Microbiological aspects of food hygiene

Report of a WHO Expert Committee
with the participation of FAO

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with the participation of FAO

Geneva, 16–22 March 1976

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MICROBIOLOGICAL ASPECTS OF FOOD HYGIENE

Report of a WHO Expert Committee with the participation of FAO

A WHO Expert Committee on Microbiological Aspects of Food Hygiene with the participation of FAO met in Geneva from 16 to 22 March 1976. The meeting was opened by Dr W. Chas Cockburn, Director, Division of Communicable Diseases, on behalf of the Director-General of WHO.

INTRODUCTION

Awareness of microbiological health hazards arising from the consumption of contaminated food has grown in recent years and has resulted in national and international intensification of food hygiene programmes. To maximize the effectiveness of these programmes, it is important to use the best information currently available. The Committee therefore critically reviewed recent developments in the field of food microbiology with a view to assessing their usefulness for further improvement of existing food hygiene programmes.

The increased concern about microbiological contaminants in food was clearly shown by the recommendations passed by the United Nations Conference on the Human Environment, held in Stockholm in 1972. Similar recommendations have also been passed by the World Health Assembly, resulting in intensified WHO activities in this field. This is particularly reflected in the efforts to develop microbiological specifications for foods for further consideration by the FAO/WHO Food Standards Programme.[1] This work is done in close collaboration with FAO and other international organizations. In particular, the International Commission on Microbiological Specifications for Foods has produced valuable material for the development of internationally acceptable specifications.

In addition, the International Organization for Standardization (ISO) has recently established a sub-committee to harmonize and standardize microbiological methods used for all kinds of foods. The

[1] See footnote 1 on p. 81.

Committee noted that the United Nations Environment Programme is supporting many of the activities in this field, including the Joint FAO/WHO International Food Contamination Monitoring Programme.

The Committee noted also that food microbiology had been previously considered by the Expert Committee on Microbiological Aspects of Food Hygiene,[1] which met in Geneva in 1967, and by a Study Group on Food-borne Disease,[2] which met in 1973 to discuss methods of sampling and examination in surveillance programmes. This Group stressed the need to coordinate the work of various international bodies involved in formulating microbiological specifications in order to prevent overlapping of efforts and strongly emphasized the need for collaboration between these bodies and WHO.

The Committee recognized the progress made by the WHO Food Virology Programme, which has now reached the stage at which information can be disseminated to those who need it.

Among the training and research activities coordinated by WHO, the Committee particularly noted that the Pan American Zoonoses Centre has conducted individual training courses and carried out research on food microbiology for a number of years.

The Committee gave special attention to the relative public health importance of the various food-borne disease agents with regard to the severity and incidence of the diseases.[3] It considered further the epidemiological aspects of these diseases, taking into account growth, survival and, where applicable, toxin production under various conditions of production, processing, and storage. It also concerned itself with prevention and control of microbiological hazards including those related to population movement, tourism and local food habits. Recognizing that laboratory analysis is indispensable to every food hygiene programme, the Committee stressed the need for further development of methods of microbiological examination, the development of microbiological specifications for foods, and the introduction of an adequate system of laboratory quality assessment.

Other aspects of the broad field of food microbiology, such as the beneficial effects of food microorganisms, and microbial spoilage, could not be covered in detail. However, the Committee felt that it was important to emphasize the role of food spoilage in reducing man's

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[1] WHO Technical Report Series, No. 399, 1968.

[2] WHO Technical Report Series, No. 543, 1974.

[3] See Annex 1, which classifies the hazards from representative food-borne pathogens.

already inadequate food supply. This inadequacy may result in severe malnutrition in certain areas of the world. As malnutrition in combination with endemic diarrhoeal diseases is one of the most significant health problems among children in many developing areas, every possible effort should be directed to preventing microbial spoilage of food.

The Committee considered also the cost/benefit aspects of microbiological examination of foods. While the primary objective of this work is the protection of the health of the consumer, the protection of his purse by ensuring that foods retain their freshness and keeping quality until consumption is also important. It is essential that the limited resources available be applied to those parts in the chain of food production where the maximum effect in safeguarding the health of the consumer can be produced. It is considered that the report presented will facilitate the recognition of such areas.

References to Literature and Additional Reading

References to literature and additional reading on specific aspects of food hygiene and food-borne diseases are listed after the appropriate sections or chapters. Some references with wider coverage are listed below.

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PART I

MICROBIOLOGICAL AGENTS OF FOOD-BORNE DISEASE

1. BACTERIA

1.1 *Salmonella*

Salmonellosis is usually food-borne and generally results from the consumption of contaminated foods that have been mishandled, allowing the organism to grow. However, person-to-person spread may occur, especially in acute-care hospitals, paediatric wards, nurseries, and nursing homes (*1*).

During the past 10 years the role of *Salmonella* as a causative agent of food-borne disease has attracted increasing attention all over the world. The prevalence of salmonellae in animals, foods, man, and the environment has been studied extensively in many countries. The factors that influence survival and spread of salmonellae in the environment, the effects of different systems of animal husbandry, and faults in food preparation that may lead to salmonellosis in man are now rather well clarified. It has been shown that the main reservoir of *Salmonella* is the intestinal tract of man and animals, and cycles of infection between animals, man and the environment seem to exist. This is illustrated by a study carried out on an island in the Netherlands (see Annex 2).

1.1.1 *Incidence*

In many countries salmonellae are the most important causative agents of food-borne disease. Owing to differences in food habits, distribution systems, methods of livestock production, and environmental pollution, wide geographical variations in incidence levels are found.

The real incidence of salmonellosis in many countries is not well known and comparison of the numbers of isolations may be misleading owing to variations in population characteristics, under-reporting, and differences in epidemiological and laboratory techniques. For example, in the USA the number of reported isolations is estimated to be only about 1% of the number of cases.

In most countries the proportional distribution by age is consistent. The highest incidence is found among children less than one year of age with decreasing incidence in the age groups 1–5 and 6–10 years. After the age of 10 the incidence remains at a low level that shows little variation until advancing years, when it increases slightly.

1.1.2 *Mechanism of infection and epidemiological considerations*

The salmonellae do not produce an exotoxin, and disease arises from the ingestion of the living organisms. The larger the number ingested, the greater the likelihood of illness. The mechanism of action is not yet clearly understood, though it is known that the organisms invade and grow in the intestinal mucosa, producing acute enteritis and colitis. Occasionally, the blood stream may be invaded, leading to generalized or localized systemic infection.

Some 1 700 serotypes of salmonellae are known but in most countries only some 40–50 serotypes are isolated regularly from humans, animals, and foods. Of these serotypes, only about 10 are endemic in any country at any one time. In most countries *S. typhimurium* is the predominant serotype isolated from man, but the frequency of isolation of different phage types within this serotype varies widely among different countries, in much the same way as variation in serotype frequency.

New serotypes may be introduced into any country by the importation of live animals or animal and human food. *S. agona*, for instance, was introduced into several countries (Federal Republic of Germany, Netherlands, United Kingdom, and USA) by contaminated fish meal and became rapidly established in poultry, pigs, and cattle and in foods of animal origin. Since its introduction, this serotype has been increasingly isolated from human patients. Like many other serotypes, *S. agona* has rarely caused clinical disease in animals. Usually the animal acts only as an excretor, spreading infection to other animals either directly or through the farm environment.

Salmonellae are widely distributed in the environment through the discharge of animal and human wastes to land and natural waters. In areas with a dense population salmonellae can easily be recovered from birds, flies, and rodents as well as from surface waters to which effluents are discharged (*2*). In this respect, the discharge of faecal material from humans and animals plays an important role. Waste waters are treated only to a certain degree and are mostly discharged to surface waters. Even the most efficient sewage treatment brings about only a reduction in the numbers of microorganisms present in crude sewage. This means that in effluent from treated sewage salmonellae may be found in numbers up to 10^3–10^4/100 ml. The sero- and phage-types found in waste water reflect the types in the human and animal populations. If large numbers of food-producing animals are raised in such areas, the same types may be found in foods of animal origin.

Foods of animal origin, particularly meat, poultry, and in some instances unpasteurized egg products, are considered to be the primary source of human salmonellosis. Most of these foods, e.g., red meat and poultry, become contaminated during slaughter and processing from the gut contents of healthy excreting animals. In the same way, every food that is produced or processed in a contaminated environment may become contaminated with salmonellae and may be responsible for outbreaks or cases as a result of faults in transport, storage, or preparation. In some countries fish taken out of, or kept in, polluted water, serve as a vehicle. Cross-contamination of cooked foods from raw ingredients, kitchen utensils, or surfaces has been described frequently as a cause of salmonellosis. Occasional outbreaks of salmonellosis have been traced to the consumption of contaminated milk powder, dried eggs, carmine red, dried yeast, vegetable protein extracts, chocolate candy, and even apple cider. Recognition of the hazard from these materials has led to corrective measures that have essentially eliminated the problem. However, salmonellae-contaminated glandular preparations (dried thyroid and pancreatic powders), which are consumed raw in the treatment of deficiency diseases, continue to present a hazard.

The number of organisms required to produce clinical infection depends on the virulence of the organism, the age and general health of the person, and probably many other factors.

An extensive international outbreak of *S. eastbourne* food poisoning on the North American continent in 1974 (*3*) involved chocolate candy containing well under one *Salmonella* cell per gram. Similarly, the 1975 outbreak caused by *S. newport* in the USA resulted from consumption of minced beef containing very few viable cells per 100 grams.