

Food safety in the 21st century

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The global importance of food safety is not fully appreciated by many public health authorities despite a constant increase in the prevalence of foodborne illness. Numerous devastating outbreaks of salmonellosis, cholera, enterohaemorrhagic *Escherichia coli* infections, hepatitis A and other diseases have occurred in both industrialized and developing countries. In addition, many of the re-emerging or newly recognized pathogens are foodborne or have the potential of being transmitted by food and/or drinking water. More foodborne pathogens can be expected because of changing production methods, processes, practices and habits. During the early 21st century, foodborne diseases can be expected to increase, especially in developing countries, in part because of environmental and demographic changes. These vary from climatic changes, changes in microbial and other ecological systems, to decreasing fresh-water supplies. However, an even greater challenge to food safety will come from changes resulting directly in degradation of sanitation and the immediate human environment. These include the increased age of human populations, unplanned urbanization and migration and mass production of food due to population growth and changed food habits. Mass tourism and the huge international trade in food and feed is causing food and feedborne pathogens to spread transnationally. As new toxic agents are identified and new toxic effects recognized, the health and trade consequences of toxic chemicals in food will also have global implications. Meeting the huge challenge of food safety in the 21st century will require the application of new methods to identify, monitor and assess foodborne hazards. Both traditional and new technologies for assuring food safety should be improved and fully exploited. This needs to be done through legislative measures where suitable, but with much greater reliance on voluntary compliance and education of consumers and professional food handlers. This will be an important task for the primary health care system aiming at "health for all".

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The global importance of food safety is not fully appreciated by many public health authorities. Epidemiological surveillance has demonstrated a constant increase in the prevalence of foodborne illness. Moreover, there have been some devastating outbreaks of salmonellosis, cholera, enterohaemorrhagic *Escherichia coli* infections, hepatitis A and other diseases in both developed and developing countries. Cholera and other diarrhoeal diseases, traditionally considered to be spread by water or person-to-person contact, are in fact largely foodborne. In the industrialized countries up to 10% of the population may suffer annually from foodborne diseases (1).

There has been considerable public interest in transgenic foods, toxic chemicals in food, the irradiation of foodstuffs, and the possible risk of transmission of "mad cow" disease through the consumption of beef. Food safety is likely to receive

increasing attention in the 21st century, especially as some global changes, already in progress, are likely to have predominantly adverse effects in this field. Urbanization, alterations in microbial and other ecological systems, and diminishing supplies of food and fresh water are among the factors in question. A much more serious challenge is foreseeable, however, in connection with changes resulting directly in the degradation of sanitation and the immediate human environment.

Evolving influences

Demographic changes

Within two decades the human population is predicted to reach 8.5 billion, 80% of which is expected to be in developing countries (2). This compares with 5.8 billion in 1996. This tremendous increase and the uneven distribution can be expected to cause serious problems of food security and safety, environmental degradation, large-scale migration from rural to urban areas and from poor to richer countries, and significant changes in ecosystems.

In industrialized countries the proportion of people aged over 60 years is predicted to rise from 17% now to 25% by 2025. A similar phenomenon is occurring in the developing countries. Such change is

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likely to lead to acute socioeconomic problems and the emergence of many people with reduced resistance to diseases, including foodborne diseases.

Environmental hazards

The risk of foodborne disease is substantially heightened by biological and chemical contamination of areas where food is produced, processed and consumed. Population growth, unplanned migration from rural to urban areas, and consequent slum formation are bound to increase pollution. Drinking-water supplies and waste disposal systems come under intensified pressure in such circumstances, particularly in developing countries, and the risk of spread of foodborne pathogens is thereby exacerbated.

The incidence of foodborne infections and intoxications is significantly influenced by temperature (3). Substantial increases in such infections have been reported in temperate regions experiencing long hot summers. The United Nations Intergovernmental Panel on Climate Change has forecast that the average temperature will rise by about 1.1 °C and 3.1 °C over 1995 levels by 2030 and 2090 respectively. The global effect on foodborne disease and other aspects of human health is unpredictable because the relationships involved are complex and multifactorial. However, an association has been established between the prevalence of cholera and dysentery and the oceanic phenomenon known as El Niño. This underlines the need for accurate forecasts of this and other phenomena so that preventive measures can be taken against the diseases concerned.

Toxic chemicals released into the environment by industrial processes and agricultural practices may enter the human food chain. When small quantities are present in food the effects on health are thought to be minimal. Nevertheless, there is concern in this area, one reason being that pesticides are known to suppress the immune system in experimental animals. Pesticides have been found in human tissues, notably fat, in developing as well as developed countries, but their effect on the human immune system has not been thoroughly studied. Even so, they are likely to act as immune suppressants in humans (4). The use of agricultural chemicals and the release of industrial wastes are likely to increase during the next few decades, given the pressure of population increase. The consequences could well be serious, especially among some 20 million children in developing countries whose resistance to disease is diminished by malnutrition (2).

Social and behavioural factors

Poverty and inequity are the principal factors contributing to poor health. Indeed, poverty has been called the world's deadliest disease (5). With regard to food safety, the gap between privileged and unprivileged groups may seem less marked than in other areas because foodborne diseases are quite prevalent in rich societies as well as in poor ones. However, people in rich societies generally suffer

from mild diseases that persist because of hazardous lifestyles (preference for raw foods, mishandling of foods, etc.), whereas in poor communities the serious, life-threatening diseases such as infant diarrhoea, cholera, typhoid fever and fluke infection are still quite prevalent and cause high levels of mortality. Between a fifth and a quarter of the world's population exists in absolute poverty; the proportion is increasing (6) and is likely to continue doing so. Poverty can be expected to be the principal challenge to equity in health care, including the control of foodborne diseases.

Behaviour and lifestyle have a strong bearing on foodborne diseases (7). The risky practice of eating shellfish and other foods in the raw state is increasingly common in affluent societies, where consumers are demanding minimally processed foods with long shelf-lives, no preservatives, and low salt and sugar content (8). Under such conditions, pathogens are likely to multiply to dangerous levels, even at refrigerator temperatures, and the probability of infection and intoxication thereby increases. Consumer concerns about food irradiation, an affordable means of rendering food safe, even in the raw state, are likely to decline in the next century because of the intrinsic merits of the technology and the efforts of health educators.

Scientific and technological progress

There is a prospect of intensive husbandry being used to grow transgenic plants and animals that are resistant to pests and diseases, thus reducing the need for chemical control. The increasing use of aquaculture for the production of fish should make it possible to apply safety measures more effectively now that reliable food safety advice is available for this area of production (9–11).

The expansion of international and interregional trade in human and animal foodstuffs can be expected to increase the risk that contaminants will be carried for long distances. Simple and rapid screening methods should be developed for the detection of pathogens in such products, together with innovative approaches to their application in the interest of food safety. It will also be necessary to develop simplified methods for the diagnosis of foodborne diseases in humans and to use them in worldwide surveillance.

During the 20th century the tried and tested methods of preventing food contamination and rendering contaminated foods safe, among them cooking, pasteurization, sterilization and fermentation, have been improved. Newer methods, such as irradiation, microwave cooking and high-pressure treatment, have been developed. Further progress in this area will undoubtedly be made in the future. Information technology offers the prospect of revolutionizing health education, the exchange of epidemiological data, and the training of health professionals (2). Finally, the large-scale use of solar power as a non-polluting, low-cost renewable energy

source should help to increase food safety in some parts of the world by making cheap energy for refrigeration more widely available.

A worldwide threat

Foodborne diseases are mostly caused by bacteria, viruses, helminths and fungi. The available evidence suggests that these diseases are more prevalent in developing countries than in developed countries. Serious foodborne diseases such as cholera, typhoid fever and liver fluke infection, virtually eliminated in developed countries, are still common in the developing world.

Foodborne diseases are evidently increasing in both developed and developing countries. The reasons for this are not fully understood. It is clear, however, that the problem is compounded because of expanding international trade in foodstuffs and the movement of vast numbers of people across national boundaries in various capacities (12). Greater international cooperation is needed to deal with this matter.

It is expected that the surveillance network for these diseases will cover most countries by 2020. The curve of prevalence should level off first in those countries where surveillance is already being carried out and the public authorities are becoming aware of the significance of foodborne diseases.

Foodborne infections and intoxications figure prominently among the new diseases and infections discovered in the last few decades. They include campylobacteriosis, *Cyclosporidium*, *Cyclospora* and enterohaemorrhagic *E. coli* infections, and listeriosis. In addition there are new strains of *Vibrio cholerae* and drug-resistant strains of several enteric pathogens, particularly *Salmonella* and, possibly, *Helicobacter pylori*. New foodborne diseases can be expected to appear in the coming millennium.

Control strategies

The cooperation of various disciplines and sectors is essential if food safety is to be achieved. In a national administration they may come under different ministries, for instance those of health, agriculture, the environment, trade, and education. A strong food safety agency is needed to bring about cooperation between government departments, nongovernmental organizations and community leaders. Such an agency should be independent of trade and economic interests and should report, ideally, to the health ministry (13). Unfortunately, in most countries it is likely to take many years to establish the required mechanisms.

On the scientific side it is vital to set up surveillance systems (14) for foodborne diseases and to monitor food for contaminants. Some of the methods used in laboratory and other surveillance procedures are costly and need highly skilled

professionals, who are unavailable in many developing countries. Simpler and less expensive tests should be developed urgently so that required information for assessing and combating foodborne hazards can be obtained at low cost. In the USA, active surveillance of foodborne listeriosis followed by control measures led to a reduction of 48% in mortality attributable to this infection (15).

Appropriate technologies have to be applied at suitable points in the food chain. The aims are to prevent the entry of pathogens into food and drinking-water, to prevent their growth, and to inactivate them where necessary.

Legislation is required, but on its own it cannot yield the desired results. Increased reliance has to be placed on the compliance of food handlers, managers of food establishments, consumers and others educated in what has to be done to achieve food safety. The information revolution can be expected to increase the coverage achieved in this field. Health education in relation to food safety should be one of the principal tasks of primary health care networks.

Food contamination and the control of foodborne diseases have become a transnational challenge that can only be met if international cooperation is strengthened in the following areas:

- The surveillance of foodborne diseases should become a global activity, individual components of which should operate effectively at country level while regional programmes provide coordination. In parallel there should be early warning systems concerned with the potential for the transnational spread of foodborne diseases and food contaminants. In this context it is to be hoped that the International Health Regulations, now under revision, will become a powerful legal instrument.
- National food safety control systems should be strengthened within national public health sectors. This requires international and bilateral technical cooperation. The bilateral development agencies and the development banks should join others active in this field, e.g. FAO and WHO. Improved coordination and cooperation are needed between government sectors and between governments, industry, consumers and nongovernmental organizations.
- Public health and food control laboratories should be enabled to monitor contaminants in food and to assist in the identification of contaminants causing disease. Much closer collaboration between these laboratories and clinical laboratories should therefore be fostered. The international donor community should assist developing countries in this task.
- Risk assessment should be undertaken to an increased extent in order to establish food safety standards both nationally and internationally. International cooperation is needed to assist

developing countries with the integration of risk analysis into national food safety control programmes. WHO should intensify its efforts on the application of risk assessment for the development of standards for biological hazards in food.

- Culture-specific health education is essential for food preparers and schoolchildren.

It is highly probable that food safety will decline in the first two or three decades of the 21st century because of unfavourable environmental and human

factors. Matters should improve thereafter, thanks to scientific and technological progress, if there is a recognition that food comes not only within the sphere of agriculture and trade but also within that of public health. ■

Acknowledgements

The authors gratefully acknowledge the valuable advice and ideas of Dr Yasmine Motarjemi, Dr G. Moy and Mr A. Reilly.

Résumé

Salubrité des aliments au XXI^e siècle

L'importance mondiale de la salubrité des aliments n'est pas appréciée à sa juste mesure par de nombreuses autorités sanitaires publiques en dépit du fait que la surveillance épidémiologique a mis en évidence une augmentation constante de la prévalence des maladies transmises par les aliments. De plus, de nombreuses flambées dévastatrices de salmonelloses, de choléra, d'infections à *Escherichia coli* entérohémorragique, d'hépatite A et d'autres affections se sont produites tant dans les pays industrialisés que dans ceux en développement. En outre, nombre des agents pathogènes réémergents ou récemment identifiés se transmettent, ou peuvent se transmettre, par les aliments ou l'eau de boisson. On peut s'attendre à un accroissement du nombre de ces agents pathogènes à cause des modifications des méthodes de production, des procédés, des pratiques et des habitudes.

Au cours des premières décennies du XXI^e siècle, il faut s'attendre à une augmentation des toxi-infections alimentaires, notamment dans les pays en développement, en partie à cause des modifications écologiques et démographiques que l'on observe actuellement et qui se poursuivront pendant une grande partie du siècle prochain : changements climatiques, modifications des systèmes microbiologiques et écologiques, diminution des ressources en eau potable. Néanmoins, en ce qui concerne la salubrité des aliments les changements provenant de la dégradation des systèmes d'assainissement et de l'environnement humain immédiat représenteront un défi encore plus grand : vieillissement des populations, urbanisation non planifiée, migrations,

production en masse des aliments résultant de la croissance démographique et de nouvelles habitudes alimentaires. Le tourisme de masse et l'ampleur du commerce international des aliments et des produits alimentaires entraînent une propagation transnationale des agents pathogènes, faisant que les problèmes de salubrité des aliments ne se limitent plus à un seul pays mais en touchent plusieurs.

Les produits chimiques toxiques dans l'alimentation ont été et resteront un sujet sous surveillance gouvernementale de grand intérêt pour le public. L'identification de nouveaux agents et effets toxiques (toxicité sur le système immunitaire ou endocrinien) aura des conséquences sanitaires et commerciales pour le monde entier.

Les milieux de la santé publique auront la tâche majeure de relever l'immense défi que représente la salubrité des aliments au XXI^e siècle. Pour cela, il conviendra d'appliquer de nouvelles méthodes d'identification, de suivi et d'évaluation des dangers liés à l'alimentation. Il faudra améliorer et exploiter au mieux les techniques traditionnelles et nouvelles permettant de garantir la salubrité des aliments. Des mesures législatives devront ainsi être prises dans les situations qui le demandent, mais il faudra compter encore bien davantage sur le respect volontaire des règles et sur l'éducation des consommateurs comme des professionnels de l'alimentation. Il s'agira là en effet d'une tâche importante pour le système des soins de santé primaires, qui vise à l'instauration de la «santé pour tous».

Resumen

La inocuidad de los alimentos en el siglo XXI

La importancia mundial de la inocuidad de los alimentos no es suficientemente reconocida por muchas autoridades de salud pública, pese a que la vigilancia epidemiológica ha revelado un aumento constante de la prevalencia de las enfermedades de transmisión alimentaria. Además se han registrado numerosos brotes, con efectos devastadores, de salmonelosis, cólera, infecciones por *Escherichia coli* enterohemorrágica, hepatitis A y otras enfermedades, tanto en países industrializados como en países en desarrollo. Por

añadidura, muchos de los agentes patógenos reemergentes o recientemente identificados son transmitidos por los alimentos o podrían propagarse a través de los alimentos y/o el agua de bebida. Cabe prever la aparición de nuevos agentes patógenos de transmisión alimentaria como consecuencia de los cambios experimentados por los métodos de producción, la preparación de los alimentos y las prácticas y los hábitos de los consumidores.

Es de prever que durante los primeros decenios del siglo XXI aumentarán los casos de enfermedades de transmisión alimentaria, en parte debido a los cambios ambientales y demográficos que ya están teniendo lugar, y que persistirán bien entrado el siglo venidero, lo que incluye desde los cambios climáticos, pasando por los cambios de los sistemas microbianos y de otros sistemas ecológicos, hasta la disminución de las reservas de agua dulce. Sin embargo, un reto aún mayor para asegurar la inocuidad de los alimentos será el que plantearán los cambios que desembocarán directamente en el deterioro del saneamiento y del entorno humano inmediato. Ello comprenderá el envejecimiento de las poblaciones humanas, la urbanización no planificada y las migraciones y la producción masiva de alimentos como resultado del crecimiento demográfico y de los nuevos hábitos alimentarios. El turismo masivo y el intenso comercio internacional de alimentos y piensos están favoreciendo la propagación transnacional de agentes patógenos transmisibles a través de esos productos, de manera que los problemas de inocuidad alimentaria que afectan a un país acaban afectando también a otros países.

La presencia de productos químicos tóxicos en los alimentos ha sido y seguirá siendo un tema de

considerable interés público y merecedor de la vigilancia de las autoridades. A medida que se identifican nuevos productos tóxicos y se descubren nuevos efectos tóxicos (p.ej., inmunotoxicidad y efectos endocrinos), las repercusiones sanitarias y comerciales de los productos químicos adquieren alcance mundial.

Afrontar el enorme reto que supone asegurar la inocuidad alimentaria en el siglo XXI será una de las principales tareas de las autoridades de salud pública. Para ello habrá que utilizar nuevos métodos de identificación, vigilancia y evaluación de los riesgos transmitidos por los alimentos. Es necesario mejorar y explotar plenamente las tecnologías disponibles, tanto tradicionales como de nuevo tipo, para asegurar la inocuidad de los alimentos. A ese fin deberán adoptarse medidas legislativas cuando proceda, pero la eficacia en ese sentido dependerá mucho más del cumplimiento voluntario de las medidas y de la educación de los consumidores y de los manipuladores de alimentos. Ésa será sin duda una tarea importante para el sistema de atención primaria de salud, con miras al logro de la «salud para todos».

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