

Introduction to the Teaching Package

Importance of food safety for nutritionists and other public health professionals

a. Introduction

Malnutrition is one of the most serious problems facing the world today. As well as its effects on the individual, it inhibits social and economic development and thus has an impact on the whole community. Diarrhoea, which has a synergistic relationship with nutritional status, kills millions of children in developing countries. 159 countries participating in the International Conference on Nutrition in Rome reaffirmed the importance of overcoming these problems. This was a call for action, not only to nutritionists, but to public health professionals of all disciplines.

Merely increasing or altering food supplies cannot eliminate malnutrition. Its causes are complex and interdependent, and extend to food quality and safety. Today, many governments, recognising the importance of providing safe, nutritious food, have put control systems in place to protect consumers and promote trade. These include laws to ensure food quality and safety.

However, government actions alone cannot prevent foodborne disease. The Joint FAO/WHO Expert Committee on Food Safety has defined food safety as "all conditions necessary during the production, processing, storage, distribution, and preparation of food to ensure that it is safe, sound, wholesome, and fit for human consumption". Since food is processed/handled in the home and in food service establishments, people must be taught about food safety.

Strategies for ensuring food safety have to focus on several areas. These are described in the following sections.

b. Hazards related to food

Biological hazards. Each year, an estimated 1.8 million children die and millions more suffer from malnutrition due to frequent episodes of diarrhoea. This problem has been linked to poor water quality and inadequate sanitation but food is now recognised as a major transmission route; up to 70% of all cases by one estimate (2). In industrialised countries, despite the progress made since the beginning of this century in general sanitation levels, diarrhoeal diseases are increasing and are widespread (3). Most cases of gastro enteritis in industrialised countries are caused by *Campylobacter jejuni* and *Salmonella* spp. (4, 5). The traditional pathogens of the faecal-oral route such as *Salmonella typhi*, *Shigella* spp. and *Vibrio cholerae* are usually traced to travellers from developing countries.

The link between contaminated food and diarrhoeal diseases is well established for industrialised countries (3). Studies in developing countries show a similar situation (6, 7, 8); for instance complementary foods are often contaminated with pathogenic strains of *E. coli* (9, 10), a major cause of infant diarrhoea.

In the industrialised world, changes in patterns of foodborne disease are linked to changes in what people eat and how they prepare it (11). For example, drinking raw milk for "health" reasons has caused campylobacteriosis and salmonellosis, and anisakiasis in North America has been linked to increased sushi consumption. Changing food habits in non-industrialised countries may lead to similar problems.

Prevention of foodborne diseases is important because they have debilitating effects and thus an impact on short- and long-term nutritional status (12).

Chemical hazards. To be nutritious and safe, food must be free not only of microbiological hazards but also from synthetic and natural chemical contaminants. Many countries have introduced legislation related to the problem of food adulteration and the use of pesticides, hormones, antibiotics and other man-made chemicals. Food additives such as sweeteners, colorants, antioxidants and other chemicals used to improve quality, safety or shelf life have been regulated nationally and internationally, especially by the Codex Alimentarius. Concern for the environment has prompted legislation concerning heavy metals and radioisotopes. Developing countries also have problems linked with local customs, such as the use of glaze containing lead oxide in artisanal pottery.

Food adulteration is still a problem in some developing countries. In Indonesia, some beverages sold by street vendors contain textile dyes or prohibited colours (13).

Many foods contain natural toxins or anti-nutritional factors. For example, cassava (*Manihot esculenta*, Kranz) contains cyanogenic glucosides that must be removed from the tuber before consumption (14).

Nutritional inadequacies. Foods can pose a health hazard when an essential nutrient, such as iron, iodine and vitamin A, is missing or is not present in amounts sufficient to meet dietary intake requirements. Similarly, food processing may decrease vitamins and other nutrients in raw commodities, so the food must be enriched. Many countries require the use of fortified foods, such as salt and flour.

Food allergies and intolerances. Some people are sensitive to food ingredients that present no risk to the general population. Hypersensitivity to sulphite is well documented and even a small amount can trigger a life-threatening reaction. Some people are sensitive to natural products such as peanuts, or components in foods such as gluten in wheat.

c. The use of knowledge about food safety

Knowledge of foodborne diseases is used to develop prevention strategies. Intervention can take place at all levels of food processing, from cultivation and rearing, through harvesting or slaughter, processing, distribution and storage, and final preparation in institutions, restaurants and the home.

Public health professionals with a thorough understanding of foodborne disease can play a major role in preventing foodborne diseases. They should learn about problems related to local food habits, social conditions and religious practices. For

example, in some developing countries, street food, which is associated with numerous chemical and microbiological hazards, is a significant portion of the household diet (15).

They must also know how to determine where contamination can occur, or microorganisms survive and grow, and how to prevent this from happening. As explained in this course, the Hazard Analysis and Critical Control Point (HACCP) approach, combined with Good Hygienic Practice, is a mean to enhance microbiological safety. (16, 17).

This course has been developed to address these requirements. We hope that you will find it useful.

References

1. **World Health Organization.** 'Facts About Infant Feeding' **Issue No 3.** April 1993. An information sheet.
2. **Henry F.J.** Combatting childhood diarrhoea through international collaborative research. *Journal of Diarrhoea Diseases Research*, **9.** 165-167 (1991).
3. **World Health Organization.** Technical Reports Series, No 705. *The role of food safety in health and development:* Report of a joint FAO/WHO Expert Committee on Food Safety. 1984
4. **Todd E.** Epidemiology of Foodborne Illness: North America, Chapter 2 pp 9-15 in *Foodborne Illness - A Lancet Review.* Edward Arnold. London (1991).
5. **Cooke E. M.** Epidemiology of Foodborne Illness: UK. Chapter 3. pp 16-23 in *Foodborne Illness - A Lancet Review.* Edward Arnold. London (1991).
6. **Michanie S. et al.** Critical Control Points for Foods Prepared in Households in which Babies had Salmonellosis. *International Journal of Food Microbiology* **5.** 337-354 (1987).
7. **Michanie S. et al.** Critical Control Points for Foods Prepared in Households whose Members had either Typhoid Fever or Diarrhoea. *International Journal of Food Microbiology.* **7.** 123-124 (1988).
8. **Bryan F. et al.** Hazard Analyses of Foods Prepared by Migrants Living in a New Settlement on the Outskirts of Lima, Peru. *Journal of Food Protection.* **51.** 314-323 (1988).
9. **Black R.E. et al.** Contamination of Weaning Foods and Transmission of Enterotoxigenic *Escherichia coli* diarrhoea in Children in Rural Bangladesh. *Transactions of the Royal Society for Tropical Medicine and Hygiene.* **76.** 259-264 (1982).
10. **Motarjemi Y. et al.** Contaminated Weaning Food: A Major Risk Factor for Diarrhoea and Associated Malnutrition. *Bulletin of The World Health Organization.* **71.** 79-92 (1993).

11. **van Schothorst M. and Cox. L. J.** 'Newer' or Emerging Pathogenic Microorganisms in Meat and Meat Products. In *Proceedings of the 35th International Congress of Meat Science and Technology*, Copenhagen, 20-25.8. 1989. **Vol. 1.** pp. 55-67. Published by Danish Meat Research Institute, 1989.
12. **WHO - FAO.** *International Conference on Nutrition.* Major issues for nutrition, Rome, December 1992.
13. **IBP - TNO - VU.** Streetfood Enterprises. Case Studies of Producers and Vendors in Bogor, West Java. *Streetfood Project Working Report 4.* August 1990.
14. **Odigbo E.U.** Cassava: Production, Processing and Utilisation. pp 145-200 in *Handbook of Tropical Foods.* Chan H.T.Jr. Editor. Marcel Dekker Inc. New York (1983).
15. **IBP - TNO - VU.** The Role of Street food in Household Consumption: a Survey in Bogor. *Street food Project Working Report 6.* March 1992.
16. **International Commission for Microbiological Specifications in Foods (ICMSF).** Microorganisms in Foods 4. Application of the Hazard Analysis Critical Control Point (HACCP) system to ensure microbiological safety and quality. Blackwell Scientific Publications. London. UK. (1988).
17. **Motarjemi Y. and van Schothorst M.** HACCP: Principles and Practice. WHO/ICD Teacher's manual. World Health Organization, Geneva, 1999.

Course design

Modular design

The eleven modules of this course begin by discussing the nature of microorganisms and other hazards, move on to factors affecting microbial behaviour and survival, and then to the identification and control of hazards in food and food processing and preparation.

The modular design allows the course to be adapted to local needs. It was first prepared for nutritionists in South East Asia attending the M.Sc. course on Community Nutrition at the University of Jakarta, Indonesia, but it can be adapted to other regions and courses for other professionals (food and public health inspectors, nurses, home economists etc.)

Practical orientation

This course emphasises knowledge and skills that can be used to recognise unsafe food and preparation practices, and shows how to apply this knowledge to develop intervention strategies.

Interactive approach

Since an interactive approach is essential to encourage and involve the students and help them acquire skills, the students should work in groups for the field and classroom exercises.

Evaluation

Course evaluations by the students and the teachers will be used as a basis for improvements.

Specific objectives

At the end of the course, participants will:

- Understand what safe foods are and how food safety can be achieved.
- Recognise unsafe foods and preparation practices.
- Understand the effect of infection and intoxication on nutrition.
- Be able to intervene in preventing foodborne diseases.
- Be able to teach the basic principles to others.

Visual aids and lecture material

In this package, you will find:

LECTURE NOTES

The lecture notes are supplements to the slides and, with the recommended reading, should cover the information needed to achieve the course objectives. The notes give suggestions for the interactive exercises and 'morning vitamins' sessions. The teacher should be prepared to adapt the course to the group.

OVERHEAD PROJECTOR SLIDES

Black and white overhead sheets in protective sleeves that can be used directly on the projector are provided. All overheads are labelled in the bottom left-hand corner with the module, lecture and overhead number. Teachers can supplement the overheads with slides illustrating subjects of local interest.

STUDENT HAND-OUTS

The student hand-outs contain copies of the overheads for each module, two per page. Students for notes can use the back of each page.

Course content

The course is designed for students with a minimum knowledge of microorganisms and microbiology. If the level of knowledge is higher, the teacher can spend less time on basic microbiology and more on HACCP, particularly the practical aspects.

The following sections summarise the material covered in each module.

1. BASIC FOOD AND WATER MICROBIOLOGY

Lecture 1. Introduction

Introduces the course philosophy and structure.

Lecture 2. The nature of microorganisms and parasites

Describes the characteristics of the main groups of microorganisms, both harmful and beneficial, and how they grow.

Lecture 3. Microbiological ecology

Describes the natural microflora, including pathogens, associated with raw materials, and about the related hazards. Explains the importance of understanding microbial ecology and behaviour in the prevention of foodborne disease.

Lecture 4. Safety of Potable Water

Describes the various hazards that may be found in drinking water and how the water can be made safe.

2. FOODBORNE PATHOGENS

Lecture 1. Infectious foodborne pathogens

Explains which pathogens are infectious and where they come from, the symptoms of the diseases they cause, and some of the factors that affect infection. *Does not discuss the mechanisms of infection.*

Lecture 2. Toxigenic foodborne pathogens

Describes toxins, the symptoms of the most important foodborne intoxications, the factors affecting the survival of toxigenic organisms and the relative stability of toxins.

3. SIGNIFICANCE OF FOODBORNE DISEASE

Lecture 1. The impact of diarrhoea on nutritional status

Discusses the relationship between diarrhoea and nutritional status and its special significance for infants and young children, as well as possible intervention strategies.

Lecture 2. Impact of foodborne disease – health, social and economic implications

Describes the social and economic burden of foodborne disease on individuals, communities, governments and society as a whole. Discusses the immediate effects, the vicious and often self-sustaining circle of foodborne disease, and long-term impact of secondary disease states.

4. HAZARDS ASSOCIATED WITH CHEMICAL CONTAMINATION IN FOODS

Lecture 1. Chemical and Physical Hazards in Foods

Discusses the principal chemical contaminants found in or on foods, the circumstances that lead to their presence, and the potential hazards they may pose. Examines the toxicants that occur naturally in some foods and the effects of food processing.

Lecture 2. Allergens

Identifies many naturally occurring food materials that can cause severe allergic reactions in some people.

5. FACTORS AFFECTING SURVIVAL, GROWTH AND CONTROL OF MICROORGANISMS

Lecture 1. Factors affecting survival and growth

Explains how the study of traditional food preservation has provided information about factors affecting microbial activities, and how these factors can be manipulated to prevent undesirable survival and growth of microorganisms in foods.

Lecture 2. Food technologies to render and keep foods safe

Describes various technologies to render food safe, such as heat and irradiation. It also describes techniques that make use of temperature, water activity and pH to control the development of microbial hazards. Explains techniques to prevent recontamination.

6. EPIDEMIOLOGY AND PREVENTION OF FOODBORNE DISEASE

Lecture 1. Distribution and occurrence of foodborne illness

Explains how surveillance of foodborne diseases is used to identify the sources of problems and factors that contribute to their spread.

Lecture 2. Factors contributing to foodborne illness

Explains how studies of outbreaks have helped us to understand the factors contributing to foodborne illness. Describes bad hygiene practices that lead to hazardous situations and good hygiene practices that can help prevent illness.

Lecture 3. Strategies for preventing foodborne illness (optional)

Discusses regulatory and educational measures for preventing foodborne disease.

7. LOCAL PROBLEMS OF SIGNIFICANCE FOR FOODBORNE DISEASE

Lecture 1. Street Food

Describes the hazards associated with street foods, with a particular emphasis on the local community.

Lecture 2. Locally relevant example

Invites students to discuss local food preparation practices, traditions, beliefs, socio-economic conditions and the potential problems associated with them. The teacher should relate the subjects to the previous modules. Local researchers can be invited to lecture.

8. FOOD HYGIENE

Lecture 1. Good Hygienic Practices

Highlights the main aspects of Good Hygienic Practices, which are prerequisites for the establishment and implementation of a HACCP plan. If possible, the lecture should be followed by a visit to a food factory.

Lecture 2. Good Hygienic Practices Applied to Food Service Establishments (optional)

Focuses on the aspects of GHP that are particularly important for food service establishments.

Lecture 3. Cleaning and Disinfection

Gives instructions for cleaning and disinfection in a factory setting.

9. Application of the Hazard Analysis and Critical Control Point (HACCP) System

Lecture 1. HACCP - The system and definitions

Defines the terms used in HACCP.

Lecture 2. Hazard Analysis and Critical Control Point determination

Explains how to use decision trees to identify hazards and critical control points, as well as how hazards and control points may vary, depending on how a process is carried out.

Lecture 3. HACCP - Recapitulation and interactive exercises

Discusses the questions posed in HACCP decision trees. Includes an exercise based on home or food-service preparation to teach the student how to prepare flow diagrams and symbols and to identify the knowledge needed to carry out HACCP.

Students should work in groups to prepare flow sheets and discuss the problem. The exercise should then be discussed with the whole class.

The handout showing the time-temperature curve is given during the exercise only to those who realise that they need the information on heating provided in the graph.

10. Biotechnology and food safety (optional)

Defines the basic terms and presents examples of the use of genetic modification in food production; discusses the related food safety issues.

11. Running the Food Safety Course

Lecture 1. Train the trainers

Discusses general training principles and planning considerations, as well as course objectives.

Lecture 2. Food Safety Course Organisation

Deals with the practical aspects of course organisation. Lists and explains the tasks to carry out, both before the course begins and when classes are in progress.

Lecture 3. Role of WHO and ICD in Food Safety (optional)

Describes some of the international organisations that are interested in or are directly or indirectly involved in the development of food safety policies and/or their implementation.

Appendices provide additional advice on the organisation of the course.

Suggested Course Timing

The recommended length of course is 8 days. Trainers are free to make the time shorter or longer to fit local circumstances, provided they present all the mandatory material. Trainers are recommended to make the course as informal as possible; this can be done by introducing group sessions, videos or discussion groups. Trainers will also have to include breaks for tea/coffee according to local custom.

Day 1

Module 1: Basic food and water microbiology

08.00-09.00 Introduction
09.00-10.00 The nature of microorganisms and parasites
10.00-11.00 microbiological ecology
11.00-12.00 Safety of potable water

Module 2: Foodborne pathogens

13.00-14.00 Infectious foodborne pathogens
14.00-15.00 Toxigenic foodborne pathogens

Evening reading: papers for "Morning vitamins" (optional)

Day 2

Module 3: Significance of foodborne disease

08.00-09.00 Morning vitamin discussions (optional)
09.00-11.00 The impact of diarrhoea on nutritional status
Impact of foodborne diseases: health, social and economic implications
11.00-12.00 Group exercise: Discussion of food safety problems in participants' countries

Module 4: Hazards associated with chemical contamination in foods

13.00-14.00 Chemical hazards in foods
14.00-15.00 Allergens (may include optional video)
15.00-16.00 **Group exercise:** Discussion of Incident summaries (optional)

Day 3

Module 5: Factors affecting survival, growth and control of microorganisms

08.00-09.00 Morning vitamin discussions
09.00-10.00 Factors affecting survival and growth
10.00-11.00 Food technologies to render and keep foods safe
11.00-12.00 **Group exercise:** Discussion of Incident summaries (optional)

Module 6: Epidemiology and prevention of foodborne disease

13.00-14.00 Distribution and occurrence of foodborne illness
14.00-15.00 Factors contributing to foodborne illness
15.00-16.00 Strategies for preventing foodborne illness (optional)

Evening reading: papers for "Morning vitamins" (optional)

Day 4

Module 7: Potential local problems of foodborne disease

09.00-10.00 Street food
10.00-11.00 Locally relevant example (optional)

Module 8: Food hygiene

11.00-12.00 Good Hygienic Practices (GHP)
13.00-14.00 GHP applied to food service establishments (optional)
14.00-15.00 Cleaning and disinfection

Day 5

Module 9: Application of the Hazard Analysis and Critical Control Point (HACCP) System

08.00-10.00 HACCP: the system and definitions
Hazard Analysis and Critical Control Point determination
HACCP: recapitulation and interactive exercise
10.00-10.45 Video: "*Food safe, food smart*"
10.45-12.00 HACCP exercise in class
13.00-14.00 preparation for HACCP exercise in the field (e.g. street food)
14.00-16.00 HACCP exercise in the field

Day 6

HACCP exercise in the field (Street food)

Day 7

HACCP(continued)

08.00-12.00 Presentations of HACCP exercise in the field
13.00-14.00 Food safety in a large company: a lecture by a speaker from ICD (optional)
14.00-15.00 Preparation for the company visit (optional)
15.00-16.00 **Module 10: biotechnology and food safety (optional)**

Day 8

Other Optional topics

08.00-12.00 visit to a large scale food manufacturing company or service operation
(preferably a factory belonging to an ICD member company)
14.00-15.30 Feedback from the field visit
15.30-16.00 Evaluation of the course and presentation of certificates