering these points. Managers with a higher level of education will find the more detailed information in the chapters useful. It is the 'Important training points' that should be stressed in the food handlers' training course. The illustrations throughout the guide can be used to clarify points during the training course.

Important training points

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Introduction

Foodborne illness—outlining the problem

A foodborne illness generally involves a disturbance of the gastrointestinal tract, with abdominal pain, diarrhoea, and sometimes vomiting. Illness is caused by eating food containing a significant amount of harmful (pathogenic) bacteria, or the toxic products of their growth. The illness may affect an individual, one or two members of a family or other close group, or many people. The symptoms may be mild, lasting only for a few hours, or serious, lasting for days, weeks or months, and needing intensive treatment. In vulnerable groups, such as infants and the elderly, the illness is likely to be more severe.

Public health

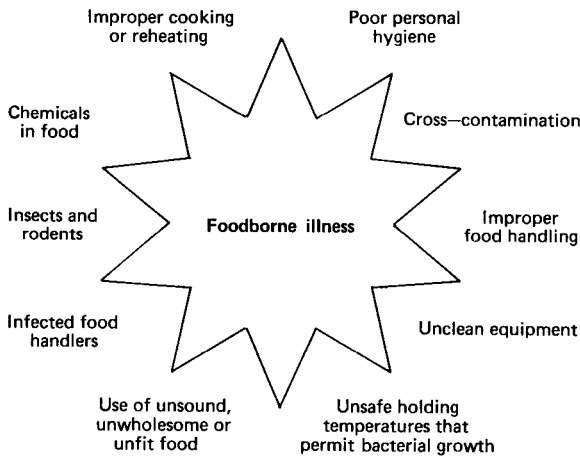
Foodborne illnesses continue to be a major public health problem in the developed and developing worlds alike. Statistics tend to underestimate the number of cases of foodborne illness because not everyone affected visits a doctor, and doctors may not report all the cases they treat to the appropriate health authority. Some cases may not be recognized as foodborne illness.

Factors contributing to foodborne illness

Current statistics for foodborne illness in various industrialized countries show that up to 60% of cases may be caused by poor food handling techniques, and by contaminated food served in food service establishments. No valid data are available for most developing countries, but there is reason to believe that they have similar problems. Bacterial contamination of food can, however, be eliminated by hygienic handling. Effective cooking, followed by appropriate hot or cold storage of the cooked foods are the principal safety factors with poultry and other meats.

Some public health measures can themselves affect food safety. For example, the use of sewage for irrigation can contaminate crops and lead to parasitic and other infections of both humans and food animals. Potentially toxic chemicals, for example pesticides used in agriculture, can find their way into foods. The indiscriminate use of insecticides and rodenticides in kitchens also creates hazards. Harmful natural toxins occur in food, and toxic metals and compounds can find their way into food from utensils, food containers or work surfaces. Viruses, yeasts, and moulds can also be responsible for foodborne illness. The factors that contribute to foodborne illness are summarized in Fig. 1.

Fig. 1. Summary of factors that contribute to foodborne illness.



Economic aspects

Foodborne illness can be responsible for much economic loss and hard work for those involved in the food service industry. Working days and income may also be lost for the customers affected by the illness. Contaminated food has to be withdrawn from sale and discarded. There may be adverse publicity on television or radio, or in the newspapers. This publicity can lead to economic loss, closure, law suits or prosecution. These effects can be out of all proportion to the illness and discomfort suffered by affected customers. It is hard to build up a good reputation in the food service industry, but easy to lose it.

Some countries miss out on potential income from tourism because of the prevalence of serious foodborne illnesses, such as typhoid and dysentery.

Investigations of outbreaks of foodborne illness can also be very time-consuming and expensive. The investigating authorities may spend many hours tracing the social contacts of affected people, assessing attack rates in groups of affected people, and collecting and examining samples of food, stools, and urine from affected people or suspected carriers.

Consumer service

Food service establishments perform a public service. In many countries meals eaten away from home are an important feature

of leisure activities, particularly in tourist areas. Clean and hygienic presentation of food is expected by customers.

Clean surroundings are likely to promote good standards of behaviour among food handlers. People tend to respond to their environment, so it is likely that workers will stay longer in their jobs if their place of work is clean and pleasant. The tourism and leisure industries benefit particularly from high standards of hygiene and cleanliness in food service establishments.

The effects of foodborne illness on digestion

To understand how foodborne pathogens act on the human body, a basic understanding of the digestive process is needed.

Food may be defined as any solid or liquid that, when swallowed, supplies the body with energy for growth or functioning. For this energy to be released, food must be broken down into its various parts by the process of digestion. Digestion takes place in the alimentary canal, which is the tube that passes from the mouth to the anus. The mechanical action of the teeth, the muscular movement of the alimentary canal, and the chemical reactions caused by the digestive juices all help to achieve this. The complete process of breakdown is called digestion.

The process of digestion converts nutrients from the food into a form that can be absorbed by the body. Absorption involves transferring these nutrients through the walls of the alimentary canal and into the blood.

The main method of propelling food along the alimentary canal is peristalsis. The walls of the canal contract in waves and propel the food onwards. If poisonous or irritant substances enter the stomach, they induce a reverse peristalsis which, combined with contractions of the abdominal muscles and diaphragm, produces vomiting. If the irritant substances are not removed by vomiting, they pass into the intestine and produce contraction, pain and diarrhoea. Different types of foodborne pathogens may cause different body reactions, but generally the clinical features of foodborne illness are diarrhoea, abdominal pain, vomiting and possibly fever. There may be associated symptoms of nausea, prostration, and dehydration. Dehydration is especially common, and life-threatening, in infants and children.

Introduction to microbiology

In learning about food safety there is a need for an elementary knowledge of microbiology, which is the study of all forms of plant and animal life too small to be seen by the naked eye. In food microbiology, attention is restricted to four groups of organisms—bacteria, moulds, yeasts, and viruses.

As well as being present in humans, these organisms are found in soil, air, water, and often in, or on, our food. Foodborne illness is most often caused by bacteria and viruses.

Bibliography

- CHARLES, R. H. G. *Mass catering*. Copenhagen, WHO Regional Office for Europe, 1983 (European Series No. 15).
- FREEDMAN, B. *Sanitarians' handbook*, 4th ed. New Orleans, Peerless Publishing Company, 1977.
- LONGREE, K. *Quantity food sanitation*. New York, Inter-Science Publishers, 1967.
- RIEMANN, H. & BRYAN, F. L. *Food-borne infections and intoxications*, 2nd ed. New York, Academic Press, 1979.
- WHO Technical Report Series, No. 705, 1984 (*The role of food safety in health and development: report of a Joint FAO/WHO Expert Committee on Food Safety*).

PART I

**CAUSES OF
FOOD CONTAMINATION**

Chapter 2

Bacteria

A bacterium consists of only one cell—it is unicellular. Bacteria are so small that individually they cannot be seen without a microscope. They may be as small as 0.0005 mm, and clusters of a thousand or more are only just visible to the naked eye; 50 000 placed side by side may measure barely 25 mm. Bacteria are the most common cause of foodborne illness.

Bacterial growth

Bacteria consume food as a source of energy, and for cell growth. A bacterium must absorb food through its cell wall. To do this it requires a suitable environment.

Temperature

Bacteria grow best within a certain temperature range. They are classified into three groups, depending on which temperature range they prefer (see Fig. 2).

- *Psychrophilic (cold-liking bacteria)*
Growth range 0–25 °C.
Optimum temperature 20–25 °C.
- *Mesophilic (middle-liking bacteria)*
Growth range 20–45 °C.
Optimum temperature 30–37 °C.
- *Thermophilic (heat-liking bacteria)*
Growth range 45–70 °C.
Optimum temperature 50–55 °C.

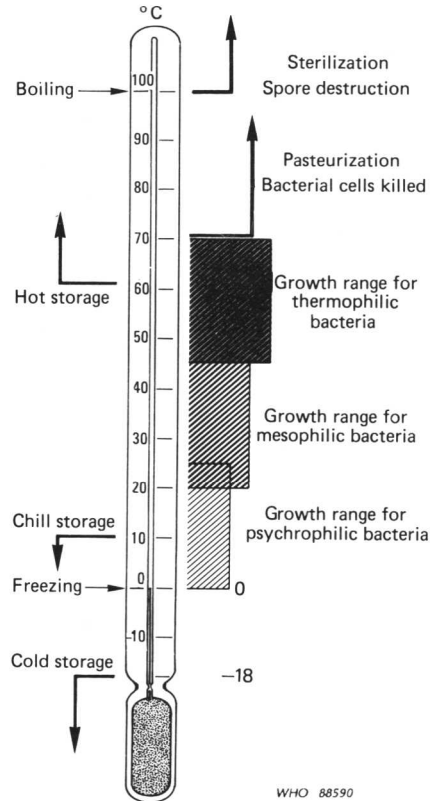
The species that cause disease and infection in humans grow best at body temperature (37 °C) and are therefore mesophilic. The ones that cause food spoilage in the refrigerator are psychrophilic. If the temperature is below their normal growth range, bacteria will usually not grow. However, they may not be killed by this low temperature and will often start growing again when favourable temperature conditions return.

On the other hand, if bacteria are heated above their normal temperature range for a significant period of time, they will be killed (see Fig. 3). For any given species to be killed a specific combination of time and temperature is needed.

Time

When bacteria find suitable conditions, reproductive growth can occur. Bacteria reproduce by dividing themselves into two equal

Fig. 2. Important temperatures in food safety.



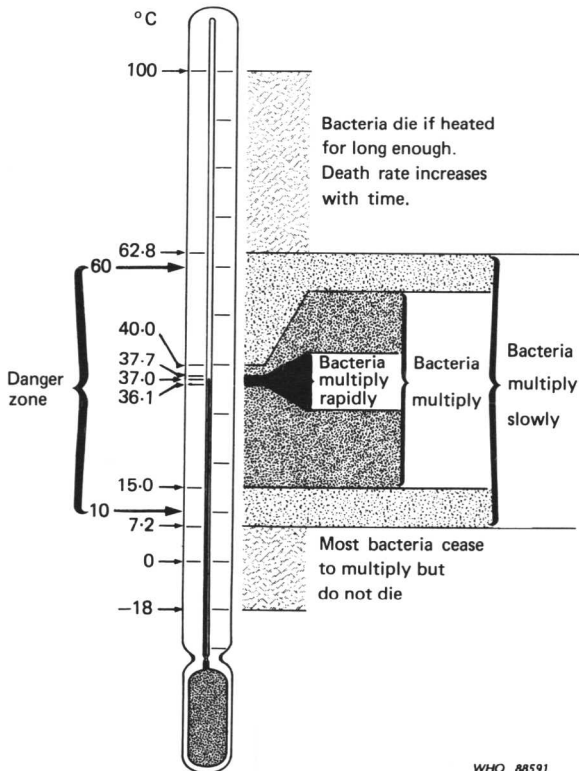
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portions. Under suitable conditions of environment and temperature, division occurs once every 20 to 30 minutes. Thus under favourable conditions for continuous growth one cell could give rise to over 17 million in 8 hours, and 1 billion (10^9) in 10 hours (see Fig. 4).

Moisture

Bacterial cells are composed of approximately 80% water. Water is an essential requirement for them. However bacteria cannot use water if it is combined with solids, for example salt and sugar. Concentrated solutions, for example 200 g/litre salt solution, do not generally support the growth of bacteria.

Fig. 3. Control of pathogenic bacteria by temperature.



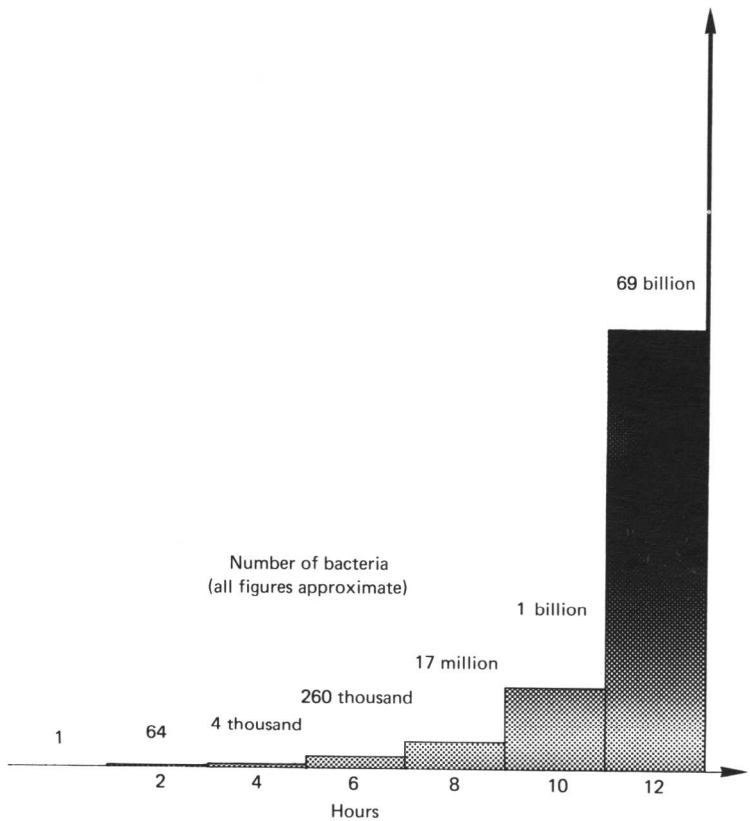
Oxygen

Some bacteria will grow only if oxygen is present (aerobic bacteria), others only if it is absent (anaerobic bacteria). Others, called facultative anaerobes, can live without oxygen, but prefer an environment where oxygen is present.

pH

The acidity or alkalinity of a substance is measured on the pH scale. This refers to the hydrogen-ion concentration of a substance. A pH of 7 is neutral (for example water), a pH below 7 is acid, and a pH above 7 is alkaline. Most bacteria prefer a slightly alkaline pH of between 7.2 and 7.6, although some are able to withstand more extreme conditions. For

Fig. 4. Multiplication of bacteria under favourable conditions.



example, the lactic acid bacteria responsible for turning milk sour, and bacteria used in cheese production can tolerate an acidic pH as low as 4.

Light

Bacteria usually grow best in darkness, although this is not a necessity. Ultraviolet light is lethal to them and may be used in some sterilization procedures.

Bacterial spores

Most bacteria die in the absence of nutrients or under unfavourable environmental conditions. Certain bacteria, however,